BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,

Principal Bench, New Delhi

O.A. No. 304/2019

(M.A. No. 81/2021, M.A. No. 83/2021, M.A. No. 96/2021 & M.A. No. 85/2021 to M.A. No. 88/2021 & I. A. No. 184/2022)

M. Haridasan — Applicant

Vs.

State of Kerala & ors. — Respondent(s)

14.	**Annexure-12:** Work order to CSIR-CIMFR issued by Kerala State Pollution Control Board dated 15-11-2022.	
15.	**Annexure-13:** Final report of CSIR-CIMFR.	
16.	**Annexure-14:** Combined site assessment report with respect to ambient air quality monitoring of nine selected quarries.	

(Nazimuddin)
Scientist F
Central Pollution Control Board
Delhi-110032

Date: 02.03.2023
Place: Delhi

BEFORE THE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI

Original Application No 304 of 2019

IN THE MATTER OF

M HARIDASAN: Applicant

Vs

State of Kerala & others: Respondents

REPORT OF THE JOINT COMMITTEE CONSTITUTED BY HONOURABLE NATIONAL GREEN TRIBUNAL

1.0 Background

Honourable National Green Tribunal (NGT), Principal Bench (PB), New Delhi, registered a grievance related to the operation of stone quarries received through post as an original application (OA) 304 of 2019 ***'Suo Motu'***. The grievance submitted by M Haridasan was about stone quarries and crushers operating without requisite safeguards at Kizhakkencherry Village, Palakkad District in the State of Kerala. According to the applicants (M Haridasan & Others), the operation of stone crushers and quarrying activities are adversely affecting the environment, flora and fauna in the area. Honourable NGT observed that State prescribed distance criteria of 50 m is highly inadequate and can have deleterious

effects on noise pollution, air pollution, general environment and public health.

As per the order dated 28-02-2020, Honourable NGT sought a report from the Central Pollution Control Board (CPCB) on the distance criteria for stone quarries and to prescribe more stringent conditions and appropriately longer distance. Honourable Tribunal directed to maintain longer distances for siting stone quarries as per the order dated 21-07-2020; relying on the report submitted by CPCB, following precautionary principle, considering the right of the inhabitants, who are affected by air and noise pollution generated in the course of stone quarrying/ mining. As per the order dated 21- 07-2020, it was mandated to have 100 and 200m distance for stone quarry operations without and with blasting, respectively.

Subsequently, the aggrieved mining/ quarry lessees (project proponents) in the State of Kerala filed appeals (MA Nos. 80, 83, 85, 88 to 95 of 2021) in the OA 304 of 2019 seeking impleadment with specific prayer ***'not to interfere'*** with the distance criteria already laid down by the State Mining Department and Kerala State Pollution Control Board (KSPCB). The appeals filed by the project proponents also raised the question of whether NGT has jurisdiction to initiate ***'Suo Motu'*** action against violation of environmental norms. Honourable NGT after considering the matter expressed that there is no merit in the contentions that the Tribunal has no jurisdiction on the matter of distance criteria for mining. Honourable NGT also adjudged that the claims of project

proponents that CPCB have no jurisdiction under E(P) Act and dismissed the specific plea of the project proponents that mining should not be obstructed owing to the peculiar topography of Kerala were devoid of any merit.

After examining the prayers in the original application and project proponent's contentions in detail, Honourable NGT directed for an expert study by a joint committee comprising representatives from the following institutes/ organizations:

- Indian Institute of Mines/ Indian Institute of Technology (IIT), Dhanbad.
- CSIR- Central Institute of Mining & Fuel Research (CIMFR), Dhanbad.
- CSIR- Central Building Research Institute (CBRI), Roorkee.
- Indian Institute of Technology (IIT), Roorkee.
- Wadia Institute of Himalayan Geology, Dehradun.
- Directorate General of Mine Safety.
- Central Pollution Control Board (CPCB).

The joint committee was entrusted with the task of an expert study on the subject of safe distance for stone quarry from habitations vide order dated 09-12-2021 and relevant portion of the Honourable NGT directions are reproduced herewith:

"Accordingly, we constitute a seven-member joint Committee comprising CPCB, Indian Institute of Mines/ IIT, Dhanbad, CSIR – Central Institute of Mining & Fuel Research (CIMFR), Dhanbad, CSIR-Central Building Research Institute (CBRI), Roorkee, IIT Roorkee, Wadia Institute of

Himalayan Geology, Dehradun and Directorate General of Mines Safety, GoI. The nodal agency will be CPCB for coordination and compliance. The cost of the study will be initially borne by CPCB and thereafter as may be decided by this Tribunal. The Committee may undertake visit to the relevant sites and except for such visits, conduct proceedings online, if necessary. The Committee will be at liberty to take assistance from any other expert/institution. The Committee may inter-alia study the impact of blasting with Nonel Detonation technology at distances of 50m, 75m, 100m, 125m, 150m, 200m and 250m. The study will include the impact caused by vibrations on different soil strata /earth profile in the area and on noise and air levels, on building and human and wildlife. The study may be completed within three months and report furnished within four months. Any stakeholder will be at liberty to give their respective view point to the Committee. State of Kerala and Kerala State PCB will facilitate undertaking of above study. The report may be furnished to this Tribunal within four months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF and also upload the same on website of CPCB simultaneously so that the concerned parties/Departments can access the same for further course of action".

Central Pollution Control Board (CPCB), was bestowed with the role of overall coordination and nodal agency for the expert study and report finalization. Honourable NGT made Kerala State Pollution Control Board (KSPCB) and other relevant Kerala State Departments responsible for the facilitation/ coordination/ arrangements for conducting field studies. In compliance to the Honourable Tribunal order, CPCB deputed a nodal officer/ coordinator and initiated actions to constitute the joint committee as per the NGT directives. CPCB conducted preliminary discussions with the KSPCB being the facilitator for the entire expert study and requested to appoint a nodal officer/ coordinator from KSPCB.

Though, the Honourable Tribunal directed that the cost of the study will be initially borne by CPCB, it would be a difficult task for CPCB to coordinate and arrange all logistics in Kerala for the expert study. In this scenario, KSPCB was requested to facilitate the field activities and logistic arrangements in Kerala for site visits and expert study. The expenditure/ cost involved with the expert study /logistic arrangements for the joint committee shall be re-appropriated as per the final verdict of Honourable NGT in this matter.

In pursuance to the Honourable NGT directions dated 09-12-2021 the initiatives taken by the joint committee were appraised to Honourable NGT in the form of three interim status reports dated 09-05-2022, 28-10-2022 & 13-01-2023. After the submission of third interim report, Honourable NGT issued directions vide order dated 18-01-2023 directed the joint committee to submit report by 28-02-2023 and the relevant portion of the order is reproduced below:

"Even though we are disappointed at long delay caused in the process when there should not have not been any difficulty in completing the work in one-year period, as last opportunity, we grant further extension up to 28.02.2023 for submission of the report which may now be positively filed by that date".

Copies of the Honourable NGT orders dated 09-12- 2021 and 18-01-2023 are annexed as ***Annexure 1A*** and ***Annexure 1B***.

2.0 Joint Committee

In compliance with the Honourable NGT directions, a joint committee was constituted vide CPCB office memorandum dated 18-01-2022 (***Annexure 2***) with members/ representatives as per nominations received from respective institutes/ organizations. The nodal officer/ coordinator of KSPCB was included in the joint committee as special invitee to attend all committee meetings for facilitating and coordinating the expert study in Kerala. Joint committee was constituted with the following representatives:

Prof. Manish Shrikhande, Professor Dept. of Earth Quake Engineering, IIT, Roorkee.	Member
Dr. R J Perumal, Scientist F/ Professor Wadia Institute of Himalayan Geology, Dehradun.	Member
Dr. D P Kanungo, Chief Scientist CSIR-CBRI, Roorkee.	Member
Dr. Siddharth Singh, Sr. Principal Scientist CSIR-CIMFR, Dhanbad.	Member
Prof. B S Choudhary, Associate Professor Dept. of Mining Engineering, IIT (ISM), Dhanbad.	Member
Shri. Venugopal Swamy Kadem/ Shri. Sanjay Kumar Gimmedi, Dy. Director (Mining), DGMS, Bangalore.	Member
Dr. Ritesh Kumar, Assistant Professor Dept. of Earth Quake Engineering, IIT, Roorkee.	Member
Dr. Deepesh V, Scientist C, (Nodal officer) Central Pollution Control Board, RD, Bengaluru	Member convener
Shri. Krishnan M N, Env. Engineer, (Coordinator: KSPCB) Kerala State Pollution Control Board, Palakkad, Kerala.	Special Invitee

After the constitution of the joint committee, KSPCB was instructed to constitute a State level facilitation committee for facilitating field studies in Kerala and to take stock of the monitoring infrastructure/ facilities available/ pooling relevant information/ data for the expert study. A detailed letter was forwarded to the Chairman, KSPCB in this regard on 08-03-2022 (***Annexure 3***).

As per the Honourable NGT order, Joint Committee is shouldered with the following responsibilities:

- Hearing of the affected parties / stakeholders
- To formulate & finalize the methodology for the expert study.
- Scientific selection of expert study sites.
- Finalize monitoring protocols (Vibration, Noise & Air pollutants)

2.1 Joint Committee: Deliberations

Joint Committee had 14 sittings/ meetings in the course of time and planning of the expert study was done through a series of online meetings with the facilitation committee set up by the KSPCB and other officials from KSPCB tasked with assisting. the committee in the matter. The minutes of the last joint committee meeting held on 16-02- 2023 is annexed as ***Annexure 4***. All joint committee meetings were organized by the nodal agency and one physical meeting (in hybrid mode) to finalize the site selection was organized by the coordinator, KSPCB at the conference hall, Regional office, KSPCB, Thiruvananthapuram on 22-11-2022. A

separate meeting with the committee members was conducted on 27-02-2023 exclusively for the finalization of the joint committee report and recommendations.

2.2 Joint Committee: Site visits

Joint committee had the preliminary site visits at Ernakulam District in the month of May, 2022. Committee visited three stone quarries in Ernakulam District, Kerala to acquaint with the operations of typical building stone quarries in Kerala. Second site visit was carried out at one building stone quarry location at Thiruvananthapuram on 25-08-2022. Committee also visited 10 shortlisted quarries in the central (Ernakulam region) & northern zone (Kozhikode region) of Kerala from 09 to 11th November, 2022 for the final site selection. Three quarries were visited at the southern zone (Thiruvananthapuram region) during 21-22nd November, 2022.

3.0 Hearing of the stakeholders

In compliance to the Honourable NGT directions to consult the stakeholders, joint committee conducted physical hearing of all concerned stakeholders and an online survey to garner the opinions/ views / suggestions from all concerned.

3.1 Physical hearing

In compliance with the Honourable Tribunal direction, the joint committee facilitated hearing of all stakeholders and conducted physical hearings at Kozhikode, Ernakulam and Thiruvananthapuram. The venues for the physical hearing were

arranged by KSPCB in the northern zone (Kozhikode), central zone (Ernakulam) and southern zone (Thiruvananthapuram) of Kerala State. Public notice (***Annexure 5***) regarding hearing was published in leading Malayalam and English dailies in Kerala and was also published in the website of KSPCB. As per the arrangements done by the KSPCB Coordinator, hearing was conducted from 23rd, 24th and 25th August, 2022 at Kozhikode, Ernakulam and Thiruvananthapuram respectively.

During the hearings, 48 (Kozhikode), 53 (Ernakulam), and 61 (Thiruvananthapuram) persons orally presented their viewpoints/ issues/ complaints/ suggestions on stone quarries before the joint committee members. All the presentations/ dispositions were recorded live and the summary of the presentations were made in the form of minutes of the hearing (***Annexure 6***). During the hearing participants submitted written submissions on stone quarries before the joint committee and a total of 209, 76 and 90 submissions were received at Kozhikode, Ernakulam and Thiruvananthapuram respectively. The details of physical hearing, participation and details of submission received are summarized in ***Table 1.***

3.2 Online survey

Apart from the physical hearing an online survey was also conducted by the joint committee. The online survey was hosted from 09-08-2022 to 26-08-2022 so that stakeholders can record their viewpoints on the building stone quarries in Kerala. In the online survey, the joint committee received 6734 responses and

the opinion received through online survey has been summarized and reviewed. The joint committee reviewed the outcome of physical hearing and online survey and decided to incorporate the public complaint/ grievances as one of the rationale for the site selection to carry out expert study.

Table 1: The details of physical hearing, participation & submissions received.

Hearing date & venue	*23-08-22, Kozhikode*	*24-08-22, Ernakulam*	*25-08-22, Thiruvananthapuram*	*Total*
No. of registered participants	*209*	*76*	*90*	*375*
No. of oral submissions	*48*	*53*	*61*	*162*
No. of complaints/ submissions against existing quarry operations.	*78*	*50*	*70*	*198*
Submission in favour of existing quarry operations.	*131*	*25*	*19*	*175*
Suggestions / study reports	*0*	*1*	*1*	*2*

The online survey (***Annexure 7***) regarding stone quarries in Kerala was open for public response online from 09-08-2022 to 26-08-2022 and a total of 6734 responses were recorded. Based on the total responses (6734) received, 65.3 % of the participants were living near stone quarries. Only 13.3% of the participants were working in quarries/ associated with stone quarry operations.

However, 58% of the responses indicated that there are no critical environmental impacts related with stone quarry operations and 32% highlighted that the stone quarries operations are linked with impacts due to vibration, dust, noise, land use pattern and transport nuisance. 10% of the responses highlighted a particular impact due to stone quarry operations. But 74.7% of the responses indicated that they have no grievances related to stone quarries.

For a question on the criteria for safe distance for stone quarries, 46.9% voted for site specific assessments followed by 38.4% opting for scientific rationale considering the local geological profile and environmental factors (***Figure 1***).

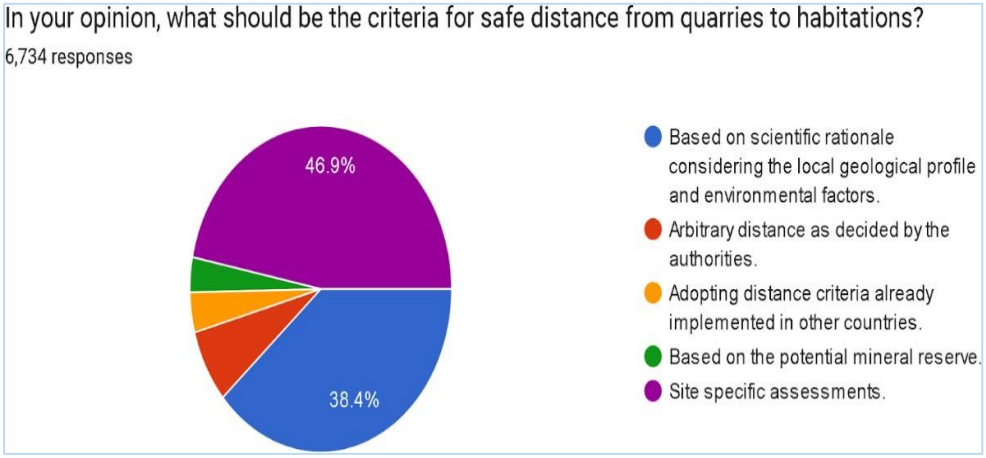

Figure 1: Opinion poll on safe distance criteria

A total of 220 grievances/ opinions/ suggestions/ justifications were received during the online survey. There are few documents suggesting to adopt scientific blasting, harness technologies to remotely record the ground vibrations and to enforce regulations effectively with modern know-how. Other petitions put forth the idea of different distance criteria in different locations based on

the geology/ topography/ population density, ecological importance, etc. It was also suggested to make it mandatory on quarry proponents to provide medical coverage to the nearby residents. Summary of the submission received in the online survey is given in ***Table 2***.

Table 2: Details of submissions received during the online survey.

Details of submission	*Numbers*
Submissions in favour of the quarry operations with the existing distance criteria of 50 m.	**30**
Petitions/ Complaints/ Grievances against stone quarries.	**126**
Technical/ Scientific suggestions/ opinions/ notes.	**4**
Photographs/maps of stone quarries.	**14**
Documents related to stone quarries (Newspaper cutting, Court orders,Action taken reports, Stop memos, Relevant acts/ rules, justification notes, etc.)	**46**
Total submissions	**220**

4.0 Planning of the expert study

During the committee deliberations, it was suggested that the expert study essentially including the assessment of vibrations, noise and air pollutants generated during the course of mining will be a herculean task to extend the study in all operating quarries in Kerala and the study should be confined to selected, representative sites in Kerala. It was decided that the site selection should be based on the tectonic/ geological profile of Kerala as the propagation of vibration depends on the geophysical attributes of the site. The importance of tectonic profile was highlighted by the committee as it may amplify the vibrations differently based on the local geological attributes. Committee also decided to map the

quarries in the tectonic/ geological map of Kerala (***Annexure 8***) to aid in the selection of representative study locations. Committee also approved the suggestions to explore the use of simulator software/ models to study the effect of vibrations. However, site specific assessment data are to be relied upon as the amplification of vibrations depends a lot on the local geology of the site.

The site-specific empirical relationships for calculation of blast-induced vibration parameters like peak particle velocity (PPV) and peak particle displacement (PPD) are commonly used for estimation of blast loads in design. However, these relationships are not able to consider the variation in rock parameters and uncertainty of in situ conditions. The Peak Particle Velocity (PPV) is generally a good index of damage to structure due to vibration. The vibration level at a distance depends on charge per delay, vibration frequency, rock characteristics (type, unit weight, layering, slope of layers), blast hole conditions, presence of water, propagation of surface and body waves in the ground, and to a lesser extent on method of initiation. Hence, it is important to select study locations in areas having distinct geological/ tectonic attributes as it affects propagation of vibration. Thus, the blast induced vibration studies need to be carried out in locations with distinct geotechnical profiles.

Since, the State of Kerala has myriad geological/ lithological/ tectonic profiles, it is important to select sites representing different geological profiles for assessing vibration under varying geological profiles. Geologically, Kerala is occupied by

Precambrian crystallines, acid to ultra-basic intrusives of Archaean to Proterozoic age, Tertiary (Mio-Pliocene) sedimentary rocks and Quaternary sediments of fluvial and marine origin. Both the crystallines and the Tertiary sediments have been extensively lateritised. Rocks of Archaean Era encompass a wide spectrum of litho-assemblages ranging from Khondalite, Charnockite, Gneiss and meta-sedimentary rocks occupying the Western Ghats including the foothill region.

Expert studies were conducted at nine representative stone quarries, three each in three zones (Northern/ Central/ Southern Kerala): One quarry each under large, medium and small scale categories selected for the study. CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR) was entrusted to carry out blasting trials and blast induced vibration assessment in all selected quarries. The summary of various study components decided by the joint committee is tabulated in ***Table 3***. Selected quarries for the expert study mapped in the geological map of Kerala is placed at ***Figure 2***.

As per the joint committee decisions, it was decided to scientifically select the sites for the expert study to assess the effect of stone quarry operations and mapped all the working stone quarries with valid mining permits on a geological map of Kerala State. Then the sites were shortlisted based on geology, tectonic elements, magnitude of the operations, dimension of the quarry area, etc., to carry out the expert study. Additionally, the quantum of public complaints/ grievances was also incorporated as one of

the rationale for the site selection and the final nine sites were selected based on site visits and other practical site considerations.

Table 3: Study components, methodology and implementing agency

Study component	*Methodology*	*Agency*
Hearing of stakeholders &online survey	Physical hearing and online survey in English / vernacular language on the impacts of stone quarries.	KSPCB/ CPCB under the supervision of theJoint committee.
Blast induced vibration, air over pressure, fly rock & study on the blast influence zone.	Blast induced ground vibration, air over pressure/ air blast assessment using seismographs at 50m, 75m, 100m, 125m, 150m, 200m, and 500m perimeters from the blast point. High speed camera/ digitalcamera used to study the fly rock distance zone during the blasting trials.	Rock Excavation Engineering Division,CSIR-Central Institute of Mining and Fuel Research (CIMFR), Dhanbad.
Noise, Ambient Air pollution monitoring and mine pit water quality.	Noise monitoring carried out using class 1, noise level meters as per the CPCB noise monitoring protocols. Air pollution assessed for PM 10 and PM 2.5 parameters. Monitoring done at 50m, 100m, 200m & 500 m radius around the blasting zone.	Kerala State PollutionControl Board and Central Pollution Control Board.

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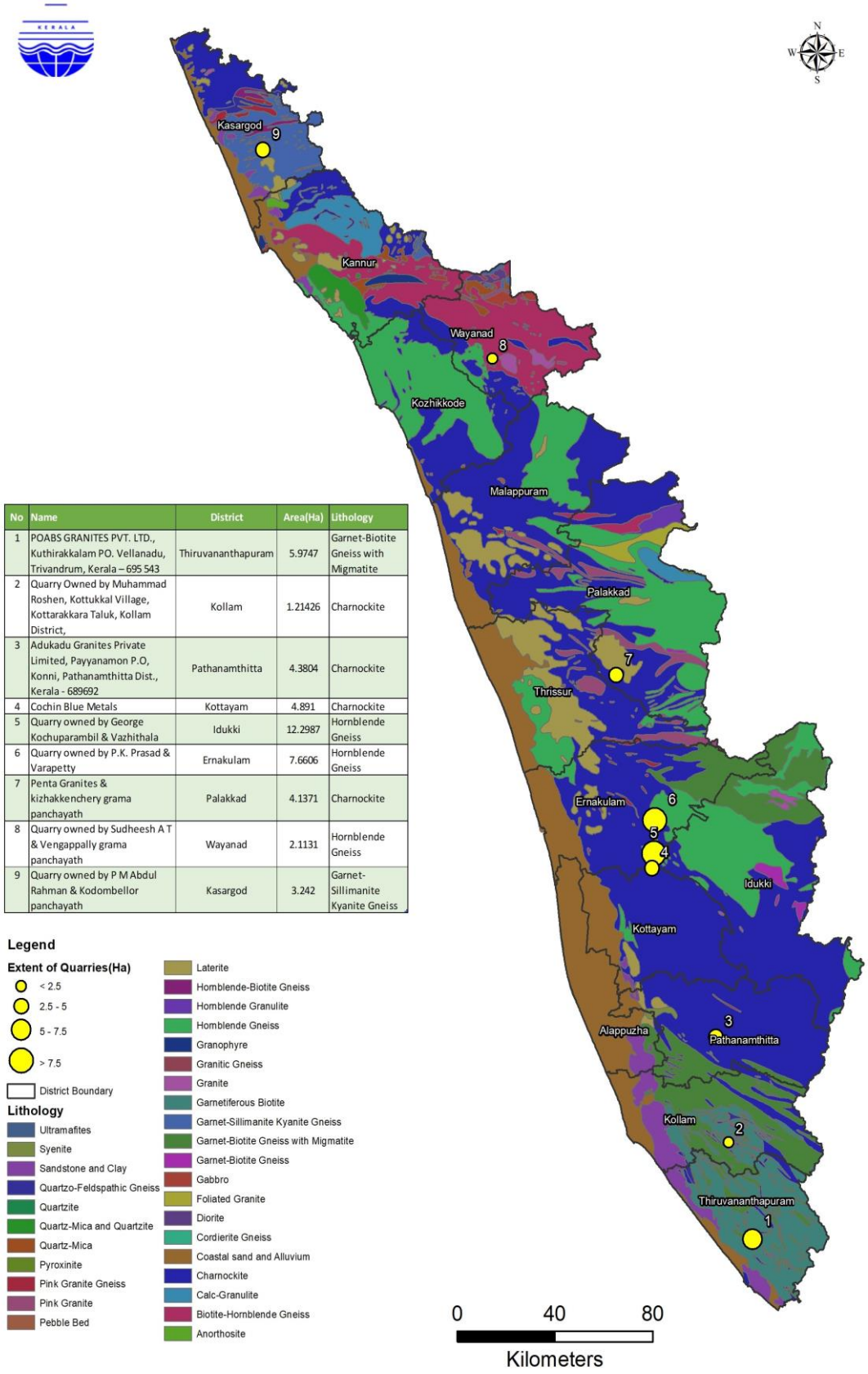

No	Name	District	Area(Ha)	Lithology
1	POABS GRANITES PVT. LTD., Kuthirakkalam PO. Vellanadu, Trivandrum, Kerala – 695 543	Thiruvananthapuram	5.9747	Garnet-Biotite Gneiss with Migmatite
2	Quarry Owned by Muhammad Roshen, Kottukkal Village, Kottarakkara Taluk, Kollam District,	Kollam	1.21426	Charnockite
3	Adukadu Granites Private Limited, Payyanamon P.O, Konni, Pathanamthitta Dist., Kerala - 689692	Pathanamthitta	4.3804	Charnockite
4	Cochin Blue Metals	Kottayam	4.891	Charnockite
5	Quarry owned by George Kochuparambil & Vazhithala	Idukki	12.2987	Hornblende Gneiss
6	Quarry owned by P.K. Prasad & Varapetty	Ernakulam	7.6606	Hornblende Gneiss
7	Penta Granites & kizhakkenchery grama panchayath	Palakkad	4.1371	Charnockite
8	Quarry owned by Sudheesh A T & Vengappally grama panchayath	Wayanad	2.1131	Hornblende Gneiss
9	Quarry owned by P M Abdul Rahman & Kodombellor panchayath	Kasargod	3.242	Garnet-Sillimanite Kyanite Gneiss

Legend

Extent of Quarries(Ha)

- < 2.5
- 2.5 - 5
- 5 - 7.5
- > 7.5
- District Boundary

Lithology

- Ultramafites
- Syenite
- Sandstone and Clay
- Quartzo-Feldspathic Gneiss
- Quartzite
- Quartz-Mica and Quartzite
- Quartz-Mica
- Pyroxinite
- Pink Granite Gneiss
- Pink Granite
- Pebble Bed
- Laterite
- Hornblende-Biotite Gneiss
- Hornblende Granulite
- Hornblende Gneiss
- Granophyre
- Granitic Gneiss
- Granite
- Garnetiferous Biotite
- Garnet-Sillimanite Kyanite Gneiss
- Garnet-Biotite Gneiss with Migmatite
- Garnet-Biotite Gneiss
- Gabbro
- Foliated Granite
- Diorite
- Cordierite Gneiss
- Coastal sand and Alluvium
- Charnockite
- Calc-Granulite
- Biotite-Hornblende Gneiss
- Anorthosite

Figure 2: Selected quarries

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A brief note on the prevailing licensing system and monitoring mechanism for quarrying minor minerals in Kerala is annexed as ***Annexure 9***. The note was provided by the representative of Dept. of Mining & Geology, Kerala in the facilitation committee.

5.0 Assessment methodology

5.1 Assessment of particulate matter/ dust

5.1.1Particulate matter (PM 10)

Ambient air is defined as any unconfined part of the Earth's atmosphere, that is the surrounding outdoor air in which humans and other organisms live and breathe. Particulate Matter (PM 10: Particulate matter less than 10 µm diameter) in ambient air (Cyclonic Flow Technique) using respirable dust samplers (*APM 480, Envirotech, India*). Air is drawn through a size-selective inlet and through a 20.3 X 25.4 cm (8 X 10 in) filter at a flow rate, which is typically 1132 L/min. Particles with aerodynamic diameter less than the cut off-point of the inlet are collected by the filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of PM 10 in the designated size range is calculated by dividing the weight gain of the filter by the volume of air sampled. A 20.3 x 25.4 cm (8 x 10 in) glass fibre filter is used to collect particles. For determining the local weather parameters, a weather tracker (*Kestrel, 4500, Nielson Kellerman, USA*) with built in anemometer and tripod mounted wind vane was used. With the help of a weather tracker, monitoring directions were identified and weather parameters were monitored during the study.

5.1.2 Particulate matter (PM 2.5)

PM 2.5 refers to fine particles that are 2.5 micrometres (µm) or smaller in diameter. An electrically powered air sampler (PM 2.5 Sampler: *APM 550, Envirotech, India*) draws ambient air at a constant volumetric flow rate (16.7 LPM) maintained by a mass flow / volumetric flow controller coupled to a microprocessor into specially designed inertial particle-size separator (i.e. cyclones or impactors) where the suspended particulate matter in the PM size ranges is separated 2.5 for collection on a 47 mm polytetrafluoroethylene (PTFE) filter over a specified sampling period. Each filter is weighed before and after sample collection to determine the net gain due to the particulate matter. The mass concentration in the ambient air is computed as the total mass of collected particles in the PM size ranges divided by the 2.5 actual volume of air sampled, and is expressed in µg/m3. The microprocessor reads averages and stores five-minute averages of ambient temperature, ambient pressure, filter temperature and volumetric flow rate. In addition, the microprocessor calculates the average temperatures and pressure, total volumetric flow for the entire sample run time and the coefficient of variation of the flow rate.

Sampling/ monitoring of particulates (PM 10 & 2.5) was planned at 50, 100, 200 and 500 m distances in three directions from the blasting zone. Two directions were in the downwind direction and one in the upwind direction based on the predominant wind direction of the study site. All three directions were apart by 120 degrees and four samplers were suitably deployed in each

direction to meet the distance requirement of 50, 100, 200 and 500m from the blast site. The air samplers (both PM 10 & 2.5) were deployed as per the siting requirements prescribed in the CPCB guideline (National Ambient Air Quality Series: NAAQMS/36/2012-13). Instruments were deployed to get a height of the sampler inlet at 3 - 10 m above the ground level. Actual deployment of samplers in the field was done at suitable distance from any direct pollution source and as per the siting criteria prescribed by CPCB. However, the study areas were invariably with undulating topography with towering quarry benches at different heights, rocky structures/ outcrops, buildings, plantations and trees extending above the height of the samplers. These site specific scenarios may present barriers or deposition surfaces for PM which were unavoidable bottlenecks in many quarry locations.

Distance of the sampler to any air flow obstacle, must be more than two times the height of the obstacle above the sampler and wherever possible samplers were placed according to the CPCB monitoring guidelines. Certain trees may also be the sources of PM in the form of detritus, pollen, or insect parts and in many quarry locations, there were large rubber plantations and natural vegetation in the vicinity of the quarry. Site specific hindrances were experienced in many locations and the instruments were deployed to suit the site specific topography.

5.2 Assessment of noise pollution

As per the clause 7 (1) of the Noise Pollution (Regulation and Control) Rules 2000 which was amended in January 2010, complaints can be made to the authority if the noise levels exceed the ambient noise standards by 10 dB (A) or more in any area or zone. Thus the primary aim of this monitoring is to determine whether the noise contributed by any source is increasing the ambient noise level by 10 dB(A) or more. Therefore, the noise monitoring includes assessment of ambient noise level when the source is not contributing any noise followed by the monitoring of ambient noise when the source is contributing/ producing noise. In this scenario, the source of noise is the operation of the stone quarries. Since, ambient noise is contributed by several sources, it is necessary to delineate other potential sources like road/ traffic noise and other specific noise sources in the vicinity of the monitoring location and ambient noise levels have to be assessed when the target source is not contributing noise.

Type 1, integrating, averaging sound/ noise level meter with data logging function (*CEL- 63x Environmental Noise Meter, Casella, Casella Measurements, Bedford, UK*) were used simultaneously at 50, 100, 200 and 500m in each of three monitoring direction (each direction apart by 120°).

Noise monitoring was done in batches of one-hour long duration to cover the entire monitoring period of 12 hours. Monitoring was planned to capture the ambient noise level in the area when the stone quarry is not operating (Ambient Noise), and ambient noise

levels were assessed while the stone quarry was in operation. Noise monitoring sessions were done uniformly in all the sites except for a few instances where monitoring officials could not man the instruments due to safety routine while conducting blasting in quarry and few readings could not be recorded due to the safety reasons.

5.3 Blasting trials & assessment of ground vibration, Air over pressure & fly rocks

In line with the scope of work prepared by the Joint Committee (***Annexure 10***), a letter of intent to award the work of scientific studies on blasting influence zones in selected quarries in Kerala was issued to CSIR-CIMFR. Based on the acceptance letter dated 21-10-2022 (***Annexure 11***), work order was issued by KSPCB (***Annexure 12***) to Rock Excavation Engineering Division of CSIR-CIMFR.

The field investigation to assess the ground vibration/ air overpressure, fly rock and the human response to vibration was carried out by CSIR-CIMFR team with the following study components:

- Reconnaissance Survey within 500 m (Mapping of the Area)
- Study of the Land Profile/ Topography
- Study of the Nature of Rock Deposits/ Rock Geology
- Experimental Blasts

- Monitoring of Ground Vibration, Air Overpressure/ Air blast and fly rock.
- Study of Human Response to Ground Vibration/Blasting Noises.

A team of experts from CSIR-CIMFR supervised the experimental blasts in consultation with the concerned officials of KSPCB and the quarry management. A minimum of ten (10) experimental blasts were conducted in each selected quarry. The different drilling patterns, total number of holes, explosive charging and firing patterns were experimented in each quarry. Ground vibration and air overpressure monitoring points were selected at the distances of 50 m, 75 m, 100 m, 125 m, 150 m, 200m, 250 m & 500 m from the blasting sites. In addition to this, the monitoring point was also fixed at 300 m which is "Danger Zone" as per Reg. 164 (1-A, b) of MMR 1961. In order to study the structural response of houses/buildings, ground vibrations were also monitored on the structures. The geophones of the seismographs were firmly fixed on the ground surfaces as well as on the structures using *plaster of paris*. Microphone sensors were also fixed nearby the seismographs as per the International Standards. Geophone sensor was fixed as the triggering source for all the seismographs. The triggering level for the geophone sensor was also set as 0.50 mm/s for the seismographs.

Ground vibrations and air overpressures (air blasts) generated from the blasting operations were monitored using eight numbers of portable computer-operated digital seismographs (*MiniMate,*

MiniMate Blaster, MiniMate Plus & Micromate seismographs of M/s Instantel Inc., Canada). All the seismographs have four channels, with one triaxial transducer for monitoring of ground vibration (in mm/s or in/s) in three orthogonal directions and one-channel for monitoring air overpressure/ noise in dB(L) or Pa. All the seismographs record vibrations in three directions i.e. Longitudinal (L), Vertical (V) and Transverse (T). They also record peak frequency of vibration in individual direction and compute the peak vector sum of vibration.

Blaster's Ranger II™ high speed digital video camera system (*M/s MREL Group of Companies Limited, Canada*) was used to study the rock movement and fly rock occurrences. Additionally, a digital video camera was also used to record all the blasting events.

The detailed study report with annexures, the executive summary along with cover letter is annexed as (***Annexure 13***).

6.0 Expert study in selected quarries in Kerala

Day wise schedule of the expert study conducted in 9 selected quarries in Kerala is given below ***Table 3***. Details of the selected quarry location and the period of expert study is summarized at ***Table 4***.

Table 3: Typical schedule of the expert study conducted in selected quarries.

Day	***Activities***
1	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs. Preliminary site inspection for deploying seismographs by CSIR-CIMFR team.
2	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.). Fixing locations for seismographs and human response surveys in the vicinity by CSIR-CIMFR team.
3	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.). Mine pit water sampling. Supervised blast trials and assessment of ground vibration, air over pressure and fly rocks by CIMFR team.
4	Maintenance check of instruments used, safe packing for transportation. Transporting monitoring gears to the next station.

The expert study in all selected quarries in Kerala was carried out with one day for ambient air quality measurement (without the operation of quarry) and next day with the operation of the quarry. Individual site reports with the observations on dust, noise and mine pit water quality was prepared by the monitoring team of

KSPCB for all the nine quarry sites. Combined site report of all nine quarries is annexed as ***Annexure 14***.

Table 4: Details of selected stone quarries and period of expert study.

No.	*District (Station name)*	*Name and address of quarry*	*Extent/ Area (Ha)*	*Lithology/ Geology*	*Study period*
1	Pathanamthitta **(PTA)**	Adukadu Granites, Payyanamon P.O, Konni, Kerala – 689692.	4.3804	**Charnockite**	12-16th Dec, 2022.
2	Kollam **(KLM)**	Quarry Owned by Muhammad Roshen, Kottukkal Village, Kottarakkara.	1.21426	**Charnockite**	17-20th Dec, 2022.
3	Trivandrum **(TVM)**	POABS GRANITES, Kuthirakkalam PO. Vellanadu, Kerala – 695543	5.9747	**Garnet-Biotite Gneiss with Migmatite**	21-24th Dec, 2022.
4	Ernakulam **(EKM)**	Parackel Granites, Varapetty, Anjalpetty, Ernakulam, Kerala-	7.6606	**Hornblende Gneiss**	26-29th Dec, 2022.
5	Idukki **(IDK)**	United Granites and Metals (Kochuparambil), Vazhithala, Idukki, Kerala-685583	12.2987	**Hornblende Gneiss**	01-04th January, 2023.
6	Kottayam* **(KTM)**	Cochin Blue Metal Industries Private Limited, Methiri P O, Ramapuram, Kottayam	4.891	**Charnockite**	05-08th January, 2023.
7	Palakkad **(PKD)**	Penta Granites, Neethipuram, Elavampadam P O, Palakkad	4.1371	**Charnockite**	09-12th January, 2023.
8	Wayanad **(WYND)**	Profile Sand 1 (Quarry owned by Sudheesh A T), Vengappally, Wayanad, Kerala.	2.1131	**Hornblende Gneiss**	13-16th January, 2023.
9	Kasaragod **(KSD)**	National Granites (Quarry owned by P M Abdul Rahman), Koliyar Attenganam P O, Thayyannur, Kasragod.	3.242	**Garnet-Sillimanite Kyanite Gneiss**	17-20th January, 2023.

**** Quarry owned by M/s. KKJ Group International India Pvt Ltd., Puvakkulam, Kottayam was original selected by the committee and it was not in operation during the study due to expiry of permit. Quarry owned by M/s. Cochin Blue Metal Industries Pvt Ltd., was selected from Kottayam District.***

6.0 Outcome and observations of expert study

6.1 Blasting trials and assessment of vibration

The experimental blasts were designed as per the existing pattern claimed by the mine management as well as modified patterns to obtain adequate data for the study. The total number of holes and explosive charge and other details for the blasting in different blasting zones are not detailed in the mining plans in case of few selected quarries. Hence, the blast design patterns were modified with increased number of holes, total explosive charge, reduced burden and spacing with reduced explosive charge per hole. The number of holes and total explosive charges were increased as a result of human response study where some of the people living in the vicinity of quarries claimed that the normal practice of blasting by the mine management had a bigger size (higher intensity) than that blasting conducted on the experimental day. Therefore, the experiments were designed to study the influence even under the worst scenario.

Considering the peak dominant frequency of ground vibration wave, the ground vibration data recorded at different quarries (even ground vibration value of 10.42 mm/s recorded at 28 m distance from the blast) were all within the safe level as per DGMS Ground Vibration Standards. However, due to human response studies at different quarries, PPV value of 5 mm/s has been considered as the safe level. Based on the actual data recorded at different mines, the threshold level of PPV should be 10 mm/s. Out of the ground vibration data recorded from the 91 blasts, ground vibration data exceeded the permissible limit of 5 mm/s

only in five cases within a zone of 50-100 m. Out of these five cases, the experiment was designed with an increased number of holes and total explosive charge in four cases.

Fly rocks were observed only in two cases during the experimentation. The distance of fly rocks was limited up to 25 m in both the cases. AOP limit as per United States Bureau of Mines (USBM) standard is 134 dB(L) and as per CPCB standard is 140 dB with 100 impulses/day. AOP is different from Noise, and blast induced AOP may be higher than 65 dB(L) even at a distance of 500 m.

The influence zones in this report have been determined on the basis of the outcomes of the experiments, and there cannot be an objective answer that this would be the safe distance for blasting as it depends on different blast design parameters. The recommendations on the various influence zones in the CSIR-CIMFR report (***Annexure 13***) have been determined with the above explanation.

6.2 Noise pollution

From the assessment, operation of quarry significantly contributes to ambient noise up to a radial distance of 200 m from the blasting zone. Major noise contributing operations are drilling, rock breaking, blasting, loading/ unloading, excavators, pneumatic compressors, truck movements, etc. In three locations extraneous sources of noise were observed during the study at 200 m point as most of the points were near to the periphery of the lease area.

Noise contributions from public roads, public spaces, and safety sirens were noticed at these locations. Thus it is logical to limit the noise influence zone up to 150 m from the blasting zone.

6.3 Dust pollution

Effect of particulate matter/ dust is limited to a distance of 100 m from the blasting point, though dust generation can happen anywhere in the lease area. Due to the undulating topography the placement of instruments was challenging and the structures inside the quarry also act as barriers or deposition surfaces. Based on the assessment, the influence zone of dust/ particulate matter is up to 100 m, beyond this point there were no drastic increases in the dust concentration. The micro weather conditions in quarry area also changes instantaneously and heavily influences the pollution transport phenomena.

6.4 Mine pit water quality

In all the samples collected, presence of certain cations like potassium, sodium, calcium and magnesium registered in higher concentrations which could be due to the presence of minerals from granite stone. This indicates that there is a faint influence of mining activity on the mine pit water quality which could be the calcium, sodium, potassium and magnesium ions from plagioclase or orthoclase feldspar commonly found in un-weathered granite. Feldspar usually undergoes hydrolysis and form kaolinite clay, sodium and potassium. Calcium, sodium, potassium and magnesium levels in the mine pit water samples indicates the influence of quarrying. Similarly, total dissolved solids (TDS) and

conductivity in many samples were higher. The total suspended solids (TSS) in few quarries were also higher, indicating poor management of mine pit water.

Most of the stone quarry operators have not provided any garland drains around the quarry to manage runoff water which ultimately end up in the mine pits. The provision of settling tank is also not provided to ensure proper management/ treatment of surface runoff as well as mine pit wastewater before it is discharged to the environment. In many locations, public raised complaints on the illegal discharge of mine pit water in the vicinity.

7.0 Specific observations

7.1 Observations: Physical hearing of stakeholders

- Hearing of stakeholders conducted from 23rd, 24th and 25th August, 2022 at Kozhikode, Ernakulam and Thiruvananthapuram respectively.
- During the hearings, 48 (Kozhikode), 53 (Ernakulam), and 61 (Thiruvananthapuram) persons orally presented their viewpoints/ issues/ complaints/ suggestions on stone quarries before the joint committee members.
- During the hearing participants submitted written submissions on stone quarries before the joint committee and a total of 209, 76 and 90 submissions were received at Kozhikode, Ernakulam and Thiruvananthapuram respectively.
- A total of 375 participants registered for the hearing conducted by the committee and 162 persons, orally

presented their opinion on the existing operations of the quarry in Kerala and expressed their take on the distance criteria.

- Complaints raised related to blast induced nuisances such as ground vibration, air overpressure, fly rock, duct and sound by the aggrieved public during the hearing was considered as one of the rationale for site selection for scientific study to identify the nuisances
- A total of 198 submissions were received against the existing operations of the quarries. Most of the complaints were against existing operations of stone quarries and the hardships with respect to noise, dust, water pollution and structural damages due to blast induced vibration.
- The project proponents submitted that due to ceiling restriction in the area of land that can be acquired by an individual, further increase in distance criteria shall further increase the need to hold more land for quarrying and due to the requirement to keep longer buffer area, valuable miner mineral resources cannot be exploited optimally for the development projects of the State.
- There were 175 submissions in favour of the existing operations and prescribed distance criteria of 50m from quarry lease boundary. Public associated with quarry operations submitted that they have not experienced any difficulties with the existing quarry operations and requested to retain the prescribed 50m distance.
- Majority of the complaints are related to traffic nuisance due to quarry vehicles conveying huge loads of quarry products.

Continuous use of heavy vehicles through narrow village roads prevents local people from using the roads. At present, this issue is orphaned with no authorities identified to regulate/ address the traffic nuisance created by quarry trucks.

7.2 Observations: Online survey

- Joint committee received 6734 responses through an online survey. A total of 220 grievances/ opinions/ suggestions/ justifications were received during the online survey.
- Committee received 30 submissions in favour of the quarry operations with the existing distance criteria of 50m and 126 petitions/ complaints/ grievances against the stone quarries.
- Committee also received 4 technical/ scientific suggestions/ opinions on the NONEL blasting technology and other modern technical advancements in blasting technology through the online survey.
- 58% of the responses indicated that there are no critical environmental impacts related with stone quarry operations and 32% highlighted that the stone quarries operations are linked with impacts due to ground vibration, dust, noise, land use pattern and transport nuisance. 10% of the responses highlighted only one of the above impacts due to stone quarry operations.

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7.3 Observations: Blast induced ground vibration

- Scientific study which was conducted at 09 (Nine) mines located at different parts of the Kerala state. During site selection the mine size and geology of the area was also considered. Through the study the blast results were quantified using modern calibrated instruments and observations are summarized in ***Table 5***.
- The maximum value of vibration recorded at a distance of 50 m from the blasting face was 8.21 mm/s having dominant excitation frequency of 230 Hz.
- The magnitude of vibrations recorded at the distances of 50 to 77 m distances from the different quarries were less than 5 mm/s except in five cases, where the vibration magnitudes were 8.21 mm/s (50 m distance), 5.882 mm/s (51 m distance), 5.68 mm/s (63 m distance), 5.585 mm/s (77 m distance) and 5.042 mm/s (69 m distance).
- The ground vibration data recorded at the distance ranging between 78 m and 137 m were all less than 2.8 mm/s except in one case, where magnitude was 3.619 mm/s at 100 m distance.
- The maximum value of PPV recorded at a distance beyond 138 m distances from the blasting faces, were less than 1.66 mm/s in all the quarries.
- In most of the cases ground vibration data could not be recorded when the vibration monitoring points were more than 300 m.

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Table 5: Minimum and Maximum Values of PPV and AOP recorded during experimental trials at different stone quarries of Kerala.

Location of Quarry (District)	*PPV (mm/s)*				*AOP [dB(L)]*				*PPV recorded below 50 m*	
	Minimum		**Maximum**		**Minimum**		**Maximum**			
	m	***mm/s***	***m***	***mm/s***	***m***	***dB(L)***	***m***	***dB(L)***	***m***	***mm/s***
Pathanamthitta	250	0.554	50	4.115	250	91.5	89	110.6	46	3.29
Kollam	100	0.558	50	2.349	75	109.2	50	126.2	48	2.28
Trivandrum	250	0.524	50	8.21	183	97.5	45	124.8	45	6.85
Ernakulam	296	0.539	51	5.882	275	91.48	51	123.4	41	4.36
Idukki	354	0.651	75	4.229	320	91.48	42	116.6	42	3.50
Kottayam	241	0.813	28	10.42	200	93.98	28	126.8	28	10.42
Palakkad	205	0.751	55	2.514	205	91.48	92	112.6	35	4.474
Wayanad	197	0.554	50	1.849	197	97.5	145	116.9	40	2.865
Kasaragod	112	0.524	50	3.053	75	97.5	79	128.6	35	4.664

Table 6: Permissible peak particle velocity (mm/sec) as per Directorate General of Mine Safety (DGMS) in India (Technical Circular Number 7 of 1997).

Type of structure	*Dominant excitation frequency, Hz*		
	< 8 Hz	***8 - 25 Hz***	***> 25 Hz***
(A) Buildings/structures not belonging to the owner			
i) Domestic houses/structures (Kuchha brick and cement)	**5**	**10**	**15**
ii) Industrial Buildings (RCC and framed structures)	**10**	**20**	**25**
iii)Objects of historical importance and sensitive structures.	**2**	**5**	**10**
(B) Buildings belonging to owner with limited span of life			
i) Domestic houses/structures (Kuchha brick and cement)	**10**	**15**	**25**
ii) Industrial Buildings (RCC and framed structures)	**15**	**25**	**50**

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- In majority, higher dominant excitation frequencies of ground vibration waves were obtained ranging from 25 to 125 Hz. The minimum frequency of recorded vibration data was 14.2 Hz. Considering frequency values, the safe vibration limit as per DGMS Standard comes to 10 mm/s. Hence, the ground vibration data recorded near the public houses/structures in the different quarries are all within the safe limit as per DGMS standard (***Table 6***).
- In many quarries qualified resident mining engineers are not engaged by the project proponents. During the expert study, mining engineers from other quarries and institutes were in supervisory role during the expert study. Knowledge and expertise on NONEL blast technology is also lacking.

7.4 Observations: Air overpressure/ Air blast

- The air-overpressures (AOP) data recorded were in the range of 91.48 dB(L) to 128.6 dB(L).
- The dominance of AOP data recorded at a distance of 50 m was in the range of 110 to 120 dB(L) (***Table 5***).
- The maximum value of AOP recorded at a distance of 100 m from the blasting face, was 122.2 dB(L).
- All the AOP values recorded beyond 150 m from the blasting faces were below 120 dB(L).
- The threshold level of air-overpressure is 134 dB(L) as per USBM standard. Considering the 134 dB(L) as safe limits, the recorded values of AOP at all the quarries were within the limit.

7.5 Observations: Fly rock

- The blasting events were recorded using a high speed video camera or digital camera.
- No fly rock was observed during the study except in two cases when fly rocks occurred (<25 m) but were within the blasting area only.
- Hence, CIMFR team recommended to do a careful inspection of blasting faces by the competent engineer prior to blast.
- Muffling of blast patch with suitable material such as belt conveyor should be used, also angular crushed stone chips size of 2 mm to 4 mm should be used in the stemming column to prevent stemming ejection.

7.6 Observations: Noise pollution

- As per the clause 7 (1) of the Noise Pollution (Regulation and Control) Rules 2000, complaints can be made to the authority if the noise levels exceed the ambient noise standards by 10 dB (A) or more in any area or zone. Thus the primary objective of the monitoring is to determine whether the noise contributed by the source is increasing the ambient noise level by 10 dB(A) or more.
- The difference in noise recorded on operation day than the non-operation day was more than 10 dB(A) in six quarries at a distance of 50m and 100m (***Figure 3***).
- The difference in noise recorded on operation day than the non-operation day was more than 10 dB(A) in three quarries at a distance of 200m (***Figure 3***).

- Thus it is observed that contribution to the ambient noise due to overall quarry operation is significant in six quarries up to a distance of 100m and up to 200m in three quarries.
- Effect of noise pollution is significant up to 200 m in quarries monitored in Pathanamthitta, Ernakulam and Palakkad.
- Ambient noise standards of 55 dB(A) for residential areas are applicable from the boundary of quarry/ lease area and any increase in ambient noise by 10 dB(A) shall be deemed as violation/ exceedance in noise. As per the assessment noise significantly increased by more than 10 dB(A) up to 200m.
- Maximum noise recorded during operation in 50m was 74.49 dB(A) at Palakkad, in 100m was 75.05 dB(A) at Kollam and in 200m was 64.24 dB(A) at Pathanamthitta.
- Noise differences recorded at small quarries (Kollam and Wayanad) were below the 10 dB(A) and hence insignificant.
- It was observed that at noise monitoring stations at 200 m extraneous noise from other sources were reported by the monitoring team at various locations. Noise from the roads/ traffic/ public places contributed to the overall ambient noise in few locations. Hence, the influence of noise may be limited to 150m and not till 200m. For practical purposes with NONEL technology, it would be safe to earmark an area of 150m from the blasting zone as a noise influence area.

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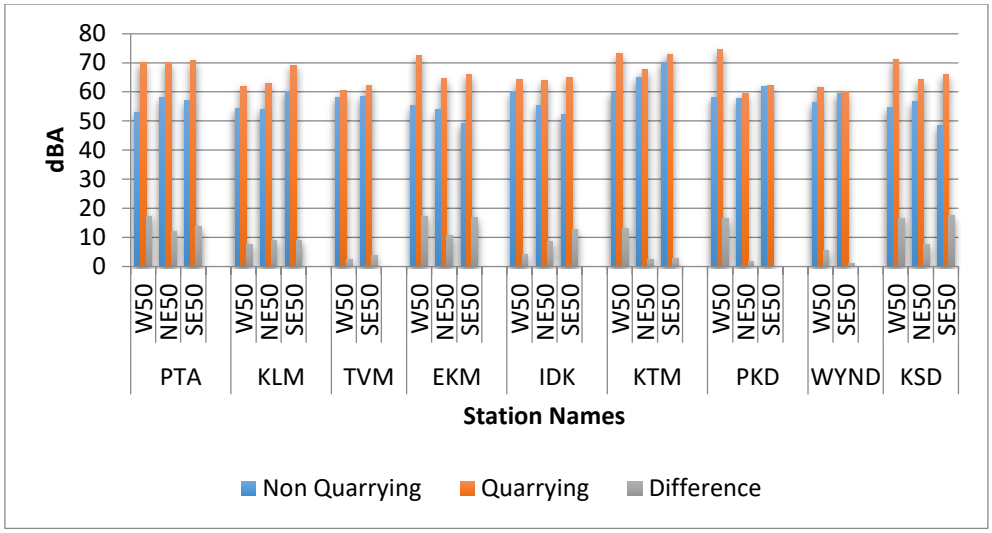
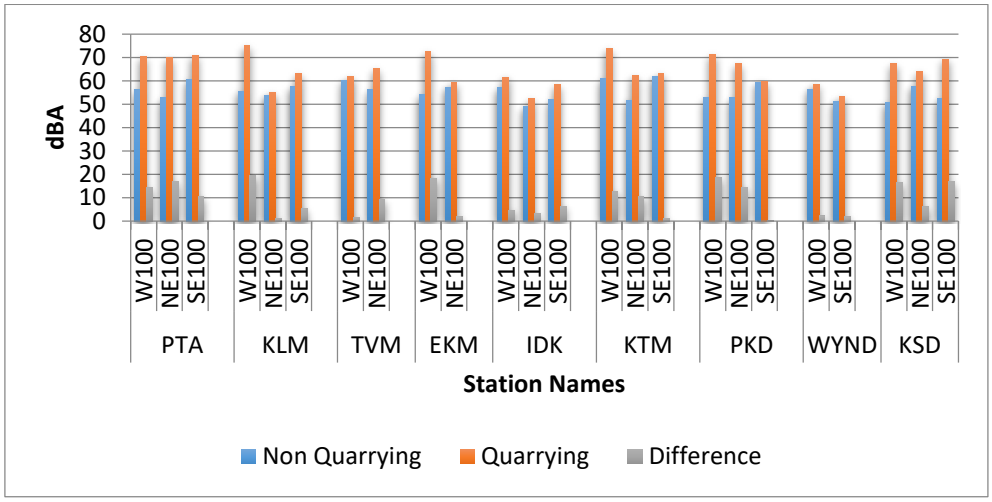
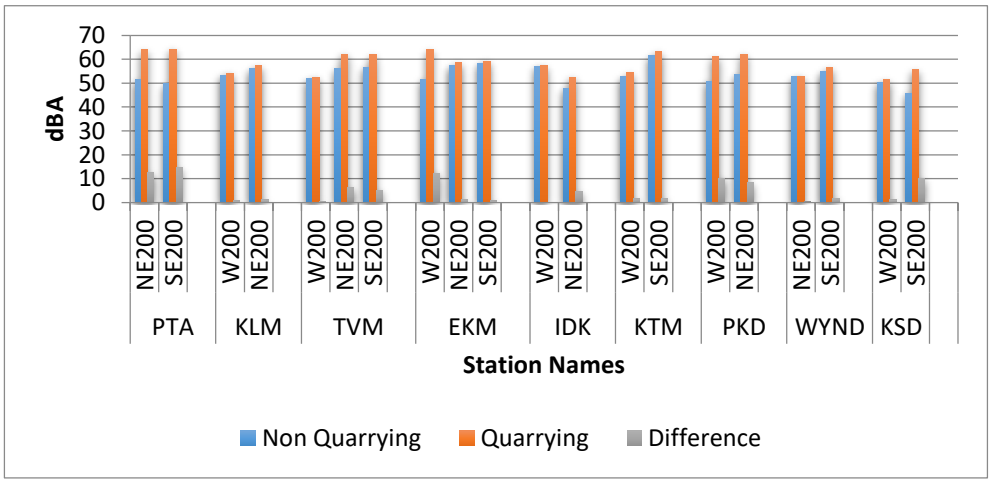
Figure 3: Difference in noise dB Leq (A) values at 50, 100 & 200 m station.



Difference in Leq (A) values of all 50 meter stations in various sites



Difference in Leq (A) values of all 100 meter stations in various sites



Difference in Leq (A) values of all 200 meter stations in various sites

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7.7 Observations: Dust pollution

7.7.1 Particulate Matter 2.5 (PM 2.5)

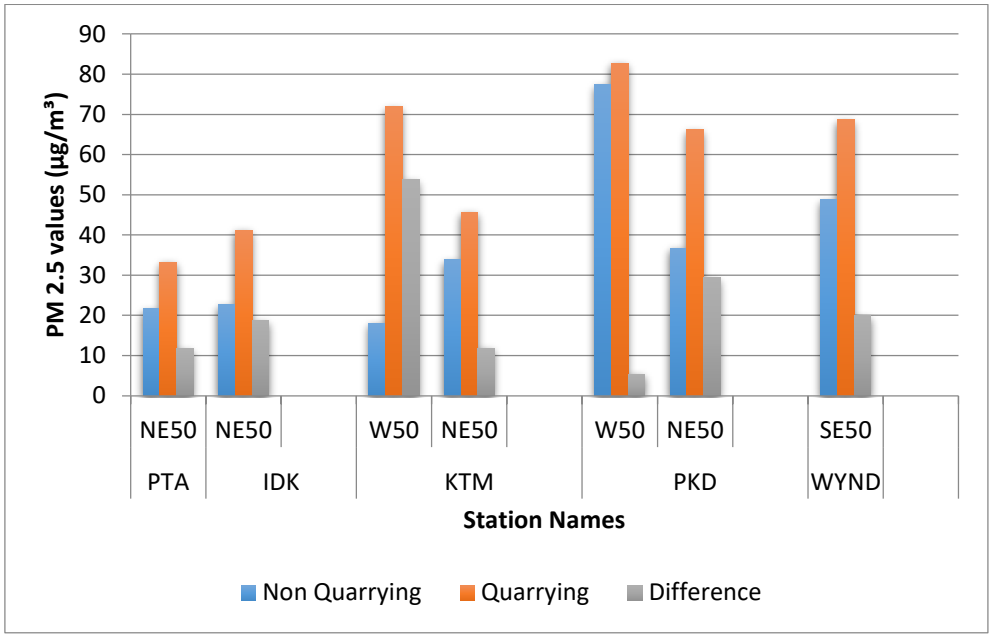
- Ambient air quality standards with respect to particulate matter PM 10 and PM
- 2.5 are 100 µg/m3 and 60 µg/m3 (24Hrs average) in residential areas. Since the quarry operations are limited to day time, the dust monitoring as per the CPCB guidelines was carried out for 12 Hrs (06.00 to 18.00 hrs).
- Effect of particulate matter is limited to a distance of 100 m from the blasting point. Highest PM 2.5 value was recorded at 50m was 82.73 µg/m3 (12 Hrs average) at Palakkad and largest increase in PM 2.5 on operation day was 53.84 µg/m3 registered at Kottayam.
- Highest recorded PM 2.5 value at 100m was 68.26 µg/m3 (12 Hrs average) at Ernakulam and the maximum difference observed on operation day is 44.93 µg/m3 registered at Palakkad.
- The 12 Hrs average PM 2.5 values recorded at four quarries during the operation exceeded the 24 Hr average at 50 and 100m (***Figure 4***).

7.7.2 Particulate Matter 10 (PM 10)

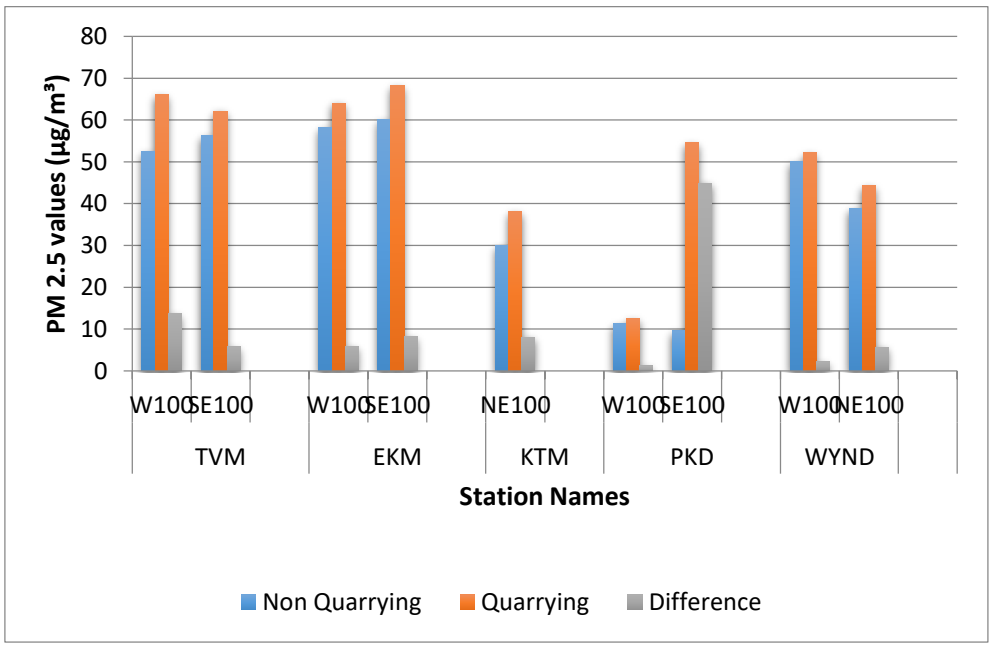
- The 12 Hrs average PM 10 values recorded at three quarries during the operation exceeded the 24 Hr average at 50m (***Figure 5***).
- The 12 Hrs average PM 10 values recorded at two quarries during the operation exceeded the 24 Hr average at 100m (***Figure 5***).

➢ As per the assessment effect of particulate matter due to quarry operation is only up to 100m from the blasting zone.

Figure 4: Difference in PM 2.5 values at 50 and 100 m stations



Difference in PM 2.5 values of all 50 meter stations in various sites



Difference in PM 2.5 values of all 100 meter stations in various sites

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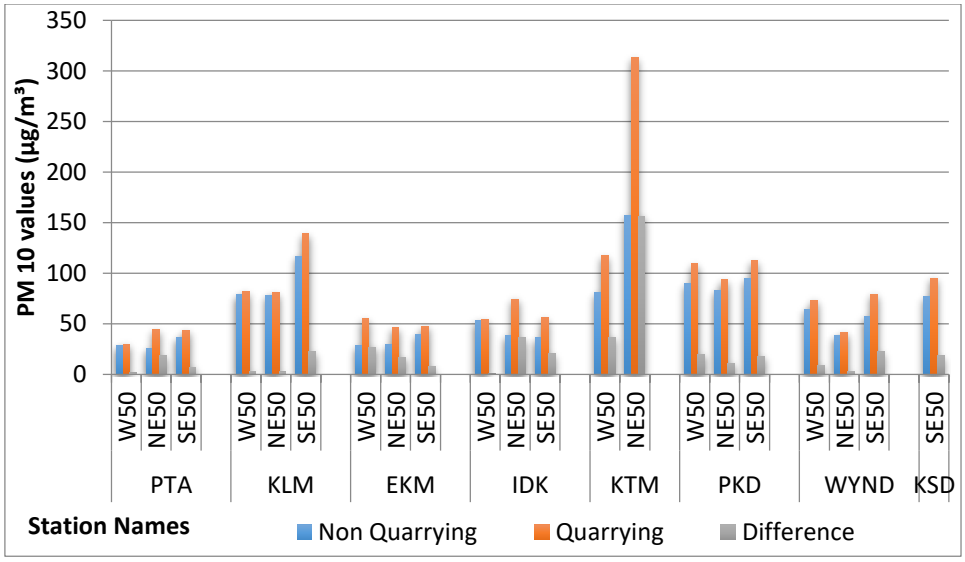
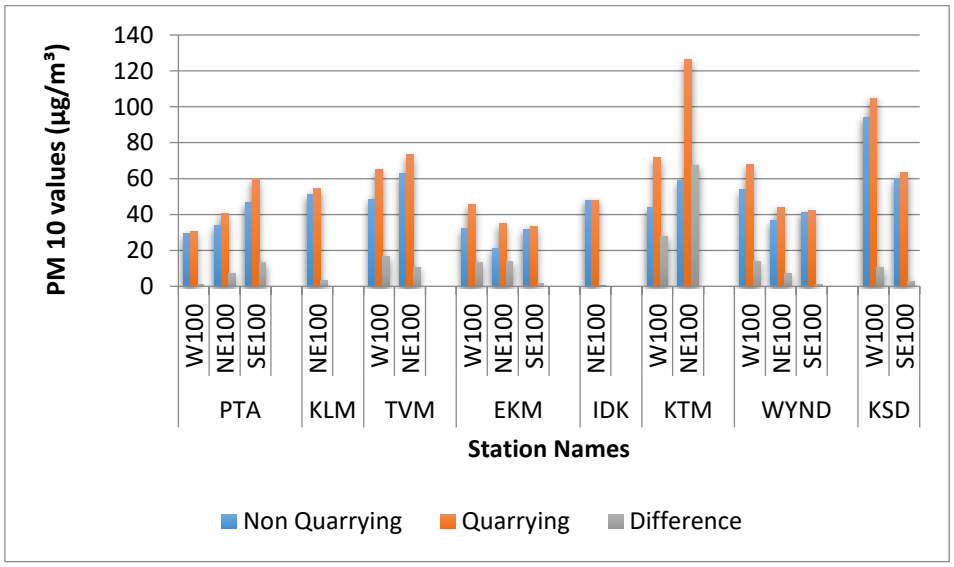
Figure 5: Difference in PM 10 values at 50 & 100m stations



Difference in PM 10 values of all 50 meter stations in various sites



Difference in PM 10 values of all 100 meter stations in various sites

7.8 Observations: Mine pit water quality

- The water quality analysis of mine pit wastewater collected during the expert study indicates the influence of quarrying on the accumulated runoff water in the mine pits.
- Run off management with proper garland drains and settling tanks to be ensured.

8.0 Suggestions and recommendations

As per the assessment study the influence zone of ground vibration is 50-100 m from the blasting zone. The maximum value of Air Over Pressure (AOP) recorded was at a distance of 100 m from the blasting face. The fly rock ejections were noticed in two instances and it were less than 25 m from the blast zone. As per the assessment of noise, the influence zone is up to 200 m and it was observed that extraneous noise from other sources spiked the readings at some of the 200 m stations. Hence, a distance of 150 m can be considered as the noise influence zone from the blasting zone. The particulate matter emissions were obvious up to a distance of 100 m from the blasting zone and hence it can be considered as the influence zone of dust emissions.

The influence zones of assessment parameters are depicted in ***Table 7***.

Table 7: Impact/ influence zone of assessment parameters

Parameter	***Distance (m)***				***Remarks/ observation***
	50	***100***	***200***	***500***	
Ground vibration					Out of the ground vibration data recorded from the 91 blasts, ground vibration data exceeded the permissible limit of 5 mm/s only in five cases within a zone of 50-100 m.
AOP					The maximum value of AOP recorded at adistance of 100 m from the blasting face, was 122.2 dB(L)
Fly rock					No fly rock was observed during the study except in two cases when fly rocks occurred (<25 m) but were within the blasting area only
Noise					Contribution to the ambient noise due to overall quarry operation is significant up to 200m.
Dust					As per the assessment effect of particulate matter due to quarry operation is up to 100m from the blasting zone.

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Considering the permissible limits, geology, current blasting practices (hole diameter, depth of hole, explosive type, stemming length, initiation system) adopted during the scientific study (which was under strict supervision) blast induced vibration assessment, air over pressure, ambient air quality (dust & noise) results, the routine practices (same as during the scientific study) adopted (with minimum supervision, repetitive blasts in a day) for conducting rock blasting and for the safety of the nearby habitats the following recommendations are suggested:

1. Rock blasting should not be allowed within the radial distance of 150 m from quarry blasting zone if there exist houses or structures not belonging to the mine owner within this distance. Thus, if the blast zone is in the periphery/ boundary of the quarry lease area, distance criteria of 150 m has to be maintained from the nearest house/ structures not belonging to the mine owner.

2. Special precautions to be taken during blasting within danger zone. As per Regulation 164 (1-A, b) of Metalliferous Mines Regulation (MMR) 1961, 300 m radially from blasting site is considered as Danger Zone.

3. The stone quarry operators have to engage qualified mining engineers for overall supervision of routine blasting in scientific manner as per the CSIR-CIMFR assessment report and also for ensuring compliance to the bylaws of

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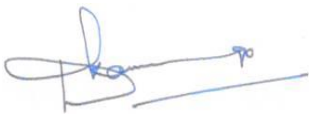
regulations governing the Minor Mineral Extraction, issued by the authorities from time to time.

4. Regulatory checks and surveillance mechanism needs to be strengthened by the mining regulatory authorities for effective enforcement of stone quarry regulations.

Dated: 28th February, 2023

Prof. Manish Shrikhande
IIT, Roorkee.



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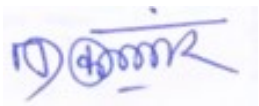

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ANNEXURE 1A

Item No. 01 (Court No. 1)

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

(By Video Conferencing)

M.A. Nos. 80 to 83, 85 to 88, 95 and 96/2021

IN

Original Application No. 304/2019

M. Haridasan Applicant

Versus

State of Kerala & Ors. Respondent(s)

Poabs Granites (Pvt.) Ltd. & Anr.
Kuthirakulam P.O., Vellanand,
Thiruvanthapuram District,
Kerala State — Applicants in M.A. Nos. 80 & 81/2021

M/s. Panachayil Industries
West Othara P.O.,
Thiruvalla Taluk,
Pathanamthitta District
Kerala State — Applicant in M.A. Nos. 82 & 83/2021

Crystal Granites Ltd. & Anr.
Chulli P.O., Thathupara,
Ernakulam,
Kerala State-683581 — Applicants in M.A. Nos. 95 & 96/2021

Raju K. Thomas & Ors.
Vadasserikkara Post,
Pathanamthitta District,
Kerala-689662 — Applicants in M.A. No. 85/2021

Reji Joseph & Anr.
Narikkattu House,
Chamampathal Post,
Vazhoor, Kottayam District
Kerala-686517 — Applicants in M.A. No. 86/2021

Thomsun Aggregates
Kuttipparambil (H),
Vadaathoor P.O., Kottayam District
Kerala State-686010 Applicants in M.A. No. 87/2021

Michael Granites & Ors.
Kanjirathumkunnu House,
Ramapuram Bazar Post,
Kottayam District,
Kerala State-686576 Applicants in M.A. No. 88/2021

Date of hearing: 09.12.2021

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER

Applicant: Ms. Nishtha Kumar Advocate for original applicant

Respondent(s): Mr. Krishnan Venugopal, Senior Advocate with
Mr. E.M.S. Anam, Advocate for Applicant in M.A 80-81/2021
Mr. E.M.S. Anam, Advocate for Applicant in M.A. 82,83,95&96/2021
Mr. Abhilash M.R., Advocate for Applicant in M.A 85 to 88/2021
Mr. Jogy Scaria, Advocate for KSPCB

ORDER

1. These applications have been filed by mining lessees (project proponents) undertaking quarry mining at various locations in Kerala, which also involves blasting. Mining is beyond 50 meters while according to the original applicant longer distance has to be maintained, following precautionary principle having regard to the right of inhabitants, who are affected by air and noise pollution generated in the course of mining operations. This Tribunal earlier passed order dated 21.7.2020 laying down longer distance in the light of report of the CPCB by which the present PPs are aggrieved.

2. The PPs have drawn attention to the order of the Hon'ble Supreme Court dated 25.10.2021 in a batch of matters permitting filing of

applications before this Tribunal by the parties affected by the order of this Tribunal. The said batch of matters involved *inter-alia* the issue whether this Tribunal has jurisdiction to initiate *suo motu* action against violation of environmental norms which stands concluded by the judgment reported in *Municipal Corporation of Gr. Mumbai Vs. Ankita Sinha & Ors.,* 2021 (12) SCALE 184. Therein, it was held that the affected parties are entitled to be heard and they had not been heard in the present matter. The operative part of the order is reproduced below:

> "*In light of the issue answered by this Court in Civil Appeal Nos. 12122-12123 of 2018 and connected cases titled as "Municipal Corporation of Gr. Mumbai Vs. Ankita Sinha & Ors." reported in 2021(12) SCALE 184,* ***it would be appropriate to permit the appellant(s) to raise all contentions/objections as may be available and permissible in law before the National Green Tribunal (In short "the Tribunal") in the first place. The Tribunal may consider those contentions/objections and record reasons for accepting or rejecting the same, so that the appellant(s) if dis-satisfied may have further remedy of appeal(s) before this Court.***
>
> ***In other words, all contentions raised in the present appeal(s) on these aspects, including on merits are left open, to be considered by the Tribunal afresh.***
>
> *We say so because the judgment rendered by this Court predicates that even if the Tribunal intends to initiate suo motu action, must give opportunity to the parties likely to be affected before passing any adverse order against them. Viewed thus, the ex-parte preemptory order(s) passed by the Tribunal without giving opportunity to the person(s) likely to be affected by such order(s), be treated as effaced from the record.*
>
> *Keeping that principle in mind, we deem it appropriate to relegate the appellant(s) before the Tribunal with liberty to raise all contentions as may be permissible in law, to be decided by the Tribunal afresh on its own merits.*
>
> *Notably, the decision of the High Court assailed in these appeal(s) also gives that liberty to the appellant(s). However, we expressly grant such liberty to the appellant(s), as aforesaid, in terms of this order.*

> *The appellant(s) may, therefore, file a formal application to take up all contentions before the Tribunal which may be considered by the Tribunal afresh on its own merits and in accordance with law, including raised in this appeal(s) and in respect of matters, referred to by the Tribunal in the earlier order. The Tribunal to decide the proposed application expeditiously.*
>
> *Learned counsel for the appellant(s) submits that before the Tribunal finally answers the issues raised by the appellant(s), the Tribunal may consider of issuing appropriate interim order to enable the appellant(s) to give effect to the contract/lease agreement in respect of the project in question. We accede to this prayer."*

3. All the Applications are identical and relief sought is impleadment and directions not to interfere with the distance presently being followed as per rules laid down by the mining department and Kerala PCB.

4. We have heard learned Counsel for the parties.

5. As far as impleadment is concerned, the said prayer is granted, as the applicant has no objection to such a course being adopted in the light of order of the Hon'ble Supreme Court.

6. On merits also, stand in all the applications is almost same. The PPs claim to be carrying on quarry mining, using blasting at various locations under leases granted by the Mines Department of Kerala under the Kerala Minor Mineral Concession Rules, 1967. Minimum safety distance of 50m is maintained from nearest dwelling units. Grievance of the original applicant that 50m distance is not enough and reliance on observations of the Hon'ble Supreme Court in *M.C. Mehta v. Union of India, (1996) 8 SCC 462 and Mohammaed Haroon Ansari v. District Collector, Ranga Reddy District, (2004) 1 SCC 491* is uncalled for.

7. To complete the narration, we may record that the Tribunal sought a report from CPCB and as per report dated 09.07.2020, it was suggested

that minimum distance should be 100m where blasting is not involved and 200m where blasting is involved. The Tribunal accepted the said view and, vide order dated 21.07.2020, issued directions in terms thereof which are reproduced for ready reference, as follows:

> *"3. Accordingly, the CPCB has filed its report on 09.07.2020 concluding as follows:*
>
> ***"6.0 Conclusion:***
>
> *In view of available information, following minimum distance criteria may be considered for permitting stone quarrying by SPCBs:*

Mining Type		***Minimum Distance***	***Locations***
A.	***When Blasting is not involved***	***100 m***	*Residential/Public buildings, Inhabitedsites, Protected monuments, Heritage sites, National / State Highway, District roads, Public roads, Railway line/area, Ropeway or Ropeway trestle or station, Bridges, Dams, Reservoirs, River, Canals, Lakes or Tanks, or any other locations to be considered by States.*
B.	***When Blasting is involved***	***200 m *****	

> *****Note: The regulations for danger zone (500 m) prescribed by Directorate General of Mines Safety also have to be complied compulsorily*** *and necessary measures should be taken to minimise the impact on environment.*
> *However, if any states is already having stringent criteria than the above for minor mineral mining (i.e. more prescribed distances than the above), the same shall be applicable."*
>
> *4. In view of the above, the said criteria be followed throughout India. The CPCB may monitor compliance."*

8. In view of rival submissions, question is whether there is any scope for interference by this Tribunal.

9. Original applicant has opposed the applications of the PPs and submitted that minimum distance of 200m must be maintained in the interest of safety of the inhabitants as well as flora and fauna in the area. The Tribunal must follow the 'Precautionary' principle and, if any, further

study is undertaken, mining may not be allowed within 200m pending such study. It was also submitted that mining is continuing illegally in violation of orders of Hon'ble Supreme Court and on that aspect the matter is being further raised before the Hon'ble Supreme Court by the applicant.

10. Stand of learned Counsel for the PPs is that distance of 50m is laid down under the Mines and Mineral Rules as well as under the orders of the State PCB. Any longer distance is beyond the jurisdiction of this Tribunal. CPCB also has no jurisdiction as powers under the EP Act are only with MoEF&CC.

11. Further submission is that due to topography of the State of Kerala, longer distance will obstruct the legitimate mining activities in violation of sustainable development principle. With the use of Nonel Detonation technology, 50m distance is adequate and does not cause any adverse impact.

12. Reliance has also been placed on a CSIR-Central Institute of Mining & Fuel Research study conducted in June 2021 on "SCIENTIFIC STUDIES FOR DESIGN OF SAFE BLAST PARAMETERS AT PEROORKADA STONE MINE, KUTHIRAKALAM P.O. VELLANADU, THIRUVANANTHAPURAM, KERALA" concluding and recommending as follows:

> ***"8. CONCLUSIONS AND RECOMMENDATIONS***
> ***8.1 Conclusions:***
>
> *The following conclusions can be drawn from the results of the study on blast vibration analysis:*
>
> *i) From the blasting trials, with the designed blast patterns, it was observed that blast induced ground vibrations; air overpressure and fly rock were within safe limits*
> *ii) The use of bottom hole-initiation systems like shock tubes in conjunction with noiseless trunk line delays (NTLD) during trial blasts kept the vibration and air over-pressure to the allowable limits.*

iii) *Proper stemming with coarse grained sand reduced the chances of flyrock and limited to bare minimum within the quarry area.*

iv) *The throw of the muck was found to be favourable for easy removal and handling by machines*

v) *The maximum value of blast induced ground vibration (PPV) level recorded at the south eastern boundary from where the closest civil structure (water tank), is 1.024 mm/s with dominant excitation frequency as 82.25 Hz at a distance of 125 m.*

vi) *The maximum projectiles range of flyrock was observed as 10-15 m from the blast site and the air overpressure levels recorded were within the safe limits (<128 dB).*

vii) *This clearly indicates that the blast design parameters followed during the studies at the mine are quite safe to the nearby habitats and structures.*

8.2 Recommendations:

On the basis of data analysis and results of the study the following points are recommended for consideration and strict adherence for controlled blasting and safety of structures:

1. *It is recommended to practice the blast design parameters as burden =1 m spacing = 1.2m, hole depth = 1.8 m to 3m and specific charge = 0.35 kg/m ^{3}.*
2. *Maximum hole depth can be upto 3m. Holes of lesser depth may have a tendency of generating more flyrock.*
3. *In case of varying hole depth, charge per holes should be calculated on the basis of specific charge (0.35 kg/m3)*
4. *The hole diameter should be kept at 32mm and there should be no variation in diameter of the drilled holes.*
5. *Typical blast deigns shown in the figure 6 and 7 should be followed for safe blasting practice*
6. *The safe maximum charge per delay for the distances of 45m and above, from the dwellings/structures is mentioned in Table-5, and Figure 16, which should be followed to contain the ground vibrations and flyrock within the limits.*
7. *Although, the nearest house not belonging to quarry owner, is towards South-east direction of the mine at a distance of 250 m and the safe maximum charge per blast for that distance, as per the Table-4, is 8.29 kg*
8. *Prilled Ammonium Nitrate Fuel Oil (ANFO) and Cartridge emulsion explosive of 25mm diameter to be used for all production blast rounds. Care should be taken to ensure utilization of explosive within the prescribed shelf-life period.*
9. *Blast rounds should be planned in such a manner that at least one free face is available*
10. *Maximum four rows are to be fired in each blast round to avoid cumulative confinement and flyrock problem.*
11. *Top of the face should be cleaned for any debris. The face should be cleared of muck of the previous blast as it creates flyrock.*
12. *The free face direction should be, as far as possible, opposite from the hutments/ structures (temporary or*

permanent). The propagation of the initiation should be opposite to the structures/ habitats."

13. We have duly considered the above submissions. We do not find any merit in the objection of the PPs that this Tribunal has no jurisdiction in view of distance laid down under the Mines and Mineral Rules. in view of law laid down *inter-alia* in *Mantri Techzone Pvt. Ltd. v. Forward Foundation and Ors.*,[1] and *the Director General (Road Development) NHAI v. Aam Aadmi Lok Manch.*[2] There is also no merit in the contention that CPCB has no jurisdiction under the EP Act. CPCB has jurisdiction under EP Act, as per delegation under section 23 of the said Act as well statutory powers under the Air and Water Acts and also under directions of this Tribunal. Plea of the PPs that the study relied upon clinches the matter in their favour is also not born out from the said study. There is also no merit in the contention that even at the cost of environment mining must be allowed having regard to peculiar topography of Kerala.

14. Thus, while the stand of the PPs cannot be accepted, out of abundant caution, we are inclined to consider further expert study on the subject of safe distance for mining from habitations.

15. Accordingly, we constitute a seven-member joint Committee comprising CPCB, Indian Institute of Mines/ IIT, Dhanbad, CSIR - Central Institute of Mining & Fuel Research (CIMFR), Dhanbad, CSIR-Central Building Research Institute (CBRI), Roorkee, IIT Roorkee, Wadia Institute of Himalayan Geology, Dehradun and Directorate General of Mines Safety, GoI. The nodal agency will be CPCB for coordination and compliance. The cost of the study will be initially borne by CPCB and thereafter as may be decided by this Tribunal. The Committee may undertake visit to the

[1] 2019 SCC online SC 322, Para 43-47
[2] AIR 2020 (SC) 3471, Para 75

relevant sites and except for such visits, conduct proceedings online, if necessary. The Committee will be at liberty to take assistance from any other expert/institution. The Committee may inter-alia study the impact of blasting with Nonel Detonation technology at distances of 50m, 75m, 100m, 125m, 150m, 200m and 250m. The study will include the impact caused by vibrations on different soil strata /earth profile in the area and on noise and air levels, on building and human and wildlife. The study may be completed within three months and report furnished within four months. Any stakeholder will be at liberty to give their respective view point to the Committee. State of Kerala and Kerala State PCB will facilitate undertaking of above study. The report may be furnished to this Tribunal within four months by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF and also upload the same on website of CPCB simultaneously so that the concerned parties/Departments can access the same for further course of action.

M.A. Nos. 80/2021, 82/2021, 95/2021 stand disposed of.

List OA 304/2019 for further consideration on 11.05.2022.

A copy of this order be forwarded to CPCB, Indian Institute of Mines/ IIT, Dhanbad, CSIR - Central Institute of Mining & Fuel Research (CIMFR), Dhanbad, CSIR-Central Building Research Institute (CBRI), Roorkee, IIT Roorkee, Wadia Institute of Himalayan Geology, Dehradun, Directorate General of Mines Safety, GoI, State of Kerala and Kerala State PCB by e-mail for compliance.

Adarsh Kumar Goel, CP

Sudhir Agarwal, JM

Dr. Nagin Nanda, EM

December 09, 2021
M.A. No. 80/2021 to M.A. No. 83/2021,
M.A. No. 95/2021, M.A. No. 96/2021,
M.A. No. 85/2021 to M.A. No. 88/2021
DV

ANNEXURE 1B

Item No. 06 Court No. 1

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

Original Application No. 304/2019
(M.A. No. 81/2021, M.A. No. 83/2021, M.A. No. 96/2021 & M.A. No. 85/2021 to M.A. No. 88/2021 & I. A. No. 184/2022)

M. Haridasan Applicant

Versus

State of Kerala & Ors. Respondent(s)

Date of hearing: 18.01.2023

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE PROF. A. SENTHIL VEL, EXPERT MEMBER

Applicant: Ms. Nishtha Kumar, Adv. for Applicant

Respondent: Mr. Jogy Scaria, Advocate for Kerala SPCB
Mr. Nishe Rajen Shonker, Advocate for the State of Kerala

ORDER

1. The Issue for consideration is the safeguards in operation of stone quarries close to residences and public roads in Kerala. Distance prescribed by the Kerala State PCB being inadequate against safety of buildings and environment, the Tribunal vide order dated 21.7.2020 directed longer distance, based on expert committee report, after study on direction of this Tribunal.

2. In the light of order of the Hon'ble Supreme Court dated 25.10.2021 in a batch of matters against order of the Tribunal, giving liberty to the aggrieved parties to move this Tribunal for reconsideration, the matter was further considered vide order dated 09.12.2021. On such further

consideration, the Tribunal did not find any substance in the stand of the project proponents (PPs) for reduction in distance as earlier directed. It was observed:

"

6. On merits also, stand in all the applications is almost same. ***The PPs claim to be carrying on quarry mining, using blasting at various locations under leases granted by the Mines Department of Kerala under the Kerala Minor Mineral Concession Rules, 1967. Minimum safety distance of 50m is maintained from nearest dwelling units****. Grievance of the original applicant that 50m distance is not enough and reliance on observations of the Hon'ble Supreme Court in M.C. Mehta v. Union of India, (1996) 8 SCC 462 and Mohammaed Haroon Ansari v. District Collector, Ranga Reddy District, (2004) 1 SCC 491 is uncalled for.*

7. To complete the narration, we may record that ***the Tribunal sought a report from CPCB and as per report dated 09.07.2020, it was suggested that minimum distance should be 100m where blasting is not involved and 200m where blasting is involved.*** *The Tribunal accepted the said view and, vide order dated 21.07.2020, issued directions in terms thereof which are reproduced for ready reference, as follows:*

> *"3. Accordingly, the CPCB has filed its report on 09.07.2020 concluding as follows:*
>
> ***"6.0 Conclusion:***
>
> *In view of available information, following minimum distance criteria may be considered for permitting stone quarrying by SPCBs:*

Mining Type		***Minimum Distance***	***Locations***
A.	***When Blasting is not involved***	***100 m***	*Residential/Public buildings, Inhabitedsites, Protected monuments, Heritage sites, National / State Highway, District roads, Public roads, Railway line/area, Ropeway or Ropeway trestle or station, Bridges, Dams, Reservoirs, River, Canals, Lakes or Tanks, or any other locations to be considered by States.*
B.	***When Blasting is involved***	***200 m *****	

> *****Note: The regulations for danger zone (500 m) prescribed by Directorate General of Mines Safety also have to be complied compulsorily*** *and necessary measures should be taken to minimise the impact on environment.*
> *However, if any states is already having stringent criteria than the above for minor mineral mining (i.e. more prescribed distances than the above), the same shall be applicable."*

4. In view of the above, the said criteria be followed throughout India. The CPCB may monitor compliance."

8. In view of rival submissions, question is whether there is any scope for interference by this Tribunal.

9. ***Original applicant has opposed the applications of the PPs and submitted that minimum distance of 200m must be maintained in the interest of safety of the inhabitants as well as flora and fauna in the area. The Tribunal must follow the 'Precautionary' principle and, if any, further study is undertaken, mining may not be allowed within 200m pending such study. It was also submitted that mining is continuing illegally in violation of orders of Hon'ble Supreme Court and on that aspect the matter is being further raised before the Hon'ble Supreme Court by the applicant.***

10. Stand of learned Counsel for the PPs is that distance of 50m is laid down under the Mines and Mineral Rules as well as under the orders of the State PCB. Any longer distance is beyond the jurisdiction of this Tribunal. CPCB also has no jurisdiction as powers under the EP Act are only with MoEF&CC.

11. Further submission is that due to topography of the State of Kerala, longer distance will obstruct the legitimate mining activities in violation of sustainable development principle. With the use of Nonel Detonation technology, 50m distance is adequate and does not cause any adverse impact.

12. Reliance has also been placed on a CSIR-Central Institute of Mining & Fuel Research study conducted in June 2021 on "SCIENTIFIC STUDIES FOR DESIGN OF SAFE BLAST PARAMETERS AT PEROORKADA STONE MINE, KUTHIRAKALAM P.O. VELLANADU, THIRUVANANTHAPURAM, KERALA" concluding and recommending as follows:

"8. CONCLUSIONS AND RECOMMENDATIONS
8.1 Conclusions:

The following conclusions can be drawn from the results of the study on blast vibration analysis:

i) From the blasting trials, with the designed blast patterns, it was observed that blast induced ground vibrations; air overpressure and fly rock were within safe limits
ii) The use of bottom hole-initiation systems like shock tubes in conjunction with noiseless trunk line delays (NTLD) during trial blasts kept the vibration and air over-pressure to the allowable limits.
iii) Proper stemming with coarse grained sand reduced the chances of flyrock and limited to bare minimum within the quarry area.
iv) The throw of the muck was found to be favourable for easy removal and handling by machines
v) The maximum value of blast induced ground vibration (PPV) level recorded at the south eastern boundary from where the closest civil structure (water tank), is 1.024 mm/s with

dominant excitation frequency as 82.25 Hz at a distance of 125 m.

vi) *The maximum projectiles range of flyrock was observed as 10-15 m from the blast site and the air overpressure levels recorded were within the safe limits (<128 dB).*

vii) *This clearly indicates that the blast design parameters followed during the studies at the mine are quite safe to the nearby habitats and structures.*

8.2 Recommendations:

On the basis of data analysis and results of the study the following points are recommended for consideration and strict adherence for controlled blasting and safety of structures:

1. *It is recommended to practice the blast design parameters as burden =1 m spacing = 1.2m, hole depth = 1.8 m to 3m and specific charge = 0.35 kg/m ^{3}.*
2. *Maximum hole depth can be upto 3m. Holes of lesser depth may have a tendency of generating more flyrock.*
3. *In case of varying hole depth, charge per holes should be calculated on the basis of specific charge (0.35 kg/m3)*
4. *The hole diameter should be kept at 32mm and there should be no variation in diameter of the drilled holes.*
5. *Typical blast deigns shown in the figure 6 and 7 should be followed for safe blasting practice*
6. *The safe maximum charge per delay for the distances of 45m and above, from the dwellings/structures is mentioned in Table-5, and Figure 16, which should be followed to contain the ground vibrations and flyrock within the limits.*
7. *Although, the nearest house not belonging to quarry owner, is towards South-east direction of the mine at a distance of 250 m and the safe maximum charge per blast for that distance, as per the Table-4, is 8.29 kg*
8. *Prilled Ammonium Nitrate Fuel Oil (ANFO) and Cartridge emulsion explosive of 25mm diameter to be used for all production blast rounds. Care should be taken to ensure utilization of explosive within the prescribed shelf-life period.*
9. *Blast rounds should be planned in such a manner that at least one free face is available*
10. *Maximum four rows are to be fired in each blast round to avoid cumulative confinement and flyrock problem.*
11. *Top of the face should be cleaned for any debris. The face should be cleared of muck of the previous blast as it creates flyrock.*
12. *The free face direction should be, as far as possible, opposite from the hutments/ structures (temporary or permanent). The propagation of the initiation should be opposite to the structures/ habitats.***"**

13. We have duly considered the above submissions. ***We do not find any merit in the objection of the PPs that this Tribunal has no jurisdiction in view of distance laid down under the Mines and Mineral Rules. in view of law laid down inter-alia in Mantri***

Techzone Pvt. Ltd. v. Forward Foundation and Ors.,[1] and the Director General (Road Development) NHAI v. Aam Aadmi Lok Manch.[2] There is also no merit in the contention that CPCB has no jurisdiction under the EP Act. CPCB has jurisdiction under EP Act, as per delegation under section 23 of the said Act as well statutory powers under the Air and Water Acts and also under directions of this Tribunal. Plea of the PPs that the study relied upon clinches the matter in their favour is also not born out from the said study. There is also no merit in the contention that even at the cost of environment mining must be allowed having regard to peculiar topography of Kerala."

3. In spite of above, the Tribunal thought it proper to direct further study on the subject and constituted a seven member joint Committee for the purpose to furnish report to this Tribunal within four months. It is sad to note that inspite of expiry of one year, the Committee has failed to give its report and has been seeking further time vide letters dated 20.07.2022, 28.10.2022 and 13.01.2023.

4. Even though we are disappointed at long delay caused in the process when there should not have not been any difficulty in completing the work in one year period, as last opportunity, we grant further extension up to 28.02.2023 for submission of the report which may now be positively filed by that date.

List for further consideration on 06.03.2023.

Adarsh Kumar Goel, CP

Sudhir Agarwal, JM

Prof. A. Senthil Vel, EM

January 18, 2023
Original Application No. 304/2019
(M.A. No. 81/2021, M.A. No. 83/2021, M.A. No. 96/2021 & M.A. No. 85/2021 to M.A. No. 88/2021 & I. A. No. 184/2022)
AB

[1] 2019 SCC online SC 322, Para 43-47
[2] AIR 2020 (SC) 3471, Para 75

ANNEXURE 2

CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE "NISARGA BHAWAN", 1ST FLOOR
THIMMAIAH ROAD, 7 'D' CROSS, SHIVANAGAR
BENGALURU-560 079
Phone: 080-23233739, 080-23233827, Fax: 080-23234059
Email: zobangalore.cpcb@nic.in

Tech/39/RDS/NGT/2021-22/741 18th January, 2022

OFFICE MEMORANDUM

Sub: Constitution of Joint Committee as per the directions of Honourable National Green Tribunal (NGT), Principal Bench order dated 09-12-2021 in the matters of MA Nos. 80, 83, 85, 88, 89, 90, 91, 92, 93, 94, and 94 of 2021 in OA No. 304/2019.

Honourable NGT in the above matter of OA 304/ 2019, by an order dated 21-07-2020, directed to maintain longer distances for siting stone quarries in the light of Central Pollution Control Board (CPCB) report following precautionary principle considering the right of the inhabitants, who are affected by air and noise pollution generated in the course of mining. Subsequent, to the NGT order, the aggrieved mining lessees (project proponents) filed appeals (MA 80, 83, 85, 88 to 95 of 2021) in the OA 304/2019. All the MAs sought impleadment in the matter with specific prayer of not to interfere with the distance laid down by mining department and Kerala Sate Pollution Control Board (KSPCB).

After examining the project proponents' contentions in details, Honourable NGT is inclined to consider an expert study afresh by a joint committee on the impact of blasting using NONEL Detonator Technology in stone quarries. The study includes impacts on vibrations on different soil strata/ earth profile, on noise levels, on air pollution levels, on buildings, humans and wildlife. In compliance of the NGT directions, a joint committee is constituted with following members as per nominations received from respective institutes/organisations.

S. Smruti
18/1/2022

Members of Joint Committee

No	*Name & Designation*	*Institute/ Organization*
1	Prof. B S Choudhary, Associate Professor	Dept. of Mining Engineering, IIT (ISM), Dhanbad-826004. bhanwarschoudhary@iitism.ac.in, 91-326-223-5735
2	Dr. Siddharth Singh, Sr. Principal Scientist	CSIR-CIMFR, Barwa Road, Dhanbad-826001. ss@cimfr.nic.in, ssgcmri@yahoo.com, 9431122769
3	Dr. D P Kanungo, Chief Scientist	CSIR-CBRI, Roorkee-247667. dpkanungo@cbri.res.in, 9412073009
4	Prof. Manish Shrikhande, Professor	Dept. of Earth Quake Engineering, IIT, Roorkee-247667. manish.shrikhande@eq.iitr.ac.in, 91-1332-285437
5	Prof. Ritesh Kumar, Assistant Professor	Dept. of Earth Quake Engineering, IIT, Roorkee-247667. ritesh.kumar@eq.iitr.ac.in, 91-01332-284981
6	Dr. R J Perumal, Scientist F	Wadia Institute of Himalayan Geology, Dehradun-248171. ramperu@wihg.res.in, 91-135-2525142
7	Shri. Venugopal Swamy Kadem, Dy. Director (Mining)	Directorate General of Mine Safety (DGMS), Bangalore Region, Bengaluru, Karnataka-560071. kademvenugopalaswamy@gmail.com, 9434738698
8	Dr. Deepesh V, Scientist C **(Member convener/ Nodal officer)**	Central Pollution Control Board, Regional Directorate, Bengaluru, Karntaka-560079. deepesh.cpcb@nic.in, 9611128895

In compliance to NGT order, the joint committee shall formulate a methodology for the expert study. The impact assessment shall be conducted at various radial distances from the blasting point and committee shall recommend a safe distance to be maintained from the mines/ quarries. The committee may undertake visit to the relevant sites in Kerala and interact with the stakeholders. The scope of the joint committee may be amended from time to time based on NGT's interim orders, committee deliberations or any other issues highlighted by any of the stake holders.

CPCB shall technically coordinate the entire activity in organizing meetings with committee members, coordinating site visits, compilation of technical inputs, report finalization and filing of final report as nodal agency.

S. Suresh
18/11/2022

The joint committee will be free to coordinate with other concerned authorities and take assistance of any individual/ institution if required. In this connection, at any point of time if committee feels that any additional assistance from institution/ individual is required, same may be included as special invitee for considering the views but not as committee member. The committee may also consider other relevant issues related to the study based on the interactions with stakeholders. After finalization of the report by the joint committee, latest by 9th April, 2022, the report shall be sent to CPCB, Delhi for filing it in NGT, Principal Bench, Delhi after obtaining concurrence from Competent Authority. The time frame shall be strictly followed considering the date fixed for filing the report as per the NGT order.

Honourable NGT made KSPCB and other relevant Kerala State Departments responsible for the coordination/ arrangements for conducting field studies. Relevant field sites for the study shall be finalized in consultation with the KSPCB. As per the nomination of KSPCB, details of official nominated as Coordinator/ Nodal Officer for this purpose is given below.

Shri. Krishnan M N, Environmental Engineer **(Coordinator/ Nodal officer)**	Kerala State Pollution Control Board, District Office, Palakkad, Kerala. kspcbpalakkad@gmail.com, 9447975719

Coordinator/ Nodal Officer from KSPCB shall be responsible for facilitating field studies and coordinating the functioning of joint committee in Kerala. The nodal officer from KSPCB shall participate in the joint committee meetings as a special invitee. KSPCB will arrange entire logistics, arrangement for field visits and meetings for all committee members till the report is accepted by NGT. KSPCB shall interact with State Departments responsible for mining/ minor mineral quarry activities for further arrangements to conduct the expert study, finalization of field visits, hearing of parties and meeting with other stake holders as per the NGT directions. The related monitoring shall also be arranged/ conducted by KSPCB as and when desired by the Joint Committee.

From time to time CPCB shall circulate minutes of the meetings and draft reports to all members through email and also through online messenger/ chat group, to be created exclusively for the purpose.

S. Suresh
18.1.2022

Committee members are requested to share their mobile numbers for this purpose. It is the primary responsibility of all committee members to respond immediately and to provide suggestion/ concurrence to the minutes/ reports and in case of non-response from any members within the time frame, it will be considered as concurrence to the report. Individual correspondence may not be preferred and all views shall be posted in the group so that all committee members will have the track of the issues.

First joint committee meetings shall be conducted through online wherein, further dates for joint committee proceedings could be finalized considering the time frame set by NGT.

S. Suresh
18/11/2022

(S. Suresh)
Regional Director
9480672128
ssuresh.cpcb@nic.in

To:

1. Prof. B S Choudhary, Associate Professor, Dept. of Mining Engineering, IIT (ISM), Dhanbad-826004. *bhanwarschoudhary@iitism.ac.in*
2. Dr. Siddharth Singh, Sr. Principal Scientist, CSIR-CIMFR, Barwa Road, Dhanbad-826001. *ss@cimfr.nic.in, ssgcmri@yahoo.com*
3. Dr. D P Kanungo, Chief Scientist, CSIR-CBRI, Roorkee-247667. *dpkanungo@cbri.res.in*
4. Prof. Manish Shrikhande, Professor, Dept. of Earth Quake Engineering, IIT, Roorkee-247667. *manish.shrikhande@eq.iitr.ac.in*
5. Prof. Ritesh Kumar, Assistant Professor, Dept. of Earth Quake Engineering, IIT, Roorkee-247667. *ritesh.kumar@eq.iitr.ac.in*
6. Dr. R J Perumal, Scientist F, Wadia Institute of Himalayan Geology, Dehradun-248171. *ramperu@wihg.res.in*
7. Shri. Venugopal Swamy Kadem, Dy. Director (Mining), Directorate General of Mine Safety (DGMS), Bangalore Region, Bengaluru, Karnataka-560071. *kademvenugopalaswamy@gmail.com*
8. Dr. Deepesh V, Scientist C (Member convener/ Nodal officer), Central Pollution Control Board, Regional Directorate, Bengaluru, Karntaka-560079. *deepesh.cpcb@nic.in*
9. Shri Krishnan M N, Environmental Engineer, (Coordinator/ Nodal officer) District Office, KSPCB, Palakkad, Kerala. *kspcbpalakkad@gmail.com*
10. MS, Kerala State Pollution Control Board, Thiruvananthapuram, Kerala.
11. Director, Directorate of Mining & Geology, Thiruvananthapuram, Kerala.
12. DH, IPC-II, CPCB, Delhi.
13. Admin Section, CPCB, Bengaluru
14. Accounts Section, CPCB, Bengaluru

S. Suresh
18/11/2022

(S. Suresh)
Regional Director

ANNEXURE 3

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE, GOVT. OF INDIA

NGT MATTER/ TOP PRIORITY

Tech/39/RDS/NGT/2021-22/ 885

8th March, 2022

To

The Chairman
Kerala State Pollution Control Board,
Head Office, Plamoodu Junction, Pattom P.O.
Thiruvananthapuram – 695004

Sub: Honourable National Green Tribunal (NGT), Principal Bench order dated 09-12-2021 in the matters of MA Nos. 80, 83, 85, 88, 89, 90, 91, 92, 93, 94, and 95 of 2021 in OA No. 304/2019: Information/ details sought for the expert study/ joint committee meeting.

Ref: CPCB, OM: Tech/39/RDS/NGT/2021-22/741, dated 18-01-2022.

Sir,

As per the Honourable NGT order dated 09-12-2021, it is directed to carry out expert study by a joint committee on the impact of blasting using NONEL Detonator Technology in stone quarries in Kerala. The study includes assessing impact of vibrations on different soil strata/ earth profile, noise levels, air pollution levels, impact on buildings, humans and wildlife. In compliance of the NGT directions, a joint committee is constituted as per the reference and Honourable NGT made KSPCB and other relevant Kerala State Departments responsible for the coordination/ arrangements for conducting field studies. Preliminary discussions with the nodal officers/ coordinators from CPCB and KSPCB were carried out and following preliminary requirements were delineated for the expert study.

- To formulate a facilitation committee with representatives from the Departments of Mining and Geology, Industry, Forest, organizations like PESO, KFRI and other concerned stake holders to facilitate field studies in Kerala. The facilitation committee and KSPCB shall make arrangements for the expert studies and specific role for each of the stake holders in the facilitation committee may be assigned by KSPCB.

--- 2/-

क्षेत्रीय निदेशालय (दक्षिण) : निसर्ग भवन, ए–ब्लाक, प्रथम एवं द्वितीय तल, तिम्मय्या रोड, 7–डी मैन, शिवनगर, बेंगलूरु – ५६० ०७९.
Regional Directorate (South) : " Nisarga Bhawan ", A-Block, 1st & 2nd Floors, Thimmaiah Road, 7th D - Main, Shivanagar, Bengaluru - 560 079.
दूरभाष / Telephone : 080-23233739. 23233827, 23233996, 23233600, 23232559, 23226002, 23222539, Fax : 080-23234059
ई–मेल / E-mail : cpcbszo@yahoo.com, zobangalore.cpcb@nic.in

प्रधान कार्यालय : परिवेश भवन, पूर्वी अर्जुन नगर, दिल्ली– ११० ०३२.
Head Office : Parivesh Bhawan, East Arjun Nagar, Delhi - 110 032.
दूरभाष / Telephone : 011-43102030, Fax : 22305793, 22307078, 22307079, 22301932, 22304948
ई–मेल / E-mail : cpcb@nic. in, वेबसाईट / Website : www.cpcb.nic.in

- To provide data/ information on the stone quarries operating in Kerala, including those operating in high hazard locations (earthquake/ landslide prone areas as per the hazard map of Kerala) and those operating in ecologically sensitive areas. KSPCB may also identify stone quarries where the expert studies can be considered.

- Details of facilities/ competency available with KSPCB/ other stake holder organizations/ R&D institutes that can be utilized for the expert study to assess the impact of blasting in terms of vibrations, noise, air pollutants and effects on buildings, humans & wildlife.

Since, the matter pertains to the stone quarries in Kerala, it would be a difficult task for CPCB to coordinate the field activities and logistics arrangements for the joint committee. In this scenario, it is requested that KSPCB may coordinate the field activities and logistic arrangements in Kerala. The expenditure/ cost involved with the expert study /logistic arrangements for the joint committee shall be re-appropriated once the study is completed as per the final verdict of Honourable NGT in this matter.

It is requested to update the actions plans and provide the data/ information sought preferably before the joint committee meeting fixed on 14th March, 2022.

Yours faithfully

S. Suresh 8/3/2022

(S. Suresh)
Regional Director
9480672128
cpcbsuresh@gmail.com

Copy to:

1. The Member Secretary, KSPCB, H.O., Pattom P.O., Thiruvananthapuram – 695004.
2. Shri. M N Krishnan, Coordinator/ Nodal Officer, KSPCB, Palakkad.
3. The DH, Legal Division, CPCB, HO, Delhi.
4. The DH, IPC-II, CPCB, HO, Delhi.

ANNEXURE 4

MEETING MINUTES (16-02-2023)

Meeting title	***Meeting of the Joint Committee held on 16.02.2023 for ensuring compliance to the directions of Honourable National Green Tribunal (NGT), Principal Bench, Delhi's order dated 09-12-2021 in the matter of OA No. 304/2019.***
Sequence	Meeting # 14
Date	16th February, 2023
Time	15.45 to 17.35 hrs. IST
Platform/ Venue	Online meeting via 'Google Meet'
Meeting link (online)	https://meet.google.com/wpn-dbun-rrd
Meeting facilitator	CPCB, Regional Directorate, Bengaluru, Karnataka.
List of attendees/ absentees	List of participants attended the meeting is enclosed as **Annexure-I**

A meeting of the Joint Committee was held on 16-02-2023 to discuss the status of study with regard to the impact of blasting using NONEL detonator technology in stone quarries in compliance to Honourable NGT orders passed in OA No.304/ 2019 and to discuss the following aspects:

1. Review of the draft report on impact of blasting using NONEL detonator technology with respect to vibration in nine stone quarries in Kerala submitted by CSIR-CIMFR.
2. Review and discussions on the notes provided by DMG, Kerala.
3. Discussion on the draft site assessment reports (ambient air, noise levels and mine pit water quality) prepared by Kerala SPCB.
4. Joint Committee's draft final report preparation.
5. Opinions/ suggestions/ inputs/ observations from committee members to be incorporated in the Joint Committee's report.
6. Any other relevant points to be included in the report.

Shri. J Chandra Babu, Regional Director, CPCB, Bengaluru welcomed all the members of the Joint Committee and other officials from KSPCB and DMG, Kerala. The meeting started formally by reiteration of the Honourable NGT directions dated 19-12-2021 and member convener presented the gist of the NGT order. The Regional Director informed that the deadline

given by the Honourable NGT in the recent order dated 18-01-2023 is 28-02-2023 and the Joint Committee has to finalize the report and submit the recommendations before the deadline. As per the first agenda of the meeting, he requested CSIR-CIMFR to present the findings of the blasting trials/ vibration assessment.

Dr. C Sawmliana, Chief Scientist, Dr. Vivek Kumar Himanshu and other expert team members participated in the joint committee meeting and Dr. Vivek made an elaborate presentation on the important findings, observations and recommendations of the CIMFR report. Dr. Vivek, briefly provided the outcome of the vibration assessment and about the generalized predictor equations derived for rock type/ quarry site and for the whole State of Kerala.

Joint committee members provided comments on the outcome of the CIMFR study report and the recommendations in the draft report. Dr. B S Choudhary, informed that he has already suggested few modifications in the report and opined that the report has technically presented the study outcomes quite comprehensively. He also noted that details of assessment of fly rock were not included in the report for all the sites. He also sought clarifications on the assessment of air over pressure (AOP) as the AOP assessed in the study is on a higher side. Dr. D P Kanungo opined that instead of giving recommendations by classifying zones based on technical observation/ statutory provisions, it should conclusively highlight the effect of vibration at different distances. Dr. D P Kanungo suggested that the recommendation part needs to be revised in a simple language with less technical jargons so the Honourable NGT can grasp the contents of the recommendations. Shri. J Chandra Babu, Regional Director, seconded his observation and reiterated that the recommendations need to be concise and crisp and based on the limited study covering major, medium and minor stone quarries. Shri. Sanjay Kumar, emphasized on various cases of fly rock incidents and also explained the provisions of various statutes applicable to stone quarries. Dr. Siddharth Singh, suggested that the recommendations of CSIR-CIMFR study should be very crisp and in plain language so that Honorable NGT can get the gist of all the study outcomes. Dr. D P Kanungo also commented that the vibration assessment study was done only in nine quarries among the several hundreds of quarries operating in Kerala, which is a small data set which may not be a representative experimental data set for all the quarries and cannot be generalized for the whole State of Kerala. Thus, he insisted that the extrapolation/ modeling/ predictions made using the 9 data set may not result in an accurate prediction/ extrapolation and the whole data set and the above disclaimer needs to be a part of the report. He summed up that the committee should rely on the experimental

data set generated from 9 quarries and should finalize the report in line with the expectations of the Honourable Tribunal. CIMFR's technical report shall be relied on for making the final recommendations by the joint committee.

The CIMFR team responded that maximum vibration was detected at 77 m as per the study and that is based on the experimental/ existing blast pattern carried out and the real blasting pattern may be different as the existing patterns suggested in the mine plan are not followed. As per the survey, the public had already complained that the intensity of blasting is much more. Dr. D P Kanungo insisted that the report should rely only those put in paper and not to rely on the verbal information and further insisted that the existing blast pattern followed was based on the undertaking from the project proponents.

Dr. Vivek also informed that in some cases the existing blasting patterns were not at all practical in quarry operations. Dr. D P Kanungo again insisted that deviations from existing blast patterns are beyond the purview of the committee and the report shall be very specific with conclusion based on experimental values. He opined that technically the report of CIMFR is excellent but the committee also should see the operational level in which the recommendations are to be implemented. Dr. Vivek replied that the experimental data generated in the study is based on the existing and experimental data and any deviations in blast intensity may result in a different data set. Shri. J Chandra Babu, RD, CPCB, Bengaluru suggested that CSIR-CIMFR may provide site specific data sets (as per EMP of the stone quarry operator and as per the study conducted with respect to blasting activity by CIMFR) and observations and recommendations based on the vibration assessment carried out in nine stone quarry sites and he requested CIMFR to consider the suggestions made by the committee members and submit the final report preferably by 20-02-2023 after incorporating all the suggestions appropriately. Dr. C Sawmliana, CIMFR, informed that they will incorporate all the suggestions of the committee and he also clarified that the AOP is measure at impulse frequency weighting and it is different from the ambient sound level measured at the quarry site.

Shri. Krishnan M N, Nodal officer, KSPCB presented one of the site report of the quarry at Pathanamthitta and explained the contents of the report. He explained the details of assessment, instrument deployed, monitoring methodology, time of monitoring, data recorded and the outcome of the dust and noise monitoring carried out at quarry sites. Elaborate explanations

were given on details of weather parameters monitored and the particulate matter assessed during the study. As per his presentation, the effect of noise due to quarry operations are up to 200m distance and the effect of particulate matter is only up to 50 and 100m from the blasting site. He also informed that in many sites, particulate matter is more on the non-operation day due to the site specific weather parameters like wind speed, wind direction and relative humidity. It was informed that the dust suppression practice done on the quarry operation day might have suppressed the dust and it was reflected in lesser particulate values in many sites. He also attributed the unusual readings at the upwind locations to other dust sources in the proximity and to the large vegetation like rubber plantations around the quarry sites. He also explained the analysis result of mine pit water collected from the locations. With respect to noise measurement, it was presented that most of the noise measurements were higher at 50, 100 and 200m distance and there is significant variation of 10 dB(A) in many stations at 50 and 100 m distances. In response to the suggestion of Dr. D P Kanungo regarding comparison of the observed noise data at the 9 stone quarry sites with the ambient noise standards, Shri. Krishnan clarified that the noise standards are applicable at the boundary of the quarries.

With respect to stone quarry mine pit water quality, Shri, Krishnan informed that Kerala PCB is not prescribing any water quality limits for stone quarries and hence the obtained result cannot be compared with any standards. Shri. J Chandra Babu, RD, CPCB, Bengaluru and all the members of the Joint Committee were of the opined that consent shall be amended to all the stone quarry operators in Kerala by prescribing suitable pond water/ effluent discharge standards keeping in view of the final mode of discharge and its probable impact on the receiving environment. He also suggested that some treatment systems shall be included in the consent mechanism for stone quarries.

Shri. Sanjay Kumar explained the provisions of various statues and technical circulars of DGMS and informed that he shall make a gist on the various statues with respect stone quarrying and he opined that mining lease/ permit shall not be granted by Department of Mining & Geology within the 300m from the habitats. Shri. Vinod, Geologist, DMG, Kerala informed that in Kerala the quarries are permitted to operate from 50 m from residential buildings and a detailed write-up on the rules and requirements was already submitted to the joint committee.

Upon detailed deliberations, the Joint Committee taken following decisions:

- It was suggested that a modified/ revised report of the CSIR-CIMFR after incorporating all the suggestions made by the committee members shall be submitted to CPCB & KSPCB by 20-02-2023.
- NODAL Officer, Kerala PCB was instructed to finalize and submit all the 9 stone quarry site assessment reports to Nodal Officer, RD, CPCB Bengaluru by 20-02-2023.
- Representatives of DGMS and DMG, Kerala shall submit existing policies or guidelines relating to buffer zone or distance criteria applicable to the stone quarries by 20.02.2023.
- Dr. B S Choudhary and other Joint Committee members were requested to formulate recommendations of the Joint Committee for inclusion as a part of the report of the Joint Committee, by 21.02.2023.
- Draft report of the joint committee shall be prepared and shared online with all the members as well as CPCB, Delhi by 22.02.2023 by the Nodal Officer, RD, CPCB-Bengaluru with the concurrence of the RD, CPCB, Bengaluru and comments if any shall be submitted to Nodal Officer, on or before 23-02-2023 so that the finalized report of the Joint Committee shall be forwarded to CPCB, Delhi by RD, CPCB, Bengaluru for filing before the deadline with the concurrence of the competent authority in CPCB.

The meeting ended with a vote of thanks to all the joint committee members and other officials who participated in the meeting. Contributions of all the committee members and officials were acknowledged.

The meeting concluded at 17.35 hrs.

Member convener

20-02-2023

ANNEXURE-1

Attendees/ Participants list	
Joint Committee Members	
1	Dr. B S Choudhary, Associate Professor, Dept. of Mining Engineering, IIT (ISM), Dhanbad.
2	Dr. D P Kanungo, Chief Scientist, CSIR-CBRI, Roorkee.
3	Dr. Siddharth Singh, Sr. Principal Scientist, CSIR-CIMFR, Barwa Road, Dhanbad.
4	Shri. Sanjay Kumar Gimmedi, Dy. Director (Mining), Directorate General of Mine Safety (DGMS), Bangalore Region, Bengaluru, Karnataka..
5	Dr. Ritesh Kumar, Assistant Professor, Dept. of Earthquake Engineering, IIT, Roorkee.
6	Dr. Deepesh V, Scientist C, Central Pollution Control Board, Regional Directorate, Bengaluru, Karnataka. *(Member convener)*
7	Shri. Krishnan M N, Environmental Engineer, Kerala State Pollution Control Board (KSPCB), District Office, Palakkad, Kerala. *(Special invitee/ Coordinator-KSPCB)*
Central Pollution Control Board officials	
8	Shri. J Chandra Babu, Regional Director, Central Pollution Control Board, Regional Directorate, Bengaluru, Karnataka.
Members of State level facilitation committee	
9	Shri. Vinod, Geologist, DMG, Palakkad, Kerala.
10	Asst. Engineer, Kerala State Pollution Control Board (KSPCB), District Office, Palakkad, Kerala.
CSIR-CIMFR	
11	Dr. C Sawmliana, Chief Scientist & Expert study head, CSIR-CIMFR, Barwa Road, Dhanbad.
12	Dr. Vivek Kumar Himanshu, Scientist, CSIR-CIMFR, Barwa Road, Dhanbad.
Absent list	
1	Dr. R J Perumal, Scientist F, Wadia Institute of Himalayan Geology, Dehradun.
2	Prof. Manish Shrikhande, Professor, Dept. of Earthquake Engineering, IIT, Roorkee.

ANNEXURE 5

KERALA STATE POLLUTION CONTROL BOARD
കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ്
Pattom PO, Thiruvananthapuram - 695 004
Phone: 0471-2312910, 2318151-54, 55 FAX: 0471-2318134, 2318152
E-mail:ms.kspcb@gov.in Web: www.keralapcb.nic.in

PUBLIC NOTICE

Hearing of stakeholders in the matter of safe distance for stone quarries in Kerala

Honourable National Green Tribunal (NGT), Principal Bench (PB), Delhi in the matter of Original Application (OA) No. 304/ 2019, directed vide judgment dated 21-07-2020 to maintain longer distances for siting stone quarries in the light of a report submitted by Central Pollution Control Board (CPCB) following precautionary principle considering the right of the inhabitants, who are affected by air and noise pollution generated in the course of mining. Subsequent to the above NGT order, the aggrieved mining lessees (project proponents) filed appeals in the OA 304/2019 for impleadment in the matter with specific prayer of not to interfere with the distance criteria laid down by the mining department and Kerala State Pollution Control Board (KSPCB). After examining the project proponents' contentions in detail, Honourable NGT directed for an expert study by a joint committee on the subject of safe distance for stone quarries from habitations vide order dated 09th December, 2021. Specific directions were given to study the impact of blasting in stone quarries. The study includes impacts on vibrations on different soil strata/ earth profile, on noise levels, on air pollution levels, on buildings, humans and wildlife.

A joint committee is constituted in this matter as per the directions of NGT and the committee is in process of planning the expert study in selected quarries in Kerala. The Committee will study the impact of blasting at various distances caused by vibrations on different soil strata and on noise and air levels, on buildings and human and wildlife. **The Tribunal had also ordered that any stakeholder will be at liberty to give their respective viewpoint to the Committee.** In compliance with the order of Honourable NGT, the Joint Committee is conducting hearings of stakeholders at following locations in Kerala as detailed below.

Date	Region	Venue	Districts covered	Time
23.08.2022	Northern Region	Hotel Alakapuri, Palayam, Kozhikode	Palakkad, Malappuram, Kozhikode, Wayanad, Kannur & Kasargod	10.30 am -1.00 pm
24.08.2022	Central Region	Training Centre, Kerala State Pollution Control Board, Regional Office, Gandhi Nagar, Kochi-20	Kottayam, Idukki, Ernakulam & Thrissur	10.30 am -1.00 pm
25.08.2022	Southern Region	Priyadarshini Space Planetarium Hall, Pattoor PMG Road, PMG, Thiruvananthapuram	Thiruvananthapuram, Kollam, Pathanamthitta, & Alappuzha	10.30 am -1.00 pm

As per the directions of the Joint Committee constituted in the matter of OA 304/2019, Kerala State Pollution Control Board is organizing hearings of stakeholders on behalf of the Joint Committee. Any stakeholder can attend the hearing and express their respective viewpoint orally or in writing before the Committee. Arrangements are made to participate in an online survey seeking viewpoints from stakeholders through an online survey form. The link to the survey form will be uploaded in the website of Central Pollution Control Board (www.cpcb.nic.in), Kerala State Pollution Control Board (www.keralapcb.nic.in) and will be opened from 10 am on 9.8.2022 to 5 pm on 26.08.2022

For and on behalf of
Kerala State Pollution Control Board
Sd/-
Member Secretary

KERALA STATE POLLUTION CONTROL BOARD
കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ്
Pattom P.O., Thiruvananthapuram – 695 004 പട്ടം പി.ഒ., തിരുവനന്തപുരം - 695 004
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E-mail:ms.kspcb@gov.in Web: www.keralapcb.nic.in

പൊതു അറിയിപ്പ്

കേരളത്തിലെ ക്വാറികൾക്ക് സുരക്ഷിതമായ അകലം സംബന്ധിച്ച വിഷയത്തിൽ ബന്ധപ്പെട്ടവരുടെ വാദം കേൾക്കൽ

ഒറിജിനൽ അപേക്ഷ (O.A) നമ്പർ 304/2019-ന്റെ കാര്യത്തിൽ ബഹുമാനപ്പെട്ട ദേശീയ ഹരിത ട്രൈബ്യൂണൽ (NGT), പ്രിൻസിപ്പൽ ബെഞ്ച് (PB), ഡൽഹി, 21/07/2020 ലെ വിധിപ്രകാരം ഖനന വേളയിൽ ഉണ്ടാകുന്ന വായു, ശബ്ദ മലിനീകരണം മൂലം ദുരിതമനുഭവിക്കുന്ന നിവാസികളുടെ അവകാശം പരിഗണിച്ച് മുൻകരുതൽ തത്വം പാലിച്ച് കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡ് (സിപിസിബി) സമർപ്പിച്ച റിപ്പോർട്ടിന്റെ വെളിച്ചത്തിൽ കരിങ്കൽ ക്വാറികൾ സ്ഥാപിക്കുന്നതിന് കൂടുതൽ ദൂരം നിലനിർത്താൻ നിർദ്ദേശിച്ചു. മേൽപറഞ്ഞ NGT ഉത്തരവിനെത്തുടർന്ന്, ഖനന വകുപ്പും കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡും നിശ്ചയിച്ചിട്ടുള്ള ദൂരപരിധി മാനദണ്ഡങ്ങളിൽ ഇടപെടരുതെന്ന പ്രത്യേക പ്രാർത്ഥനയോടെ, ഖനന പാട്ടക്കാർ (പ്രോജക്ട് വക്താക്കൾ) O.A. 304/2019 ൽ അപ്പീലുകൾ ഫയൽ ചെയ്തു. പ്രോജക്ട് വക്താക്കളുടെ വാദങ്ങൾ വിശദമായി പരിശോധിച്ച ശേഷം, 2021 ഡിസംബർ 09 ലെ ഉത്തരവ് പ്രകാരം, വാസസ്ഥലങ്ങളിൽ നിന്ന് കരിങ്കൽ ക്വാറികൾക്ക് സുരക്ഷിതമായ അകലം എന്ന വിഷയത്തിൽ സംയുക്ത സമിതിക്ക് വിദഗ്ധ പഠനത്തിന് ബഹുമാനപ്പെട്ട എൻ.ജി.ടി. നിർദ്ദേശം നൽകി. ക്വാറികളിലെ സ്ഫോടനത്തിന്റെ ആഘാതം പഠിക്കാൻ പ്രത്യേക നിർദ്ദേശം നൽകി. വിവിധ മണ്ണ് സ്ട്രാറ്റ/എർത്ത് പ്രൊഫൈലിലെ വൈബ്രേഷനുകൾ, ശബ്ദത്തിന്റെ അളവ്, വായു മലിനീകരണ തോത്, കെട്ടിടങ്ങൾ, മനുഷ്യർ, വന്യജീവികൾ എന്നിവയിലെ ആഘാതങ്ങൾ പഠനത്തിൽ ഉൾപ്പെടുന്നു.

എൻ.ജി.ടിയുടെ നിർദ്ദേശപ്രകാരം ഈ വിഷയത്തിൽ രൂപീകരിച്ച സംയുക്ത സമിതി കേരളത്തിലെ തിരഞ്ഞെടുത്ത ക്വാറികളിൽ വിദഗ്ധ പഠനം ആസൂത്രണം ചെയ്യാനുള്ള പ്രക്രിയയിലാണ്. പ്രകമ്പനങ്ങൾ മൂലം വിവിധ മണ്ണ് സ്ട്രാറ്റകളിലും ശബ്ദ വായു അളവുകളിലും കെട്ടിടങ്ങളിലും മനുഷ്യർക്കും വന്യജീവികൾക്കും ഉണ്ടാകുന്ന ആഘാതം സമിതി പഠിക്കും. സമിതിയോട് തങ്ങളുടെ അഭിപ്രായം അറിയിക്കാൻ ഏതൊരു തത്പര കക്ഷിക്കും (സ്റ്റേക്ക് ഹോൾഡേഴ്സ്) സ്വാതന്ത്ര്യമുണ്ടെന്നും ട്രൈബ്യൂണൽ ഉത്തരവിട്ടിരുന്നു. ബഹുമാനപ്പെട്ട ദേശീയ ഹരിത ട്രൈബ്യൂണൽ ഉത്തരവിന് അനുസൃതമായി, സംയുക്ത സമിതി കേരളത്തിലെ സ്റ്റേക്ക് ഹോൾഡേഴ്സിനായി ചുവടെ പറയുന്ന സ്ഥലങ്ങളിൽ ഹിയറിംഗ് നടത്തുന്നു.

തീയതി	പ്രദേശം	വേദി	ജില്ലകൾ	സമയം
23.08.2022	വടക്കൻ മേഖല	ഹോട്ടൽ അളകാപുരി, പാളയം, കോഴിക്കോട്	പാലക്കാട്, മലപ്പുറം, കോഴിക്കോട്, വയനാട്, കണ്ണൂർ, കാസർകോട്	രാവിലെ 10.30 ഉച്ച 1.00
24.08.2022	മധ്യമേഖല	ട്രൈനിംഗ് സെന്റർ, കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ്, മേഖല ഓഫീസ്, ഗാന്ധി നഗർ, കൊച്ചി-20	കോട്ടയം, ഇടുക്കി, എറണാകുളം, തൃശൂർ	രാവിലെ 10.30 ഉച്ച 1.00
25.08.2022	തെക്കൻ മേഖല	പ്രിയദർശിനി സ്പേസ് പ്ലാനറ്റോറിയം ഹാൾ, പാറ്റൂർ പി.എം.ജി. റോഡ്, പി.എം.ജി. തിരുവനന്തപുരം	തിരുവനന്തപുരം, കൊല്ലം, പത്തനംതിട്ട, ആലപ്പുഴ	രാവിലെ 10.30 ഉച്ച 1.00

O.A.304/2019 ൽ രൂപീകരിച്ച സംയുക്ത സമിതിയുടെ നിർദ്ദേശങ്ങൾ അനുസരിച്ച്, കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ് സംയുക്ത സമിതിക്ക് വേണ്ടി ബന്ധപ്പെട്ടവരുടെ ഹിയറിംഗുകൾ സംഘടിപ്പിക്കുന്നു. ഏതൊരു തല്പരകക്ഷി (സ്റ്റേക്ക് ഹോൾഡർ) ഹിയറിംഗിൽ ഹാജരാകാനും കമ്മറ്റിക്ക് മുമ്പാകെ വാക്കാലോ രേഖാമൂലമോ അവരുടെ കാഴ്ചപ്പാട് അറിയിക്കുവാനും കഴിയും. ഓൺലൈൻ സർവ്വേ ഫോമിലൂടെ വീക്ഷണങ്ങൾ തേടുന്ന ഒരു ഓൺലൈൻ സർവ്വേയിൽ പങ്കെടുക്കുന്നതിനുള്ള ക്രമീകരണവും ചെയ്തിട്ടുണ്ട്. സർവ്വേ ഫോമിലേക്കുള്ള ലിങ്ക് കേന്ദ്ര മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ വെബ്സൈറ്റിലും (www.cpcb.nic.in), കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡിന്റെ വെബ്സൈറ്റിലും (www.keralapcb.nic.in) 09/08/2022 ന് രാവിലെ 10 മുതൽ 26/08/2022 വൈകുന്നേരം 5 വരെ ലിങ്ക് തുറന്നിരിക്കും.

കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡിന് വേണ്ടി
ഒപ്
മെമ്പർ സെക്രട്ടറി

ദക്ഷിണ റെയിൽവേ ദക്ഷിണ റെയിൽവേ

ANNEXURE 6

Minutes of the stakeholders hearing conducted on 23.08.2022 at 10.30 am to 2.00 pm in the presence of Joint Committee constituted by Honorable NGT in OA304/2019 at Hotel Alakapuri, Palayam, Kozhikode

Hon'ble National Green Tribunal (NGT), Principal Bench (PB), Delhi in the matter of Original Application (OA) No. 304/ 2019, directed vide judgment dated 21- 07-2020 to maintain longer distances for siting stone quarries in the light of a report submitted by Central Pollution Control Board (CPCB) following precautionary principle considering the right of the inhabitants, who are affected by air and noise pollution generated in the course of mining. Subsequent to the above NGT order, the aggrieved mining lessees (project proponents) filed appeals in the OA 304/2019 for impleadment in the matter with specific prayer of not to interfere with the distance criteria laid down by the mining department and Kerala State Pollution Control Board (KSPCB). After examining the project proponents' contentions in detail, Hon'ble NGT directed for an expert study by a joint committee on the subject of safe distance for stone quarries from habitations vide order dated 09th December, 2021. Specific directions were given to study the impact of blasting in stone quarries. The study includes impacts on vibrations on different soil strata/ earth profile, on noise levels, on air pollution levels, on buildings, humans and wildlife. In compliance with the order of Hon'ble NGT, the Joint Committee planned hearings of stakeholders around Kerala. It was decided to conduct the stakeholders hearing on 23.08.2022 for Kozhikode region. Notices were published from the head office, Kerala Pollution Control Board prior to the hearing to inform the public about the stakeholders hearing and to invite their suggestions, views, comments and objections. Notices were published in the below mentioned popular dailies.

1. Malayala Manorama

2. The Hindu

The hearing of Stakeholders commenced at 10.30am on the scheduled date of 23.08.2022 at Hotel Alakapuri, Palayam, Kozhikode

The following Joint committee members and CPCB official participated in the hearing.

1. Dr. Venugopal Swamy Kadem, Committee Member, Dy. Director (Mining), Directorate General of Mine Safety (DGMS), Bangalore Region, Bengaluru.
2. Dr. R.J Perumal, Committee Member, Scientist-F, Wadia Institute of Himalayan Geology, Dehradun.
3. Dr. Ritesh Kumar, Committee Member, Assistant Professor, Dept. of Earthquake Engineering, IIT, Roorkee.
4. Dr. B.S Choudhary, Committee Member, Associate Professor, Dept. of Mining Engineering, IIT (ISM), Dhanbad.
5. Dr. Deepesh V, Committee Member/ Convener, Scientist C, Central Pollution Control Board, Regional Directorate, Bengaluru.
6. Er. Krishnan M.N, Committee Member (Special invitee), Environmental Engineer, Palakkad District Office, Kerala State Pollution Control Board.

Following officials were also present for the Stakeholders hearing

1. Er. J Chandra Babu, Regional Director, Regional Directorate, Central Pollution Control Board, Bengaluru.
2. Er. Shiju M.A, Environmental Engineer, Wayanad District Office, Kerala StatePollution Control Board.
3. Sri. Vinod M.V, Geologist, Department of Mining and Geology, Palakkad.

4. Smt. Vijaya K.C Assistant Geologist, Department of Mining and Geology,Kozhikode.
5. Sri. Gireesh I, Deputy Director, District Industries Centre, Kozhikode.
6. Sri. Baburajan T, Deputy Tahsildar, Kozhikode Taluk.
7. Sri. K.R Sajeevan, JS (G) Section, Taluk Office, Thamarassery.
8. Sri. Shameem Ajmal M, Senior Clerk, Taluk Office, Koyilandy.

357 people attended the Quarry hearing and the attendance list is given as **Annexure (A).**

Er. Krishnan M.N, Environmental Engineer, Palakkad District Office welcomed everyone to the hearing. He explained the purpose of the committee and introduced each committee members. Then he invited the public and stakeholders to share their views and comments and also to submit written complaints if any.

Altogether, 80 people who took part in the stakeholders hearing came forward and presented one by one their complaints or comments.

1. **Smile M Anto**

He said he is the proponent of a small 1 hectare ***quarry in Maruthomkara***, Kozhikode. His quarry is operated by loading workers and there are no machineries involved. This quarry is giving livelihood for many peoples in that village. 10 to 30 families solely depend on this quarry. He requested the committee to retain 50m as safe distance. He submitted his opinion in written format before the committee.

2. **Sidharthan**

He said that he is the owner of a small 20 year old quarry in Kozhikode district. His house is just 52m from the quarry. This quarry is providing jobs to 10 to 30 people. All the people around the quarry aregiving support. He has obtained all

the relevant papers from the all the departments and there are no complaints against his quarry. Blasting in his quarry is done scientifically so there have been no accidents till date. He suggested the committee to conduct a wide study and retain the safe distance as 50m.

3. **Nazeer K.V**

He said he is the proponent of a small quarry which gives labor to nearby people and loading workers. His quarry can continue only if safe distance is 50m. All residence near his quarry is beyond 50m and no accidents were reported. He humbly requested the committee to consider 50m as safe distance.

4. **M.K Babu**

He said that he is running a 15 year old small quarry. 15 years ago he was residing just 50m away from another quarry, each day he woke up to the sound of blasting,he never experienced any impact from that quarry.He said he don't know the scientific side but from his experience 50m can be considered as safe zone, even in that area he only felt air vibration so 50m is sufficient for safely running a quarry. He also said his business partner's house is within 50m from a quarry; this house does not have any cracks or damages. He conducted a scientific study in his quarry by filling 10 to 15 glasses with water and kept them at 5m, 10m etc. from the blasting point and conducted 30 blasting at a time and there was no impact. He pointed out that studies conducted by National agencies have reported that the impact of blasting only effects 30 m to 35m radius. Scientific blasting is used for Maradu flat dismantling, likewise safe Nonel blasting technique is used in his quarry.He suggested the committee to reduce safe distance below 50m because we have newest technologies emerging every day. If 50m safe zone is not retained, his quarry will be shut and this will affect 50 laborers and to top of all, this will adversely affect the construction field.

5. **Habeeb Rahman**

He is representing as the ***Chairman of Calicut District Quarry Crusher M-sand coordination committee***. He said he prefers 50m because of the new blasting technology. Previously the quarries were using Ammonium Nitrate.Other statequarries are using big bore blasting methods but with the consideration of Kerala's high population density, especially in the northern part of Malabar area, quarries are using Nonel blasting technology which has low impact. He submitted Quarry impact study report before the committee. He said if we compare the total requirement of construction materials in Kozhikode district with the total production, we can see only 50% is supplied from the quarries around. If we increase the safe zone beyond 50m, illegal quarries will emerge. There are only four Quarries in our neighboring district, Wayanad, Other neighboring district Kannur is also facing material scarcity. If you increase the safe distance most of the quarries will close resulting in unemployment of many. We don't have big industries around northern parts of Malabar comparing to other states, many people depend on this industry. He submitted a written request before the committee.

6. **Jibu Abraham**

He introduced himself as a new generation mining engineer as well as the proponent of ***Poabs and granite products, Perinthalmanna and Poabs rock product, Mukkam.*** They are using scientific methods for quarrying. In 2011, he approached NIRM and conducted trial blasting, according to their suggestion he introduced electrical lay blasting technique in his unit, and then changed to Nonel blasting. He is also the secretary of Kerala mines group vocational training centre, giving training to mining workers across Kerala. Accidents related to quarrying have subsided in the past five years because every unit is implementing bench

cutting, scientific blasting and also the employees are aware of their responsibilities. Each unit is providing livelihood directly or indirectly to 400 to 500 families. In Kerala, we have restrictions for land holding so a company cannot hold more than 15 acres,increasing safe distance is not viable for most of the units. He submitted the slow motion video evidence for showing the impact of blasting. With the help of scientific blasting, sound pollution is controlled in his unit. He requested the committee to retain 50m as safe distance. He said that MoEF authorities checked his unit and they are satisfied with the functioning of his quarry. He submitted the report before the committee

7. **Jacob E.A**

He introduced himself as the Managing partner of ***Chelupara granites, Thottumukkam***. NGT already know Kerala is different from other states as we have higher population density. Most of the issues regarding quarry can be resolved if Government of Kerala consider quarry as an industry. Quarries are operating after obtaining 6 licenses from different departments. All quarries are working with proper safety norms and papers.

8. **Balakrishnan**

He said he is from Thottumukkam, Kozhikode. Around twenty quarries are working near this place. The quarry near to his house has 3 leases, 2 EC's within the same compound. Landslide occurred in 2018 and soil piping occurred in 2019 in this area.Study conducted during this time by CESS, GSI, CWRDM - clearly says this area is prone to landslidesand recommended authorities to relocate peoples during heavy rain. Peoples living near this quarry submitted a complaint to Kozhikode collector and Geologist and requested them not to renew their EC but they prepared a report supporting the quarry owner. He recommended the safe distance as 500m. Vibration from this quarry is high, nearby residence has cracks. He submitted photo evidence of quarry impact. He said quarry proponents are

saying they are using bench cutting method but there are no such things. He said all the government authorities are supporting quarry owners.

9. Vinayan V.K

He is the joint secretary of ***Kasaragod Jilla Paristhithi Samithi***. He said a person residing near the quarry in Darbathadka nearly escaped from a flying stone during blasting. Intensity of quarrying can be clearly seen from the dig formed. They submitted complaint before authorities but there was no action from their side. Stones are falling beyond 240m from this quarry. People are forced to stop agricultural works during the blasting time due to the falling rocks. Elderly peoples are affected by noise and dust produced from this quarry.Houses beyond 500m to 600m have formed cracks.

10.Ajith Kumar K.G

He is a farmer from Kasaragod district. He says that there are two working quarries near to his house. Quarry named ***National Metals*** is 50m away from his farm land and ***Sree Shiva*** granites 150m away from his property. Several time he narrowly escaped from the flying stones. Once a stone fell on his neighbour while he was standing in his field. He said that the ejecting stones are creating problems in this area. Quarry owners are saying they are using Nonel method. On 17/06/2022, a stone weighing 2kg from Sree Shiva Granites fell near to him, another stone fell almost 300m from the quarry. Animals like Porcupines, Wild boars, and Mongooses are fleeing from this area. In 2020 or 2021, a minor landslide occurred just 60m below the blasting area. He submitted the photo evidences of cracked houses. He said he is not economically stable to build a new house. He pointed that a stream flowing from National Metals which contains polluted water is contaminating nearby streams. He submitted written complaints before the committee members. He requested to consider 250m as safe distance.

11.M. Kujamutty

He is the owner of ***Calicut Granite***, a 30 year old Quarry. His quarry is using Nonel method for the past 3 years. He said the workers in his quarry used to stand just 30m from the blasting point and observed no impact. There are no complaints against his quarry till date. If the committee increase the safe distance beyond 50m, almost 80% of quarries in Kerala will be shutdown. Now the rate of material is just 50 paisato 80 paisa per kilo gram, this rate will increase up to 10 Rupees to 15 Rupees if material scarcity occurs. For constructing a 2000 sq.ft house, we require 50 to 100 ton material, imagine the price hike we have to face.Most of the residences near the quarry complaining about cracks are not build properly. He also said that land slide occurred in Kavalappara was not due to quarrying. Quarries around Kerala are providing jobs for many peoples. A single person can hold only 15 acres of land, if we implement 200m safe distancing in Kerala this industry will come in to the hands of big corporate companies which will lead to price hike. He requested the committee to retain 50m.

12.V Badhusha

He is the representative of ***Wayanad Prakrithi Samrakshana Samithi***. Most of the quarries in Wayanad District are situated in the eastern slope of Western Ghats. He requested the committee, not to allow any quarries around 2km from the eastern slope of Western Ghat. Experts from CESS, GSI are saying not to allow any quarries in this area. He said 50m is not enough, stones falling beyond 200m is a common case in Wayanad. Chain blasting is effecting the mental In the year 2000, a resident in Ambalavayal, Wayanad, whose house was 250m from the quarry lost her right leg due the stone ejected from the quarry. Abortion rate in this area is very high. health of young children's and pregnant ladies. Most of the quarries in Wayanad are situated near to tribal colonies, authorities are not hearing their complaints. A land slide occurred in Vellamunda, Wayanad just below a quarry destroyed an entire tribal colony and one person lost his life. In 2018 at Athani, Wayanad a landslide started from a quarry destroyed 8 to 10

houses. He said someone earlier was saying there was only 4 quarries in Wayanad was not a correct statement. There is a quarry in Kadachikunnu, Muppinad Panchayath which is just 60m from the nearest reserve forest. Chalipuzha stream originating from this forest is a main water source for the villagers. This is a sensitive zone which is included in Gadgil committee report. There are lots of illegal quarries in Wayanad district. He pointed that 25% of buildings in Kerala are vacant. Westerners are not using rocks for construction likewise we can reduce the usage. Kerala government implemented a restricted centralized distribution system for river sand he suggested same should be considered for quarries. He requested the committee to conduct a scientific study to identify the locationsand quantity to be mined and should make local body the custodian. He suggested 500m for safe quarrying.

13.<u>Varghese</u>

He is the state secretary of ***Western Ghats Protection Council***. He said quarrying in Kerala is not scientific. A study conducted by KFRI says there are 5924 quarries in Kerala. Among this 50% of quarries do not have Environmental clearance. Distance is not the only the matter here, this natural resource should be considered as public property and government should be the custodian. At present, rate of material is determined by quarry owners. From this, Government is getting considerably small amount as royalty. Geology department in Kerala doesn't have proper data regarding the amount of rocks mined; this is causing great financial loss for our Government. He requested the committee to make a common policy for these mines and give full custody to Government. Most of the quarries have own crushers inside their boundary which do not requires permission from geology department and they are not paying royalty for their raw materials. Dust from these crushers is destroying our cultivation and creates sound pollution. There are 270 rock quarries in Wayanad district among which only 6 quarries are working now the remaining 264 quarries have deep pits

containing water which can cause landslide. Quarry owner should take the responsibility of filling them.

14.<u>Sujeesh Joseph</u>

From ***Kanichar Panchayat, Kannur District***. He said that there are 2 quarries operating in that area for past 10 yrs. They have given 20 complaints regarding the same.No actions were taken on their complaints. Nearly 150 landslides took place in that area, photos and videos of the same is produced before the committee. 3 people died and they are operating without any proper instructions.2 quarries are not operating at present. Main road is only 30m fromthe blasting area. He also requested the committee to visit the above said quarries and to take necessary steps to stop the same. The name of 2 quarries are ***New Bharath stone crusher*** and ***Sreelakshmi quarry***.

15.<u>Rajan</u>

General Secretary, Green Kerala Movement.He said that as per CPCB,thesafe distance for the quarry is 500m and this should be implemented. Asper Metalliferrous Mines Regulation Act, regulation/section 164, the safe distance is 500m and the law says that the employees should be moved to a safe distance of 200m at the time of blasting and this should be implemented in Kerala.He also said that Public Liability Insurance Act,1991 is also to be implemented in Kerala. He also continued that as per EIA, quarrying shall not be carried out in the area having 45degree slope, many quarries are violatingthis rule.Therefore, this also should be implemented in the State.He said that Kerala is densely populated area and divided in to coastal region, middle region and high range areas. So, if there is a quarrying activity in hilly areas, this 50m distance will adversely affect the people who are staying in the nearby areas of the hills.According to the report of KFRI, 95% of the quarries are situated nearby the river or water bodies and the next biggest disaster iswater scarcity. So quarries

should be allowed within 1km from the water bodies.Also, he said that based on the wind flow, the dust can be moved upto 1or2 km, so 50m distance is not acceptable.Polluted water from quarry is being mixed with water bodies,also the quarry dust will get deposited in the banks and bottom of the rivers and creates concreted base, there will be no penetration of water to sub surface or water table and also it effects the aquatic lives. He continues that, in Moochikunnu, 32 residences got damaged including a temple "Maha Siva kshethra" and walls of the temple are broken. Complaint regarding the same will be submitted by the people from that area who are also present here.So he requested the committee to keep a safe distance of 500m from residences and also 1km from the water bodies.

16.Dr. Afil M Alex

From Kannur District. He said that based on this sitting, the safe distance will be finalised, but on 2nd of this month (i.e. 02.08.2022) an application for a quarry was submitted by Mr. Rajeevan, this quarry is facing many allegations.As per village sketch issued by the village officer, there is no stream near the quarrying area, but in 20m from that area there is a hydroelectric project started in 1999 and name of the project is 'Munnurkulam Pico Hydro Electric Project'. Photographs of the same will be submitted before the committee. Even if the distance criteria of 200m are not fixed, they are getting the approvals and also there is a slope of 40 degree. District Collector, Mir Mohammed IAS has already said this area is land slide prone. He said that road near quarry should have a minimum 7or 8m width, but roads in his village is only 3m, still they have got permission. Village officer issued a plan and then revised the same for the above said quarry, in this revised planalso, water body is not mentioned.If they have started operating the quarry the water body will get polluted. This water is used for agricultural activitiesand human needs. Also, he said we need scientific validation before fixing the safe distance and also requested the committee to cancel the EC of this project, if they operate the quarry, it will adversely affect

the people in that area as there are many heart patients nearby. He concluded before the committee requesting to allow a safe distance of at least 250m from quarries and also quarrying should be done scientifically.

17.A.K.Davison

General Convenor, Quarry Owner's Coordination Committee. He said that quarry ownersare facing many issues because of the new rules coming each day. He also said thatthe complaints raised before the committee are not genuine and are fake. The complainant's residences are beyond 500m from the quarriesand are raising fake issues, and submitting complaints for economical benefits.Many people are complaining that their residences are getting crack due to the operation of the quarry but cracks are not only formed from quarrying activity, but the complainants are making issues based on that to get money from the quarry operators. Many environmentalists or Activists and also advocates are after quarries and making complaints and filing cases for their benefit. He also said that Scientist Sri T V Sajeevan from KFRI have written a book about quarrying activities, in that he specifies 5984 quarries are in Kerala and he concluded that whether he is not sure they are operating or not.At the time of flood and landslide in Kerala, some people use to saythat this is due to the operation of 5984 quarry which makes people panic. Also he said that 50m is more than enough for quarrying activity. Environmentalists are taking money from quarry operators in the name of study of Western Ghats and they are acting against them. He said that 50m is enough for the safe running of quarry operations. If the distance is increased above 50m, none of the quarries in Kerala will work, this cause shortage of materials for construction industry. He concluded that all quarries are running as per the instructions of SEIAA.

18.T K Abdul Latheef

Secretary, Small Scale Quarry Association. He said that from 1967 onwards, 50m is the distance criteria as per mining act, because maximum safe distance is 35m from the blasting point.So, making the distance more than 50m is not needed as we already have controlled blasting facility.Kerala is a state which already introduced Land reform Act,if the distance criteria is more than 50m then the quarrying operator should have more than 15 acres of land but nobody can keep more than 15acres of land in Kerala. So, it is very difficult for operating small quarries and there will be shortage of materials in the state. He also said that land sliding is not occurring due to the operation of quarry, it is because of cloud burst and it is a natural phenomenon.Land sliding is occurring due to the old mines already existing in the forest areas. He concluded that control blasting is the only solution and distance criteria shall be fixed to 50m,if distance criteria is increased, there will be no quarrying activity in the State. He also concluded that all rules regarding this should be amended for the smooth running of quarries.

19.P.G Devasiya

From Dhoni, P.O,Palakkad. He said that there are 2 quarries operating in their area which are not operating now. For the past 10-12 years,they are approaching Pollution Control Board and Mining & Geology Dept. with grievances against the operation of quarry.Also, he submitted documents regarding the same before the commission.He also said that one quarry operation is stopped and other one is operating near to the forest area which is part of Western Ghats. 12 families are moved out of that area due to the operation of quarry. This quarry is operating near to the catchment area of Malampuzha dam. He also said to the committee members to conduct a meeting around the 50m of the quarrying area. They've submitted document of the existing blasting details to committee members. Quarries are operating within 50m from the forest area.He said that, initially, the quarry was started in 2 acres of land and presently

total 22 acres area have quarried. They have again obtained licences but we cannot trace from where did they obtained the approval so far. He said he have 8 acres of land below the quarrying area and they are not useful for agricultural activities now. He have reported the same along with documents submitted. Because of this quarrying activity, last month 3 people died due to the elephant attack because of the operation of the quarry as the blasting is carried out at the areas where elephants used to gather.The above said stopped quarries have made 10 lakh tones of products so far without prior approvals from concerned departments from 2012 to 2022.He said that at the timing of blasting, people nearby around 5km find it difficult to survive there and he is staying in a rented house far from quarry, as he's not able to stay in his own house due this quarrying operation. He also said that Olavakkode Railway Station is about 5km from these quarries. He concluded his conversation requesting the committee members to kindly make the distance criteria from 50m to a minimum of 250m.

20.<u>Sreejith</u>

From Nanmanda, Kozhikode. He said that he is from Hindu Adivasi community staying at Nanmanda Grama Panchayath. There is a quarry & crusher operating in the name ***ABBA Crusherand quarry*** in Balussery Grama Panchayath, started operation in 2016. Our complaints are not considered by any department, as we are Adivasis. After the operation of the above said company, cattle's over there are starving without food and also, drinking water over the area is now unfit for drinking. He also said that whenever we are raising complaints against the unit, the quarry operators are filing false cases against us before the Hon'ble High Court, Ernakulam. He said the protest arranged against the unit was a failure, and they were harassed by the unit owners and false cases were filed in the police station.He concluded that the above said unit should be closed at the earliest and complaint regarding the same is submitted before the committee.

21.<u>Shyam Nelleri</u>

Manager, Naduvathur Stone Crusher& Quarry. He said someone has spoken that that cracks are formed in their houses due to blasting. He added that he is aCivil engineer worked under Indian Army. He said that there are 2 offices inside his quarry and there is no crack in that buildings so far. There are residences and mosque beyond these quarries and no problems were reported and the complainants'allegations are false.He also said that there is residence in between 50m and workers are working there and no problems reported so far. So he concluded that 50m is safe and no problems will be occurred based on it.

22.<u>Beerankutty</u>

Vengara, Malappuram District. He said that he is running a crusher with 50 labours, and due to shortage of granite stone, crusher unit is stopped at present. One reason for shortage is that this granite stones are used for the construction of backwaters in the coastal region of Malappuram district. The quarry nearby was running scientifically and by bench cutting. If the distance is increased, there will be shortage of granite stones and our units will be in shutdown stage. As we all know about the Maradu case, the flats are destructed scientifically without getting damages to the nearby buildings. Now a days quarries are operating scientifically by bench cutting and using Nonel detonators and they are safe, if the distance criteria is increased, there will be shortage of raw materials and operation of many crusher units will be in trouble. The people in Kerala have a tendency to raise objection in many development activities. GAIL scheme was first opposed by the people of Kerala and now many people are using CNG vehicles like that they are opposing the same in quarry cases. Therefore, he concluded that the distance criteria to be fixed below 50m as we have scientific blasting facilities.

23.<u>Roy</u>

From Karikayam, Palakkad. He said his complaint is against ***Penta Granite Quarry, Palakkad***, his 0.5acre plot is near to the boundary of the quarry and the

quarrying area is near to this plot and before they were removing soil from that buffer area. He said that his and his brother's rubber plantation is adversely affected due to this. He have filed complaints before the Minister of Agriculture, Human Rights Commission and District Collector. Based on the complaints, Tahsildar visited the site and reported that it should be verified by the agricultural officer. In continuation to that, Agricultural officer visited and reported but no action was taken against the unit. He also said that he has constructed a house in 2015 in that area, at that time quarrying has not startedand when he went to Panchayath for obtaining building number to that house, Panchayath refused his application as there is quarry in 100m. They filed case against me and my brother in both Munsif Court and High Court, so Panchayath have not given building number due to these cases. Quarry operators had given many cases against him including criminal cases. He said that there is a court order that soil can be removed with a distance of 20m from his residence for quarrying activity, but the geologist have given quarrying lease near to the boundary of his residence in 2017. He have showed all the documents to the committee members and concluded that distance criteria should be calculated from the boundary of the plot, not from residences, else nobody can build houses nearby the quarries. He has filed many cases before court but no actions were taken on that and have lost nearly 5 lakhs of rupees regarding this.No actions were taken by the geologist of Palakkad.

24.<u>M.Haridasan</u>

From Kizhakkanchery, Palakkad. He said that he is the petitioner in O.A 304/2019 before the Hon'ble National Green Tribunal and said that Mine Safety Directorate have declared 300m area near to quarry as dangerous area and extended the distance criteria to 500m.Even if the distance is 500 m, at the time of blasting it is dangerous that stones are going beyond 500m from quarry.So, 500m is also not a safe distance.Even after existing of Mines Act, Kerala Minor

Mineral Concession Rule, Explosive Rule, many accidents occurredbecause of blasting. Even if the distance criteria is 50m or 100m there are many accidents reported and report of the same have to be collected by the committee from Mining and Geology Department. Committee constituted by Government of Kerala regarding the study of Quarry reported that permits shall not be given to residences within 300m of quarrying area.14th Kerala Legislative Environment Committee have made that there shall be no residences within 200m of quarrying area. Therefore, hereby concluding before the committee that there shall be minimum distance of 300m from road, water bodies and residences to quarrying area and also each and every quarry cannot be monitored frequently. Hence increasing distance criteria is the only solution for the above issues. While issuing an approval for quarry, there should be a limit made for blasting and quarrying but many quarries are quarrying more than that and many quarries have got penalty for the same. Also he asked how the quarry operators are getting explosive more than permitted to them.So, proper monitoring cannot be done in quarries.Hence, he requested that distance criteria of 300m shall be implemented in quarries.

25.Abbas B.K

From Panagal, Kasargode District. He said that present distance criteria of 50m shall be implemented otherwise large quarrying only will be there and there will be shortage of materials for construction and poor people will suffer from that and there will be lose of job for thousands of people. Therefore, requesting the committee to retain 50m distance criteria.

26.Augustine Thuruthimattathil

From Thottumukkam, Kozhikode District. He said that there is a quarry operating in 165m from his residence owned by Palakkal Aboobacker. Because of this quarrying activity, there is a huge loss for him. It’s been 3years since he

has tapped his rubber plantation. Due to the operation of this quarry and crusher, heavy dust particles made him an asthma patient. There are 4 no.s of people in his family facing various health issues. The quarry operator is illegally mining beyond buffer zone including his property. Complaint has been filed before various department but no actions are taken against them. Due to heavy dust suppression, cattle's are dying. Because of the quarrying operation, he and his family cannot survive in that area. He also said that there are 2 roads which are within 50m from quarrying area. There are mosque and public buildings, but they are not complaining about the quarry as they are getting benefits from quarry owner. Finally I have submitted a case before the Hon'ble High Court and in that it is clearly mentioned that there are cracks in his house which was built in 2010.Therefore, he concluded by requesting the committee to make distance criteria of minimum 500m.

27.Limnesh

From Thottumukkam, Kozhikode. He said that there more than 200 people staying there including SC/ST community. There are many quarries operating in their area and quarrying are carried out more than the approved limit. Whenever they are complaining about the quarry activity, the quarry owners are making false complaints in police station against the people over there. Also, there are cracks occurring in nearby residences. Because of blasting, there is heavy vibration and children are suffering a lot of problems from that. Also there are 2 or 3 Anganvadi's nearby quarrying areas and many complaints were given but no actions were taken.Many vehicles are running with loads both during day and night time without permits.For the past 6 months, ***Cheluppara crusher*** got stay from the court but still the load is going from the unit. Submitted documents and pendrive before the committee including all the data.

28.Fr. KuriakoseKochukaippel

From Koorachundu, Kozhikode District. He said that the complainants who talked here before him were correct. He added that he has come here to convey the issues faced by the Church, School and people who reside nearby, before the committee members. Some of the people who are along with me today are rubber tapping labourers. He had come against a quarry named '***Porali***'. The main issue here is deciding the safe distance criteria. The church and 50 houses are beyond 200m from this quarry. This church, School and houses has been built more than 15 or more yearsback, but the crack came to this houses are after starting the operation of quarry. He also said that the decisions by the committee shall not be taken based on the number of complaints received as the quarry association have submitted many letters in favour of 50m as they are more in numbershere.So he requested committee members to make a wise decision on the subject and submitted documents before the committee.

29. Shyla, Thiruvallur

She said that she is living near a quarry and there has been no damage to the house till date.

30. K C Krishnan, Maruthonkara

He is residing near a quarry. People are making false accusation against quarries like crack on residence, flood, and environmental disaster. He also stated that crack on residence is due to construction faults. It won't be easy to obtain construction material if the distance is more than 50m. Quarry gives employment tomany people.It was not easy to obtain all the statutory licenses.This industry is operating according to the rule, so 50m is enough for quarry.

31. Ansar, Koodaranji,Koompara

He said in their ward, 5 quarries are working. A stream originating from ***Mathalikunn quarry*** which has traces of explosive and quarry waste, is joining to nearby river. Health inspector collected samples from that river for analysis,

resultsshows thequality is poor. Streams, rivers near quarry is polluted because of the chemicals used for blasting. People living in near quarry areas face difficulty by using this water. Top soil in quarrying area is dumped near streams, during monsoon season it is mixed withwater and flow through river. They have permission to transportonly 8 ton material but they are transporting over load,going through the small Panchayath road and it will damage the road. They are destroying Buffer zone and blasting is done near forest.

32. Gopi

He says that quarry is giving employment to many people. If beyond 50m is given, most of the quarries will have to stop. He requested to let the quarry to operate. No residence is permitted within 1km from buffer zone.

33. A Resident from Balussery, Kozhikode

She said that she is residing near quarry owned by C P Muhammed, Balussery. Her father is a patient .There are many cracks formed intheir residence. This quarry have license till 2023 but they are not obeying any of the conditions, no bench cutting, and no sprinkler. Quarry owners are not living near the quarry so they don’t have to face these issues.

34. Shoba, Thiruvallur

She is residing near quarry. She says that she doesn’t face any problem due to quarrying activity nearby.

35. Prasanna

She is residing near quarry. She has no issues.

36. Sheeba, Thiruvallur

She is residing near quarry. She says that quarry use to provide water during the peak of summer.

37. Janu, Vadakara

She is residing near quarry. She says that she gets benefit from quarrying.

38. Reeja

She is residing near quarry. She says that she has no problem due to blasting.

39. Koppan

He is a quarry worker, says he knows the impact of blasting but quarry owners never consider their problems.

40. Abdul Azeez

He says that quarrying was done 12m near to a common Cemetery. They filed a complaint against quarry but no action was taken and also false report was given. Please instruct quarry owner to live near the quarry and include this as a condition.

41. M.Kelappan

He says that on August 1st 2022, earthquake happened in 36 areas due to 2 quarries, ***Geo Sand crusher and Newbharath crusher***. In 2017, an earthquake happened in this area .These units are dumping M Sand into river. They filed complaint, as a result district collector issued a 15 day stop memo but a geologist inspected this areaand reduced it to 7 days.Three people died, 5 houses completely destroyed, 40 plus houses partially destroyed and 100 hectares of land destroyed due to earthquake. He said they want to stop these 2 quarries. On August 20th, collector issued an order to transfer the load from the quarry.

42. A Resident from Kanichar, 9th ward

He says that earthquake happened in 36 areas because of the activities done by ***Geo sand and Newbharath crusher*** unit. Quarry owner are giving money to people for supporting the quarry unit.

43. Satheesh M Bastian

He says that landslides and earthquake occurs in their area is affecting poor people. ***Newbharath and Sreelakshmi crusher*** are causing theses earthquake. In their area only medium rain occurred during the monsoon. At the top of the hill, twoquarries are working. During the disaster, entire people living under the hill was devastated with the impact. Poor people can't move their house accordingly. He requested the committee not to allow quarries on top of the hills.

44. M.P Moideen

He comes from Vengapally GramaPanchayath in Wayanad District, The area of this Panchayath is said to be 21.6 square kilometer. The population is less than 12,000. Six Granite quarries and about 4 Crushers are occupying one third of the total area. His house is less than 600 meter from a quarry. The rigorous eruption here is causing a lot of problems. This is a worrying situation; he said that if you look at this Panchayath, there is no other ward with so many quarries. There is a possibility for major disasters in the steep terrains of Wayanad district. He said that even if we complain about this matter to any authority,nothing will happen. Geology department is giving permission for this, and they do not look back despite the complaints of so many people. They buy lands where there is a possibility of damage. But they are not solving the problems like dust and sound pollution. He requests not to allow 50 meter distance. He said that their life and property need to be protected and for this they need a system. So many quarries were given permission in this valley without any expert study.

45. Shekaran

He from Kondotti, Nediyidippu N H colony in Malappuram district. He said that a large number of people from tribal community are living in their region. Their main occupation is quarry related works. Thousands of peoplewill become jobless without this quarry. Water stored in these can be used for agriculture and other

purposes. More than 50 households in this area drink water from this quarry. He says that someretired government officials will speak against the quarry because they don't consider this job opportunity. So what they have to say is that these quarries need to be protected. They also need protection for their homes. He says that his home is 60 metre away from the quarry and there is no damage to thehouse yet. There is no crack in the 35-40 years old building next to the crusher. Most of the land here is being used for Temples, Church, Mosques etc. according to the Land Reform Act. The remaining part of the land is used for the construction work; they said they will become jobless without the construction work. So their job has to be protected.

46. Abdul Gafoor

President of Crusher union Association, Malappuram district, he says that infrastructure development is done with quarry products, we don't export product outside of Kerala. We are importing materials from other states. Due to the shortage of materials many works were stopped like Vizhinjam. This should be handled technically. We can adopt the modern blasting technique and requested not to change the distance above 50 meter, Destruction of Maradu flat is an example. If change the distance is increased above 50 meter, this will affect 75% quarries and also results in the shortage of materials for construction. Even the people who opposed this will now have to pay Rs 250/- for what they get for Rs 25. He said that this problem should be handled technically. The department should present the possibilities of this in the Green Tribunal.

47. Fazil

He is from Mukkam, he said that Kerala is different from Tamil Nadu, Karnataka, and other states in India. Kerala has different land levels and ecosystem. He said that here we have many limitations. If the distance is increased, it will result in material shortage and the price will increase for the product. He says that many

people are working in this field and they will lose their job including him. In Kerala, most of people are mislead by fake environmentalists, alleging that all natural calamities are created by quarry. He added that these calamities happens naturally.

48. Suresh

He is from Vengapally district in Wayanad district. He said that about 6 quarries are working here at present, andits heard that more new quarries are given licenses. He said that he resides near a quarry, and at the time of quarry blasting, problems like unbearable sound,damages of house, flying of stones etc. are being faced. No remedial action were taken by the quarry unit, even after reporting this. He added that, after expert study, no new permit should be allowed.

49. Abdurahiman

He's from Malappuram district. He says 100 peoples are working directly and indirectly under him. Considering 5 members in a home, around 500 people will get benefit from his unit. Now government has decided to borrow 1000 crore for Onam, so promoting this sector for generating revenue income is essential. He added that 50 metre distance criteria should be retained.

50. Muneer

He's from Mukkam, he says 10 ago, there were illegal mining, and quarries used ammonium nitrate for blasting resulting in heavy vibrations, but after 2012, when EC was made mandatory, things are under control. There are many essential requirements for quarry operation, like Mining manager, Mining mat, benching, supervisor etc. If this system is maintained, 50 meter is more than enough.

51. Riyas

He's from Koppam, Palakkad. Presently, he works in a ready mix company. He says,if the distance criteria is increased to 200 meter, then 80 % quarries may get

closedand will result in huge shortage of raw materials required for construction. Also, material cost will increase, many would lose job, poor people may find it difficult to build a house. The quarries are now operating after obtaining all statutory licenses. If properly monitored, 50 metre distance criteria can be retained.

52. Thankachan

He's from Nediyidippu in Malappuram district. He says there are 3 quarries operating near to his house, and he's residing over there for around 15 years, but has never faced any problem from quarries. There are no problems with the quarry operating under the rules and guidelines. A maximum of 50 or 100 pits will be blasted from one quarry. According to his opinion there is no problems with quarry. He said allegation regarding abortion cases in women raised in this hearing is baseless citing example of Thrissur Pooram.

53. Adnan

He's from Kadampuzha in Malappuram district, he running a quarry for 15 years. He said that when an application was given to State Environmental Impact Assessment Authority, they asked him 'why you are applying for a small quarry'? but, this area has provision for a small quarry only. The land owners gives their land for quarrying for lease, as they plan that area to use for rain water harvesting after mining. As per a complaint received against the quarry 5 years ago, ground vibration test was carried out, hiring a government approved firm, and the report says that the impact of blasting is only up to 38 metres.He added that he's an engineer as well as a PWD contractor, and concluded that operating with latest blasting system, 50 m distance criteria shall be retained.

54. Ashraf

He’s from Kazhakkal in Kozhikode district. He said that in Kerala, M Sand and aggregatesare the main raw materials in demand for construction works. He added that many legal documents are required for approval of a crusher.

55. Joshi

He’s from Mukkam, Kozhikode. He said there are altogether 23 crushers and quarries working in Kodiyathur and Karassery Panchayath. A land with Survey No.108, is locked over there. This land cannot be utilised for any purposes, not even for applying loan for educational purposes. One complaint each in 2020, and 2021 was filed against these units. He concluded that necessary actions shall be taken against these units.

56. Najeeb

He’s from Vengapally Panchayath, 10th ward. He said that there has never been a landslide in his area. He added that many complaints are not genuine, and decisions shall be taken only based on technical report.

57. Vijesh

He’s from Kavilumpara Panchayath, his complaint is against the quarry nearby his residence. He says that waste water from quarry contaminates water sources nearby. Rs.172000 fine has been imposed by the Geology Department for this quarry once, but the quarry started working again. He says the complaints filed are of no use, and it is heard that permission is going to be given for a new quarry in this locality. He concluded that quarries should not been allowed in hilly areas and the distance criteria shall be increased to 200 metres.

58. Muhammad

He said that many people works in his quarry, and there has been no complaints from nearby residents. If the distance criteria is increased, then 90% quarry may

get closed in Kerala, he says 50 metre distance criteria shall be retained and thereby protect workers welfare.

59. A Resident from Keezhariyur, Koyilandy

From Naduvathur, Kizhariyoor Panchayath, Koyilandy in Kozhikode district, he said that in his place Anappara, Kizhariyoor, a quarry has been operating for 30 years. In the beginning years, it works only 2 days in a week with small blasting, but after obtaining license, they started blasting heavily, resulting in damage of 36 houses, 4 wells, and 1 Temple. He concluded that houses and property shall be secured from quarry.

60. Sabhu

He's from Kodiyathoor Panchayath in Kozhikode district, he said that in the quarry nearby to his place, Electric blasting method is practised, and this cause vibration on earth and causing damages for buildings. M sand slurry from crusher unit get mixed with water, it floats along in the streams and finally it reaches Chaliyar river. He has submitted a complaint letter.

61. Muhammad Basheer

He's from Thottumukkam, Kozhikode district. He workedfor40 years in the field of mining, and also he is mining manager. He says that the mining work if practised in scientific way, 50 meter distance is enough.

62. Majeed, Nadapuram, Kozhikode

He says he stays in a house of 4000 sq.ft, nearby to a small quarry. No cracks in his house till date.

63. Raveendran, Meppayyur, Kozhikode

Many people depend on quarry for living. 50 m distance criteria of quarry shall be retained.

64. Khader Babu, PWD Contractor

Building material cost will increase by 10 times if distance criteria is increased from 50 m.

65. Asif, Payyanad, Malappuram

He says a quarry was functioning smoothly in this area for 30 years. Issues started when another quarry started functioning. Uncontrolled blasting causing flying of granite stones even at 500 m distance, cracks in nearby houses, noise pollution etc.are the issues faced. District Collector, Thahasildar visited the site. But, no action taken from their side. Village officer said he has pressure, so can't take action. Safe living, safety of houses, belongings, and agriculture land shall be ensured.

66. Balan PP, Meppayyur, Kozhikode

He says he's been functioning a quarry since 20 years, 50 m distance criteria of quarry shall be retained.

67. Shibu, Maloor, Kannur

A quarry functioning in his area is located in a hilly area. The lower area nearby the quarry faces problem while blasting. The springs originating from the quarry area is depleting.

68. Abdul Razak, Malappuram

Engineer in Construction field.He says,50 m distance criteria of quarry shall be retained for country's development. If Scientificmeasures are practiced, no problem will arise.

69. Fyjaas, Mukkam, Kozhikode

He says he runs a crusher in 5 acre land. In Kerala, only 15 acres of land can be kept by a person, so their situation shall be considered.

70. Abdullah, Malappuram

He says he's been functioning a quarry since 20 years, no issues for nearby residences,50 m distance criteria of quarry shall be retained.

71. Abdul Latheef Bava

He says he runs the quarry named ***Naduvathur Stones, Koyilandy***, which was mentioned earlier in the hearing that it caused cracks in 36 houses, and a Siva Temple. He says blasting done in morning and evening is being recorded, two cameras are focused on to quarry. District Collector, and Geologist visited the site when complaint aroused. He's been running the quarry since 30 years. The Siva temple is 500 m away, the damage caused is because the temple is very old. The vibration test conducted shows vibration distance is 39 m.

72. **Santhosh, Kunduthode, Kozhikode**

His two floored residence is nearly 150 m to the quarry which is functioning since 60 years. The stream in the premise is still running full. If properly functioned, no issues with quarry.

73. Safwan

He says there are two quarries nearby to his residence, no issues till date. He asks how houses can be built if quarries are asked to close.

74. **Muhammed Ismail Makki, Kozhikode**

Kozhikode District Quarry Owners Association. He said that, as per KCR Act, only 15 acres of land can be possessed by a person, then how come 200 m quarry distance be maintained? 50 m distance criteria of quarry shall be retained.

75. **Kunjappu, Kondotty, Malappuram**

For 200 m distance criteria, 75 acres of land is required. With modern technologies practiced, 50 m distance criteria of quarry shall be retained.

76. **A Resident from Melmuri, Malappuram**

He says a quarry was functioning smoothly in his area for 30 years. Since 5 years, more quarries started functioning. This created competition within quarries, creating huge nuisance to 200 residences nearby. No control measures are practiced, no authorities – Police, Geology, PCB are monitoring. Uncontrolled blasting causing problem. The workers in the quarry are mostly from other states. Finding it difficult to live, can't leave the place as very cheap rate is offered when land kept for sale. He added they are not against development, but safe living shall be ensured.

77. **A Resident from Padinjaremukku, Ward-1, Melmuri, Malappuram**

He says the quarries and crushers nearby are creating nuisance. The water in stream flowing nearby is polluted, cracks can be seen in 70% of houses nearby.

78. Muhammed, Vatakara

Hesays cracks can be seen in 75% of houses nearby.

79. A Resident from Melmuri, Malappuram

He informed that he's a gulf returnee, who worked abroad for 32 years, now finding it difficult to live peacefully because of quarry nearby. His house is around 150 to 200 m away from quarry, there are around 75-80 houses nearby. Heavy Four wheelers are passing through this area early in the morning – around 3.00 to 4.00 am. Fake cases are filed against complainants. Safe living shall be ensured.

80. Peter, Vengapally, Wayanad

He informed that there were 12 quarries in the area, as the area has more granite stone deposits. After land reforms, only 4 quarries, and 2 crushers are now functioning. 10 MT weighed machines are used in crushers, high rise buildings are located nearby – no problems till date. State faced 2 floods, but no landslides or other problems were reported in this site. Scientific Nonel blasting is practised. 50 m distance criteria of quarry shall be retained.

Sri.Krishnan M.N, EE, KSPCB concluded this hearing as directed by Joint Committee. He informed that all suggestions, proceedings are audio-video recorded, translation has been done for committee. He thanked public, stake holders who attended the hearing from 6 districts, on behalf of the Joint Committee.

Hearing concluded at 2 pm.

Minutes of the Joint Committee Hearing of Stakeholders held on 24.08.2022 in the matter of Safe Distance Criteria for Stone Quarries in Kerala as per the Order dated 09.12.2021 of the Honourable National Green Tribunal in OA 304 of 2019

The meeting commenced at 10.30 am at the Training centre, Regional office, Kerala State Pollution Control Board, Ernakulam. The following Joint Committee members appointed by the Hon'ble NGT chaired the meeting:

1. Dr. Deepesh V, Scientist C, Central Pollution Control Board, Regional Directorate, Bengaluru, Karnataka-560079. (Committee Member & Convener)
2. Dr. B S Choudhary, Associate Professor, Dept. of Mining Engineering, IIT (ISM), Dhanbad-826004. (Committee Member)
3. Dr. Ritesh Kumar, Assistant Professor, Dept. of Earthquake Engineering, IIT, Roorkee-247667. (Committee Member)
4. Dr. R J Perumal, Scientist F, Wadia Institute of Himalayan Geology, Dehradun-248171. (Committee Member)
5. Shri. Venugopal Swamy Kadem, Dy. Director (Mining), Directorate General of Mine Safety (DGMS), Bangalore Region, Bengaluru, Karnataka-560071. (Committee Member)
6. Sri. Krishnan M N, Environmental Engineer, KSPCB (Special invitee/ Nodal officer-KSPCB)

Mr. J Chandra Babu, Regional Director, Directorate, Central Pollution Control Board, Bangalore was also present.

Sri. Krishnan M N, Environmental Engineer, KSPCB, welcomed all the committee members, project proponents and the public. The meeting started with a brief description of the meeting. He informed that the meeting was convened for hearing the stakeholders and public in connection with the study on safe distance Criteria for Stone Quarries in Kerala as per the order

of National Green Tribunal in OA 304 of 2019. He also added that, this is merely a stakeholder hearing, not a platform for discussions and arguments. The following persons presented their views/grievances before the committee.

1. **Mr. Eldho Kuruvila representing Registered Metal Crusher Units Association of Kerala (RMCU)** informed that they are one of the most affected stakeholders in this matter. RMCU is an association of industrialist who have invested in mining and established processing plants to produce crushed aggregates for the construction industry in Kerala. He raised six broad points:
    a. The footprint of the total quarrying area covered by the 563 stone quarries in Kerala is less than 16 sq. km. This is a mere 0.04% of the total land area of Kerala. With the increase of safe distance beyond 50m from blast site, a large extend of valuable mineral deposit will have to be left behind and such land left out in the buffer which will remain unproductive.
    b. Certain rules have already mentioned safe distance as 50m from any reservoir, tanks, canals, residential buildings etc. If the safe distance is more than 50m in contradiction to these existing and accepted laws, the investors who had put in their hard earned money relying on existing provisions on purchased lands to start quarrying operations, will be put to much hardship and unquantifiable damages.
    c. Conservation and systematic development of minerals: - If the safe distance zone is increased beyond 50m, say 200m ie in order to mine quantity of 2.4 lakh metric tonne in 1 Ha, there is a loss of 21.29 Ha barrier safety zone area around. The mineable reserves in I ha of land is currently 2.41 lakh MT approx. leaving aside the 50m barrier losses. The barrier losses will be 152.1 lakh MT approx. if 200m distance barrier is enforced.
    d. Controlled blasting and mine safety operations: - Quarries in Kerala uses only 32mm diameter blast holes with a maximum

depth of up to 3m. Whereas in other parts of the country, the drill hole sizes are up to 150mm and up to 10m depth. Hence the explosives used in blasting are also very minimum in Kerala. Across all quarries in Kerala, currently adopting an advanced type of delay detonators called the NONEL blasting methodology and maximum charge per hole is much lesser than 2kg due to the smaller size of the drill hole.

e. Scientific studies of safe blast parameters in Kerala: - As per the studies conducted by CSIR (Central Institute of Mining and Fuel Research) and NIT, Karnataka, it is clearly established that with controlled blast design implemented, the blast induced ground vibrations, air over pressure and fly rock were within permissible standards inside the 50m distance of blast area.

f. Strict regulatory framework of mining in Kerala:- By adopting better blast design and monitoring system by quarries and with improved supervision by qualified mining professional and blasters employed at the quarries, the 50m safe distance criteria would be sufficient to limit the adverse effects of ground vibration, fly rock etc.

2. **Mr. Jifin Jacob, Manathoor, Muvattupuzha, Ernakulam** informed that the operation of nearby quarries were causing damages to the public structures, no safe distance is kept from his residence to the quarry area. Just beyond his boundary, there is a 250 ft trench that has been generated due to this quarrying activity. There is a lot of environmental damages due to the plying of in numerous trucks and torres lorries. At least 200-250 loads of material is going outside which causes air pollution and direct damages. Lung diseases and cancer are very common in that area. There are Schools and Balawadi near the quarry. No dust suppression system is provided. He concluded that 50m is not at all a safe distance, at least 500m should be there as the effect of blasting is experienced up to 5km.

3. **Smt. Lissy Elias, Muvattupuzha Taluk, Thirumaradi Village, Manathoor, Ernakulam** put forward the same complaint that had raised by Mr. Jifin Jacob. She said that her home is close to the quarry and that she is having breathing difficulties due to the dust emanating from the quarry and hence on expensive medications. Also her house is damaged and rain water is entering into the house through the cracks formed as a result of quarrying activities.

4. **Reena Varghese, Kannimala,Idukki** Environment Journalist, Metro Vartha News Paper informed that, she was coming from a village called Kannimala which is 9km from the Periyar Tiger Reserve. Illegal quarrying is being carried out in Kannimala by Thavalappara Granites. The activity is extended beyond the buffer zone. Now the same proponent is going to start a new quarry at Manjalaruvi near to the existing illegal quarry. They are doing the quarrying activity in the guise of digging a pond as Panchayath license is not needed for pond digging. She concluded that 300m minimum safe distance from the nearby residence is required for the quarries.

5. **Leela Sugavas, Koorumala, Elanji Gramapanchayath, Member of Elanji Gramapanchayath** pointed out that, this is a Tourism spot and mostly ordinary people reside there. The quarry is situated at the bottom of a hill. Her house is severely damaged due to the quarrying activities. Cracks have been developed in the roof of the house and rain water falls into the house. She and her fellow villagers have filed complaints in various authorities, but their complaints are not yet redressed. She concluded that, at least 300m should be fixed as minimum distance for safe quarrying. She also complained about a tar mixing unit which is working in the same quarry premises causing air pollution and even the food tastes bad due to the fumes coming out from the tar mixing unit.

6. **Alosious Moovatupuzha Taluk, ward 3:-** He introduced himself that he was a contractor and he constructed roads etc using locally obtained

material at that time. In the beginning of 1990s, he started a metal crusher, later this metal crusher was sold to some other person. Later this metal crusher and the adjacent quarry area had been transferred to different hands. Recently the new quarry people have started elaborate blasting in that area and which damaged his house and the houses nearby.Complaint has been given to all the government departments including Collectorate, but no solution has been obtained. He further added that people having protest against the quarry will move against the government if this illegal quarrying is allowed.

7. **C.R. Neelakandan, Thanal, Thrikkakkara, Kochi,Representing National Alliance of People Movement** pointed out the following points:
   - Ecological or hydrological mapping should be done to check whether the area is suitable for mining. Impact assessment is to be done in every site proposed for mining before granting the permit.
   - Density and size of mines should be considered.
   - Out of the total landslide in the country, 59% is happened in Kerala due to the quarrying operations.
   - In the places where regular movement of public is expected, the safe distance should be decided by considering the population density.

8. **Varkey, Mukkannur Village, Aluva Taluk, Ernakulam.**

He informed that a quarry situated about 200m from his house. In between his house and the quarry there is a cultivated land owned by him. During quarrying operations rocks reaches continuously to his house and beyond 300m from the quarry. The complaints have been given to various Government Departments regarding this, but no solution has obtained. He had filed a WP(C) in the Hon'ble High Court of Kerala, but still pending. He also pointed out that there is a 2.5m width narrow road which is used for the transportation of quarry vehicles thereby causing difficulties to the residents. Only 10 tonne vehicles are allowed to pass through this road but plying 30 tonne vehicles. He concluded that 200m minimum distance should be maintained for agricultural land also.

9. **Eloor Gopinath, State Secretary of all Kerala River Protection Council.**

He informed that Kerala Minor Mineral Rules,2015 which is presently prevailing in the matter of quarrying in the state is not at all legal, it is only to support quarry mafia. That rules had been framed not in accordance with the spirit of Supreme Court order of 2012 in Deepak Kumar Vs State of Haryana & others. He also opined that scientific study should be conducted for quarries having less than 5 hectare also and at least 300m minimum safe distance is required for all quarries. Then he pointed out that out of total landslides in the Country 59% happened in Kerala which is entirely due to quarrying.

10. **Joy Joseph, Manakkadu Village, Thodupuzha Taluk, Idukki**

He informed that the distance criteria shall not be confined only to residences, there should be a specific distance to Hospitals, Schools, Water bodies etc. Specifically, at least 2km distance to schools, hospitals etc, 1km to water bodies and a minimum distance of 500m to residential buildings.

11. **Surendran, Kunjalippara Samrakshana Samithy,Thrissur**

He informed that Kunjalipara Samrakshna Samithy is formed by the residents of Kunjalipara in Mattathur Grama Panchayath, Thrissur District to protest against the illegal rock quarrying activities by Edathadan Granites. The functioning of this quarry has caused damages to the livelihood of the nearby people. All the houses in the nearby area have been damaged due to the blasting in the quarry. Many of the nearby residents have been suffering from asthmatic problems and cancer due to the dust and air pollution. Structural damages in the vicinity of quarries even beyond 100m limit are common. He requested to visit the quarry- crusher area to assess the impact and damages caused to the environment and livelihood of the nearby people. He concluded that the 50m minimum distance is not justifiable.

12. Mathew John, Thirumaradi village, Muvattupuzha

He informed that he is coming from the same area as that of Jiffin Jacob. He is not wishing to repeat the same complaints, but he added a point that there is a check dam near to the quarry and waste water from the quarry reaches the check dam. He said that nearby people are affected by skin & lung diseases, cancer etc., and he requested to maintain at least 300m distance from the quarry.

13. Varghese Pulluvazhi, Chairman, Action Council for Environmental Protection , Perumbavoor

He informed that the matter regarding the safe quarrying distance was discussed 2 years before in the Legislative assembly. At that time Sri. Mullakkara Raknakaran M.L.A, was the chairman of the Legislative Committee for Environment and the committee submitted a recommendation about the safe distance for quarries before the legislative assembly of Kerala in the 19th committee report. In this report, the committee has specifically pointed out and recommended that there should be a minimum distance of 200m from the quarries to residences and in the same report it is also pointed out that 300m will not be enough in certain cases to prevent the damages caused due to quarrying. But the government of Kerala has not adopted this recommendation. He also pointed out that huge damages were noticed in houses in Muvattupuzha, Kothamangalam, Kunnathunad & Aluva taluks due to the quarrying operations. He requested to visit the area and conduct an Environmental impact study by the committee in the areas around 300m distance from the quarries.

14. Mohandas, Social worker

He pointed out the following points:

- Safe distance from the quarry should be increased step by step and minimum distance to the residences should be decided based on the scientific parameters and considering the terrain of the land. He also

requested to consider special consideration should be given to hospitals, schools, religious places.

- Many cultivated land got damaged due to the quarries nearby
- Drinking water source are polluted and many people are facing health problems.

He suggested to conduct a health survey in specific places where the health issues are seen. He concluded that a minimum distance of 500m is required.

15. **Manoj Kakkad, 5th ward, Karimazha grama Panchayath, Thodupuzha,, Idukki**

He informed that recently Environmental Clearance has been sanctioned to a quarry in his location. No public hearing has conducted as it is a small quarry having the area less than 5 hectare. He opined that public hearing should be made mandatory for small quarries also. Earlier the area was rubber plantation, hence large quantity of soil need to be removed before quarrying which lead to environmental damages. He pointed out that schools, church, forest area, river etc are there near to this quarry. Hence he requested to cancel the Environmental clearance.

16. **Shivadas, North Muzhuvanoor , Perumbavoor**

He informed that 3 quarries near to his residence, but presently not working due to various reasons. As of now he is not facing any environmental issues but when they resume operations, he fears that it will cause damages to his house. There was air pollution and his wife became sick. He demanded that 300m minimum distance must be mandatory for quarries.

17. **Sherin Joseph, Chairman, Arogya Standing Committee, Thedanad Grama Panchayat, Kottayam**

He informed that proposed quarry in his area has been obtained EC in 2019. He informed that there are two water tanks located within 250m,

a building within 50m, 15 houses within 100m, 70 houses within 200m, a nursery school in 165m, Panchayat road in 60m, a church within 100m & a school within 300m. He said that despite of all these, Environmental clearance has been granted which is illegal. So he demanded that Environmental clearance should be cancelled.

18. Abilash T.V., President, Gramaseva Samithi,Poovanchira, Thrissur

He informed that a quarry is located within 1.189km radius of Peechi Wildlife Sanctuary. Around 100 houses, a temple, public roads etc. are situated within 200m radius of this quarry. He pointed out that the quarry is located on the top of the hill and three landslides had occurred earlier. The operation of the quarry is creating many environmental problems and is a threat to the life of people in the valley. He added that the residents of the area are facing respiratory problems, several houses got damaged etc. Two houses have already impacted by landslips and nearby 150 families are under threat. He pointed out that running of trucks through this area is a threat to the people especially the school going children. Finally, he requested to take necessary steps to close down the quarrying activity in their village.

19. Liyo Kunnappilli, Panchayat Member, Karimannur Grama Panchayath, Idukki

He informed that a quarry was started in his ward in 2016, but it was stopped due to public complaints. Now they are planning to start the quarry again. Electric line is passing through 110m away from this quarry. The area is a landslide zone and two landslides occurred in this area and three people lost their life. He also added that drinking water sources are located within 50m of this quarry and a water tank with 4 lakhs litres capacity supplying water to 5 Panchayats is located within 200 meters. He concluded that 50m distance is not enough for quarries, at least 500m should be mandatory.

20. Peter Devassy, Mattathur Grama Panchayat, Thrissur

He informed that during the period 1966-1987, blasting was carried out at a depth of about $2\frac{1}{2}$ feet. But now with the development of modern technology, blasting is done at a depth of 18 to 20 feet and blasting is done in 50-60 pits at a time which cause much impact to the environment. He also informed that his house is at a distance of about 170m and he experiences jerking of his house during blasting. He pointed out that noise level during quarrying is above the permissible limit and waste water and slurry from the quarry reaches the nearby canal and agricultural field. He demanded that at least 1km is needed as a minimum distance for safe quarrying. He also alleged that Revenue records are manipulated to get quarry license.

21. **M.M.George, Vice President, Thirumaradi Panchayat, Mandalamala Samrakshnasamithi , Muvattupuzha Taluk, Ernakulam.**
He informed that currently 7 quarries are working & 3 quarries are proposing in his area. The quarries are proposed in Mandalamala, where Areekal waterfalls, a major tourist place in Kerala, begins and Panchayat roads are passing nearby these quarries. He said that complaints were given to various Government Authorities but no solution has been obtained. It was decided in the Gramasabha not to allow quarry operation at Mandalamala. He suggested that there should be a minimum distance of 500m from roads, canals, check dams and houses. He also requested to take necessary steps to protect the water sources.

22. **Basil M Paul, Ernakulam, Govt. contractor** pointed out that, five years ago he was associated with a quarry project and bought required land. But for the last 5 years he couldn't obtain the license. He is ready to obey all the existing rules. He also added that, people are complaining against the quarries to buy their property by the quarry proponents.

23. **Thankachan, Kalady, Quality Metals** informed that, he started a crusher unit in 1994, and obtained license from the Pollution Control Board through single window. In 2004, his unit obtained Award from KSPCB. He invested a huge amount to start the crusher. At present,

there is scarcity to get the stones and now it is receiving from Tamil Nadu. He opined that, distance norms should be specified separately for small and large units separately so as to run the unit in a sustainable manner.

24. **Prince Abraham, Mining Engineer** and a quarry owner added that quarry owners means not quarry mafia, they are doing business by following the Govt. laws. Majority of the things using in the day to day life are product of mining, people are the end users and hence mining is necessary for the living. Increasing the distance is not a solution rather than adopting new technologies. He stated that, prohibition of blasting is not a solution in quarries. Site inspections should be made periodically.

25. **Paulose Kutty, Small scale Quarry Association of Kerala, Ernakulam** informed that they had conducted several studies and it was understood that no problems were found even up to 35m from the quarry.Hence 50m is sufficient as the safe distance.

26. **Aji Abraham, Piravom** informed that, he came for giving some suggestions for the problems generated due to quarrying.

1. Study of land terrain, soil structure, rock structure, landscape etc shall be conducted up to 300m to 1km.
2. Vibration is a major issue since it is transmitted through the rock structure and hence should be measured.
3. Air pollution should be addressed. Cleanliness should be maintained in roads within 5 or 10km radius. Additional features shall be fixed to the torus lorries to extract dust.
4. In order to avoid water pollution, water shall be tested periodically.
5. A safe distance of 500m is necessary for the quarries.

27. **Joseph Antony, Meenachil Taluk, Kottayam**, informed that, he is representing the residents' association. Near to the border of Poovarani village and Kundoor village, a quarry has been working since 2012

under lease for 12 years. The residences in the North-South direction are found with cracks and experienced vibration. Also dust spreads in the surrounding area. Poovarani and Kondoor village officers have reported the same to the Thahasildar, but no actions have been taken yet. He also added that, no bench mining is practised. A case was filed regarding this in 2015 in the Munsiff Court and the commission reported that mining is carried out at a depth of 200ft and now it is up to 300ft. Based on the High Court case filed, an Environmental Engineer came for inspection and reported that there is no violation at all. He then pointed out that, the doors and windows vibrate when the quarry starts working and he opined that, a safe distance of 500m is necessary for the quarries.

28. **Sadik, Kadangod, Thrissur – Palakkad border,** represented the Myladumkunn Samrakshana Samithi, Idam Samskarika Vedi associations. He informed that, Kadangod is the largest mining area in Kerala as per the study about 'Quarries in Kerala' conducted by the Kerala Forest Research Centre. Also it is a place in which the cluster mining is carrying out. 5 quarries are currently working there. Up to 2019, there were 15 quarries under operation. Damages to houses, lung diseases etc are common in this area. But no Govt. authorities came up for an enquiry. They met the District Collector regarding the formation of a District Mineral foundation suggested in 2019 for the affected persons. But no action has been taken yet. He opined that, depending upon the geography, seismic nature, soil structure etc, the impact of mining varies. Hence an environmental impact study is necessary for fixing the safe distance for each area. Minimum 300m is required for safe living of the people residing there. He also requested the committee to visit the area.

29. **K P Ouseph, RMC Association Kerala** pointed out that, the KMGT Training centre at Chavara in which all the mining owners are members provide training for their workers including drillers, driver etc for

sustainable mining. The training centre is a Kerala Govt. undertaking attached with Kerala Minerals and Metals Ltd Chavara. He opined that, as per the report of Hon'ble DGMS, 50m safe distance can be maintained.

30. **T K Ramakrishna, Director of Mining & Geology (Retired)** suggested the use of Non Electrical Detonator (NONAL) in the quarries to reduce damage due to the blasting. He informed that, uncontrolled blasting causes damage to nearby buildings. Non Electrical Detonator is a type of delayed blasting. This technology can be used to nullify the complaints. He reminded about the blasting of 2 flats in Maradu, Ernakulam using this technology. It has the advantages of reduction of ground vibration and air blast, improved fragmentation, improved productivity and less environment impact. In Kerala, blast holes of 32mm diameter with a maximum depth of 3m are used. That means, in Kerala use of explosives is lesser compared to other states. He opined that, if this technology is used in quarries, beyond 50m there will be no fly of rocks and there is no need to change 50m safe distance.

31. **Tony Pappachan, Geologist, Poabs group** informed that, he owned 6 quarries all over Kerala and opined that, 50m is enough for the safe blasting.

32. **Ajith Manual, Kottayam r**epresenting Green Steps Nature Society informed that, according to the Public liability insurance act of Central Govt., it shall insure the persons residing nearby areas of any type of pollution causing industries. It is mentioned in the application of environment clearance and it is mandatory. Unfortunately no people are insured according to this law in Kerala. Here there are no remedial measures for the accidents occur. According to the Metalliferous Mines Regulation, a safe distance of 500m is necessary. He also added that, various activities like blasting, jack hammering, transportation etc. are being carried out in quarries. For the heavy load transportation, village

roads are being used. Even at 3.00am, vehicles use to run up and down. The houses get damage due to the jerking. Authorities must ensure that, for such heavy load transportation, whether the village roads are sufficient. He suggested that, permanent equipment shall be installed by the quarry proponent to check the exposure of dust into the atmosphere and a minimum safe distance of 500m is needed for the quarries.

33. **Satheesh, Kottayam** informed that, he is representing, Residents Welfare Association, Poovakulam. In their area, five quarries obtained environmental clearance. Due to the quarrying activities, people are suffering much and he opined that, this 50m distance is not at all safe because of the life threatening flying of stone fragments, water pollution, noise pollution etc.

34. **Paulose, Kottayam** suggested that, 50m distance criteria is not at all safe. Proper scientific studies have to be conducted before fixing the safe distance. Mostly, mining activities are being carried out to a depth beyond the rules specified.

35. **Aurangazeb, Mining Engineering, Viswesaraya Technological University, Karnataka** mentioned about the NONAL technology for blasting and unscientific studies of mining in Kerala. He also submitted his views/ points to the committee.

36. **A M Yusuf, Ex-MLA, Aluva** opined that, quarry - crusher industry is important for the development. Many people are working in this field. Those who violated the rules must be punished. If distance is increased, quarrying may be affected. Hence a joint decision is needed in this matter.

37. **Joseph, Quarry owner** informed that, in quarries, office buildings are situated just 20m away and it is not affected by the blasting and he questioned the need of increasing safe distance criteria. Also he

informed about the 40% to 50 % increase in the cost of building materials which finally increases the project cost.

38. **M.G. Santhosh, Pallavi Nagar Residence Association, Thodupuzha, Idukki** informed that two huge quarries are functioning in their ward. First one is temporarily stopped. Request for one more quarry has been initiated. That area had experienced two heavy landslides earlier and also there is a big water tank situated near the quarries which is under serious threat. He pointed out that as the area within 500m of quarries has been declared as danger zone, sanctioning 50m as safe distance is absolutely illegal. He humbly requested that a minimum 1km distance is to be ensured between quarry and residential areas while granting permission to quarries.

39. **Maneesh. P. Mohan, representing Small scale quarry association, Muvattupuzha** informed that he owns a quarry in Maradi which has been functioning for past 5 years. He pointed out that there are houses near his quarry situated 55-60m away, but till now they have not reported any issues regarding the functioning of quarry. He requested to retain the safe distance as 50m itself.

40. **Bijumon M. K, Malayattoor - Neeleshwaram Panchayath, Illithode,** informed that there is a quarry named Fathima Industries situated near his house. He mentioned that during 2018 flood, landslide occurred near to his house. So he requested to conduct study before proceeding with the paper works to continue functioning of the quarry.

41. **Muhsin, Pallikkara** mentioned 6 points:

a. Quarries which are being claimed to be illegal is actually not working anywhere in Kerala.

b. Landslides happened after 2018 flood, which is basically due to heavy rains.

c. Unscientific assumption of structural damage is mainly due to poor building materials used.

d. Air and water pollution control measures has to be strictly operated and authorities should supervise whether policies have been followed or not.

e. 50m safe distance which was being followed for years is sufficient and no issues regarding this was reported anywhere in Kerala.

f. Allegations based on slurry due to dust washing and sludge management issues is not much related to the quarry.

42. **A.A Jafar, District President, All Kerala Karinkal quarry Association, Idukki** informed that in 2012, when Pollution Control Board fixed safe distance of quarry as 100m, lots of quarries had to shut down and many workers faced employment issues. It is impossible to function quarry with safe distance as 100m and 500m. He also added that people are requesting to increase the safe distance in order to settle personal grudge towards the stakeholders. He requested to maintain the safe distance as 50m considering the situation in Kerala.

43. **Shibu P. John, Managing Director, M/s. Pynadath Granites (P) Limited, Chalakkudy, Thrissur** informed that no issues were reported from residents within100 m, complaints were raised by residents staying 400-500m away from the quarries. A scientific study was conducted with the help of Department of Mining Engineering, NIT, Karnataka. Based on this study, it is observed that there is no effect of blasting operations carried out in the quarry beyond 100m from blasting locations. He requested to retain 50m as safe distance.

44. **Anil, Manakkad Panchayath, Thodupuzha** mentioned that already two quarries exist in his Panchayath. He requested not to issue sanction for further quarry activities in their area and to retain the danger zone safe distance as 500m.

45. **M.J. James, Manakkad Panchayath, Thodupuzha** informed that his house is 90m away from the quarry owned by George Kochuparamabil.

He filed complaint in various departments (Pollution Control Board, District Collector, Governor, Kerala). His house is severely damaged with cracks. Toxic emissions from quarry exposed them to various life damaging diseases. His father died due to stroke, wife is suffering from asthma and wheezing issues and in 2018 his right leg got paralyzed due to contraction of lungs. He has also filed complaint to the Prime Minister and also planning to case file in Supreme Court. He requested to fix the minimum distance as 500m and danger zone as 1 km.

46. **Shamsu K.M, Engineer, Pallikara,** informed that the construction field is badly affected due to the scarcity of construction materials like sand, aggregates and another related material. More than 80% of the quarries in the district had closed down due to the increase in safe distance to 200m. He also added that in his experience no damages have seen developed for any structure beyond 50m from any quarry. He requested a safe distance of 50m may be retained.
47. **Jayaprakash R, Ramapuram Panchayath,Kottayam,** requested to increase the safe distance between quarry and residential area as 500m . He also suggested that if the quarry is situated at the top of the hill, danger zone should be fixed till the bottom of the hill.

48. **Jijo, Mukkannur village, Ernakulam** reported that his house is situated within 300m radial distance from a quarry. Quarry owners got the licence to function for eight years, after 18 months of uncontrollable blast, he filed a complaint and the Geologist visited the site and found that they exceeded the controlled limit and crossed the buffer zone. He requested to increase the safe distance to 500m and danger zone to 1 km.

49. **Shabeer, State Secretary, All Kerala Environmental Consultant workers' association, Kadavanthra** pointed out that safe distance of quarry should be retained as 50m and it should function without causing any adverse effects on the environment by adopting new technology.

50. Baby Poulose, Retired Mining Engineer, Tata Steel (currently working in a quarry in Idukki) stated that when there is a development, there is will be pollution. Main pollution concerned in this matter is dust, vibration and sound pollution. Regarding vibration, Studies were done by GDMS and have mentioned that vibration can be controlled by limiting the explosives within 2 kgs per hole. He also pointed out that noise level in Ernakulam city is about 150 dB(A) whereas it is limited to 85 dB(A) sound in the quarry. It is possible to control the pollution within the limit if the study recommendations are followed. He suggested that it is not necessary to increase the distance, 50m safe distance can be retained.

51. Sheeja. K. K, Thiruvaniyur, Ernakulam, complained against a quarry working near her house. Her house is severely damaged, can't sleeps at night due to quarrying activities, wells got damaged and they can't even sit outside the house during the time of blasting. She also added that a flyrock once hit her father's shoulder. Many complaints have been given, but no action has been taken during the last years. Quarry owners asked them to sell their and leave that place.

52. Reji Sebastian, Muttom village, Thoduppuzha, Idukki, pointed out that 200m should be the minimum safe distance criteria.

53. Binu Michael, Pala, Kottayam, suggested that minimum safe distance should be increased to 300m considering dust and sound pollution.

The representative of KSPCB thanked all the members of Joint Committee and the gathered public. The meeting concluded by 2pm.

Sri. Krishnan M N, Nodal officer to KSPCB, concluded the meeting and thanked all for active participation.

Hearing concluded by 2.00 pm.

Minutes of Joint Committee hearing on 25/08/2022 held at Priyadarshini Auditorium, Thiruvananthapuram for obtaining stakeholders opinion in the matter of safe distance criteria for stone Quarries in Kerala as per order of the Hon'ble National Green Tribunal.

The Hon'ble NGT vide order in OA 304/2019 dated 09/12/2021 directed Joint Committee to study quarrying and its impact so as to decide safe distance norms for stone quarries in Kerala.

The tribunal had also directed to conduct hearings of all stake holders as a part of the study. Accordingly, public hearing was arranged at Priyadarshini Hall, Thiruvananthapuram on 25/08/2022 at 10:30 am. The hearing was conducted for obtaining opinions from stakeholders and public from Thiruvananthapuram, Kollam, Alappuzha and Pathanamthitta Districts. The details of Joint Committee members are as follows.

1. Dr. R.J. Perumal, Scientist- F, Wadia Institute of Himalayan Geology, Dehradun.
2. Dr. Deepesh. V, Member Convener, CPCB, Bangalore.
3. Dr. B.S. Choudhary, Associate Professor, Indian Institute of Technology, Indian School of Mining, Dhanbad.
4. Dr. Ritesh Kumar, Associate Professor, Indian Institute of Technology, Roorkee.
5. Mr. Venugopal Swami Kadem, Deputy Director, Directorate General of Mine Safety, Bangalore.

Sri. Krishnan M.N (Nodal Officer, Joint Committee) welcomed joint Committee Members, Mr. J Chandra Babu, Regional Director, Central

Pollution Control Board, Bangalore, stakeholders and public gathered. Nodal officer invited public and stakeholders to express their views/ opinion on the matter. Sri. Krishnan M.N, Environmental Engineer, Kerala State Pollution Control Board, Palakkad gave a brief introduction regarding the hearing. Public were also given chances to express their views or complaints through online platform.

The suggestions and grievances of the public and stakeholders are as follows.

1. Smt. Faseela Bhai, Ittiva Grama Panchayat, Kollam.

She was complaining against a quarry named 'KMM Granites' in her village. Around 150 houses were present within 500m in that area. There are 200 acres of agricultural land. The quarrying is being done for more than two years. Mainly exponential blasting is done. As a result of blasting, huge amount of dusts emanates and leads to many health problems. Due to blasting, the nearby houses were cracked and Panchayat roads are damaged and became useless. The life of many quarry workers had been lost. The sound generated during blasting is more than 70dB. There are no control measures to reduce the sound. She concluded that such a quarry should not be to allowed to operate. She also requested to keep minimum safe distance of 500m for the quarries.

2. Smt. Libi Varghese, Cherukulam.

She also complained against 'KMM Granites'. She pointed out that the slurry laden water coming from the quarry is polluting the nearby streams and makes the water unsuitable for drinking and bathing. Her son is having serious health issues due to the quarrying activities. She also requested to fix a safe distance of at least 500m for safe quarrying activity.

3. Smt. Preetha, Thoppil Colony, Kilimanoor.

Her complaint is against AKR quarry'. Her house is 200m away from the quarry. Her children couldn't play/ sleep during day time. Dust generated from quarry causes health issues to her children. Well water become unusable due to quarrying activities. She suggested that such a quarry should not be allowed to operate.

4. Sri. Sasikumar, Mookunnimala, Malayinkeezhu.

He is a representative from Mookkunnimala where there are more than 40 quarries working legally and illegally. Even though his residence is 300m away from this hill, he has been suffering by various quarrying activities. The nearby public are in fear of occurrence of a land slide since a land slide had occurred in Amboori earlier. He suggests to stop the quarrying activities in that area. The quarrying area can be used for tourism activities. A safe distance criterion of at least 500m from quarry site was suggested by him.

5. Mr. K.V. Pillai, Human Right Activist, Anchal, Kollam.

He suggested to keep a minimum distance of 500m away from quarry activities. He also recommended to carry out explosion in presence of authorities to ensure the quantity of explosive used within the limits. A system should be implemented to weigh the quantity of explosives to be used for blasting. He suggested that the waste water should be properly discharged and should not be allowed to flow to the nearby areas. Sprinkling of water should be done prior to mining operation.

6. Sri. Subaidar Babu, Pathanamthitta, Muninjakal.

He said that 40-50 tonnes of material is being transported using trucks having design capacity of only 10 tonnes. This practice is increasing the risk of accidents as well as CO emission. Huge quantity of water is

being collected inside the ponds formed by the quarrying activity on the hills. During rainy season the water containing chemicals is being discharged into the village and the wells are getting polluted. The Panchayat roads are not strong enough to carry the loaded trucks. This leads to accidents. They have formed a 'Jana Jagratha Mission' in order to address these issues. The quarry is operating even during night time and unauthorized blasting are being carried out even at 12.00 am at night. He has requested to control the mining operations in existing quarries and not to issue sanction for the new quarries. He also requested to keep a minimum distance of 500m.

7.Sri. Gopalan, Kilimanoor.

His complaint was against a quarry named 'AKR Quarry'. Due to the mining activities he is suffering from lung diseases. He also mentioned about the well water pollution and water scarcity due to the quarrying activities. He requested to stop the functioning of the said quarry.

8. Sri. Celin Maniyan Nadar Binu, Nellinad Village, Kollam.

He complained against quarries working nearby his residence. His residence is about 30m away from quarry. He requested to increase siting criteria for residence from quarry and also to stop the functioning of the quarry near his residence.

9. Sri. Unnikrishnan, NGO

He questioned that whether any government official/ Minister or Panchayat President will be willing to construct a house near a quarry. He requested to keep a minimum safe distance of 500m.

10. Sri. K.A. Varghese, Konni, Pathanamthitta.

He complaint that he is facing a lot of health problems due to the quarrying activities. Dust is the main issue. His suggestion is to keep safe distance of 500m.

11. Smt. Shobhana, Kottarakkara Taluk.

She was complaining against a quarry named 'Thasna Mines'. Due to mining activity, the water gets stagnated in that area and this is a threat for people living in the nearby area. The quarry is located near 'Jatayu' natural park, Tourist center in Kollam District. There is a temple located on top of this Aayiravalli Rock which is a Sanctuary of many plants and animals. The quarrying operations will result in the destruction of flora and fauna in this area. She requested to cancel the permission given for quarrying as it affects the residence near the quarry.

12. Smt. Baby, Kilimanoor

Her complaint was also against a quarry named 'AKR Quarry'. She requested to stop such illegal quarrying operation.

13.Sri. Sachu Rajan Eepan, Murinjakal Pathanamthitta (Kalluvila Granites)

He pointed out the issues regarding the scarcity of minable area available in Kerala taking the unique geographical and topo-graphical features of Kerala into consideration. It also become difficulties to set minable area when taking the Land Reforms Act of Kerala along with the population density of the State into consideration. So the authorities are forced to maintain the minimum distance criteria as 50m while considering these facts. But when the circular regarding peak particle velocity recommended by DGMS comes into picture, SEIAA would not allow mining in 100m when peak particle velocity exceeds 10 mm/s. So it is requested that the minimum distance shall be fixed on the basis of the mining plan and EIA report. Independent study shall be conducted in each quarry for

establishing minimum distance criteria based on EIA report and mining plan.

14. Sri. Gopinathan Pillai, Pathanamthitta

He is a representative of 'Nadhi Samrakshana Samithi'. He suggested to keep a safe distance from quarrying activity for protecting forest, wild life, water and people.

15. Sri. Madhu,Kalanjoor

He was a former President of an Association for Quarries. He suggested to fix the distance criteria based on the population density of each States. He informed that the distance criteria fixed by State Pollution Control Board is for states having low population density. He mentioned that for blasting Nonel technology is being used in his quarry and using this technology, the size of hole will be less and depth of blasting will be less. As a result, sound of blasting will be also less. The Regional Director CPCB asked him to describe the remedial actions taken by him if any problems faced, how many houses got damaged from the quarrying activities and also to mention the welfare activities carried out by him. He replied that no fatal accidents occurred during the last 10 to 15 years and no undesirable damages reported from nearby residences. He also added that the company have been engaging in corporate social responsibility activities as per the company policy in addition to the recommendations of SEIAA.

16. Sri.Sethu, Kilimanoor

He was complaining against a quarry named 'AKR Quarry' which is situated inside a Dalit Colony. Due to quarrying activity, they were facing a lot of difficulties in nearby areas. He said that even beyond 500m, they were facing damages to residences. He informed that so many complaints

were filed against this quarry by the residence near it. He also mentioned that the quarry mafia attacked them due to their protest among quarries. He recommended to keep a safe distance of 500 m away from the quarry.

17. Sri. Pradeep Kumar, Thiruvananthapuram.

He was complaining about the quarry situated near Poriyottumala in Nagaroor Panchayat. Since there is no proper monitoring system in quarries, his opinion is to keep at least distance of 500m from the quarrying to save the habitation near the quarry. While quarrying, they are not limiting the depth of quarrying. He also informed that the mining activities were carrying out in buffer zone. The dust and noise pollution was also affecting the people nearby the quarry.

18. Sri. Sunny, Vellalur, Nagaroor Panchayat.

He was a farmer. Due to the mining/ quarrying activities, the drinking water is getting polluted and also increases the number of cancer patients in the nearby places. He recommended to increase the distance criteria by 500 m from nearby quarry.

19. Sri. Rajeev, Kottarakkara, Kollam.

In olden days, quarrying was done by using hand tools. But now a days machineries are used for quarrying. As a result, it arises many issues/difficulties to the people. Quarrying activities also creates problems to the children. He also requested to fill the ponds after the quarrying operations.

20. Sri. M.K. Saleem.

He is a handicapped person. The worst issue mainly happened after quarrying is the creation of huge ponds. Since there is nobody to monitor these ponds, it leads to drowning of small kids who are living in nearby

quarries. He was requesting to make it mandatory that the concerned authorities should give direction to fill up these ponds. If not, the license of such quarries should be cancelled. He also pointed about an incident happened in Kerala that is, two flats were demolished as it was built on violation of CRZ-3 zone. Likewise quarrying should also be done in a favorable way, so that the next generation will have a peaceful life. Even though Kerala is a densely populated area, he requested to keep minimum distance limit of 500m.

21. Sri. Balan, Kilimanoor Grama Panchayat.

He was complaining about the 'AKR Quarry' which is working nearby his residence. His house is made up of mud blocks and is having tiled roof. He is 69 years old and his wife is 65 years old. His humble request is to stop the functioning of AKR quarry.

22. Sri. Vimal, Thiruvananthapuram.

He was coming from Madapuram in Thiruvananthapuram. There are three quarries and three Crushers in his place within 300m. He suggested that the minimum distance between quarries should be kept as 1 Km. Nearby this quarry, an ecotourism project was located which is at a distance of 65m from the quarry. Tourists are scared to visit this ecotourism project because of the quarrying and other dangerous conditions. Thus the ecotourism project remains under developed. This results in unemployment for people residing near the project. The workers in the quarry are getting the benefits and the local people is suffering from these activities. Billion liters of water is stored for quarrying activities. This may result in flooding/ landslide during heavy rainfall.

23. Sri. Sadeekal, State Vice President of Quarry Association.

Usually a quarry is being owned and operated by a person/a group of people. While buying lands for quarrying one cannot buy more than 15 acres of land as per Kerala Land Reforms Act. For developing a mining area of 2 hectares, minimum 15 acres of land is required. This will be possible only when the distance criteria is 50m. If it increases, it is very difficult to run a quarry in that premises. Presently aggregates are sold at the rate of 75paise/kg. If distance criteria is increased, then the rate of aggregate will also increase to approximately Rs. 5/kg. His suggestion is that a safe distance of 50m is better not only for the quarry operators but also for the State. The Regional Director asked him if the people are ready to pay Rs.5/Kg then what will be his suggestion. He replied that this is not possible in Kerala because the demand for buying of aggregate is very high.

24. Smt. Lalitha Sumangala, Thiruvananthapuram.

She is a representative of small scale Quarry Association in Thiruvananthapuram. There is a quarry working nearby her house without creating any problems to public. Complaints are arising against this quarry from people who are residing kilometers away from the quarry. Cracks develop in houses where low quality materials are used for construction. Therefore, her suggestion is that within a safe distance limit of 50m, quarrying activities can be done safely by providing proper safety measures.

25. Sri. Vinod, Kilimanoor

He is complaining about quarry named ‘AKR quarry’ located within 50m from his residence. In 2020, he filed complaints against this quarry in Kilimanoor Police Station, but no action was taken from their side. Even though complaint was filed again in 2022 against the same quarry, no action has been taken by authorities. Hence he requested to stop quarrying activities in the above said quarry.

26. Sri. George

He claimed that the fundamental reason for all the climatic problem like global warming, storms, cyclone etc are due to the exploitation of limited natural resources. In order to prevent this natural calamities, we have to implement control over mining resources. He said that we are over utilizing the resources and recommended to minimize the resource utilization.

27. Sri. Lalu, Kollam.

He was the President of Small Scale Quarry Association. He has a quarry in Kottarakkara Taluk but now it was not working. No genuine complaint was raised against quarries from people residing nearby. Fake complaints were raised by people residing far away from quarries for money. His suggestion is 50m distance criteria should be retained otherwise the rocks have to be purchased from outside.

28. Sri. K.J. Chacko, Idukki.

Two quarries were functioning nearby Idukki Dam- named Kinattukara Granites and KPM Granites. These two quarries were creating a lot of pollution. His suggestion is that blasting of rocks should be done under the control of Government sectors.

29. Sri. J. Benson, Retired Additional Secretary.

Commonly mining is done by wagon drill blasting in all States. But in Kerala from 1971 onward Nonel blasting has started, so that sound, ground vibration, use of explosive etc. can be minimized. Moreover, diameter of hole is 30mm having maximum length of 3m. Safe mining can be done using nonel blasting. He pointed out that using nonel blasting method safe blasting can be done within 50m distance. 80% of rocks are coming from nearby

states, Tamil Nadu and Karnataka. There is no substitute material for rocks. As per Kerala Land Reform Act only industries can get exemption beyond 15 acres of land. As per Supreme Court direction, quarry is not coming under any industry. No quarry can be function if distance limit is increased beyond 50m. 50m is sufficient for the development of State.

30. Sri. Prasanth, Madathara, Kollam.

Complaints against 'POABS Crusher' located 400m away from his residence. Two colonies (Scheduled Caste) are residing within the 100m. A pond (approximately 2 acre) is located nearby this quarry. About 73 people living in this colony suffers a lot due to this Crusher Unit. Complaints were given to Disaster Management, District Collector, but they have not yet taken any action against this. Quantity of explosives used is high. Accidents are recurrently happening before morning 6am. Roads become dangerous for travelling. The slurry laden water is discharged directly to natural drain.

31. Sri. K. Babu, Kollam, Ittiva Panchayat.

A quarry is working nearby his house. Water scarcity is one of the major problem faced by the people residing near the quarry. Within the 50m distance from this quarry there is a Church and cemetery. His suggestion is that at least 500m distance should be considered as the minimum safe distance to quarries.

32. Sri. E.P. Anil

He is managing an Online Magazine. They are publishing articles exclusively for ecological issues. Complainant handed over Kerala State Assembly Environmental Reports from 2014 onwards to the committee. These reports were prepared after studying about quarries. He pointed out that in 2014 report, it is mentioned that there is a strong mafia behind the quarry owners and bureaucrats. He mentioned that Mukkunnimala, a sandal

wood forest which is 9km from State Head Quarters, a navy unit with police shooting facilities was working in this forest, which is owned by stakeholder mafia. When this issue was presented before the Government and the same was handed over to vigilance. But the report was not yet submitted. He suggested that quarry activities should be well studied and should come under public sector. Also he recommended to control construction activities and construction of roads should be done by good quality materials.

33) Sri. Noushad, Chithara, Mangod.

He was complaining against 'Tasna Mine'. He was working abroad. While he was abroad, his property was encroached by the quarry owners. The quarrying activities made the life of the people tragic. They used to store explosives near his property. He suggested to fix a minimum safe distance of 500m from quarry. He also suggested to carry out geophysical survey before approving the quarry project to prevent damages to ground water.

34) Sri. Augustin Joseph, Pathanamthitta, Kalanjoor Panchayat.

He was complaining about the illegal quarrying activities happening nearby his village. The quarrying operations starts from 3.30 am onwards irrespective of rules. The freedom of movement is being curtailed by the vehicular traffic and parking of heavy tippers. He pointed out that as per rules, parking facility should be arranged in yards of quarries. He also suggested to monitor the vehicular traffic to prevent accidents.

35) Sri. Raghunath, Pathanamthitta.

He was a researcher in Mining especially in Pathanamthitta District. He suggested to operate the quarries with stringent rules and disciplines. He suggested a safe distance of 50m is enough to carry out quarrying effectively.

36) Sri. Prasad.

He was a representative of All Kerala Karinkal Quarry Association. He said that Land Reform Act and Mining Mineral Rules came into effect togetherly. In this situation if the distance norms are increased beyond 50m, the quarrying operation cannot be carried out in State of Kerala. He also informed that fake complaints are being filed by public.

37) Smt. Pushpareji, Kollam.

She was living near 'KMM Quarry' at Cherukulam. She mentioned that the quarry is located at a distance of 113m from her house. Due to heavy blasting, her house got damaged severely. She also said that they were suffering from frequent respiratory problems and cough. She requested to keep a minimum distance of 500m from quarrying site.

38) Sri. Renju, Kollam, Chithara.

He said that many quarrying units or crusher units were functioning in Kollam District. Most of these quarries are not keeping a safe distance of 50m from the nearby residence. Hence he requested that the committee should conduct a surprise inspection at quarries in order to study actual scenario.

39) Sri. Abhilash, Kollam, Kottarakkara.

He was complaining about quarry named 'Chapara'. He said that the quarries were operating without obeying the rules and regulations issued by the Government. He requested to keep a minimum distance of 200m from quarry. The quarry unit is located at a distance of 20m from his residence, the polluted water is being discharged through PWD roads. As a result, they are facing water scarcity and health issues. He told that he already gave complaints regarding the above matter to the Department of Geology and

Mining, Kollam and District Collector, Kollam. But they have not yet taken any action against the complaints.

40) Sri. Shajimon, Kollam

He told that providing a distance norm of 50m is not sufficient as it threatens the life of public. So he requested to increase the safe distance as 500m from residence.

41) Sri. Unni, Kollam.

He recommended that the distance criteria shall be maintained at 500m instead of 50m.

42) Sri. Rajesh, Vembayam Panchayat.

He was complaining about a quarry named 'Ganapathy Metals'. The quarry is situated 150m away from his house. His house is made-up of mud block with thatch roof. Due to blasting activity, his house got cracked and now they are not able to stay in the house. His father is suffering from Ashtma and weekly checkup is being done. He requested to keep a safe distance of 500m from quarry.

43) Sri. Akbarlal, Nilamel, Kollam.

He made a complaint against a quarry which has recently obtained license for operation. He claimed that the quarry owner managed to get the license by making forgery in village records. He recommended to maintain a distance of 500m instead of 50m.

44) Sri. Surendra Kumar, Thiruvananthapuram.

He is coming from Mookkunnimala, Thiruvananthapuram. He pointed out that 50m distance criteria is not enough since it affects the life of people living nearby quarry. He requested to increase the safe distance as 500m from the quarry.

45) Sri. Reghuchandran Nair, Thiruvananthapuram.

He was the President of Trivandrum chamber of Commerce and Industry. He was also a Geologist. Earlier Kerala has only 96 lakh acres. Today we have only 12 lakh acres remaining. Today Kerala have only 563 quarries but earlier it was around 3000 quarries. This 563 quarries now only holds 4000 acres of land. He suggested that 50m distance can be kept as safe distance as per Supreme Court Order. He also suggested to make use of new technologies for blasting considering the safety of public.

46) Sri. Gireesh Menon.

He is a representative of Kerala Mining Vocational Training Centre. He is a Trainee Manager having 38-year experience in all major limestone, granite industry etc. Presently there are 159 members in training centre. They are providing educational awareness and training to all the employees and public residing near quarries. They also provide information regarding blasting technology. He suggested to keep 50m as distance norm.

47) Sri. Lijo Roy, Practicing advocate.

He suggested that the minimum distance should be 50m. Mining is essential for the development of the country. It also generates more employment opportunities. The mining distance can be even reduced if proper technology is adopted.

48) Sri. Muhammad Nadirsha, Chithara Panchayat, Mankode Village.

He complained about a quarry named ‘Tasna Mines’, Kottakkal. He mentioned that the quarry is working illegally. He suggested that a minimum distance of 500m should be kept as safe distance criteria. He requested that a monitoring committee should be formed to analyse the illegal mining and NOC violation of that quarry.

49) Sri. Baiju, Elamad, Kollam.

He said that the number of cancer patients in that area is considerably increased due to the use of excessive explosives in the quarries. He suggested a minimum safe distance of 500m is required from residences to the quarries. He also requested to cancel the NOC provided for the quarrying activities near Ayiravalli Temple.

50) Sri. Sunil, Association Member.

He suggested that 50m distance is enough as safe distance for quarries.

51) Sri. Sajeer Khan, Ittiva.

He suggested a minimum safe distance of 500m from quarries to residences. He also mentioned that about 50 houses developed cracks in that area due to the quarrying activities. They were transporting 200 loads instead of 20 loads. They are increasing the power of explosion 100 times and hence the houses were cracked within a radius of 300m. So it is requested to increase the safe distance limit from 50m to 500m.

52) Sri.Thambu Cheriyan, Retired Deputy Director, Mining and Geology Department.

He is working as a consultant. He suggested that by keeping 50m as safe distance the quarrying can be done safely using the modern technology and advanced blasting methods.

53) Sri. Vipin, Neyyattinkara, Excavate Operator.

He suggested that 50m is enough as safe distance for quarries. If more quarries are made functional, it will generate more employment opportunities. He concluded that if the distance is increased then no quarries can work in Kerala.

54) Sri. Anas, Thekkada Village

He mentioned that there is a chance of landslide in that area due to the quarrying activities.

55) Sri. Prasad Somrajan, Western Ghat Protection Samithi.

He recommended to maintain a safe distance not less than 200m from residence to quarries.

56) Sri. Joseph Jacob, Company Representatives, Peroorkada Mines.

He mentioned that 50m distance is enough to carry out mining operations, if proper technology is adopted.

57) Sri. Thottakkadu Sasi, District President, RMCO, TVM.

He claimed that most of the complaints raised before the committee existed before 2017. When modern technologies like nonel blasting technologies came in to effect these complaints are eliminated. There are a lot of people including road workers, hollow brick unit operators etc. depending on quarrying industry. So he suggested the safe distance as 50m from quarry.

58) Sri. Kumar, Vestas mine manager.

His mine is working in compliance with the rules and regulations of SEIAA and DGMS. Blasting is done using nonel technology. The fly rocks generated during blasting are controlled within 10m. Vibration is within the limit as per the studies conducted by various authorities. He recommends to maintain a distance of 50m as safe distance.

59) Sri. Vikraman Pillai, Pallikkal Panchayat.

He said that the quarrying operation have been stopped since 2004 as per the order of Court in the area. The mine has an average depth of 150-

200 feet. One side of the quarry is residential area and the other portion is having only a few residences. The reports are made based on the studies conducted at the non-residence area. So the actual picture is different. So the minimum distance shall be maintained as 500m instead of 50m.

60) Sri. Shibin, Enchappara.

He mentioned that quarry should not be allowed to operate near residential areas.

61) Sri. Bose Raghavan, Kalanjoor, Pathanamthitta.

There are 7 quarries and 3 Crusher units functioning in his village. He claimed that due to the operation of these quarries, the cancer patients in his village have been significantly increased. Huge ponds formed as a result of this quarrying activity may have led to another catastrophe like landslide or flood. Therefore, action has to be taken to refill these ponds after quarrying. There shall form a monetary fund for the well-being of the people who are suffering from the quarrying activities.

The representative of KSPCB thanked all the members of joint committee and the gathered public.

The meeting ended by 1:45 pm

ANNEXURE 7

ONLINE SURVEY: STAKEHOLDERS OPINION IN THE MATTER OF SAFE DISTANCE CRITERIA FOR STONE QUARRIES IN KERALA

Honourable National Green Tribunal (NGT), Principal Bench (PB) Delhi, registered a grievance (related to the operation of quarries) received through post as application (OA -304/2019) 'Suo Motu'. The grievance was about stone quarries and crushers operating without requisite safeguards at Kizhakkancherry Village, Palakkad District in the State of Kerala. According to the applicants (M Haridasan & Others), the operation of stone crushers and quarrying activities are adversely affecting the environment, flora and fauna in the area.

Honourable NGT observed that distance of 50 m is highly inadequate and can have deleterious effect on noise pollution, air pollution, environment and public health. As per the order dated 28-02-2020, Honourable NGT sought a report from CPCB on the distance criteria for stone quarries and to prescribe more stringent conditions and appropriately longer distance. In compliance of NGT order dated 28.02.2020, CPCB examined the minimum distance prescribed by various states with respect to mining of minor minerals and prepared a report "Distance Criteria for Permitting Stone Quarrying".

Honourable NGT, through an order dated 21.07.2020 approved the CPCB report on the minimum distance criteria for operation of stone quarries close to residences and public roads. NGT directed, that the same distance criteria have to be followed throughout the country.

Several project proponents/ quarry lessees challenged the direction of Honourable NGT mandating 200 m distance to stone quarries. Subsequent to the interventions of Honourable High Court and Apex courts in the matter, Honourable NGT issued order on 09-12-2021 for further expert study on the subject of safe distance for mining.

A seven-member joint committee was constituted by Honourable NGT for undertaking an expert study to determine safe distance for mining.

Stake holders will be at liberty to give their respective view point to the joint committee. It is request to participate in this online survey and record your opinion on safe distance criteria for stone quarries.

*Required

1. Name *

2. Address *

3. Contact Number (Phone/ Mobile) *

4. Are you living close to any stone quarries? *

Mark only one oval.

- Yes
- No

5. If yes, details of stone quarry in your vicinity (Up to 1 km distance)

6. Are you working in stone quarry or being associated with the stone quarry operations? *

Mark only one oval.

- Yes
- No

7. Please give details, If you are associated with stone quarries and related operations.

8. In your opinion, what are the negative impacts of stone quarries in Kerala? *

Tick all that apply.

- [ ] Blast induced vibration and resulting structural damages to buildings
- [ ] Nose pollution due to blasting and quarry operations
- [ ] Dust pollution due to quarry operations
- [ ] Water pollution due to mine pitdischarge
- [ ] Transport nuisance in small village roads
- [ ] All of the above
- [ ] None in particular

9. Which of the following are the most critical environmental impact of stone quarries? *

Mark only one oval.

- ◯ Structural damages due to unscientific blasting operations.
- ◯ Land use changes and resulting land destabilization.
- ◯ Noise and dust pollution from quarry operations.
- ◯ Water pollution due to mine pit discharge water and diversion of natural streams.
- ◯ Transport nuisance and traffic congestion in small village roads due to conveyance of quarry products.
- ◯ All of the above.
- ◯ None in particular.

10. Do you agree that stone quarries are inevitable as we depend them for the building stones and infrastructure development? *

Mark only one oval.

- ◯ Yes, but operations has to be closely monitored and regulated.
- ◯ No, environmental impacts of stone quarries are much higher.
- ◯ Yes, stone quarries are indispensable for fast tracking infrastructure development.
- ◯ Yes, but permitting stone quarries has to be done judiciously after scientific considerations of the possible negative environmental impacts.
- ◯ No, they cannot be permitted in a State like Kerala with high population density.
- ◯ No, as stone quarry operations are not closely monitored and effectively regulated.
- ◯ Yes.
- ◯ No.

11. In your opinion, what should be the criteria for safe distance from quarries to habitations? *

Mark only one oval.

- ◯ Based on scientific rationale considering the local geological profile and environmental factors.
- ◯ Arbitrary distance as decided by the authorities.
- ◯ Adopting distance criteria already implemented in other countries.
- ◯ Based on the potential mineral reserve.
- ◯ Site specific assessments.

12. According to you, which of the activities in stone quarries are not monitored/ regulated properly? *

Tick all that apply.

- [ ] Blasting operations.
- [ ] Transport and conveyance of quarry products.
- [ ] Water pollution due to quarrying activities.
- [ ] Noise and air pollution due to quarry operation.
- [ ] Top soil/ overburden management.
- [ ] Mine closure.
- [ ] Mine safety.
- [ ] All of the above.
- [ ] Not aware of the monitoring/ regulatory aspects.

13. Are you aware of the fact that the distance criteria of stone quarries were made to 50 m from residential buildings as per the Kerala Minor Mineral Concession (Amendment) Rules, 2017. *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not aware of Kerala Minor Mineral Concession (Amendment) Rules of 2017.

14. Are you aware of any public consultation/ public hearing prior to Kerala Minor Mineral Concession (Amendment) Rules, 2017 mandating 50 m distance criteria for stone quarries from residential building? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not aware of such public consultation/ hearing.

15. Are you aware of any initiatives taken by stone quarries in addressing/ mitigating the negative effects of quarrying?

16. Do you have any grievances related to stone quarries in Kerala? *

Mark only one oval.

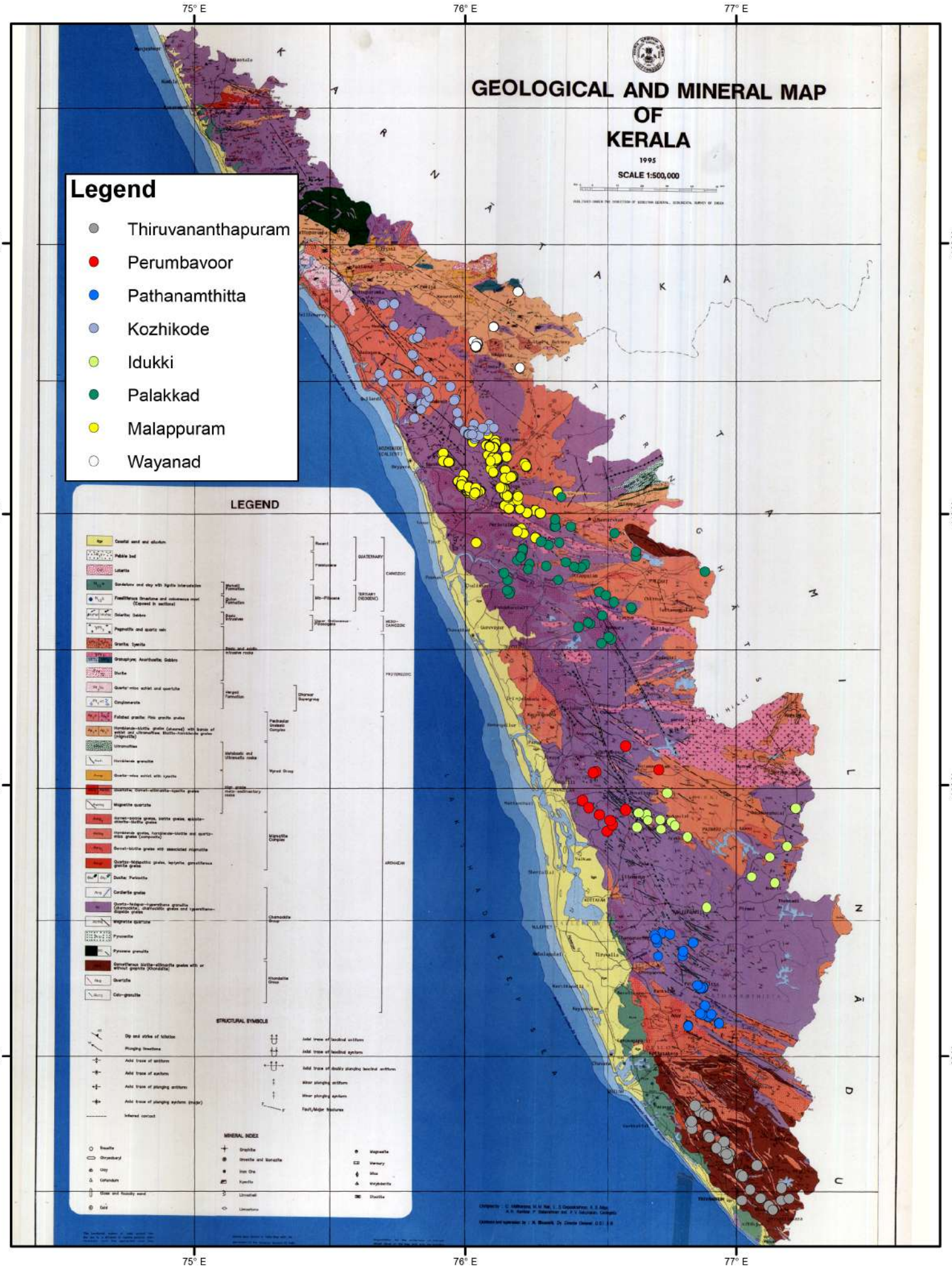
- Yes
- No

17. If you have any specific grievances related to the operations of stone quarries in Kerala, please upload the details as a single PDF file (Maximum file size acceptable is 1MB)

Files submitted:

18. Do you have any suggestions/ opinion on the safe distance criteria for stone quarries in Kerala.

ANNEXURE 8


GEOLOGICAL AND MINERAL MAP
OF
KERALA
1995
SCALE 1:500,000
Legend
Thiruvananthapuram
Perumbavoor
Pathanamthitta
Kozhikode
Idukki
Palakkad
Malappuram
Wayanad
LEGEND
STRUCTURAL SYMBOLS
MINERAL INDEX
75° E
76° E
77° E
12° N
11° N
10° N
9° N

ANNEXURE 9

Licensing and monitoring of quarrying of minor minerals

The Industries Department through Department of Mining and Geology (DMG) issues Permits (Quarrying permit is a short term permit not exceeding one year at a time limited to a maximum further period of two years. It is given at district level) and Leases (Quarrying lease is a mining lease for minor minerals granted for a minimum period of five years and maximum of twelve years. It is given at Directorate level for which a lease deed is to be executed) for quarrying of minor minerals which include building stones, gravel, ordinary clay, ordinary sand other than sand used for prescribed purposes and any other mineral declared by Central Government as minor mineral.

In addition, the DMG issues movement permits and dealer's license for stocking and selling of minor minerals.

The role of the DMG also includes inspection of mines and quarries and implementation of rules and regulations by virtue of the powers vested with it under the Mines and Minerals (Development & Regulation) Act, 1957, the Minerals Concession Rules, 1960, the Kerala Minor Mineral Concession (KMMC) Rules, 1967 and 2015, and collection of revenue on both major as well as minor minerals. DMG is also responsible, through the Kerala Minerals (Prevention of Illegal Mining, Storage and Transportation) Rules, 2015 for curbing illegal mining and clandestine movement of minerals.

Forest/Environmental Clearances (EC)/No Objection Certificates (NOC) required for issuing quarrying permits/leases include: -

- EC from the Ministry of Environment and Forest (MoEF)/ State level Environment Impact Assessment Authority (SEIAA), wherever applicable.
- Explosive license from PESO/District Administration.

- NOC from revenue authorities if the quarrying area is poramboke land/revenue land.
- NOC from Forest Department if the quarrying area is forest land.
- Consent from the Kerala State Pollution Control Board (KSPCB) to operate quarries in the case of granite building stone (GBS).

Role of the Revenue Department includes issuance of survey map of the area, issuance of certificate of demarcation of boundaries, issue of certificate to the effect that the land has not been assigned for any other purpose, issue of possession and enjoyment certificate, issue of NOC in respect of quarrying in Government *poramboke* land and rendering of assistance in the implementation of KMMC Rules.

In addition to the above, quarry operators should have valid license from Local Self Government Institutions (LSGI) as per Section 232 of The Kerala Panchayat Raj Act, 1994.

Acts and Rules Enacted by Government of Kerala

1. The Mines and Minerals (Development and Regulation) Act, 1957
2. Kerala Minor Mineral Concession Rules, 2015

1. The Mines and Minerals (Development and Regulation) Act, 1957

An Act to provide for the development and regulation of mines and minerals under the control of the Union.

GENERAL RESTRICTIONS ON UNDERTAKING PROSPECTING AND MINING OPERATIONS

- Prospecting or mining operations to be under license or lease- No person shall undertake any reconnaissance, prospecting or mining operations in any area, except under and in accordance with the terms and conditions of a

reconnaissance permit or of a prospecting license or, as the case may be, of a mining lease, granted under this Act and the rules made there under.

- Termination of prospecting licensees or mining leases- Where the Central Government, after consultation with the State Government, is of opinion that it is expedient in the interest of regulation of mines and mineral development, preservation of natural environment, control of floods, prevention of pollution, or to avoid danger to public health or communications or to ensure safety of buildings, monuments or other structures or for conservation of mineral resources or for maintaining safety in the mines or for such other purposes, as the Central Government may deem fit, it may request the State Government to make a premature termination of a prospecting license.
- Maximum area for which a prospecting license or mining lease may be granted.—No person shall acquire in respect of any mineral or prescribed group of associated minerals [in a State]— (a) one or more prospecting licenses covering a total area of more than twenty-five square kilometers; or (b) one or more reconnaissance permit covering a total area often thousand square kilometers: Provided that the area granted under a single reconnaissance permit shall not exceed five thousand square kilometers.
- Periods for which mining leases may be granted or renewed. —(1) The provisions of this section shall apply to minerals specified in Part A of the First Schedule. (2) The maximum period for which a mining lease may be granted shall not exceed thirty years: Provided that the minimum period for which any such mining lease may be granted.
- Royalties in respect of mining leases. —(1) The holder of a mining lease granted before the commencement of this Act shall, notwithstanding anything contained in the instrument of lease or in any law in force at such

commencement, pay royalty in respect of any (mineral removed or consumed by him or by his agent, manager, employee, contractor or sub-lessee) from the leased area after such commencement, at the rate for the time being specified in the Second Schedule in respect of that mineral.

- Penalties- Whoever contravenes the provisions of sub-section (1) or sub-section (1A) of section 4 shall be punishable with imprisonment for a term which may extend to five years and with fine which may extend to five lakh rupees per hectare of the area.

2. Kerala Minor Mineral Concession Rules, 2015

- In exercise of the powers conferred by sub-section(1) of section 15 of the Mines and Minerals (Development and Regulation)Act, 1957 (Central Act 67 of 1957), the Government of Kerala made the following Rules in supersession of the Kerala Minor Mineral Concession Rules, 1967 issued under Notification No. 15203/E2/63/ID dated 24th November,1967 and published as S.R.O. No. 364/67 in part I of the Kerala Gazette No. 49 dated 12th December, 1967, namely: — Kerala Minor Mineral Concession Rules, 2015.
- Grant of quarrying permit:- (1) On application made to it the competent authority under these rules may grant a quarrying permit to any Indian National to extract any minor mineral, other than dimension stone, from any specified land within the limits of its jurisdiction and authority as notified by the Government in the official Gazette from time to time on payment of royalty as the competent authority may fix on the basis of the rates specified in schedule I or IV, as the case may be and also on payment of such surface rent and cess as may be assessable on the lands.

  (2) The competent authority may grant a permit for a lower quantity than applied for or refuse to grant such permit for reasons to be recorded in writing.

(3) The area under a quarrying permit shall be a contiguous unit and shall not exceed one hectare.

(4) The competent authority under these rules shall send a copy of the quarrying permit granted by it to the District Collector and the Secretary of the Local Self Government Institution concerned.

- Application for quarrying permit: - (1) An application for a quarrying permit shall be made in Form A and shall contain the following particulars, namely: —(a) name, address, profession and nationality of the applicant;(b) name and quantity of the minor mineral for which the permit is required;(c) description such as location, survey number etc. of the lands from which the minor mineral is to be extracted;(d) purpose for which the minor mineral is to be used. (2) Every such application shall be accompanied by, — (a) a copy of the survey map of the area, attested by the Village Officer concerned or any other competent officer of the department of Land Revenue having jurisdiction over the area in respect of which permit is applied for or Assistant Director of Survey and Land Records concerned. The area in which extraction is applied for in each survey number shall be demarcated and coloured red in the map; (b)a certificate of demarcation of the boundaries of areas applied for, issued by an officer of the department of Land Revenue not below the rank of Village Officer who has jurisdiction over the relevant area;(c)a certificate from the Village Officer concerned to the effect that the land in respect of which quarrying permit is applied for, is not assigned for any special purpose by the department of Land Revenue;(d)the possession and enjoyment certificate issued by the Village Officer concerned in respect of the land from which the minerals are proposed to be extracted. In the case of revenue poramboke lands or lands owned by Local Self Government or in the case of forest lands, a No Objection Certificate from the District Collector or Secretary of the Local Self

Government Institution or Divisional Forest Officer concerned, as the case may be, to the effect that the department concerned has no objection for the extraction of minor mineral by the applicant subject to the provisions contained in these rules;(e) notarised consent letter from the owner of the land from which minor mineral is to be extracted to the effect that he has no objection to the extraction of the minor mineral by the applicant, if the land is not in the possession of the applicant;(f) No Objection Certificate from the District Collector concerned, based on the recommendation of the District Expert Committee constituted by the Government in this regard, in the case of application for extraction of ordinary clay or ordinary sand; (g)Bank guarantee from any Nationalized or Scheduled Bank at the rate of 300 (Rupees three hundred only) per cubic meter for the purpose of reclamation of pits that will be formed after quarrying in the area permitted, in respect of application for extraction of ordinary clay and ordinary sand.

- Application fee: - Every application for a quarrying permit shall be accompanied by a fee of one thousand rupees for all minor minerals.
- Acknowledgement of application: - Where an application for the grantor renewal of quarrying permit is delivered personally, its receipt shall be acknowledged forthwith, in Form C.
- Payment of Royalty. —Every applicant for a quarrying permit shall pay royalty in advance to Government at the rates specified in Schedule I or IV, as the case may be.
- Letter of intent to an applicant for a quarrying permit. —On receipt of an application for a quarrying permit with all requisite contents and particulars there of prescribed in these rules but without having the statutory licenses required to be obtained from other Departments concerned, the applicant shall be issued a letter of intent by the competent authority after making site visits

and other enquiries as the authority deems fit. Quarrying permit shall be granted and royalty collected only after obtaining all other statutory licenses/clearances/No Objection Certificates etc. from other statutory authorities concerned. The letter of intent so issued shall be sufficient for statutory authorities concerned for issuing their licenses/permissions/No Objection Certificates etc.

- Disposal of application for the grant of quarrying permit. — (1) On receipt of the application for grant of quarrying permit for undertaking quarrying operations, the competent authority shall make site inspection and take decision regarding the precise area to be granted for the said purpose and intimate the applicant to submit approved mining plan and Environmental Clearance for the precise area. Provided that, approved mining plan and environmental clearance shall not be insisted, for the issuance and renewal of permits in the case of Laterite Building Stone. (2) On receipt of an approved mining plan and Environmental Clearance for the precise area and on production of all other statutory licenses/clearances/No Objection Certificate etc. from other statutory authorities concerned, the competent authority shall issue a quarrying permit to the applicant within thirty days in Form N for ordinary earth and in Form M for all other minor minerals.
- Conditions on which quarrying permit shall be granted .—Every quarrying permit, except for ordinary earth, under rule 9 shall be granted subject to the following conditions, namely: (a) the depth of the pit below surface shall not exceed 6 meters except in the case of extraction of granite (building stones) and laterite (building stones): Provided that in the cases of quarries of granite (building stones) and laterite (building stones) where the depth of the pit exceeds 6 meters, the sides of open workings shall be sloped, stepped or benched or secured by the permit holder in such a manner so as to prevent

slope failure. When an open working is worked in steps such steps shall be of sufficient breadth in relation to their height to secure safety. In an excavation in any hard and compact ground the sides shall be adequately benched, sloped or secured so as to prevent danger from fall of sides. No trees, loose stone or debris shall be allowed to remain within a distance of three meters from the edge or side of the excavation. No person shall undercut any face or side or cause to permit such undercutting so as to cause any overhanging. Provided further that in the case of granite and laterite building stone quarries, the permit holder shall give a notice in writing in Form D to the Deputy Director General, Directorate General of Mines Safety, Southern Zone,Bengaluru-560 029; The Regional Controller of Mines, Yeshwantpur,Bengaluru-560 022 and the District Magistrate of the district when the depth of open cast excavation measured from its highest to the lowest point reaches 6 meters or when the number of persons employed on any day is more than 50 or when any explosives are used for excavation. (b) The maximum period for a quarrying permit shall be one year from the date of grant under rule 9. (c) the permit holder shall not extract and remove excess quantity of the mineral than permitted. (d) the permit holder shall not extract minerals outside the area permitted for extraction. (e) the permit holder shall furnish to the competent authority or the officer authorised by him in this regard a return in form 'F' regarding the mineral quarried and removed from the area before 10th day of every calendar month after the month of grant of quarrying permit. The permit holder shall also allow inspection of the area by the competent authority or any officer authorized by him at any time and shall give satisfactory proof as to the quantity of the mineral quarried and removed. (f) the permit holder, in cases where explosives are not used for quarrying, shall not carry on or allowed to be carried on any quarrying operations at or to any points within

a distance of 100 meters from any railway line except with the previous written permission of the Railway Administration concerned and any bridge on National Highway or 50 meters from any reservoir, tanks, canals, rivers, bridges, other public works, residential buildings, the boundary walls of places of worship, burial grounds, burning Ghats or forestlands or village roads except with the previous permission of the authorities concerned or the Government or the competent authority. Provided further that in cases where explosives are used for quarrying, the permit holder shall not carry on or allowed to be carried on any quarrying operations at or to any points within a distance of 100 meters from any railway line, any bridge, reservoir, tanks, residential buildings, monuments protected by Government, canals, rivers, public roads having vehicular traffic, other public works or the boundary walls of places of worship or 50 meters from any burial grounds or burning ghats or village roads or forest lands. (g)The area granted under a quarrying permit shall be a contiguous unit. (h)The permit holder shall not win and dispose of any type of mineral other than the mineral specified in his permit. (i) The permit holder shall erect a notice board in Malayalam at a prominent place with a minimum size of 1 meter × 1.5 meters in a metallic board near to the entrance of the quarry to the effect that it shall contain the name and address of the permit holder, mineral concession number and date, the mineral to be extracted, permit number and date and its date of expiry, quantity of extraction permitted (if applicable), area of extraction permitted, explosives used (if any), etc. The permit holder shall erect a warning board with danger sign regarding operation of the quarry, 100 meters away by the side of the road leading to it;(j) The permit holder shall allow any officer authorised by the Central or the State Government in this behalf to enter upon any building, place of excavation or land comprised in the permit for the purpose of

inspection of the same. (k)The permit holder shall carry on the operations permitted in a fair, orderly, skillful and workman like manner and shall not cause any damage to life and property in nearby areas and also not cause any serious environmental hazard;(l)The permit holder shall at all times during the term of the permit keep or cause to be kept correct and intelligible records of accounts which shall contain accurate entries showing from time to time the quantity of mineral extracted and if sold, to whom sold, place, number of transit pass etc. and it shall be open for inspection by the competent authority in this regard, during all reasonable time;(m)The permit holder shall give on demand any information pertaining to the quarrying as required by the competent authority under these rules;(n)The permit holder shall not be eligible for refund of any amount paid by way of application fee, rent, royalty or tax as the case may be;(o)The permit holder shall comply with all rules and regulations which may from time to time be issued relating to the working of the quarries and other matters affecting the safety, health and convenience of the permit holders, employees or of the public whether under the Mines Act, 1952 (Central Act 35 of 1952) or otherwise;(p)The permit holder shall without delay send to the District Collector, Deputy Director General, Directorate General of Mines Safety, Bengaluru and the competent authority under these rules a report of any accident causing death or serious bodily injury or serious damage to property which may occur during the course of the quarrying operation. (q) (1) In the case of granite and laterite (building stone) quarries where a pit has been formed as a result of any mining operation, the permit holder shall provide retention wall/barricade/fencing/compound wall surrounding the quarrying area in order to prevent accidents by falling of human beings, animals or vehicles or any other thing into the quarry;(2)The permit holder shall sufficiently fence and secure all pits that may be seen or

made in the permitted area, whether abandoned or not;(3)The permit holder shall also provide all effective preventive measures for the safety of laborers as well as the public in general.(4) The permit holder shall carry out mining operations only in accordance with the approved mining plan submitted by him for obtaining the quarrying permit.

- Compensation for damage.—The permit holder shall pay reasonable compensation as may be assessed by any lawful authority in accordance with the law in force on the subject for all damage, injury or disturbance which may be done by him in exercise of the rights granted to him by the permit and shall indemnify and be kept indemnified the State Government against all claims which may be made by any person or persons in respect of any such damage, injury or disturbance and all costs and expenses in connection therewith.

ANNEXURE 10

Assessment of blast induced vibration and air overpressure studies at selected granite building stone quarries in Kerala for ensuring compliance to the Honourable NGT, Principal Bench, Delhi directions passed in OA No.304/2019

Scope of work

- Reconnaissance survey to map all structures and sensitive areas up to 500m radius from the blast point/ mine.
- To supervise blasting trials in granite stone quarries using the explosives in the custody of the quarry license holder. The statutory persons as required under the Mines Act, 1952 appointed by the owner of the mine shall be present at the site during the blasting trails.
- To monitor ground vibration and air over pressure / air blast levels produced due to blasting in selected stone quarries (9 to 12 Nos across the State of Kerala). To find out effect of blast induced ground vibration on the structures & to eliminate chances of flying fragments and also to design safe blasting pattern (to study & fix charge per delay, charge per round, delay between holes & rows, depth of holes, spacing, burden, diameter of holes, Peak Particle Velocity (PPV), fly rock, fragmentation, flow of blasting fumes etc.).
- Assessing structural response and blast induced ground vibrations at 50, 75, 100, 125, 150, 200, 250 & 500 m perimeters from the blasting point.
- Analyse the blast vibration data to arrive at a site specific Peak Particle Velocity (PPV) predictor equation for each mine and a combined predictor equation if possible for each zone.
- To suggest safe permissible limits of vibration for various structures from 50 to 500 m perimeter as per the DGMS directives.
- To suggest safe maximum charge per delay of explosives to be used to keep vibrations levels within the permissible limits.

- To suggest a site specific blasting protocol to reduce vibrations and air overpressure.
- Blasting trials, vibration assessment and report submission shall be completed in two months' time.
- To submit the finding in report form to the Joint Committee constituted in the Honourable NGT matter of OA 304/2019.

Instrumentation

- Triaxial transducers based digital geophones, seismographs or any other equivalent digital vibration monitor to be used to assess vibration and air overpressure.
- High speed camera to record all the blasting events to study the fly rock distance zone.

Measurement

- Observation shall be made at 50, 75, 100, 125, 150, 200, 250 & 500 m from the blasting point.
- For structural response, instruments shall be mounted over the wall, floor, ceiling etc.
- For ground response, instruments shall be placed in contact with the ground.
- Observation corresponding to a minimum 10 blasts for each blasting trials in the selected quarry.

Blasting trials

- Using approved explosives and initiation systems. Observations and blast design shall be done for blasting as per the mine plan for short hole drilling blasting (32 mm hole diameter, 1.5-2.5m hole length, 1.0-1.5m hole spacing) and deep hole drilling and blasting (diameter more than 75mm - 160mm). Generally, in Kerala 100mm to 115mm holes with 6 -7m depth is practiced.

- To carry out blasting trials using the blasting protocol as per the approved mine plan using explosives as per the Petroleum & Explosives Safety Organization (PESO) license of the stone quarry.
- Apart from the above, Central Institute of Mining and Fuel Research (CIMFR), Dhanbad may conduct blasting as per the standard protocol appropriate for the quarry/ zone.
- The experimental blast shall be conducted with the existing pattern being followed in the quarry as well as modified blast design patterns. In the modified blast design patterns, short-delay electric detonators and Non-electric (NONEL)/shock tube initiation system to be used.

Expected study outputs

- To assess the ground vibrations with respect to the structures in the blast influence zone up to 500 m from the blast point and comparison with the permissible PPVs for the safe ground vibration standards notified by DGMS.
- Overview of blast induced ground vibration assessment with respect to significant variables like charge weight per delay and length of delay.
- Overview of the vibration prediction with respect to moderately significant variables like spacing, stemming amount and direction of initiation.
- Comparison of blast induced vibration with respect to ordinary/ electric / NONEL detonators wherever possible.
- Suggesting best suitable blasting protocol for each stone quarry. The analysis of the data, assessment for the blasting influence zones and submission of the final report to the Joint Committee.

Note:

A detailed techno-financial proposal as per the scope of work along with time schedule for completion of the studies may please be

forwarded to the Regional Directorate, CPCB, Bengaluru/ Coordinator, Kerala State Pollution Control Board (KSPCB) for further discussion by the Joint Committee in its next meeting and for forwarding its recommendations to the Coordinator, KSPCB, for further action accordingly for ensuring compliance to Honourable NGT directions passed in OA No.304/2019.

Since the matter is sub-judice, complete confidentiality to be ensured in all aspects of the work.

सीएसआईआर- केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान
CSIR-Central Institute of Mining and Fuel Research
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद / Council of Scientific & Industrial Research)
(अंतर्गत वैज्ञानिक तथा औद्योगिक अनुसंधान विभाग, विज्ञान और प्रौद्योगिकी मंत्रालय,भारत सरकार)
(Under the Department of Scientific & Industrial Research, Ministry of Science & Technology, Govt. of India)
बरवा रोड, धनबाद - 826015, झारखण्ड, भारत / Barwa Road, Dhanbad - 826015, Jharkhand, India
(आई एस ओ 9001 प्रमाणित संस्थान / ISO 9001 Certified Institute)

To:
Sri Krishnan M N
Environmental Engineer
Kerala State Pollution Control Board,
District Office, Palakkad,
Kerala, Pin-678 001

Ref. CSIR-CIMFR/REE/KSPCB/2022/
Date: October 21, 2022

Subject: Acceptance of Letter of Intent-Award of Work to carry out scientific studies for the assessment of influence zones due to blasting at granite quarries in the state of Kerala as per the order of Hon'ble NGT OA 304/2019

Reference: Your Letter No. PCB/PLKD/TG-304/2019 dated 21.10.2022

Dear Sir,

We thankfully acknowledge the receipt of your letter No. PCB/PLKD/TG-304/2019 dated 21.10.2022 regarding Letter of Intent-Award of Work to carry out scientific studies for the assessment of influence zones due to blasting at granite quarries in the state of Kerala as per the order of Hon'ble NGT OA 304/2019.

We, hereby, expressed our acceptance of your Letter of Intent-Award of Work to carry the above mentioned studies. Regarding the payment terms, 50% of the total scientific study cost should be paid in advance before the commencement of the field investigation The balance 50% amount should be paid after completion of the field investigation works.

The scientific study cost should be paid through e-transfer system. The details of bank for e-payment are as follows.

Bank Name: State Bank of India, Hirapur (Code – 1670), Dhanbad
Bank a/c No. 30256736794, MICR code: 826002007, IFS Code/ NEFT Code: SBIN0001670
Vender/customer Bank e-mail id: sbi.01670@sbi.co.in

Thanking you,

Yours faithfully,

Sawmliana 21/10/2022

(C. Sawmliana)
Chief Scientist & HoS
Rock Excavation Engineering Research Group
Emails: csawmliana@cimfr.nic.in & csla_cimfr@yahoo.com
Mobile No. 9471191134

ANNEXURE 12

General: 0471- 2312910, 2318153, 2318154, 2318155 Chairman: 2318150 Member Secretary: 2318151
E-mail: ms.keralapcb@gov.in FAX: 0471 – 2318134, 2318152 web: www.keralapcb.nic.in

KERALA STATE POLLUTION CONTROL BOARD
കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ്
Pattom P.O., Thiruvananthapuram – 695 004
പട്ടം പി.ഒ., തിരുവനന്തപുരം - 695 004

PCB/HO/EE4/NGT/O.A.304/2019 Date: 15/11/2022

From
Chairman

To
The Director,
CSIR-Central Institute for Mining and Fuel Research
Dhanbad – 826015

Sub: Work Order – Award of work to carry out scientific studies for the assessment of influence zones due to blasting at selected stone quarries in Kerala State in compliance to Hon'ble NGT orders passed in OA No. 304/2019

Ref: 1) CIMFR letter and proposal dated 27-9-2022
2) Recommendations of the Joint Committee constituted by Hon'ble NGT in its meeting held on 20-10-2022
3) Proceedings of the KSPCB Chairman PCB/HO/EE4/NGT/O.A.304/2019-1 dated 09-11-2022
4) Proceedings of the KSPCB Chairman PCB/HO/EE4/NGT/O.A.304/2019-2 Dated 09-11-2022

Sir,

Honourable National Green Tribunal (NGT) Principal Bench New Delhi in OA No. 304/2019, by an order dated 21-07-2020, directed to maintain longer distances for siting stone quarries in light of Central Pollution Control Board (CPCB) report following precautionary principle considering the right of the inhabitants, who are affected by air and noise pollution generated in the course of mining. Subsequent to the Hon'ble NGT order, the aggrieved mining lessees (project proponents) filed appeals (MA 80, 83, 85, 88 to 95 of 2021) in the OA No. 304/2019. All the MAs sought impleadment in the matter with specific prayer of not to interfere with the distance laid down by the Department of Mining & Geology, Kerala State Government and Kerala State Pollution Control Board (KSPCB).

After examining the project proponents' contentions in detail, Honourable NGT was inclined to consider an expert study afresh by a Joint Committee on the impact of blasting using NONEL Detonator Technology in stone quarries. The study includes impacts on vibrations on different soil strata/ earth profile, on noise levels, on air pollution levels, on buildings, humans and wildlife. In compliance with the Hon'ble NGT directions, a Joint Committee was constituted with scientists and officers from prestigious national level institutions and agencies as members and an officer from CPCB as Member Convener. The Committee through its deliberations formulated a Scope of Work "Assessment of blast induced vibration and air overpressure studies at selected granite building stone quarries in Kerala State for ensuring compliance to the Honourable NGT, Principal Bench, Delhi directions passed in OA No.304/2019" and decided to get the study conducted by a government agency having capability to conduct the study as per scope of work recommended by the Joint Committee.

The Joint Committee suggested the Kerala State Pollution Control Board (KSPCB) to invite technical and financial proposals from government sector institutions of national repute. Proposals were invited and the proposal received from Central Institute of Mining and Fuel Research (CIMFR) vide letter (1) has been adjudged by the Joint Committee, in the meeting referred (2) held on 20-10-2022, to be the only proposal which qualifies technically. The price bid sent by CIMFR along with proposal was opened by KSPCB virtually before the Joint Committee and the Joint Committee recommended the KSPCB to accept the price bid also, as per which the cost of blasting-vibration study for one stone quarry site, as per the Scope of Work prescribed, is Rs.4,50,000 (Rupees Four lakhs and fifty thousand only) excluding GST, as applicable.

Chairman, KSPCB has issued Proceedings (3) dated 9-11-2022 sanctioning the conduct of the study through CSIR-CIMFR at the rate of Rs. 4,50,000/- plus 18 percent GST per quarry as applicable. The total cost of the proposed study to be paid to CIMFR, for nine quarries, will be approximately Rs. 50 lakhs, hence sanction has

been accorded vide Proceedings (2) of the Chairman, KSPCB to release an amount of Rs. 25,00,000/- (Rupees Twenty Five Lakhs only) to CSIR-CIMFR, as first installment, for commencing the study as a part of ensuing compliance to Hon'ble NGT orders in the afore-said matter.

Therefore, work is hereby awarded to CSIR-CIMFR to conduct the study as per Scope of Work and to fulfill the requirements as per Hon'ble NGT orders passed in OA No. 304 of 2019 at 9 selected stone quarry sites in Kerala State as per recommendations of the Joint Committee. The Scope of Work is attached and it is an integral part of this document. The work to be performed shall commence by the CIMFR immediately soon after releasing the first installment (Rs.25 Lakhs) and shall be diligently pursued and the final report shall be submitted within forty five days from the date of award of work to Kerala SPCB. The Mode of Payment and other terms & conditions are detailed below:-

Mode of Payment:

i. First Installment: Approximately 50% of the total Project Cost + Taxes as applicable, rounded off to Rs. 25,00,000/- (Rs. Twentyfive lakhs only) along with the Award of Work.
ii. Second Installment: 30 % of the total Project Cost + Taxes as applicable, rounded off to Rs. 15,00,000/- (Rupees fifteen lakhs only), on submission of Final Report to the Joint Committee.
iii. Third and Final Installment: 20% of the total Project Cost + Taxes as applicable on acceptance of final report by the Hon'ble NGT.

Further to the above, kindly note the following conditions.

a) KSPCB shall not provide any additional funds on account of any further cost escalation or in view of any delay in the study; however if the number of quarries in which study are to be conducted is increased based on decision of the Joint Committee, and recommended by CPCB, amount at the rate of Rs. 4.5 Lakhs plus GST, per quarry, as applicable will be paid by KSPCB.

b) The funds shall be released in favour of the Director, CIMFR and details such as Name of the Account Holder, Account Number, Name and address of the Bank with PIN Code, IFSC Code shall be provided to Kerala SPCB to enable to release the amount as per the mode of payment.

c) CIMFR shall submit the Utilisation Certificate (UC) of the entire expenditure to KSPCB at the end of the study. Also, CIMFR shall submit tax exemption certificate obtained, if any, to KSPCB upon award of work.

d) At the end of first month, a review meeting shall be organized by KSPCB and an interim report as well as findings to be presented before the Joint Committee and Kerala SPCB by CIMFR to assess the progress of the study.

e) The amount specified by the CIMFR in the proposal and accepted by the Board shall hold good for all works done towards the completion of the project whether during the period mentioned herein or during the extended period, if any. The CIMFR shall not underlet or sublet to any person or persons, body or corporate, the execution of the study or any part thereof without prior consent of the KSPCB.

f) If the CIMFR commits breach of all or any of the terms mentioned above, the Board shall be entitled to recover from the CIMFR all damages it might suffer thereby. The amount thus due could be recovered from the CIMFR in any manner the Board chooses including recovery by Recovery Proceedings.

g) Also, CIMFR shall comply to all the terms and conditions as specified in the accepted proposal. In case of any dispute or issue, in consultation with CPCB, Kerala SPCB would resolve the issue or dispute and the decision of Kerala SPCB would be final.

Yours faithfully,

CHAIRMAN

Copy to:-

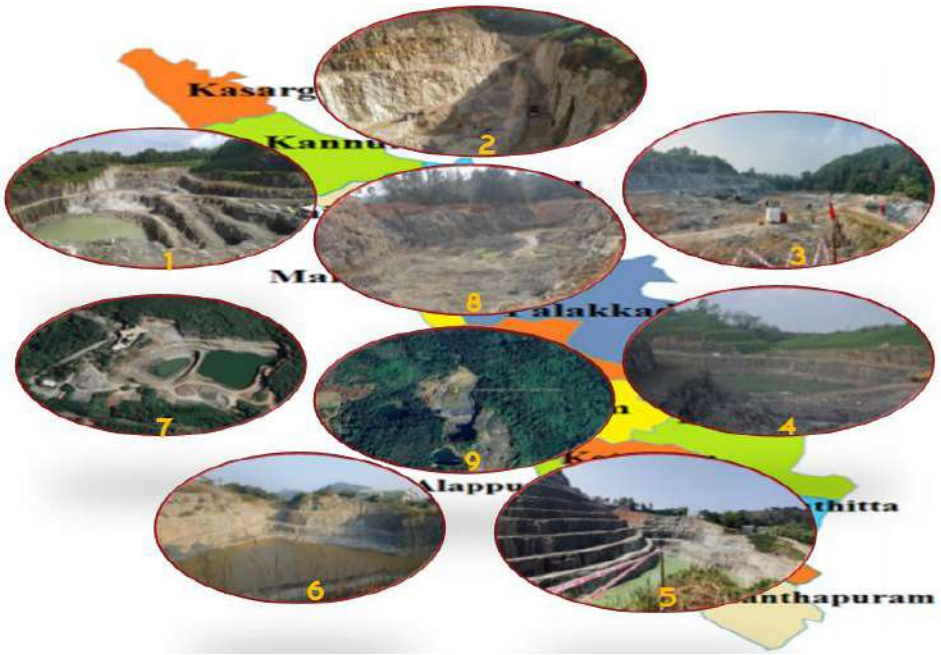
1. The Member Secretary, Central Pollution Control Board
   Parivesh Bhavan,
   East Arjun Nagar, Delhi- 110 032
2. The Regional Director
   CPCB, Regional Directorate
   NisargaBhavan, Thimmaiah Road
   2nd Main Road, Shivanagar
   Basaveshwar Nagar
   Bengalur, Karnataka- 560 079
3. The Senior Principal Scientist & Head of Section,
   Rock Excavation and Engineering Research Group,
   M/s Central Institute for Mining and Fuel Research (CSIR-CIMFR),
   Dhanbad, Jharkhand

ANNEXURE 13

Confidential

Report On

Scientific study for the assessment of influence zones due to blasting at stone quarries in the state of Kerala in compliance to the order of Hon'ble National Green Tribunal (NGT) passed in OA No. 304/2019



Rock Excavation Engineering Research Group
CSIR-CENTRAL INSTITUTE OF MINING & FUEL RESEARCH
(Council of Scientific & Industrial Research)
Barwa Road, Dhanbad (Jharkhand)

FEBRUARY, 2023

Team Members Associated with the Project

Dr. C. Sawmliana, Chief Scientist, Project Coordinator & HOS

Dr. M. P. Roy, Sr. Principal Scientist

Dr. Vivek K. Himanshu, Sr. Scientist & PL

Dr. Ranjit K. Paswan, Scientist & PL

Sri R. K. Singh, Sr. Technical Officer

Dr. N. K. Bhagat, Sr. Technical Officer & PL

Sri R. S. Yadav, Sr. Technical Officer

Sri P. Hembram, Technical Officer

Sri Amar Prakash Koushik, Technical Officer

Sri Ashish Kumar Vishwakarma, Technical Officer

Rock Excavation Engineering Research Group
CSIR-Central Institute of Mining and Fuel Research
Barwa Road, Dhanbad-826 001
Jharkhand

Report on

Scientific study for the assessment of influence zones due to blasting at stone quarries in the state of Kerala in compliance to the order of Hon'ble National Green Tribunal (NGT) passed in OA No. 304/2019

DISCLAIMER

This report is meant for internal use by Kerala State Pollution Control Board, Members of Joint Committee formed by Hon'ble National Green Tribunal, Hon'ble National Green Tribunal and other associated departments. It should not be published in full or part by any associated organization. It should not be communicated or circulated to outside parties except concerned departments. However, CSIR-CIMFR reserves the right to publish the results of the investigations for the benefit of the industry. The conclusions and recommendations are based on the results of investigations. It is hoped that the recommendations will be implemented to get the optimum results without hampering production, productivity and safety. The recommendations are the guidelines, which should be implemented in letter and spirit. The blasting influence zones classified in this study are only on the basis of Ground Vibration, Air Overpressure and Flyrocks. The influence of other blast induced hazards viz. dust, noise etc. were not under the scope of this study.

Since the day-to-day blasting operations are not under the control of CSIR-CIMFR, the research team will not be held responsible for any untoward incidence caused by blasting.

SIGNATURE OF THE PROJECT PROPONENTS

24/04/2023

(Vivek K. Himanshu)
Senior Scientist
Project Leader

24/02/2023

(Narayan Kumar Bhagat)
Senior Technical Officer
Project Leader

24/02/2023

(Ranjit Kumar Paswan)
Scientist
Project Leader

24/02/2023

(C. Sawmliana)
Chief Scientist, Project Coordinator & HOS

CONTENTS

EXECUTIVE SUMMARY

This report relates to the scientific study carried out by the Rock Excavation Research Group of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad at nine representative stone quarries in the State of Kerala selected by the Joint Committee formed by the Hon'ble National Green Tribunal. The main objectives of the study are to assess the blasting impacts in the form of ground vibration, flyrock and air overpressure (airblast) to the surrounding dwellings/structures and to determine the blasting influence zone for safe quarrying operations in State of Kerala. The field investigations were carried out during the period of 12th December, 2022 to 20th January, 2023 at the nine selected quarries viz. (1) Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Pathanamthitta District; (2) Granite/Building Stone Quarry owned by Muhammad Roshen, Kollam District; (3) Granite Building Stone Quarry of M/s POABS Granite Pvt. Ltd., Trivandrum District; (4) Parackal Stone Quarry of M/s Parackal Granite Kerala Private, Ernakulam District; (5) Rubble Stone Quarry of M/s United Granites & Metals Private Limited, Idukki District; (6) Granite Stone Quarry of M/s Cochin Blue Metal Industries Pvt. Ltd., Kottayam District; (7) Granite (Building Stone) Quarry of M/s Penta Granites, Palakkad District; (8) Granite Stone Quarry owned by Sudheesh A. T., Wayanad District and, (9) Granite Building Stone Quarry owned by P M Abdul Rahman, Kasargod District.

The investigational works, observations, results of the experimental blasts, analyses of the data, determination of blasting influence zones, conclusions and recommendations made in the report are summarized below.

1. The reconnaissance survey was carried out in each quarry to study and identify different types of structures present within the radius of 500 m from the quarry boundary. The land profile and nature of rock deposits were also studied in each quarry. Human response study was also conducted in all the quarries to understand the response of blasting impacts by the nearby habitants.

2. The experimental blasts were conducted with the prevailing blasting practices in the quarries as well as with modified blast design patterns to assess the impacts of blasting at greater distances by increasing the blasthole depths, explosive per hole, maximum explosive quantity per delay, number of holes and total explosive quantity in a round of blast.

3. A minimum of ten (10) rounds of experimental blasts were conducted in each quarry following the methodology stipulated in DGMS Technical Circular 7 of 1997 for conducting vibration study. In total, ninety-one experimental blasts were conducted at nine representative quarries during the period of scientific study.

4. All the experimental blasts were conducted using 32 mm hole diameter drilled with Jack hammers and crawler-mounted pneumatic drill machines. The total number of holes in the blasting round varied widely ranging from 05 to 60. Hole depth varied from 1.5 to 2.4 m. Burden and spacing varied from 0.8 to 1.6 m and from 0.8 to 1.6 m respectively.

5. Small diameter cartridge explosives of 25 mm diameter (125 gm weight per cartridge) were used in all the quarries. In some of the quarries, ANFO explosives were also used as main explosive charge along with small diameter cartridge explosives. The explosive charge per hole varied from 0.25 to 0.79 kg whereas maximum charge per delay varied from 0.25 to 1.3 kg. The total explosive charge varied from 1.5 to 26.525 kg.

6. Non-electric detonators (Nonel) were used in all the experimental blasts for in-hole explosive initiation and surface hole-to-hole firing. The different combinations of firing sequences were experimented to assess their impacts on ground vibrations and blast fragmentations.

7. The ground vibrations and air overpressures generated from the experimental blasts were monitored at the distances of 28 to 576 m from the blasting sites. A total of 301 blast-induced ground vibration and air-overpressure data were recorded from the nine quarries.

8. The highest magnitude of vibration recorded from the nine quarries was 10.42 mm/s with the associated dominant excitation frequency of 170.3 Hz. This was recorded at the distance of 28 m from the blasting face. The maximum value of vibration recorded at a distance of 50 m from the blasting face was 8.21 mm/s with dominant excitation frequency of 230 Hz.

9. The ground vibration level more than 5 mm/s were recorded only in five cases when the monitoring points were more than 50 m from the blasting sites. Out of the five cases, blast design patterns were modified in four cases to observe higher impacts on ground vibration.

10. The ground vibration data recorded at the distance raging between 78 m and 137 m were all less than 2.8 mm/s except in one case, where magnitude was 3.619 mm/s at 100 m distance. In most of the cases, ground vibration data could not be recorded when the vibration monitoring points were more than 300 m. Beyond 138 m of the blasting site, the magnitude of ground vibration of ground was less than 1.66 mm/s in all the quarries.

11. The dominant frequency of ground vibration wave varied widely from 14.2 to 249.5 Hz. In majority, higher dominant excitation frequencies ranges between 25 Hz and 125 Hz. The minimum frequency of recorded vibration data was 14.2 Hz.

12. Considering frequency values of ground vibration recorded at different quarries, the safe level of ground vibration as per DGMS Standard comes to 10 mm/s. All the ground vibration data recorded at the different vibration monitoring stations in all the quarries are within the safe level.

13. Although the safe level of ground vibration comes to 10 mm/s for dominant excitation frequency ranging from 14.2 to 249.5 Hz, considering human response to blasting nuisances as observed during the study and globally available literature on this subject, the ground vibration limit for the state of Kerala has been considered as 5 mm/s.

14. The air-overpressures (AOP) data recorded were in the range of 91.48 dB(L) to 128.6 dB(L). The threshold level of air-overpressure is 134 dB(L) as per USBM standard. Considering the 134 dB(L) as safe limits, the recorded values of AOP at all the quarries are within the safe level.

15. The blasting events were recorded using high speed video camera and digital camera. No flyrock was observed during the study except in two cases when flyrocks occurred (<25 m) but were within the blasting area only.

16. Ground vibration predictor equation was developed for each quarry using USMB predictor equation. The generalised predictor equations were also developed combining all the vibration for using maximum charge per delay and total charge. Ground vibration predictor equations were also developed for rock type as well.

17. Based on the ground vibration data, air overpressures data, flyrock results and their analysis results, Blasting Influence Zones consisting of six zones (Zone 0-5) have been classified. The technical and statutory recommendations for different zones have been summarised in **Table 8.4** of this report. This table may be referred to as the guidelines for granting permission during planning and execution phases in the stone quarries of the State of Kerala. The mentioned reporting system for blast design pattern, explosive consumption and volume of rock excavation should be framed to ensure safe blasting operations.

1.0 INTRODUCTION

The Kerala State Pollution Control Board (KSPCB) awarded a scientific study to CSIR-Central Institute of Mining & Fuel Research (CSIR-CIMFR), Dhanbad to carry out scientific studies for the assessment of influence zones due to blasting at stone quarries in the state of Kerala vide PO No. PCB/HO/EE4/NGT/O.A.304/2019-22 dated 09.11.2022. The main objectives of the study are to assess the blasting impacts in the form of ground vibration, flyrock and air overpressure (airblast) to the surrounding dwellings/structures and to determine the influence zone for safe quarrying operations without endangering the nearby denizens for the entire Kerala State. The development of standard guidelines for controlled blasting operations for different blasting zones from the residential houses, buildings and important structures is also one of the objectives.

The Joint Committee formed in compliance with Hon'ble National Green Tribunal (constituted with scientists, officers from prestigious National level institutions and agencies as members and officer from Central Pollution Control Board (CPCB) as Member Convener) selected nine quarries for the experimental sites to represent the whole state of Kerala. The selected nine quarries for the experimental sites are given in **Table 1.1** and shown in **Figure 1.1.**

Table 1.1. List of the selected quarries for the experimental trials

S.No	District	Details of quarry	Extent of Quarry (Ha)	Lithology
1	Pathanamthitta	Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Konni- Thazam, Konni	4.3804	Charnockite
2	Kollam	Granite/Building Stone Quarry of Muhammad Roshen, Kottukkal Village, Kottarakkara Taluk	1.21426	Charnockite
3	Trivandrum	Granite Building Stone Quarry of M/s POABS Granite Pvt. Ltd., Kuthirakkalam PO. Vellanadu, Trivandrum	5.9747	Garnet- Biotite Gneiss with Migmatite
4	Ernakulam	Parackal Stone Quarry of M/s Parackal Granite Kerala Private, Varapetty village, Kothamangala	7.6606	Hornblende Gneiss
5	Idukki	Rubble Stone Quarry of M/s United Granites & Metals Private Limited, Manakkad, Thodupuzha	12.2987	Hornblende Gneiss
6	Kottayam	Granite Stone Quarry of M/s Cochin Blue Metal Industries Pvt. Ltd., Ramapuram, Meenachil Taluk	4.891	Charnockite Group
7	Palakkad	Granite (Building Stone) Quarry of M/s Penta Granites, kizhakkencheri-2, Alathur	4.1371	Charnockite
8	Wayanad	Granite Stone Quarry owned by Sudheesh A. T., Vengappally, Vythiri Taluk	2.1131	Hornblende Gneiss
9	Kasargod	Granite Building Stone Quarry owned by P M Abdul Rahman, Thayannur, Vellarikundu	3.242	Garnet-Sillimanite Kyanite Gneiss

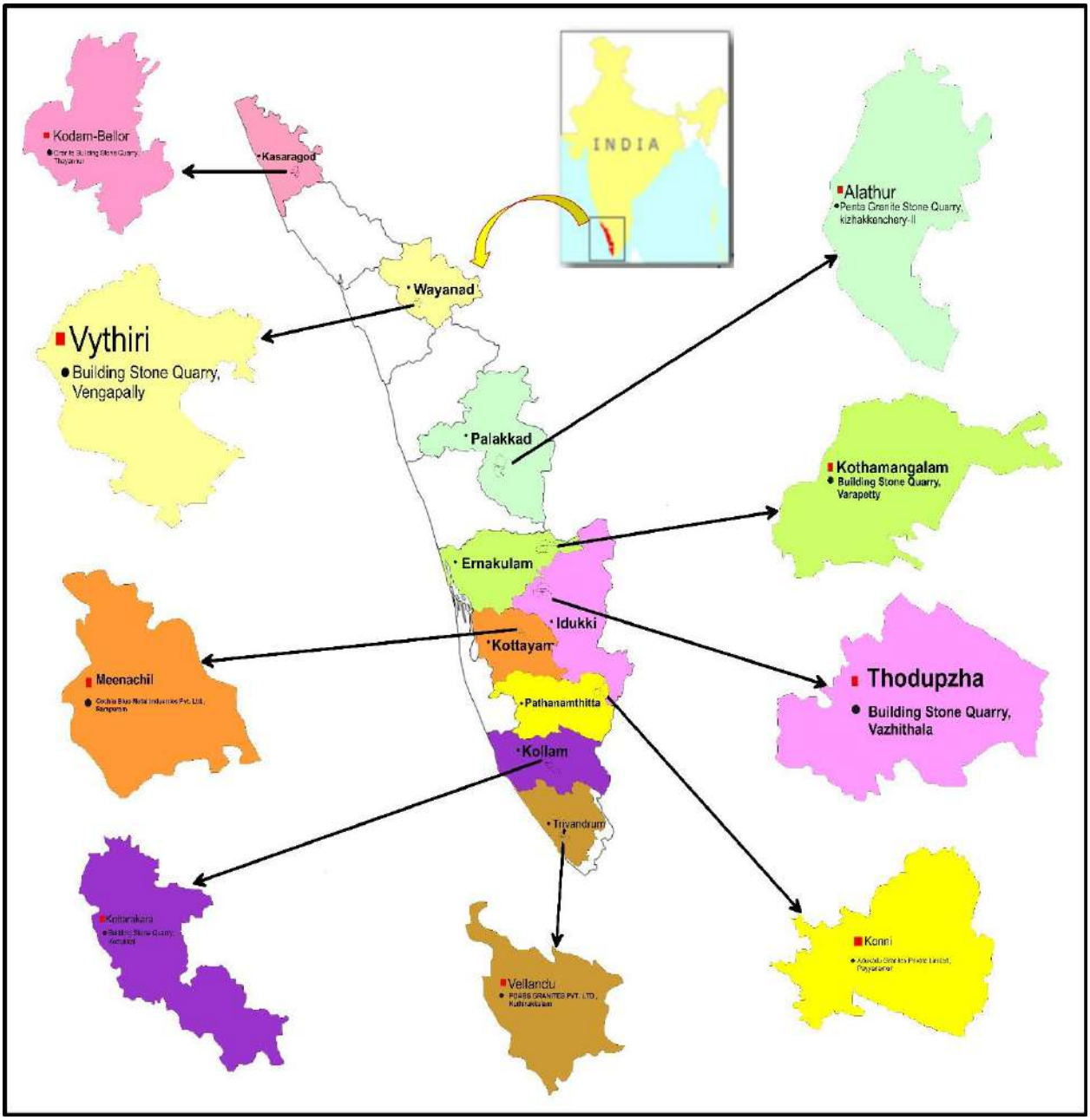


Figure1.1. Location map of nine quarries selected for field investigations

The field investigations for the assessment of blasting influence zones due to blasting were carried out at these selected nine quarries by the Rock Excavation Engineering Research Group of CSIR-CIMFR, Dhanbad. The investigations commenced from 12th December 2022 and completed on 20th January, 2023. The experimental blasts were carried out in each selected quarries using different drilling and explosive charging patterns of holes. In all the quarries, small hole diameter of 32 - 34 mm, drilled with jack hammer drills were used. In one quarry, crawler mounted drill machine was also used. Small diameter cartridge explosive

of 25 mm diameter, 125 gm weight per cartridge was used. In some quarries, ANFO explosive was also used along with cartridge explosives. Non-electric (Nonel) detonators/shock tube initiation system were used for in-hole explosive initiation and surface hole-to-hole firing in all the quarries. The ground vibrations and air overpressures generated from the experimental blasts were monitored using portable seismographs at different distances prescribed by the Joint Committee. High speed video camera as well as normal digital camera were used to record the blasting events.

This report contains the methodology followed in the field investigation work, detailed investigation works in each selected quarries, analysis of data, assessment of influence zone due to blasting and technical & statutory recommendations for safe blasting in the future.

2.0 SCOPE OF WORK

The scope of work mentioned in the work order (as per the Joint Committee) for the scientific study to determine the blasting influence zone is given below:

- Reconnaissance survey to map the structures and sensitive areas up to 500 m radius from the blast point/ mine.
- To supervise blasting trials in the stone quarries using the explosives in the custody of the quarry license holder. The statutory persons as required under the Mines Act, 1952 appointed by the owner of the mine shall be present at the site during the blasting trials.
- To monitor ground vibration and air over pressure / air blast levels produced due to blasting in the selected stone quarries. To find out effect of blast induced ground vibration on the structures & to eliminate chances of flying fragments and to design safe blasting pattern (to study & fix charge per delay, charge per round, delay between holes & rows, depth of holes, spacing, burden, diameter of holes, Peak Particle Velocity (PPV), fly rock, fragmentation, flow of blasting fumes etc.).
- Assessing structural response and blast induced ground vibrations at 50, 75, 100, 125, 150, 200, 250 & 500 m perimeters from the blasting point.
- Analyze the blast vibration data to arrive at a site-specific Peak Particle Velocity (PPV) predictor equation for each mine and a combined predictor equation, if possible, for each zone.
- To suggest safe permissible limits of vibration for various structures from 50 to 500 m perimeter as per the DGMS directives.
- To suggest safe maximum charge per delay of explosives to be used to keep vibrations levels within the permissible limits.
- To suggest a safe blasting protocol to reduce vibrations and air overpressure.
- To submit the finding in report form to the Joint Committee constituted in the Honourable NGT matter of OA 304/2019.

3.0 METHODOLOGY FOLLOWED IN THE INVESTIGATIONS

In concurrence to the scope of work given by the Joint Committee, the methodology followed in the investigation are given bellow.

I. Reconnaissance Survey within 500 m (Mapping of the Area)

In the reconnaissance survey, different types of structures with their distances from the quarry have been studied and identified. The different structures have been classified based on the DGMS Ground Vibration Standards (Technical Circular No. 7, 1997) given in **Table 3.1** as bellow:

- Residential houses and construction type
- Public structures and construction type viz. School/colleges, shopping mall, etc.
- Sensitive structures of historical importance
- Industrial structures/plant
- Other important structures: National Highway/Public roads, HT/LT lines/towers/poles etc.

Table 3.1. Permissible Peak Particle Velocity (PPV) at the foundation level of structures in mm/s [DGMS standard (*Technical Circular Number 7 of 1997*)]

Type of structure	Dominant excitation frequency, Hz		
	< 8 Hz	8-25 Hz	> 25 Hz
(A) Buildings/structures not belonging to the owner			
1. Domestic houses/structures (Kuchcha, brick & cement)	5	10	15
2. Industrial buildings	10	20	25
3. Objects of historical importance and sensitive structures	2	5	10
(B) Buildings with limited span of life and belonging to owner			
1. Domestic houses/structures	10	15	25
2. Industrial buildings	15	25	50

II. Study of the Land Profile/Topography

The land profile/topography of the area have been studied in order to assess the level difference of the mining operations with the surrounding villages/structures. GPS coordinates have been taken at different quarry site as well as the surrounding areas for preparation of Google map for the entire area.

III. Study of the Nature of Rock Deposits/Rock Geology

The nature of rock deposits viz. massiveness, joint patterns and their orientations with respect to bench face etc. have been studied and recorded for all the quarries. Rebound hardness test using Schmidt Hammer was also carried out in all the quarries.

IV. Experimental Blasts

Planning of the experimental blasts have been carried out in consultation with the Kerala Pollution Control Board (KSPCB) and the quarry management. A minimum of ten (10) experimental blasts were conducted in each selected quarry. The different drilling patterns, total number of holes, explosive charging and firing patterns were experimented in each quarry.

V. Monitoring of Ground Vibration and Air Overpressure/Air blast

As per the 'Scope of Work' given in the 'Work Order', ground vibration and air overpressure monitoring points were selected at the distances of 50 m, 75 m, 100 m, 125 m, 150 m, 200 m, 250 m & 500 m from the blasting sites. In addition to this, monitoring points were also select at 300 m which is "Danger Zone" as per Reg. 164 (1-A, b) of MMR 1961. In order to study the structural response of houses/buildings, ground vibrations were also monitored on the structures.

The geophones of the seismographs were firmly fixed on the ground surfaces as well as on the structures using Plaster of Paris. Microphone sensors were also fixed nearby the seismographs as per the International Standards. Geophone sensor was fixed as the triggering source for all the seismographs. The triggering level for the geophone sensor was also set as 0.50 mm/s for the seismographs.

VI. Study of Human Response to Ground Vibration/Blasting Noises

Apart from the scope of work given in the work order, human response to ground vibration/noises was also carried out. Questionnaires have been prepared and the residents of the surrounding areas were asked about their responses to ground vibration and noise produced by the blasting operations at the quarry.

4.0 INSTRUMENTS USED FOR FIELD INVESTIGATIONS

Ground vibrations and air overpressures (air blasts) generated from the blasting operations were monitored using eight numbers of portable computer-operated digital seismographs, namely MiniMate, MiniMate Blaster, MiniMate Plus and Micromate seismographs of M/s Instantel Inc., Canada. All the seismographs are of four channels and provided with one tri-axial transducer for monitoring of ground vibration (in mm/s or in/s) in three orthogonal directions and one-channel for monitoring of air overpressure/noise in dB(L) or Pa. All the seismographs record vibrations in three directions i.e. Longitudinal (L), Vertical (V) and Transverse (T). They also record peak frequency of vibration in individual direction and compute the peak vector sum of vibration.

Blaster's Ranger II™ high speed digital video camera system (made in Canada by M/s MREL Group of Companies Limited) was used to study the rock movement and flyrock occurrences. Additionally, digital video camera was also used to record all the blasting events.

5.0 FIELD INVESTIGATIONS

The period of field investigation carried out at the selected nine quarries are given in **Table 5.1**. Brief information of the quarry, reconnaissance survey, study of land profile, nature of rock deposits, experimental blasts, monitoring of ground vibration and air-overpressures and the results obtained in each quarry are described in this section.

Table 5.1. Name of quarry and period of the field investigations

S. No	District	Name of the Quarry	Period of study
1	Pathanamthitta	Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Konni- Thazam, Konni	12th - 16th December, 2022
2	Kollam	Granite/Building Stone Quarry of Muhammad Roshen, Kottukkal Village, Kottarakkara Taluk	17th - 19th December, 2022
3	Trivandrum	Granite Building Stone Quarry of M/s POABS Granite Pvt. Ltd., Kuthirakkalam PO. Vellanadu, Trivandrum	20th - 22th December, 2022
4	Ernakulam	Parackal Stone Quarry of M/s Parackal Granite Kerala Private, Varapetty village, Kothamangala	26th - 29th December, 2022
5	Idukki	Rubble Stone Quarry of M/s United Granites & Metals Private Limited, Manakkad, Thodupuzha	1st - 4th January 2023
6	Kottayam	Granite Stone Quarry of M/s Cochin Blue Metal Industries Pvt. Ltd., Ramapuram, Meenachil Taluk	5th - 8th January 2023
7	Palakkad	Granite (Building Stone) Quarry of M/s Penta Granites, kizhakkencheri-2, Alathur	9th - 12th January 2023
8	Wayanad	Granite Stone Quarry owned by Sudheesh A. T., Vengappally, Vythiri Taluk	13th- 16th January 2023
9	Kasargod	Granite Building Stone Quarry owned by P. M. Abdul Rahman, Thayannur, Vellarikundu	17th - 20th January 2023

5.1 GRANITE BUILDING STONE QUARRY OF M/S ADUKADU GRANITES PRIVATE LIMITED, PATHANAMTHITTA DISTRICT

5.1.1 Brief Information of the Quarry

Shri Martin Varghese, Managing Director of M/s Adukadu Granites Private Limited is operating a Granite Building Stone Quarry of 4.3904 Ha (10.8239 Acres) at Konnni-Thazham village, Konni Taluk, Pathanamthitta District of Kerala State. This granite building stone quarry is located at 4.5 km away from Konni village in Konni Taluk. It is situated at a distance of 11.4 km by road from Pathanamthitta town. It can be reached from Poyyanamon- Aducadu Road. The nearest railhead Chengannur is situated at about 37 km whereas, Trivandrum airport is situated at about 103 km away from the quarry.

The lease is located on the slope of the area gently dipping towards NW. The highest elevation in this area is 140.0 m above MSL and the lowest elevation is 97.6 m above MSL. The granite building stones are very well exposed in old working pit, where as part of area with lower elevation is covered by topsoil about 0 to 0.5 m thickness. Minimum estimated depth of granite is around 110 m. The granite building stone in the lease area are of intrusive nature with good outcrops and very good exposures in the open pits. As per the mining plan, it is proposed to produce maximum 1,24,927.50 tonnes granite building stone in the IV-Year by semi-mechanized opencast mining method. Jack hammer drill blasting with rock breakers are proposed to be used for extraction of stones.

The field investigation was carried out at this quarry during the period of 12th to 15th December, 2022. View of Granite Building Stone Quarry is depicted in **Plate 5.1.1**. The investigational work conducted at the quarry of M/s Adukadu Granites Private Limited is discussed in the following sub-sections.

Plate 5.1.1. View of Granite Building Stone Quarry of M/s Adukadu Granites Private Limited

5.1.2 Reconnaissance Survey

Reconnaissance survey was carried out on 12th and 13th December, 2022 to identify different types of structures present within the radius of 500 m from the quarry. The followings are the observations made from the reconnaissance survey.

- Within the zone of 100 m from the quarry, one residential house of Mr. Baby Jacob is located at 71 m from the quarry boundary in the S-W direction.
- Ardha-Nareeswara temple is located at distance of 150 m from the quarry boundary in the S-E direction from the quarry boundary.

- In the S-E direction of the quarry, cluster of residential houses are located near the Payyanamon – Adukadu Road at 168 m from the quarry boundary.
- Residential houses of Konnithazam village starts at 150 m from the quarry boundary in the N-E direction of the mine.
- Play School in the Konnithazam village is located at distance of 200 m in the N-E direction of the quarry.
- Only residential houses of the Konnithazam village are present within 300 m from the quarry boundary.
- Only residential houses of the Konnithazam village are present within 400 m from the quarry boundary.
- St. Andew Marathoma Church adjacent to Payyanamon – Adukadu is located at 411 m from the quarry in the S-W direction

5.1.3 Study of land profile, nature of rock deposits

Studies on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces were also conducted. It was observed that some of the residential houses are located at higher level than the quarry operations. The rock deposits are found to be massive in nature with limited joints (**Plates 5.1.2 & 5.1.3**). Rebound hardness values tested on the fresh rock surface varied from 52 to 70 and the average value is 61.10.

Plate 5.1.2. View of nature of rock deposit in Granite Building Stone Quarry

Plate 5.1.3. View of rebound hardness testing on rock surface at Granite Building Stone Quarry

5.1.4 Experimental Blasts

At Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, ten rounds of experimental blasts were conducted on 14th December, 2023 at the top, middle and bottom benches of the quarry. The blasts were conducted with the varying blast design patterns. In some of the blasts, the reduction in the burden-spacing were done by CIMFR team to record the impacts of the parametric variations. All the blasts were conducted with 32 mm blast hole diameter, drilled with Jack Hammer drilling machines **(Plate 5.1.4)**. Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge was used in all the blasts. During the experimentation, hole depths used were 1.8 m with burden varying from 0.8 to 1.2 m and spacing varying from 0.8 to 1.5 m. The explosive charge per hole varied from 0.292 to 0.375 kg and the maximum charge per delay varied from 0.66 to 0.75 kg. The number of holes varied from 5 to 15 and the total explosive charge varied from 1.70 to 5.62 kg. Charging of explosive into the blast holes is shown in **Plate 5.1.5**. **Plate 5.1.6** shows locations of the experimental blasts. Google maps showing location of the experimental blasts and ground vibration monitoring points are given in **Figures 5.1.1 & 5.1.2**. Nonel (shock tube) initiation system of 200 ms Down-the Hole Delay (DTH) and 25 ms of noiseless Trunkline Delay (TLD) were used for in-hole explosive initiation and surface hole-to-hole initiation in all the blasts. The drilling pattern, firing pattern and charging pattern used in the experimental blasts are given in **Figures 5.1.3 to 5.1.12**. The details of the blast design parameters used during the experimental blasts are given in **Table 5.1.1**.

Plate 5.1.4. Drilling of blast holes using Handheld Jackhammer drill machine

Plate 5.1.5. Charging of holes at Granite Building Stone Quarry

Plate 5.1.6. Location of the experimental blasts (B-1, B-2..) at Granite Building Stone Quarry

Figure 5.1.1. Google map showing location of experimental blasts (B#1 to 10) at Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Pathanamthitta District

Figure 5.1.2. Google map showing location of experimental blasts (B#1 to 10) and vibration monitoring stations at Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Pathanamthitta District

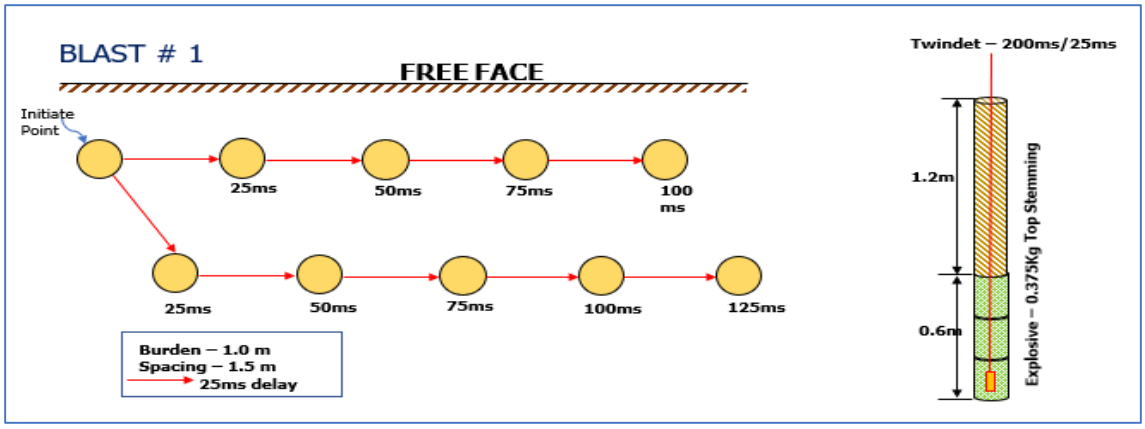


Figure 5.1.3. Drilling, firing and charging patterns in experimental blast B-1

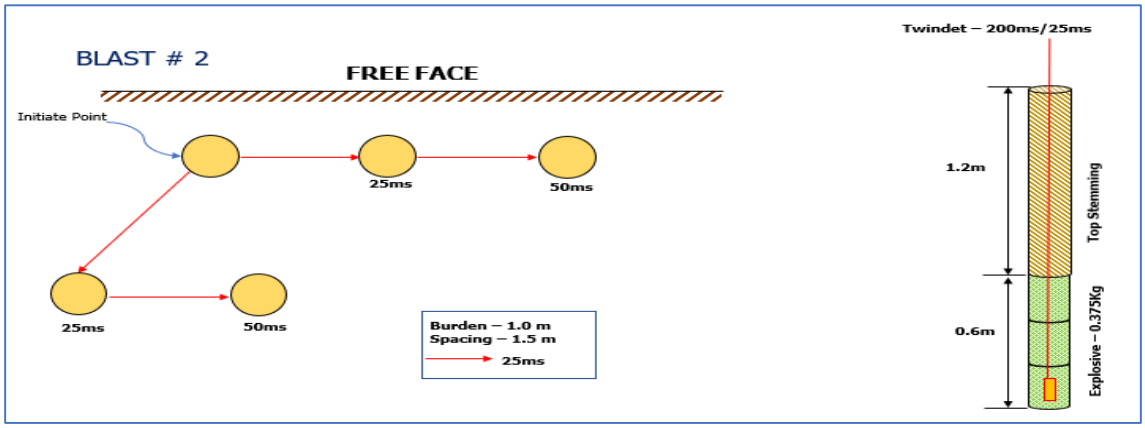


Figure 5.1.4. Drilling, firing and charging patterns in experimental blast B-2

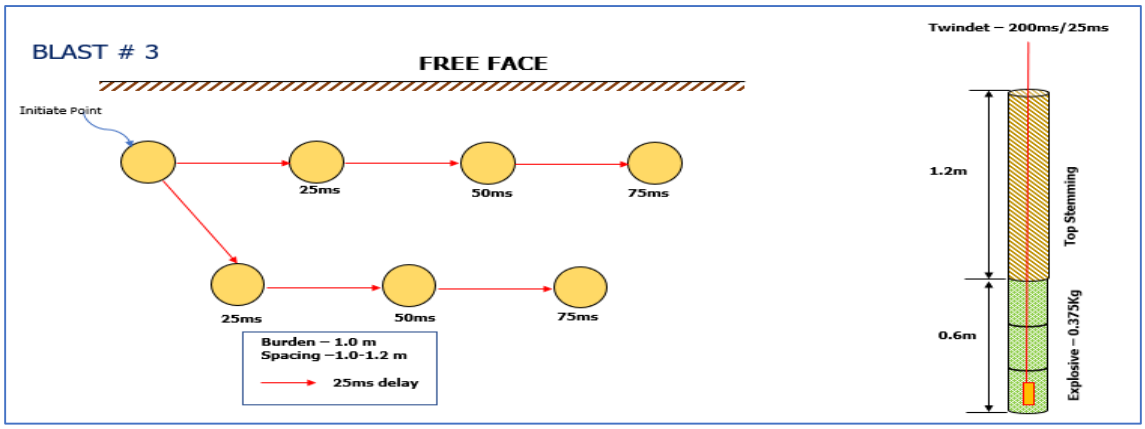


Figure 5.1.5. Drilling, firing and charging patterns in experimental blast B-3

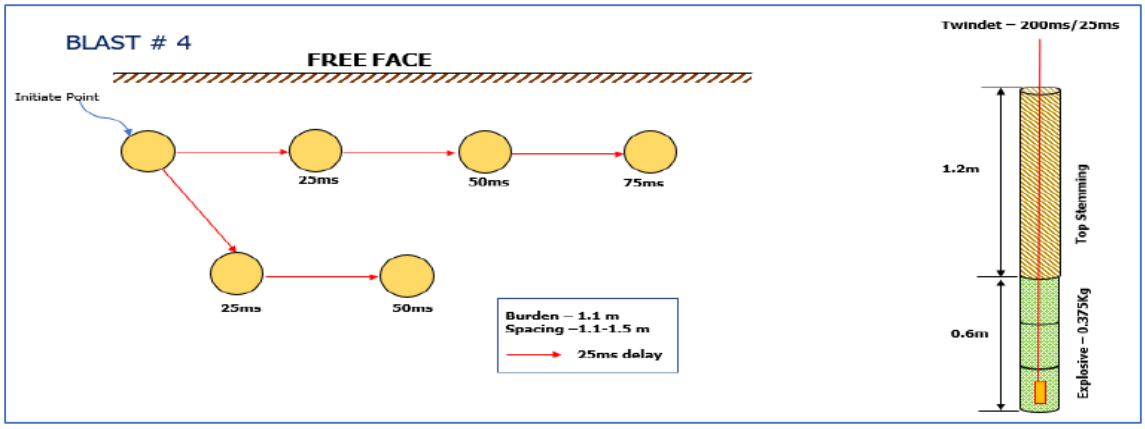


Figure 5.1.6. Drilling, firing and charging patterns in experimental blast B-4

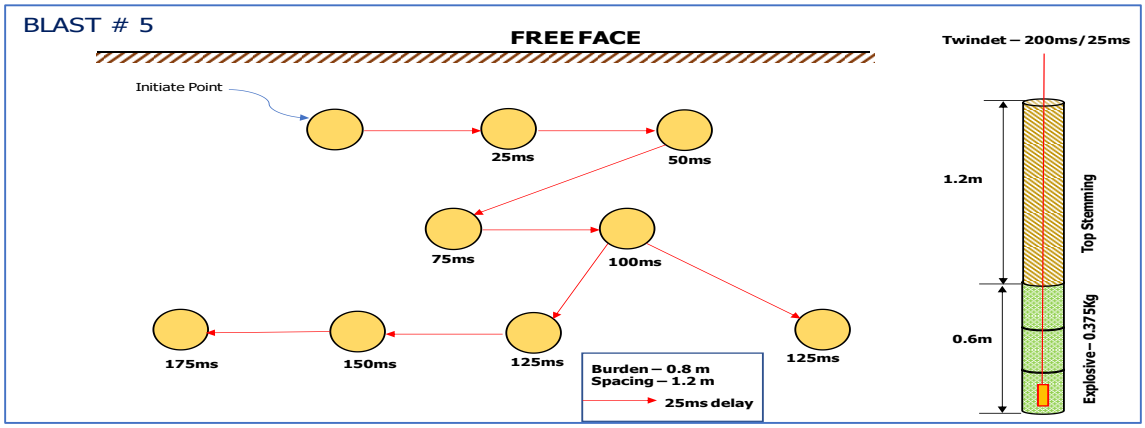


Figure 5.1.7. Drilling, firing and charging patterns in experimental blast B-5

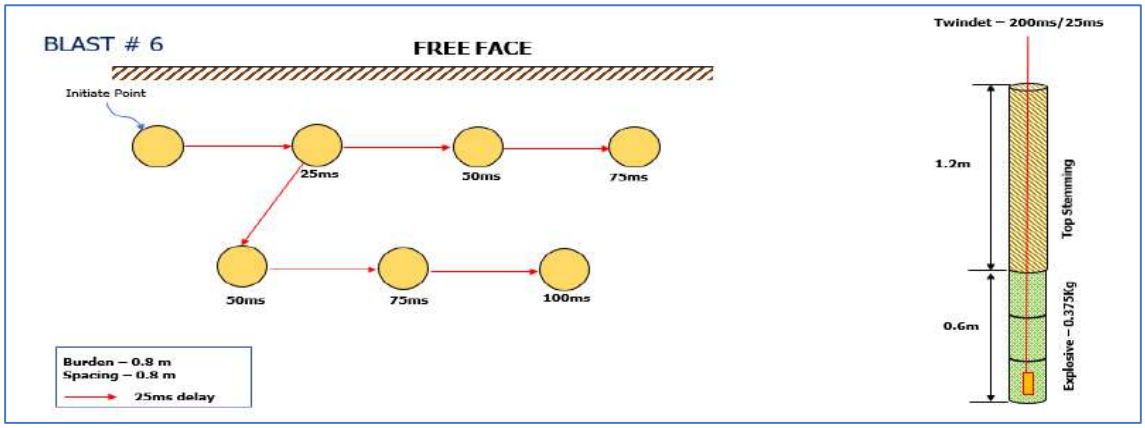


Figure 5.1.8. Drilling, firing and charging patterns in experimental blast B-6

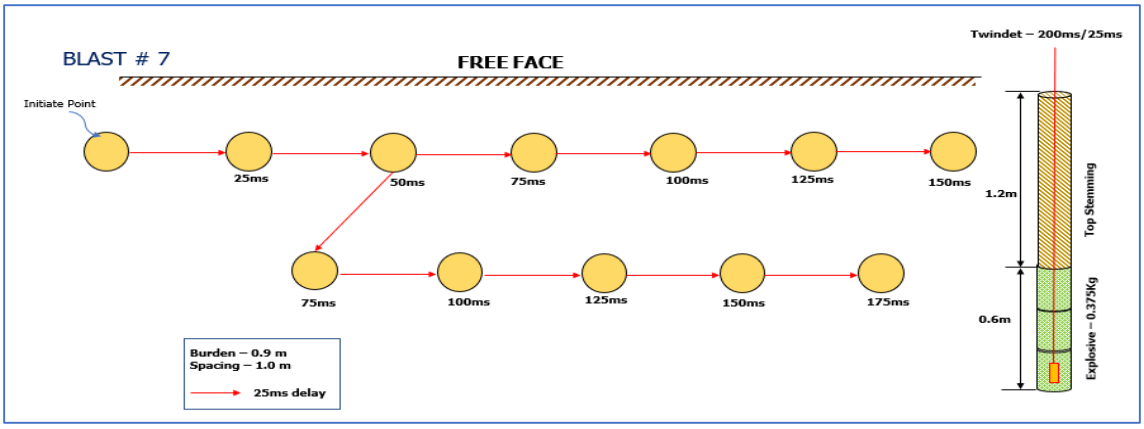


Figure 5.1.9. Drilling, firing and charging patterns in experimental blast B-7

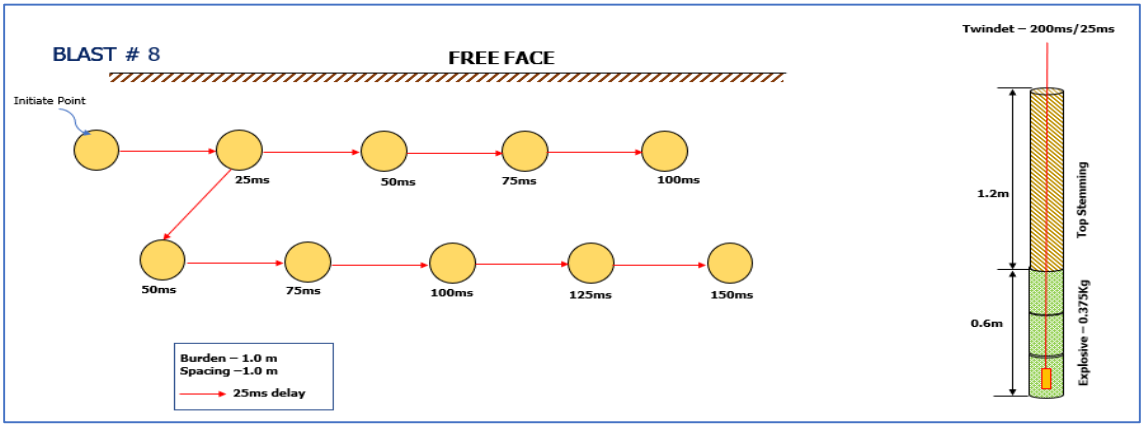


Figure 5.1.10. Drilling, firing and charging patterns in experimental blast B-8

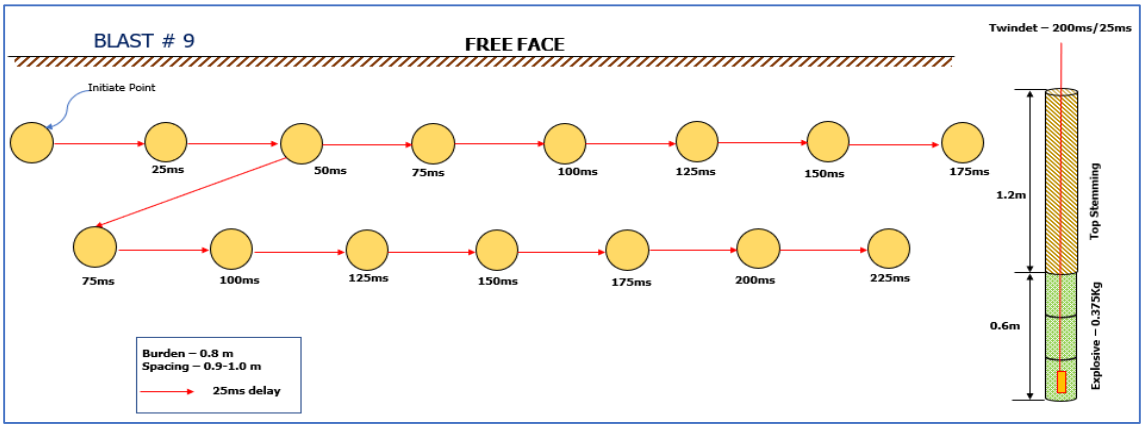


Figure 5.1.11. Drilling, firing and charging patterns in experimental blast B-9

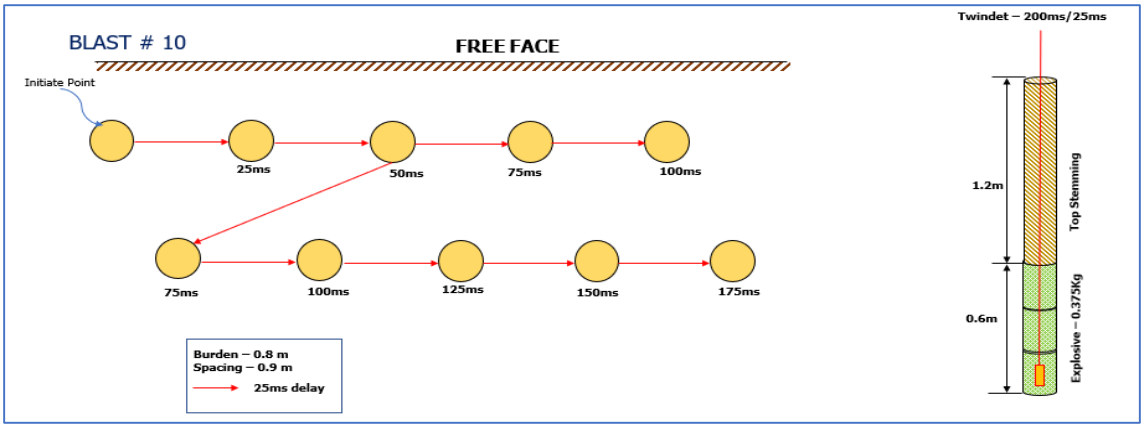


Figure 5.1.12. Drilling, firing and charging patterns in experimental blast B-10

5.1.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored using eight number of seismographs. The monitoring points were selected based on the distances prescribed by the Joint Committee as well as the request made by the residents of the nearby residential houses. One vibration monitoring point was also fixed on the roof of a private house. Views of the ground vibrations and air overpressure monitoring points are given in **Plates 5.1.7 to 5.1.11.**

Plate 5.1.7. View of vibration monitoring at 4th Bench of the quarry in N-E direction

Table 5.1.1. Details of blasts conducted on 14.12.2022 at Granite Building Stone Quarry of M/s Adukadu Granites Pvt. Ltd., Pathanamthitta District

Sl. No.	Location of blast	No. of holes	Hole Dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Explosive and Initiation type
									Explosives per hole [kg]	Total explosives [kg]	
1	N 09°15'11.01" E 76° 52'11.45" 82 mRL(Lower Bench)	10	32	1.8	1.0	1.5	2	1.2	0.292 – 0.375	3.350	25 mm dia. of Emulsion Cartridge explosive, wt. 125 gm with Nonel initiation system (DTH/TLD 200/25 ms)
2	N 09°15'11.06" E 76° 52'11.31" 81 mRL(Lower Bench)	5	32	1.8	1.0	1.5	2	1.2	0.292 – 0.375	1.709	
3	N 09°15'11.29" E 76° 52'11.10" 102 mRL(Lower Bench)	7	32	1.8	1.0	(1.0 – 1.2)	2	1.2	0.375	2.625	
4	N 09°15'11.25" E 76° 52'10.84" 101 mRL(Lower Bench)	6	32	1.8	1.1	(1.1 – 1.5)	2	1.2	0.375	2.250	
5	N 09°15'11.91" E 76° 52'10.73" 93 mRL(Middle Bench)	9	32	1.8	0.8	(0.8 – 1.2)	3	1.2	0.375	3.375	
6	09°15'11.16" E 76° 52'11.94" 80 mRL(Middle Bench)	7	32	1.8	0.8	0.8	2	1.2	0.375	2.625	
7	09°15'11.36" E 76° 52'11.71" 100 mRL(Middle Bench)	12	32	1.8	0.9	1.0	2	1.2	0.375	4.500	
8	N 09°15'11.54" E 76° 52'11.51" 100 mRL(Middle Bench)	10	32	1.8	1.0	1.0	2	1.2	0.375	3.750	
9	09°15'11.70" E 76° 52'11.03" 102 mRL(Middle Bench)	15	32	1.8	0.8	(0.9 – 1.0)	2	1.2	0.375	5.625	
10	N 09°15'12.69" E 76° 52'12.76" 100 mRL(Top Bench)	10	32	1.8	0.8	0.9	2	1.2	0.375	3.750	

Plate 5.1.8. View of vibration monitoring near Play school in Konnithazam village

Plate 5.1.9. View of vibration monitoring near Mr. T Varghese house in Konnithazam village

Plate 5.1.10. View of vibration monitoring near the house of Mr. Daniel on Konnapara road in East Direction

Plate 5.1.11. View of vibration monitoring near abandoned house towards Konnithazam village in N-E Direction

5.1.6 Ground Vibration and Air Overpressure Results

From the ten experimental blasts conducted at the quarry, thirty-one ground vibration data were recorded at different locations in and around the quarry. At many instances, specially near the residential structures/locations situated beyond 150 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration data as the magnitude of vibrations were less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring point, maximum charge per delay and the total explosive weight used in the blasting round, the magnitudes of recorded vibration varied from 0.55 to 4.115 mm/s. The monitoring distances from the blasting faces varied between 46 and 250 m. The graph plotted between vibration (PPV) recorded and distances from the blasting patch is shown in **Figure 5.1.13.** The details of recorded ground vibration and air overpressure data are given in **Table 5.1.2**. The waveform reports of some of the recorded ground vibration data are given in **Annexure-1**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 4.115 mm/s with the associated dominant frequency of more than 100 Hz. This was recorded at 50 m distance from blast No. B #2 inside the quarry. The maximum charge per delay (Q_{max}) in the blast was 0.67 kg whereas total explosive charge (Q_{total}) detonated in the blasting round was 1.7 kg. Further, magnitude of vibration recorded between 65 to 150 m from the blasting patches were less than 2 mm/s whereas between 200 and 250 m, it was less than 1 mm/s.

The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 34 – 219.6 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.1.14**. The FFT analyses reports of some of the vibration data are given in the **Annexure-1**.

Table 5.1.2. Blast induced ground vibration and air over pressure recorded at different locations due to the blast conducted on 14.12.2023 at Granite Building Stone Quarry of M/s Adukadu Granites Pvt. Ltd., Pathanamthitta District

Sl. No.	Location of blast	Max^{m} explosives weight per delay [kg]	Total explosives fired in the round [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak Particle Velocity [mm/s]	Dominant Frequency [Hz]	AOP [dBL]
1	N 09°15'11.01" E 76° 52'11.45" 82 mRL (Lower Bench)	0.667	3.350	❖ 4th Bench	46	3.287	179.8	113.5
				❖ Quarry boundary top bench	130	1.114	74.25	104.2
				❖ Near Ardhnareswar Temple	290	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	157	<0.5	NA	NA
				❖ In front of C G Thomas house in Konnithazam village	212	<0.5	NA	NA
				❖ Near playschool Konnithazam village	259	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Vargeese house	324	<0.5	NA	NA
				❖ Near Ibrahim Daniel house in Konnapara road	580	<0.5	NA	NA
2	N 09°15'11.06" E 76° 52'11.31" 81 mRL (Lower Bench)	0.667	1.70	❖ 4th Bench	50	4.115	>100	114.0
				❖ Quarry boundary top bench	128	1.801	84.88	104.9
				❖ Near Ardhnareswar Temple	300	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	160	<0.5	NA	NA
				❖ In front of C G Thomas house in Konnithazam village	215	<0.5	NA	NA
				❖ Near playschool Konnithazam village	261	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Vargeese house	325	<0.5	NA	NA
				❖ Near Ibrahim Daniel house in Konnapara road	584	<0.5	NA	NA
3	N 09°15'11.29" E 76° 52'11.10" 102 mRL (Lower Bench)	0.750	2.625	❖ 4th Bench	52	4.002	219.6	113.8
				❖ Quarry boundary top bench	129	0.992	84.13	104.9
				❖ Near Ardhnareswar Temple	308	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	160	<0.5	NA	NA
				❖ In front of C G Thomas house in Konnithazam village	217	<0.5	NA	NA
				❖ Near playschool Konnithazam village	255	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Vargeese house	320	<0.5	NA	NA
				❖ Near Ibrahim Daniel house in Konnapara road	577	<0.5	NA	NA
4	N 09°15'11.25" E 76° 52'10.84"	0.750	2.250	❖ 4th Bench	58	2.207	>100	109.9
				❖ Quarry boundary top bench	130	1.078	73.38	104.9

	101 mRL (Lower Bench)			❖ Near Ardhnareswar Temple	315	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	168	<0.5	NA	NA
				❖ In front of C G Thomas house in Konnithazam village	220	<0.5	NA	NA
				❖ Near playschool Konnithazam village	265	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Vargeese house	320	<0.5	NA	NA
				❖ Near Ibrahim Daniel house in Konnapara road	580	<0.5	NA	NA
5	N 09°15'11.91" E 76° 52'10.73" 93 mRL (Middle Bench)	0.750	3.375	❖ 4th Bench	60	2.222	210.6	120.8
				❖ Quarry boundary top bench	130	1.085	73.38	111.8
				❖ Near Ardhnareswar Temple	330	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	160	<0.5	NA	NA
				❖ In front of C G Thomas house in Konnithazam village	225	<0.5	NA	NA
				❖ Near playschool Konnithazam village	270	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Vargeese house	315	<0.5	NA	NA
				❖ Near Ibrahim Daniel house in Konnapara road	570	<0.5	NA	NA
6	N 09°15'11.16" E 76° 52'11.94" 80 mRL (Middle Bench)	0.750	2.625	❖ On top bench North side of Quarry towards Konnithazam village	100	0.696	37	111.2
				❖ Quarry boundary top bench	111	2.174	85.13	108.0
				❖ On top bench North side of Quarry towards Konnithazam village	125	0.872	34.0	<88
				❖ Backside of blast face near abandoned house in Konnithazam village	140	0.622	111.9	101.0
				❖ On Terrace of C G T. house in Konnithazam village	225	<0.5	NA	NA
				❖ Near playschool Konnithazam village	250	0.751	116.9	91.5
				❖ In Rubber farm opposite to T. Vargeese house	315	<0.5	NA	NA
				❖ Inside Ardhnareswar Temple	280	<0.5	NA	NA

7	N 09°15'11.36" E 76° 52'11.71" 100 mRL (Middle Bench)	0.750	4.500	❖ On top bench North side of Quarry towards Konnithazam village	93	0.635	73	108.8
				❖ Quarry boundary top bench	112	2.254	80.25	106.5
				❖ On top bench North side of Quarry towards Konnithazam village	116	0.899	60.25	<88
				❖ Backside of blast face near abandoned house in Konnithazam village	143	0.582	126.3	100.0
				❖ On Terrace of C G Thomas house in Konnithazam village	223	<0.5	NA	NA
				❖ Near play school Konnithazam village	244	0.582	129.1	91.5
				❖ In Rubber farm opposite to T. Vargeese house	307	<0.5	NA	NA
				❖ Inside Ardhnareswar Temple	289	<0.5	NA	NA
8	N 09°15'11.54" E 76° 52'11.51" 100 mRL (Middle Bench)	0.750	3.750	❖ On top bench North side of Quarry towards Konnithazam village	89	0.557	47	110.6
				❖ Quarry boundary top bench	114	1.905	75.25	108.8
				❖ On top bench North side of Quarry towards Konnithazam village	111	0.818	74.50	<88
				❖ Backside of blast face near abandoned house in Konnithazam village	147	<0.5	NA	NA
				❖ On Terrace of C G Thomas house in Konnithazam village	225	<0.5	NA	NA
				❖ Near playschool Konnithazam village	246	<0.5	NA	NA
				❖ In Rubber farm opposite to T. Varghese house	306	<0.5	NA	NA
				❖ Inside Ardhnareswar Temple	295	<0.5	NA	NA
9	N 09°15'11.70" E 76° 52'11.03" 102 mRL (Middle Bench)	0.750	5.625	❖ On top bench North side of Quarry towards Konnithazam village	87	0.582	37	109.5
				❖ Quarry boundary top bench	118	1.616	83.0	108.0
				❖ On top bench North side of Quarry towards Konnithazam village	108	0.939	40.0	<88
				❖ Backside of blast face near abandoned house in Konnithazam village	150	<0.5	NA	NA
				❖ On Terrace of C G Thomas house in Konnithazam village	230	<0.5	NA	NA
				❖ Near playschool Konnithazam village	250	0.554	104.4	91.5
				❖ In Rubber farm opposite to T. Vargeese house	300	<0.5	NA	NA
				❖ Inside Ardhnareswar Temple	300	<0.5	NA	NA
10	N 09°15'12.69" E 76° 52'12.76"	0.750	3.750	❖ On top bench North side of Quarry towards Konnithazam village	50	0.751	64	109.2

	100 mRL (Top Bench)			❖ Quarry boundary top bench	65	2.965	88.25	108.4
				❖ On top bench North side of Quarry towards Konnithazam village	75	<0.5	NA	NA
				❖ Backside of blast face near abandoned house in Konnithazam village	100	0.783	149.0	101.9
				❖ On terrace of CG Thomas house in Konnithazam village	175	<0.5	NA	NA
				❖ Near playschool Konnithazam village	200	0.741	115.9	<88
				❖ In Rubber farm opposite to T. Varghese house	260	<0.5	NA	NA
				❖ Inside Ardhnareswar Temple	317	<0.5	NA	NA

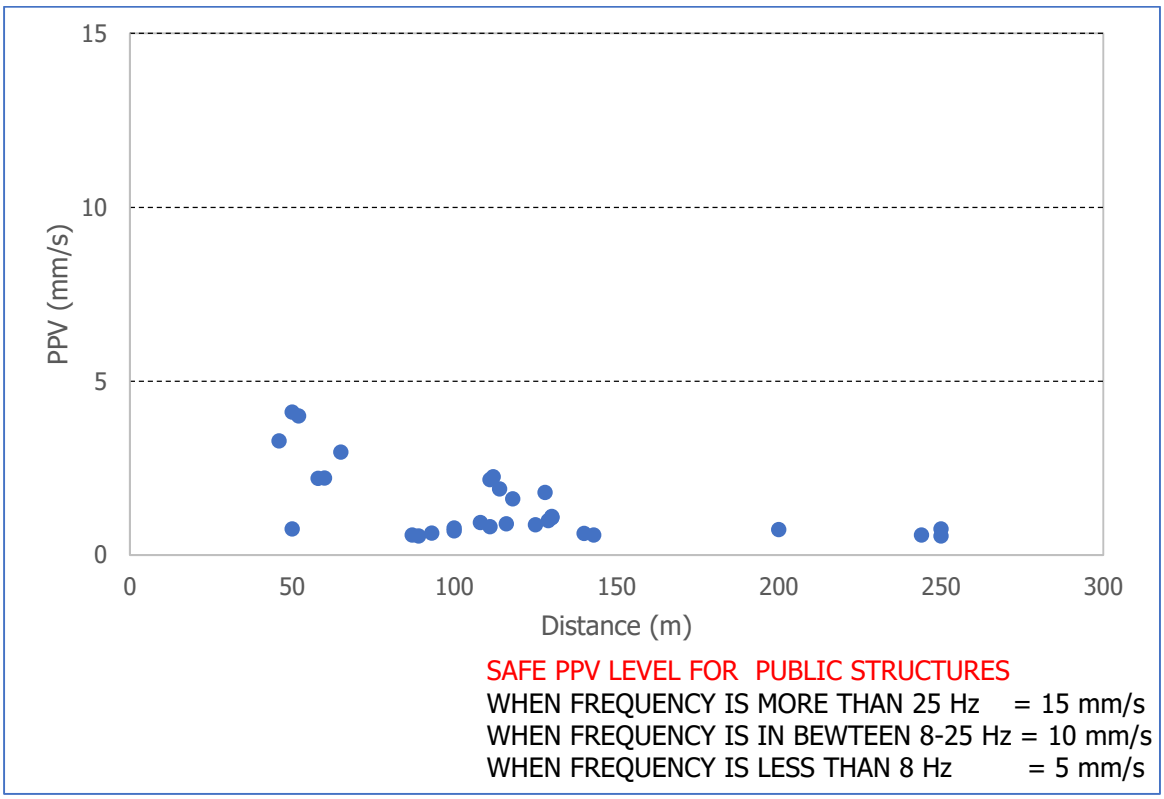


Figure 5.1.13 Plot of recorded vibration (PPV) with the distance of monitoring point from the blasting patch

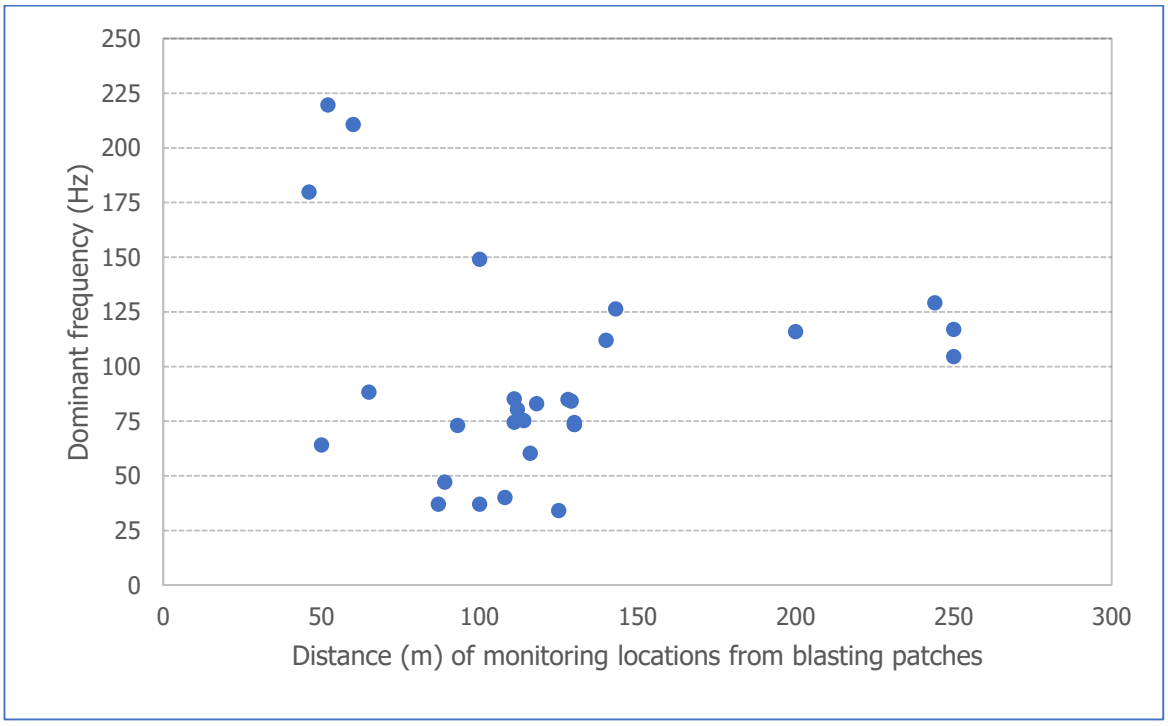


Figure 5.1.14: Plot between dominant peak frequency of vibration and distance of monitoring point from the blasting patch

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 91.5 and 120.8 dB(L). A plot of air-overpressure of recorded with respect to their concerned monitoring distances are given in **Figure 5.1.15**.

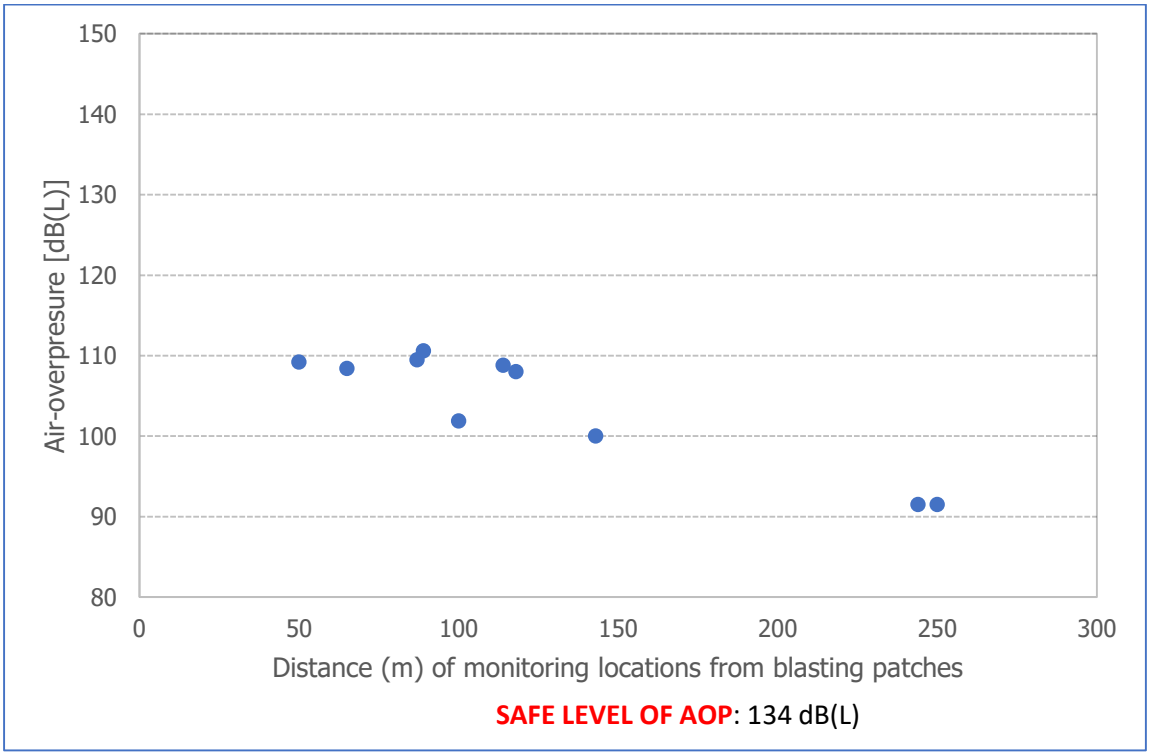


Figure 5.1.15. Plot of air-overpressure with the distance of monitoring from the blast faces

5.1.7 Flyrock Results and Observations

In order to study the occurrences of flying fragments from the blast holes, the experimental blasting events were recorded using high speed video camera as well as digital video camera. In all the experimental blasts, no flying fragments were observed or recorded. The throws of blasted materials were controlled and restricted within the blasting area only. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges. The recorded sequence of the rock movements for one of the experimental blasts is given in **Figure 5.1.16**.

1. Before Blast

2. Starting of initiation

3. Initial Stage of Rock Movement

4. Middle Stage of Rock movement

5. Last Stage of Rock Movement

6. Rock Movement Stopped

Figure 5.1.16. Sequences of rock movements in the Experimental Blast No. 6 at Granite Building Stone Quarry of M/s Adukadu Granites Private Limited, Pathanamthitta District

5.2 GRANITE BUILDING STONE QUARRY OF MUHAMMAD ROSHEN, KOLLAM DISTRICT

5.2.1 Brief Information of the Quarry

The granite building stone quarry owned by Muhammed Roshan has lease area of 1.21426 hectares at Kottukkal village, Kottarakkara Taluk, Kollam district, Kerela. The total buffer zone i.e. green belt around the mine is 0.396 Hectares. The nearest town is Ayoor which is about 6.55 Km, from the quarry site. The nearest railway station is Punalur, which is located at a distance of 15 Km from the lease area.

The highest elevation in this area is 100.0 m above MSL and the lowest elevation is 85.0 m above MSL. In this quarry, two sets of joints are seen traversing the rocks,

often rendering the rock mass as elongated and isometric blocks of different shapes and sizes. As a result, the quarry products cannot be used as blocks of different stone. Thin veins of pegmatite are seen intruding the gneissic complex. The upper part of the rock is weathered, giving rise to a thin veneer of soil, thickness of which does not exceed 1.0 m within the quarry site.

As per the Mining Plan, the granite deposits in these areas will be exploited with conventional open cast method and mode of operation will be mechanized. The removal of overburden strata and extraction of granite will be carried out by using drilling and blasting method. The bench height of 5.0 m and 5.0 m width will be maintained for the excavation work. View of the quarry is given in **Plate 5.2.1**.

Plate 5.2.1. View of granite building stone quarry of Muhammad Roshen, Kollam District

5.2.2 Reconnaissance Survey

The reconnaissance survey at this quarry was conducted on 17th and 18th December, 2022. The residential houses and important structures present within the zone of 500 m were inspected. The different structures present nearby the quarry within 500 m are listed below.

- The quarry is surrounded by the residential houses and other important structures in all the directions.
- Within the zone of 100 m from the quarry boundary, St. Thomas Church is present in the eastern side of the quarry.
- Within 200 m zone, residential houses are present in the Eastern, North – Eastern, Southern and South – Eastern side of the quarry.
- Within 300 m zone, several houses are present in all the direction of the quarry.

- Within 400 – 500 m, public road (PWD road) and residential houses are present in all direction of the quarry. Most of the houses are made of concrete with single storey. Few are also double storey buildings.

5.2.3 Study of land profile, nature of rock deposits

In the eastern side of the quarry, residential houses and St. Thomas Church are located at higher altitude than the working benches of the quarry. However, in the western side, houses are located at lower level than the working benches of the quarry. The rock deposit is massive in nature. However, joint planes are also observed in the middle portion of the quarry. The joints are dipping towards east and almost vertical as shown in **Plate 5.2.2**. Rebound hardness tested on the exposed rock surface varied from 40 to 72 with the average value of 53.

Plate 5.2.2. View of closely spacing joints dipping towards East

5.2.4 Experimental Blasts

Ten experimental blasts were conducted at Muhammad Roshen Quarry on 19.12.2022. The variations in the blast design parameters were done during the study. In the experimental blasts, burden and spacing values varied in the range of 0.8 - 1.6 m. Hole depth used was 1.5 m and total number of holes varied from 5 to 20. Muffling was also done using conveyor belts and sandbags. Drilling of holes, stemming material used, charging of holes and muffling of blast area are given in **Plates 5.2.3 to 5.2.6**.

The explosive charge per hole varied in the range of 0.18- 0.25 kg. Small diameter cartridge explosives of 25 mm diameter and 125 gm weight per cartridge were used in all the blasts. Nonel of 200 ms DTH and 25 ms TLD was used in all the blasts. The total explosive charge varied from 1.25 to 5.00 kg. Details of the blast design pattern used during the experimental blasts is given in **Table 5.2.1**. Google map showing location of experimental blasts and vibration monitoring stations at Quarry Unit of

Muhammad Roshen are given in **Figures 5.2.1 & 5.2.2**. Drilling pattern, firing pattern and charging pattern of holes are in **Figures 5.2.3 to 5.2.12.**

Plate 5.2.3. View of drilling at granite building stone quarry of Muhammad Roshen

Plate 5.2.4. View of stemming material used at granite building stone quarry of Muhammad Roshen

Plate 5.2.5. View of charging of holes at granite building stone quarry of Muhammad Roshen

Plate 5.2.6. View of muffling arrangement made at granite building stone quarry of Muhammad Roshen

Table 5.2.1. Summary of blasts conducted at Granite Building Stone Quarry of Muhammad Roshen, Kollam District on 19.12.2022.

Sl. No.	Location of Blast	No. of holes	Hole Dia. [mm]	Hole Depth [m]	Burden [m]	Spacing [m]	No. of rows	Top stemming [m]	Explosives		Explosive and initiation type
									Average Charge per Hole [kg]	Total Charge [kg]	
1.	N 08°52'51.6" E 76° 38'2.80" 72 mRL (Lower Bench)	15	32	1.5	(1.1 – 1.3)	(1.3 – 1.4)	2	1.0 - 1.1	0.25	3.75	Emulsion Cartridge explosive of wt. 125gm with Nonel initiation system (DTH-TwinDet 25/200 ms)
2.	N 08°52'51.90" E 76° 38'3.40" 90 mRL,(Lower Bench)	08	32	1.5	(1.0 – 1.6)	(1.1 – 1.4)	1	1.0 - 1.1	0.25	2.00	
3.	N 08°52'51.7" E 76° 38'3.50" 71 mRL(Lower Bench)	12	32	1.5	(1.0 – 1.1)	(1.1 – 1.6)	3	1.0 - 1.1	0.25	3.00	
4.	N 08°52'51.4" E 76° 38'3.50" 71 mRL(First Bench)	20	32	1.5	(1.0 – 1.1)	(1.1 – 1.6)	3	1.0 - 1.1	0.25	5.00	
5.	N 08°52'51.9" E 76° 38'3.90" 90 mRL(First Bench)	11	32	1.5	(1.0 – 1.1)	(1.1 – 1.6)	3	1.0 – 1.1	0.25	2.75	
6.	N 08°52'52.4" E 76° 38'4.50" 88 mRL(First Bench)	11	32	1.5	0.8	0.9	2	1.0 - 1.1	0.25	2.75	
7.	N 08°52'51.9" E 76° 38'4.20" 90 mRL(Second Bench)	8	32	1.5	(1.0 – 1.2)	(1.0 - 1.2)	2	1.0 - 1.1	0.25	2.00	
8.	N 08°52'52.2" E 76° 38'4.10" 92 mRL(Second Bench)	05	32	1.5	1.0	(1.2 – 1.5)	1	1.0 - 1.1	0.25	1.25	
9.	N 08°52'52.10" E 76° 38'4.20" 83 mRL(Second Bench)	11	32	1.5	0.8	0.9	2	1.0 - 1.2	0.18 – 0.25	2.12	
10.	N 08°52'52.20" E 76° 38'4.0" 92 mRL (Third Bench)	05	32	1.5	0.8	0.8	1	1.0 - 1.1	0.25	1.25	

Figure 5.2.1. Google map showing locations of the experimental blasts at granite building stone quarry of Muhammad Roshen, Kollam District

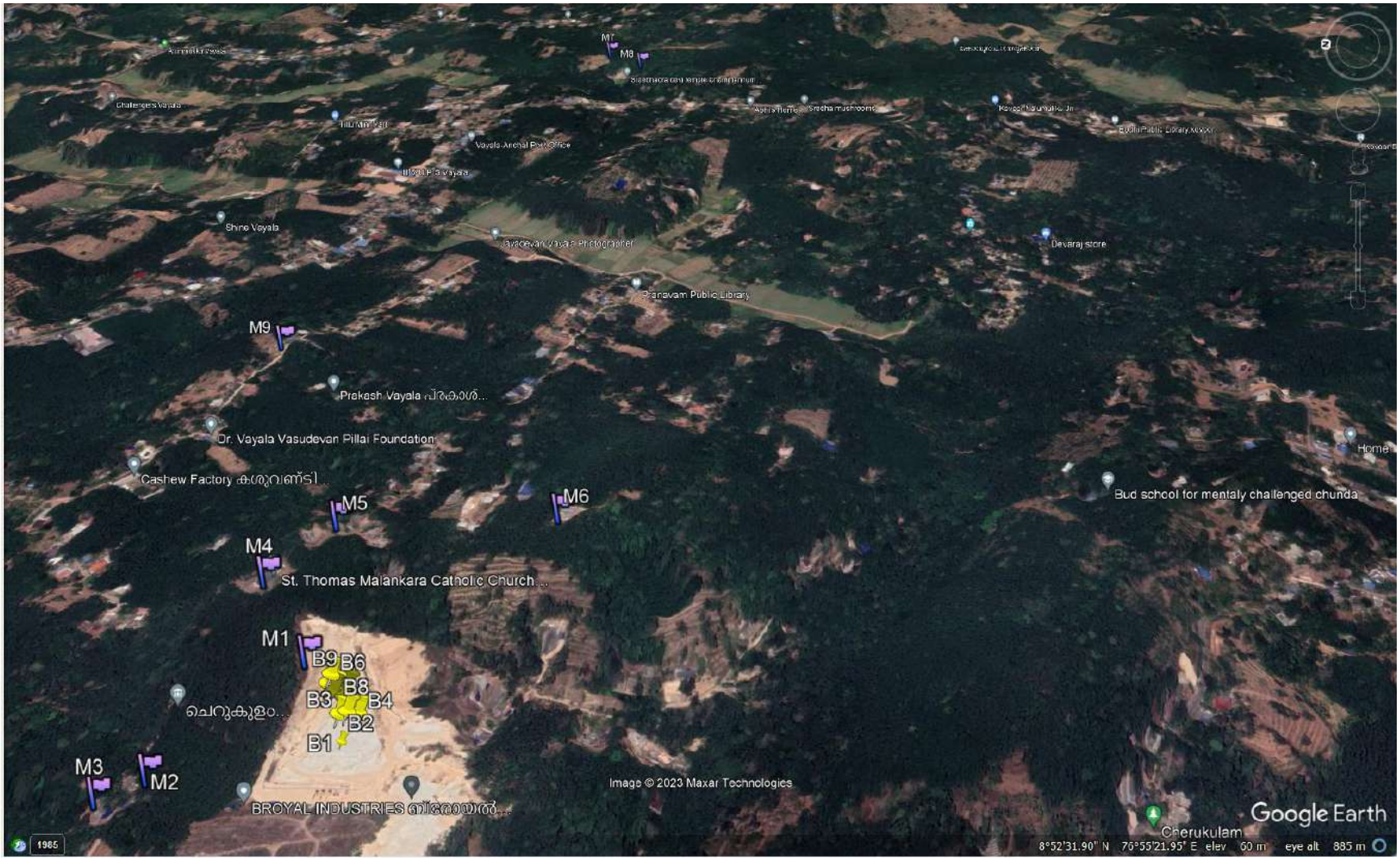


Figure 5.2.2. Google map showing locations of the experimental blasts and vibration monitoring stations at granite building stone quarry of Muhammad Roshen, Kollam District

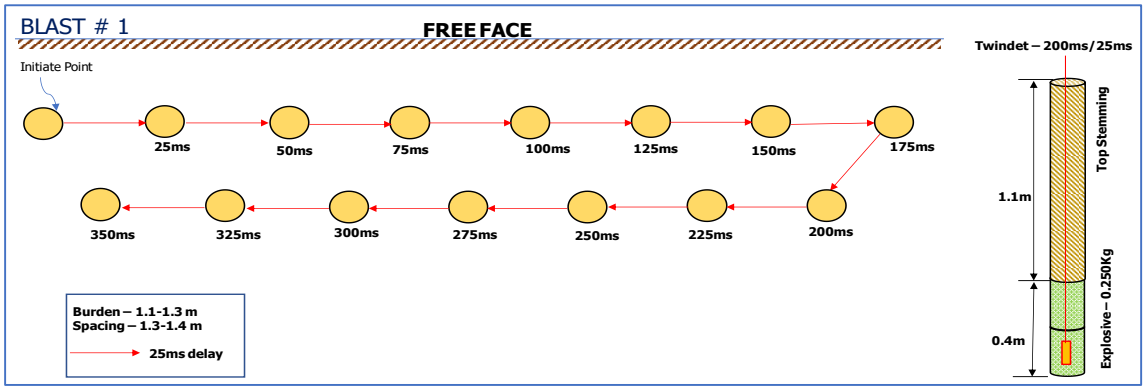


Figure 5.2.3. Drilling, firing and charging pattern of hole in Experimental Blast No.1

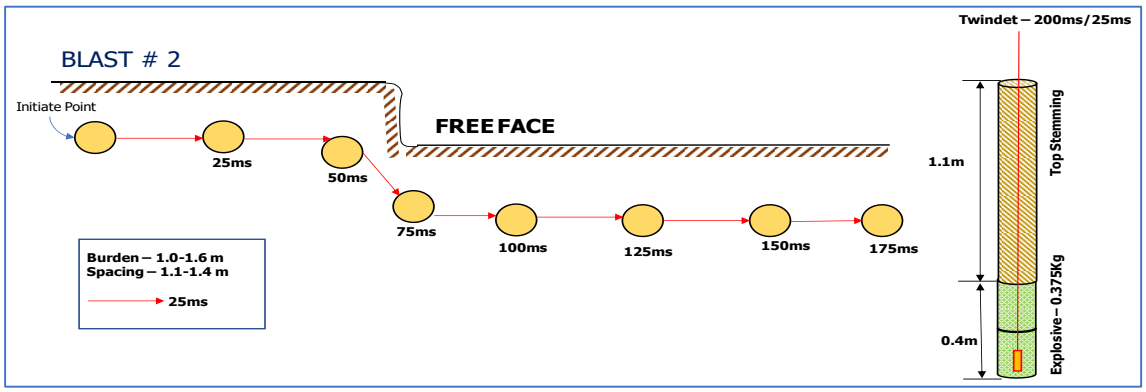


Figure 5.2.4. Drilling, firing and charging pattern of hole in Experimental Blast No.2

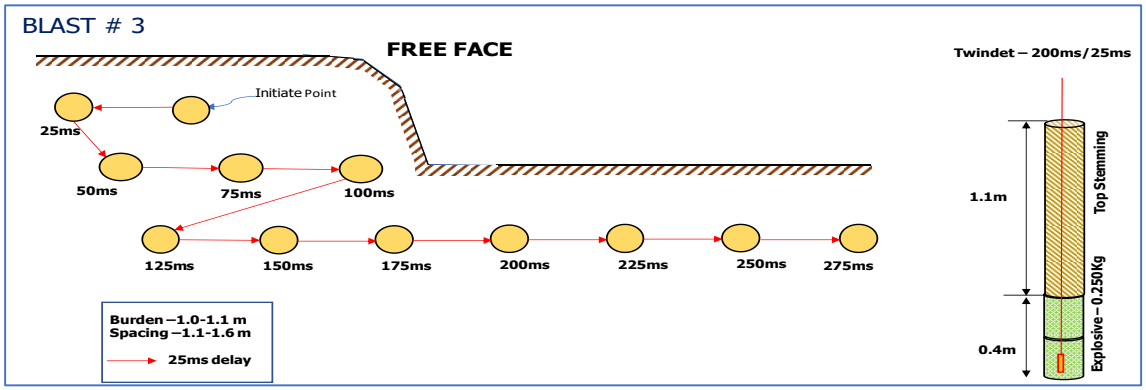


Figure 5.2.5. Drilling, firing and charging pattern of hole in Experimental Blast No.3

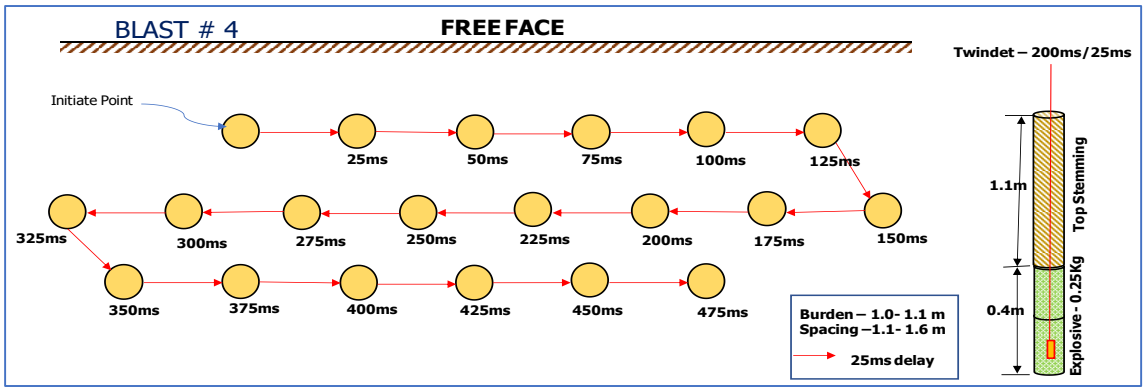


Figure 5.2.6. Drilling, firing and charging pattern of hole in Experimental Blast No.4

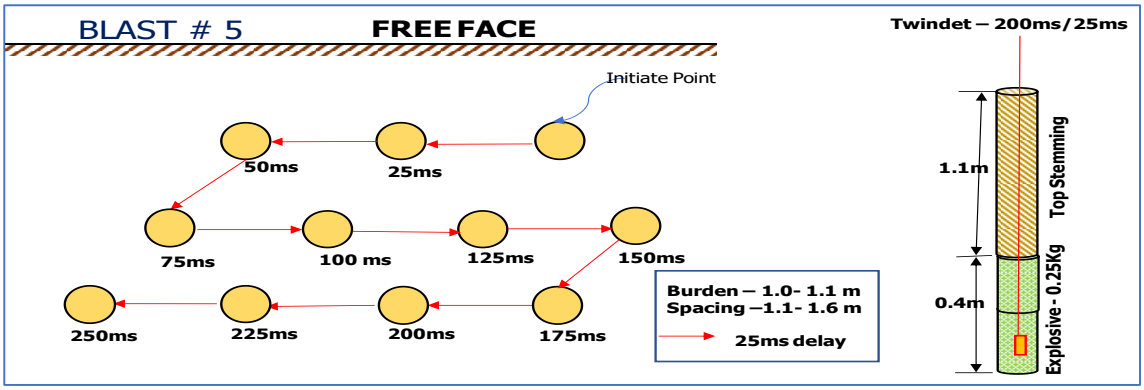


Figure 5.2.7. Drilling, firing and charging pattern of hole in Experimental Blast No.5

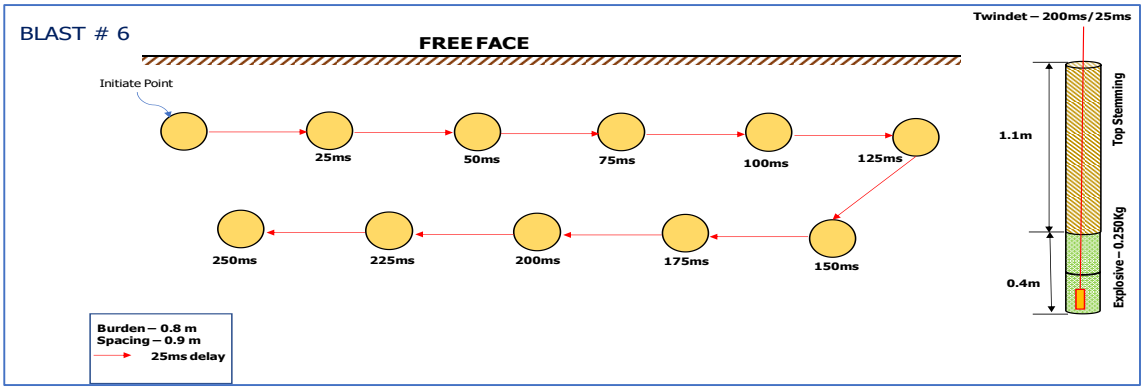


Figure 5.2.8. Drilling, firing and charging pattern of hole in Experimental Blast No.6

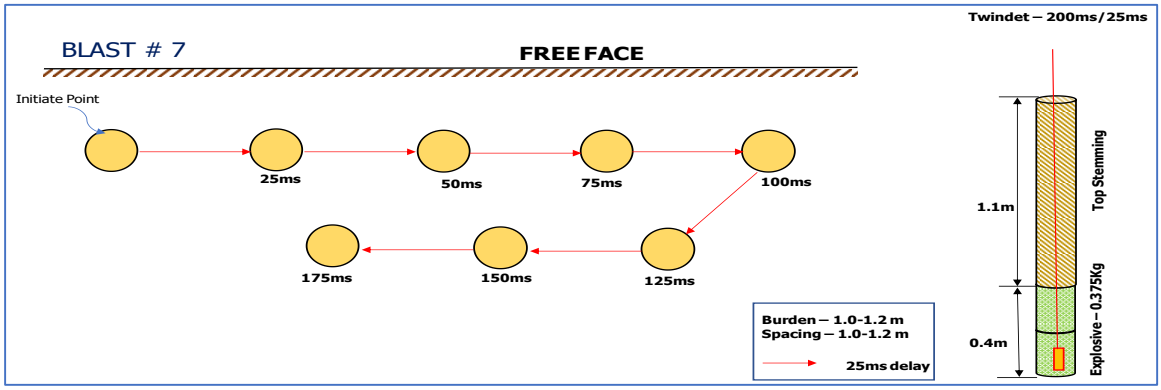


Figure 5.2.9. Drilling, firing and charging pattern of hole in Experimental Blast No.7

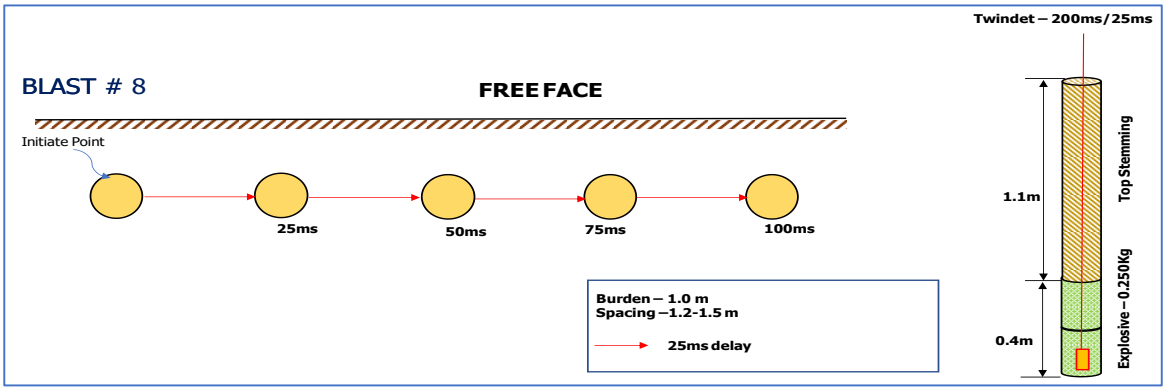


Figure 5.2.10. Drilling, firing and charging pattern of hole in Experimental Blast No.8

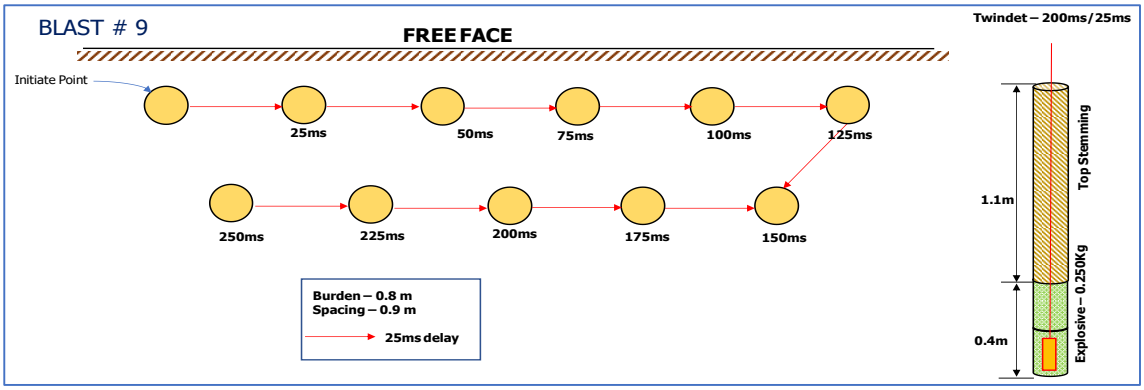


Figure 5.2.11. Drilling, firing and charging pattern of hole in Experimental Blast No.9

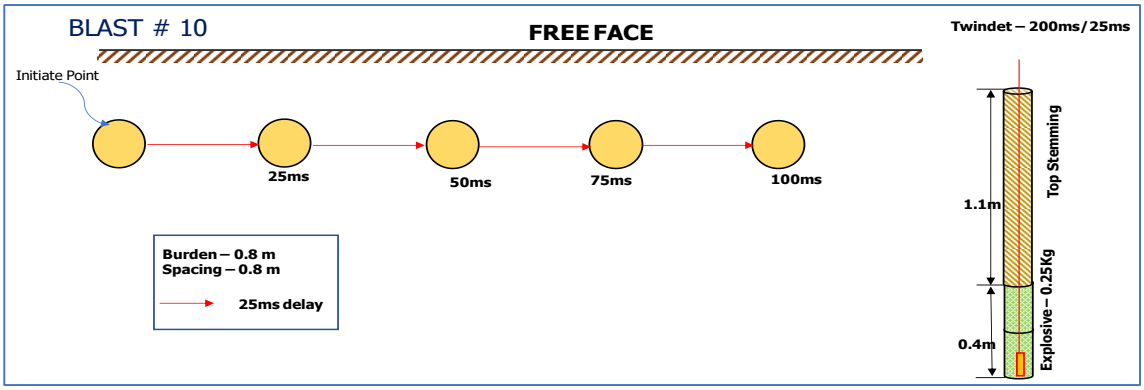


Figure 5.2.12. Drilling, firing and charging pattern of hole in Experimental Blast No.10

5.2.5 Monitoring of Ground Vibrations and Air Overpressures

During the field investigation, it was observed that the nearest village located from the present blasting faces of the quarry was Kattikul village. The nearest house of the Kattikul village was situated at 140 m from the present blasting face. St. Thomas Church was also observed to be situated near the mine workings in the back side of the free face of the blasts. Therefore, it was decided that the blast induced ground vibrations from the experimental blasts would be monitored at the nearest house of the Kattikul village, St. Thomas Church and also at varying distances between 50 – 500 m from the quarry. Eight number of seismographs were used to monitor the blast induced ground vibration in all the blasts. Out of these eight instruments, one instrument was kept on the working ramp on the backside of free face **(Plate 5.2.7).** Remaining seven seismographs were placed at different locations of Kattikul village **(Plate 5.2.8 to 5.2.13).**

The geophone of the seismographs was firmly fixed on ground surfaces using Plaster of Paris. Microphone for recording air overpressure were also fixed near the geophones. The distances of vibration monitoring points from the different experimental blasts varied from 50 to 500 m.

Plate 5.2.7. View of vibration monitoring point on the haul road

Plate 5.2.8. View of vibration monitoring point near the house of Naveesa Biwi, N-E side of quarry

Plate 5.2.9. View of vibration monitoring point on the roof top (Terrace) N-E side of quarry

Plate 5.2.10. View of vibration monitoring point near St. Thomas Church, Eastern side of quarry

Plate 5.2.11. View of vibration monitoring point near the house of Regimon MT, Kattikul village, Eastern side of quarry

Plate 5.2.12. View of vibration monitoring point near the house of Leela Kuriyan, Southern side of quarry

Plate 5.2.13. View of vibration monitoring point behind the house of Mr. Saif, S-W side of the quarry

5.2.6 Ground Vibration and Air Overpressure Results

Amongst the different vibration monitoring stations, ground vibration could be recorded at only one station which was fixed inside the quarry, on the haul road. The distance of vibration monitoring point on the haul road from the different blasting sites varied from 48 to 100 m. The total vibration data recorded from the ten experimental blasts was only ten (10). The magnitude of ground vibration data recorded varied from 0.558 to 2.349 mm/s. In rest of the vibration monitoring stations nearby the residential houses and church, ground vibration data could not be recorded.

The maximum magnitude of ground vibration recorded was 2.349 mm/s at the distance of 50 m from the blast. This data was recorded during Blast No. 8 where the total explosive charge was 1.25 kg and maximum charge per delay was 0.25 kg. The graph plotted between vibration (PPV) recorded and distance of the seismographs from the blasting patch is shown in **Figure 5.2.13.** Details of the recorded ground vibrations and air overpressures/noises are given in **Table 5.2.2**. The waveform reports of some of the ground vibration data are also given in the **Annexure-2**.

The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant frequency content of the vibration waves. The FFT analysis results of some of the vibration waveforms are given in the **Annexure-2**. The dominant frequencies of ground vibration wave at different monitoring points varied between 101.1 and 183.1 Hz. The plot of dominant frequencies v/s distances of measurement for the different vibration monitoring points are given in **Figure 5.2.14**.

The air overpressure levels recorded from the different experimental blasts varied between 109.2 and 126.2 dB (L). The maximum level of air overpressure recorded in all the experimental blasts was 126.2 dB(L), at a distance of 50 m from blast No. B-8. A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.2.15**.

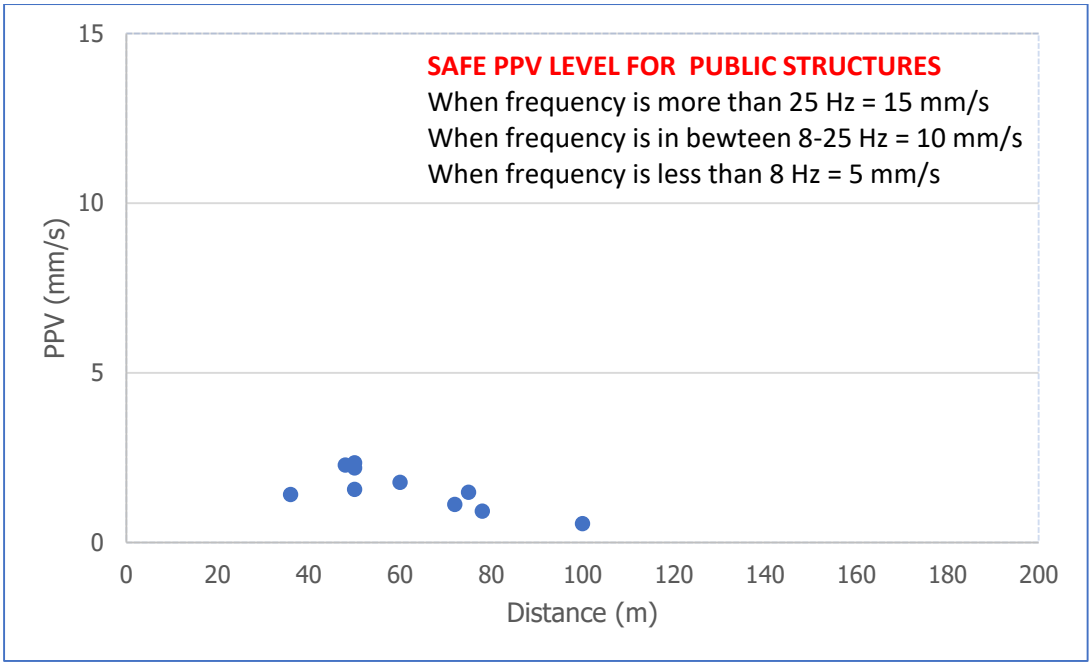


Figure 5.2.13. Plot between recorded vibration (PPV) and distances of seismographs from the blasting patches

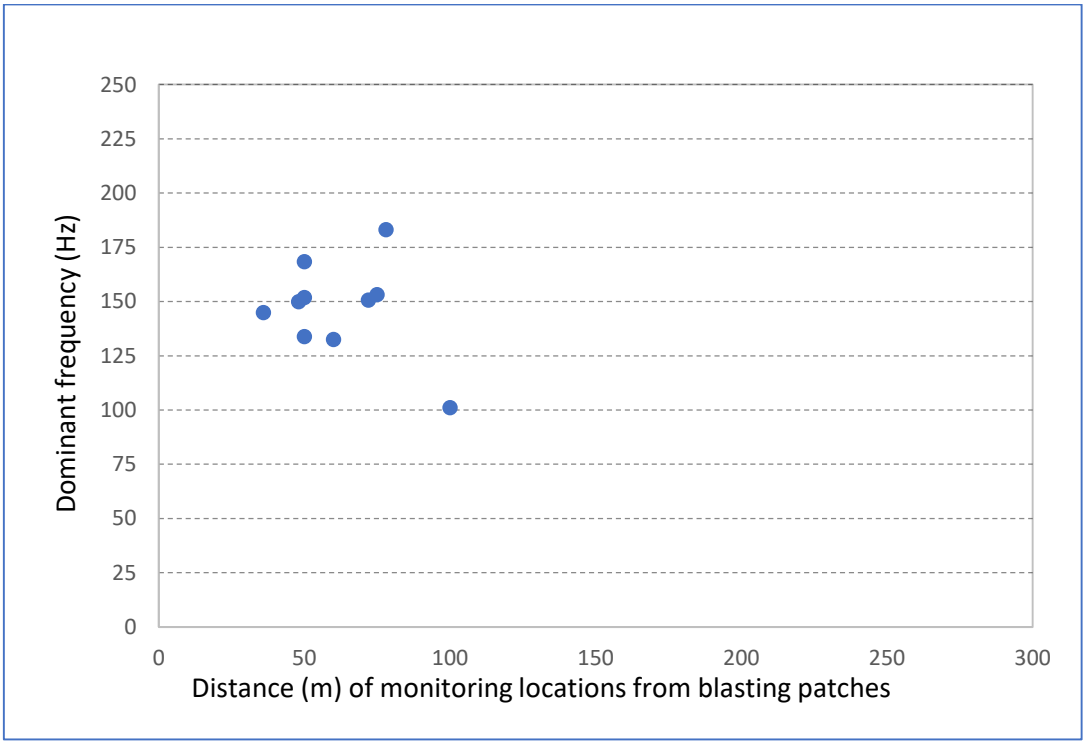


Figure 5.2.14. Plot between peak frequency of ground vibration and distances of seismographs from the blasting patches

Table 5.2.2. Blast induced vibration and air over pressure recorded at different locations due to the blast conducted at Granite Building Stone Quarry of Muhammad Roshen, Kollam District on 19.12.2022.

Sl. No.	Date of Blast	Location of Blast	Total Explosive fired in a round [kg]	Max. explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dB(L)]
1	19.12.2022	N 08°52'51.6" E 76° 38'2.80" 72 mRL (Lower Bench)	3.75	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	100 142 175 193 250 298 200 612	0.568 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	101.1 NA NA NA NA NA NA NA	122.2 NA NA NA NA NA NA NA
2	19.12.2022	N 08°52'51.90" E 76° 38'3.40" 90 mRL (Lower Bench)	2.0	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	72 139 176 174 234 284 215 592	1.122 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	150.6 NA NA NA NA NA NA NA	109.2 NA NA NA NA NA NA NA
3	19.12.2022	N 08°52'51.7" E 76° 38'3.50" 71 mRL (Lower Bench)	3.0	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	75 150 183 175 234 280 217 593	1.481 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	153.1 NA NA NA NA NA NA NA	120.7 NA NA NA NA NA NA NA

4	19.12.2022	N 08°52'51.4" E 76° 38'3.50" 71 mRL (First Bench)	5.0	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	78 155 191 180 236 275 217 596	0.925 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	183.1 NA NA NA NA NA NA NA	113.5 NA NA NA NA NA NA NA
5	19.12.2022	N 08°52'51.9" E 76° 38'3.90" 90 mRL (First Bench)	2.75	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	60 150 186 161 220 273 230 579	1.778 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	132.4 NA NA NA NA NA NA NA	116.4 NA NA NA NA NA NA NA
6	19.12.2022	N 08°52'52.4" E 76° 38'4.50" 90 mRL (First Bench)	2.75	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	36 150 186 137 198 267 250 307	1.420 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	144.8 NA NA NA NA NA NA NA	119.6 NA NA NA NA NA NA NA
7	19.12.2022	N 08°52'51.9" E 76° 38'4.20" 90 mRL (Second Bench)	2.0	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	50 155 193 155 210 264 240 292	1.571 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	133.8 NA NA NA NA NA NA NA	111.5 NA NA NA NA NA NA NA
8	19.12.2022	N 08°52'52.2" E 76° 38'4.10" 92 mRL	1.25	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house	50 146 185	2.349 <0.5 <0.5	151.8 NA NA	126.2 NA NA

		(Second Bench)			❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	150 214 273 237 293	<0.5 <0.5 <0.5 <0.5 <0.5	NA NA NA NA NA	NA NA NA NA NA
9	19.12.2022	N 08°52'52.10" E 76° 38'4.20" 83 mRL (Second Bench)	2.12	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	48 149 192 187 200 269 240 295	2.282 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	149.8 NA NA NA NA NA NA NA	126.1 NA NA NA NA NA NA NA
10	19.12.2022	N 08°52'52.20" E 76° 38'4.0" 92 mRL (Third Bench)	1.25	0.25	❖ On working bench ❖ Near Nabeesa Biwi house ❖ Roof top of Nabeesa Biwi house ❖ Saint Thomas Church ❖ Mr. Regimon House ❖ Mr. Leela M Kuriyan ❖ Near Saif House ❖ Near Jose J. V House	50 145 180 150 215 275 235 287	2.196 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	168.3 NA NA NA NA NA NA NA	119.6 NA NA NA NA NA NA NA

Co-ordinate of ground vibration monitoring station

- ❖ On working bench eastern side of mine N 08°52'53.0" E 76° 38'5.50"; 90 mRL
- ❖ Ground surface near Nabeesa Biwi house N 08°52'55.70" E 76° 38'0.90"; 82 mRL
- ❖ Roof top of Nabeesa Biwi House N 08°52'56.70" E 76° 38'0.20"; 91 mRL
- ❖ In Saint Thomas Church N 08°52'55.20" E 76° 38'8.00"; 106 mRL
- ❖ Near Mr. Regimon House in Kattikul Village N 08°52'53.90" E 76° 38'10.80"; 112
- ❖ Near house of Mr. Leela M Kuriyan (Southern side of the Quarry) N 08°52'47.0" E 76° 38'11.40"; 117 mRL
- ❖ Near the house of Mr. Saif, (South West of the Quarry) N 08°52'50.90" E 76° 38'56.40"; 101 mRL
- ❖ Near Mr. Saifuddin House Western side of mine N 08°52'48.90" E 76° 38'55.10"; 82 mRL
- ❖ Near Mr. Jose J. V House (North West Side of Quarry) N 08°52'59.30" E 76° 38'29.30"; 91 mRL

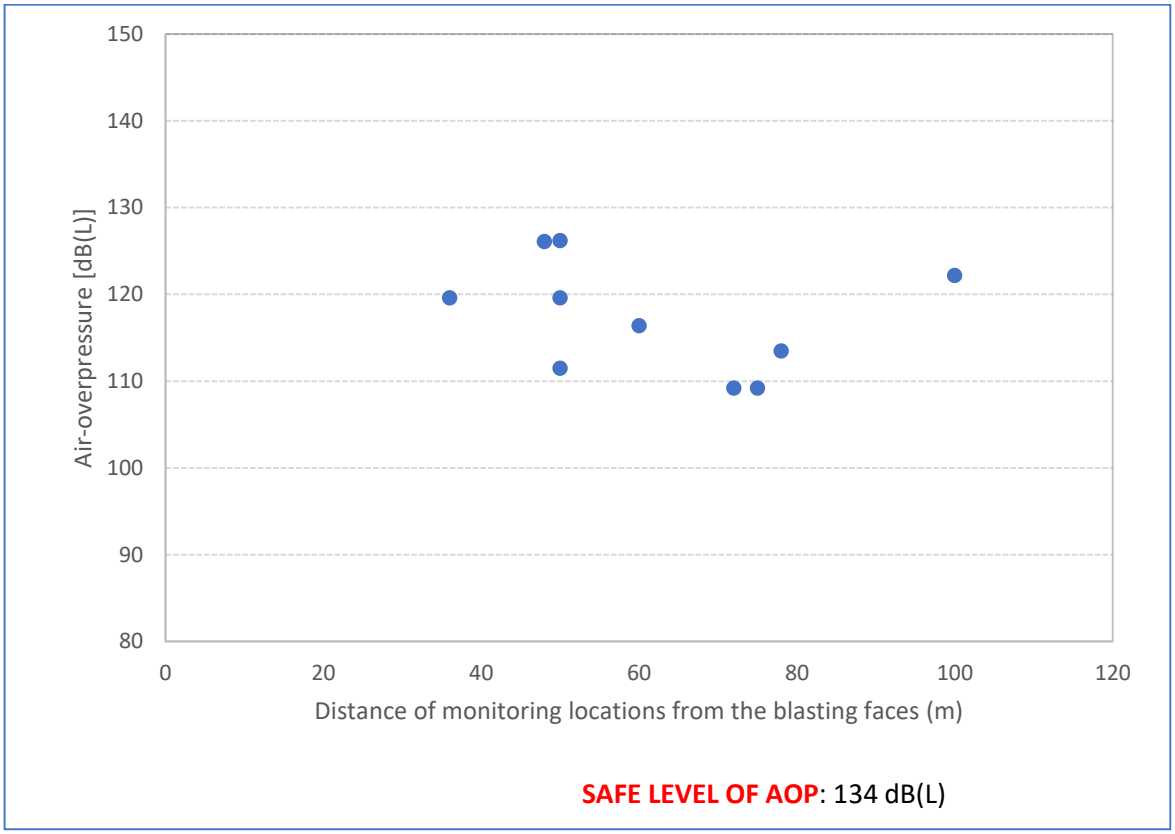


Figure 5.2.15. Plot of recorded air-overpressure versus distance of monitoring locations from the blasting faces

5.2.7 Flyrock Results and Observations

Flyrock was not observed and recorded in any experimental blasts. Throws of the blasted materials were also confined to the blasting benches only. The usages of Nonel system for bottom initiation helped in controlling flyrock. The charge factor used in the experimental blasts were less than 0.25 kg/m^3. As per the existing blast design patterns practiced by the mine managment, the explosive charge per hole was only 2 cartridges for 5 ft hole depth. Only cracks were generated in the blasts and there were no rock movements.

In some of the experimental blasts, burden and spacing were reduced to obtain better rock fragmentation with the same explosive charge. Muffling was also done using belt conveyors and sandbags. Flyrocks were completely controlled in all the blasts. The blasting event recorded in one of the experimental blasts, i.e. Blast No. 4 is shown in **Figure 5.2.16**.

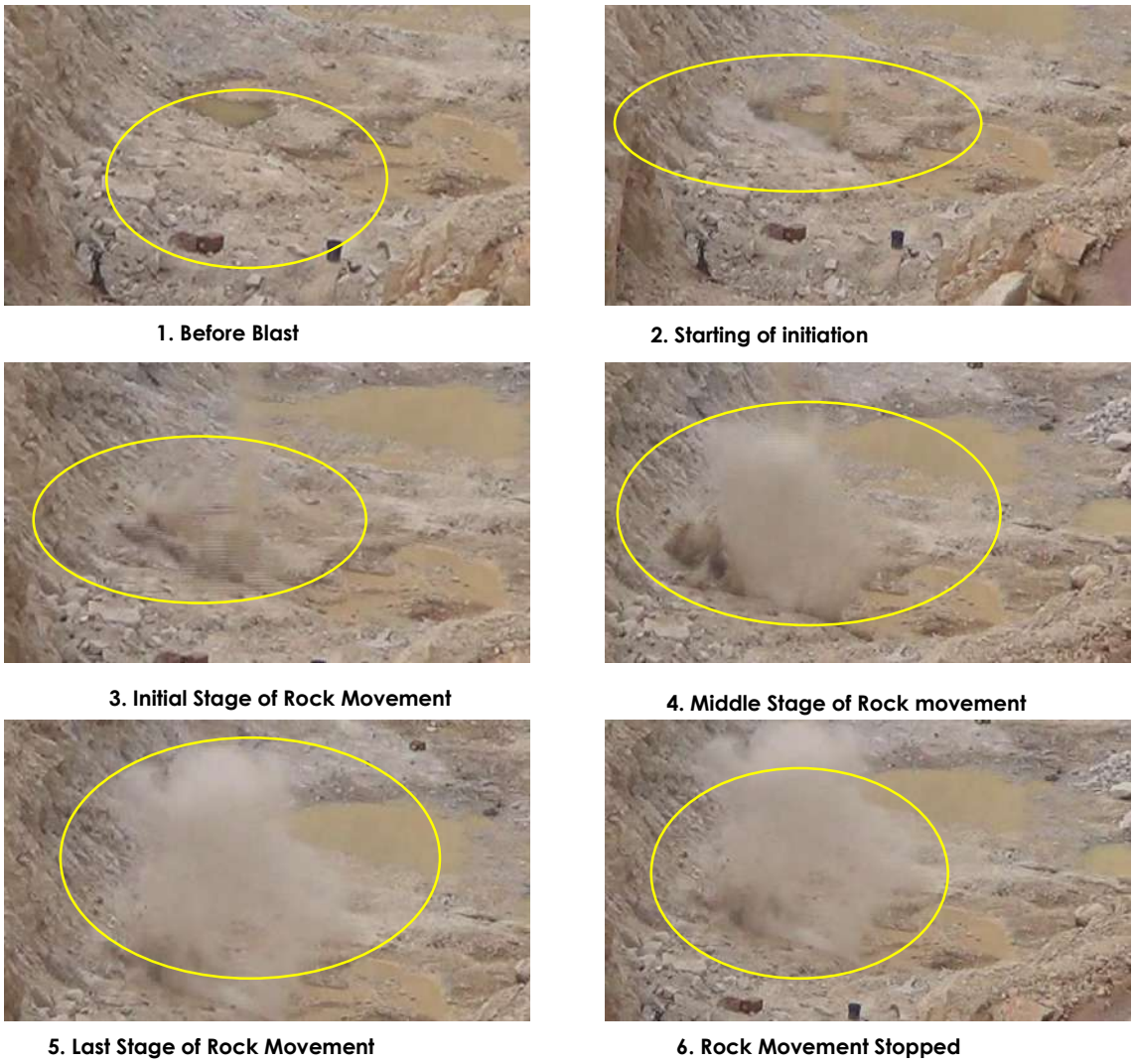


Figure 5.2.16. View of the sequences of rock movement in the Experimental Blast at granite building stone quarry of Muhammad Roshen, Kollam District

5.3 GRANITE BUILDING STONE QUARRY OF M/S POABS GRANITE PVT. LTD., TRIVANDRUM DISTRICT

5.3.1 Brief Information of the Quarry

Granite Building Stone Quarry of M/s POABS Granite Private Limited is located at Kuthirakalam village, Vellanadu Taluk, Thiruvananthapuram district of Kerala State. This stone quarry is located at 7.0 km from Peroorkada town and 12 km by road from Thiruvananthapuram city. The nearest railhead 'Thiruvananthapuram' is situated about 11 km whereas the nearest airport 'Thiruvananthapuram' is situated at about 15 km from this quarry. The total lease area is 5.9747 Ha. The quarry is categorized as open-cast-semi-mechanized. View of quarry is given in **Plate 5.3.1**. The lease-hold and surrounding area of

the quarry is shown in **Figure 5.3.1**. The field investigation at POABS Granite Pvt. Ltd. quarry was carried out during the period of 21st to 22nd December, 2022. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 5.3.1. Overall view of granite building stone quarry of M/s POABS Granite Pvt. Ltd., Trivandrum District

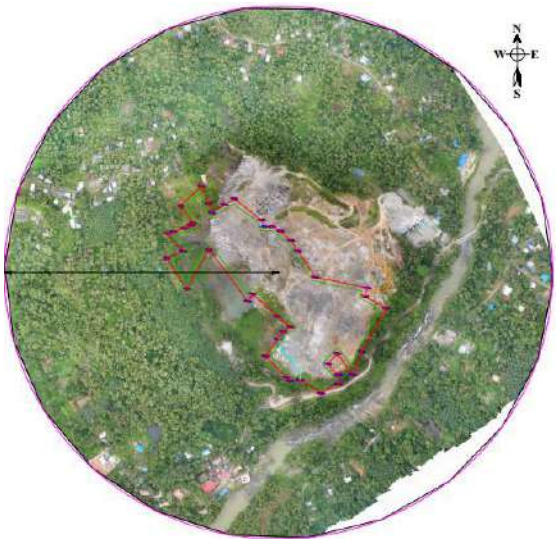


Figure 5.3.1 Google map showing lease hold and surrounding area within 500 m of the quarry

5.3.2 Reconnaissance Survey

The reconnaissance survey was conducted on 21st December, 2022. The residential houses and important structures present within the zone of 500 m were inspected (**Plate 5.3.2**). The different structures identified within the zone of 500 m from the quarry are listed below:

- At 320 m Ayiravalli, Tampura Temple and the Orphnage are located in the S-W Direction of the quarry.
- Beyond 350 m, residential houses are present in both S-W and N-W directions of the quarry.

- Within 100 m distances, PWD road and Karamana river pass-through.
- It was observed that the residential houses were located at higher level than the present workings.

Plate 5.3.2. View of reconnaissance survey of residents of Manalmalamugal village near mine boundary gate No. 02 by CSIR-CIMFR and KSPCB team

5.3.3 Study of Land Profile, Nature of Rock Deposits

Study on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces were carried out during the study. The site is geographically located between Latitude 8 ° 32 ' 27.793" N to 8 ° 32 ' 40.457" N, and Longitudes 77° 00' 21.163" E to 77 ° 00' 34.261" E. The project site and buffer zone fall in the Survey of India Toposheet No.C43X2(58 H/2). Topographically, the area is undulating. The lease hold area is located on the slope and gently dipping towards SE. The highest elevation of the mine area is 120 m above MSL and the lowest elevation is 35 m above MSL. The main rock type in the mine area is granite building stone and are very well exposed in view of old quarry working. Moreover, part of area with higher elevation is covered by topsoil of about 0 to 1.2 m thickness. The rock mass is mostly massive as well as jointed with dominance of three sets of joints and a few random sets also. The joint spacing varied between a few centimeters to more than 3 m. The rebound hardness of rock mass tested on the fresh rock surfaces using Schmidt hammer varied between 50 and 70 indicating hard rock.

5.3.4 Experimental Blasts

In total, eleven rounds of experimental blasts were conducted with the varying blast design patterns on central part of quarry. The blasts were conducted with the varying blast design patterns. All the blasts were conducted with 32 mm blast hole diameter. Crawler mounted drill machine as well as jack hammers were used for drilling of holes. The diameter of holes for both Jack Hammer drill and crawler mounted (**Plate 5.3.3**) drill machines was 32 mm. Wet empty gunny sacks were used to suppress dust during drilling of holes. A special type

designed hole cap was also used for inadvertent filling of holes and to maintain the correct depth of the hole prior to putting explosives into the holes (**Plate 5.3.4**). All the holes were measured before placing the explosives (**Plate 5.3.5**).

Matching small diameter emulsion cartridge explosives of 25 mm diameter, 125 gm weight per cartridge and ANFO explosive were used for the charging of the blastholes. Twin-det Nonel (shock tube) initiation system consisting of 250 ms of DTH and 25 ms of TLD was used in all the blasts (**Plate 5.3.6**). For inter-row delay, 42 ms of TLD was used. Coarse sand mixed with stone chips were used as stemming material to provide sufficient confinement during blasting of holes as shown in **Plate 5.3.7**. Complete charged blasting patch ready to blast is shown in **Plate 5.3.8.** Video recording of blasts were also done to know the extent of rock movement, throw and fly-rock using high speed camera (**Plate 5.3.9)**. Further to minimise the dust generation during the blasting, all the blasting patches along with additional area of anticipated throw of blasts were sprinkled with water using the mobile tanker as well as flexible water pipe line as shown in **Plate 5.3.10**.

During the study, the experiment was also planned to assess the bigger impact of blasting at greater distances by increasing the number of holes and charge per hole. The number of holes varied from 8 to 60, hole depth varied from 1.5 to 2.4 m, burden varied from 0.9 to 1.0 and spacing varied from 0.9 to 1.3 m. The explosive average charge per hole and maximum charge per delay varied from 0.37 to 0.59 kg. The total explosive charge varied from 4 to 24.0 kg. Google maps showing locations of experimental blasts and ground vibration monitoring points are given in **Figures 5.3.2 & 5.3.3**. Blast design parameters used during the experimental blasts at this Stone Quarry is given in **Table 5.3.1.** The drilling, firing and charging patterns of blasting rounds are depicted in **Figures 5.3.4 to 5.3.14**.

Plate 5.3.3. View of crawler-mounted pneumatic drill machine with wet gunny sacks and Jackhammer drill machine being used for drilling of holes

Plate 5.3.4. View of hole cap for inadvertent filling of holes and to maintain correct depth of hole prior to putting explosive into the holes

Plate 5.3.5. Measurement of hole depth before charging of holes for correct placement of explosive and to ascertain the required top stemming

Plate 5.3.6. Emulsion explosive cartridge, Twin-det Nonel detonators and ANFO explosive

Plate 5.3.7. Stemming of blast hole using coarse sand mixed stone chips

Plate 5.3.8. View of ready to fire blasting patch

Plate 5.3.9. View of recording of blasting event using High Speed Video Camera at quarry of M/s POABS Granite Pvt. Ltd.

Plate 5.3.10. Water sprinkling arrangement to minimise dust generation during blasting

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Figure 5.3.2. Google map showing location of experimental blasts at granite building stone quarry of M/s POABS Granites Pvt. Ltd., Trivandrum

Figure 5.3.3. Google map showing location of experimental blasts and ground vibration monitoring points at granite building stone quarry of M/s POABS Granites Pvt. Ltd., Trivandrum

Table 5.3.1. Location of blasts, blast design parameters and type of explosive & accessories used during the study at Granite Building Stone Quarry of M/s POABS Granites Pvt. Ltd., Trivandrum District on 21.12.2022

Sl. No.	Location of blast	No. of holes	Hole diameter [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Explosive and Initiation type
									Explosives per hole [kg]	Total Explosive detonated [kg]	
1	N 08°32'30.2", E 77° 00'26.8" 34.00 mRL, (Lower Bench)	41	32	2.2 – 2.4	1.0	1.3	3	1.2-1.35	0.59	23.57	Emulsion Cartridge explosive of wt. 125gm, ANFO with Nonel initiation system (TwinDet 25/250ms) & TLD-42ms
2	N 08°32'30.9", E 77° 00'27.2" 36.00 mRL(Lower Bench)	20	32	2.4	1.0	1.2	2	1.35	0.575	11.5	
3	N 08°32'31.1" E 77° 00'27.5" 39.00 mRL(Lower Bench)	8	32	2.2	1.0	1.2	1	1.3-1.4	0.575	4.6	Cartridge explosive, ANFO with Nonel initiation system (TwinDet 25/250ms)
4	N 08°32'30.6", E 77° 00'26.8" 34.00 mRL(Lower Bench)	30	32	2.2	1.0	1.2	3	1.4	0.57	17.25	Emulsion Cartridge explosive of wt. 125gm & ANFO with Nonel initiation system, DTH-TwinDet 25/250ms, & TLD-42ms
5	N 08°32'31.3", E 77° 00'28.6" 42.00 mRL(Lower Bench)	40	32	1.8	1.0	1.3	3	1.2	0.40	16.0	
6.	N 08°32'30.8", E 77° 00'29.2" 44.00 mRL(Lower Bench)	40	32	1.5	1.0	1.2	4	1.05	0.375	15.0	
7.	N 08°32'30.7", E 77° 00'29.5" 45.00 m RL (Lower Bench)	30	32	1.8	1.0	1.2	3	1.2	0.40	12.0	
8.	N 08°32'30.4", E 77° 00'29.6" 46.00 mRL (Lower Bench)	20	32	1.8	1.0	1.2	2	1.2	0.40	8.0	
9.	N 08°32'31.55", E 7°00'28.80" 43.00 mRL (Lower Bench)	60	32	1.8	0.9	0.9	3	1.2	0.40	24.0	
10	N 08°32'29.9", E 77° 00'30.0" 46.00 mRL(Lower Bench)	20	32	1.5	1.0	1.2	2	1.05	0.37	7.5	
11.	N 08°32'29.7", E 77° 00'29.8" 46.00 mRL (Lower Bench)	10	32	1.8	1.0	1.2	2	1.2	0.4	4.0	

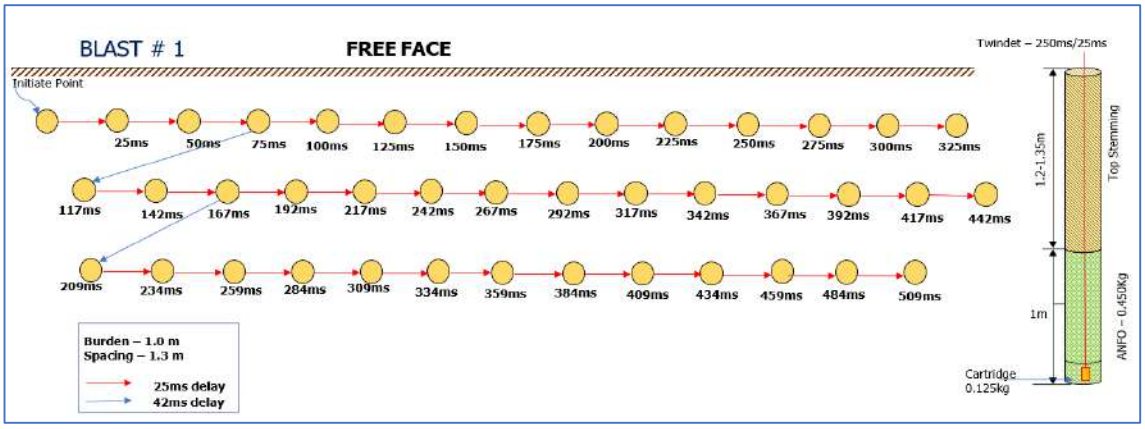


Figure 5.3.4. Drilling, firing and charging pattern of holes in Blast No.1

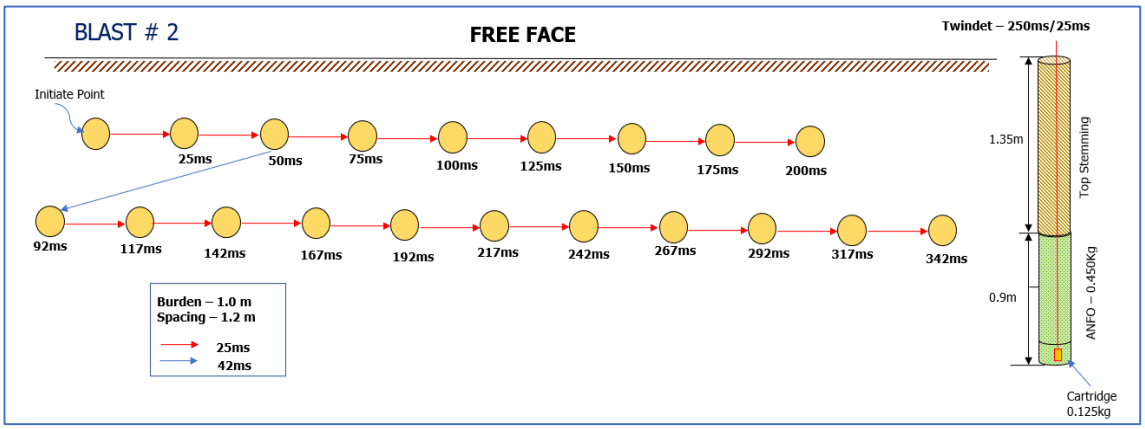


Figure 5.3.5. Drilling, firing and charging pattern of holes in Blast No.2

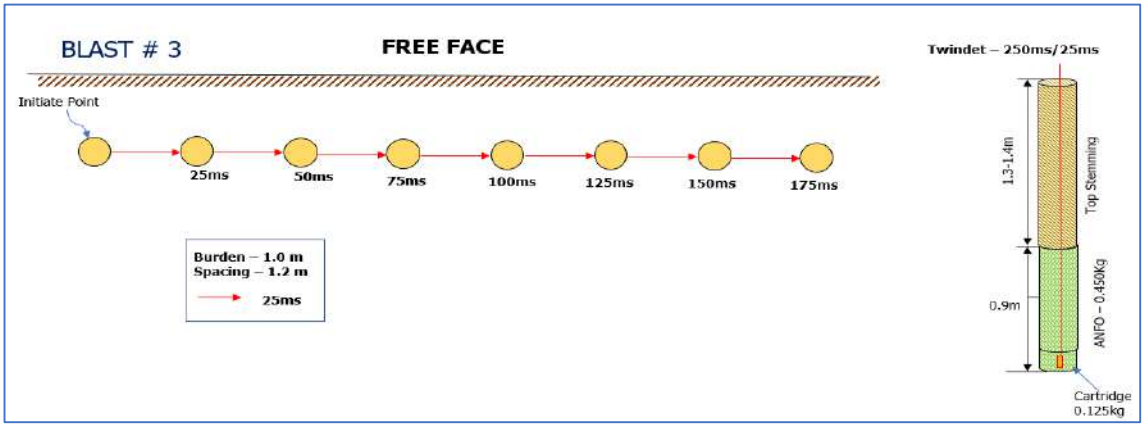


Figure 5.3.6. Drilling, firing and charging pattern of holes in Blast No.3

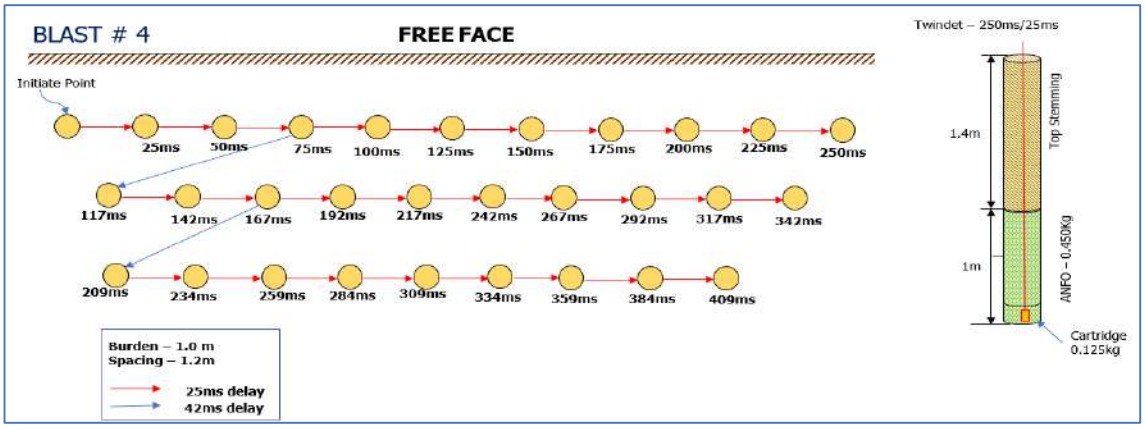


Figure 5.3.7. Drilling, firing and charging pattern of holes in Blast No. 4

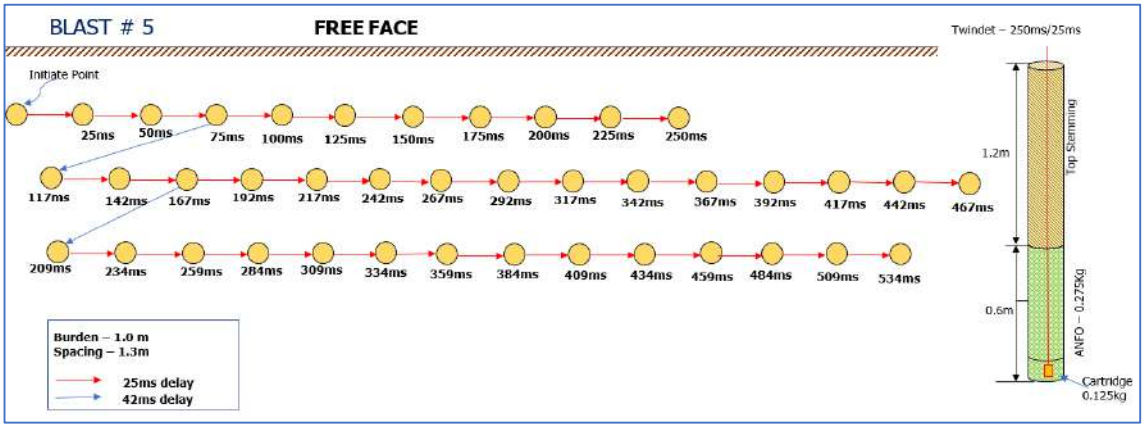


Figure 5.3.8. Drilling, firing and charging pattern of holes in Blast No. 5

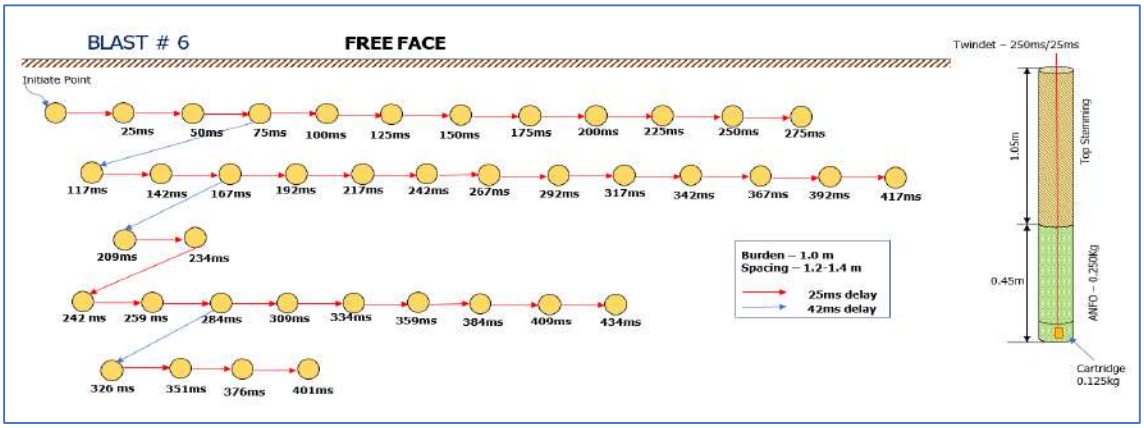


Figure 5.3.9. Drilling, firing and charging pattern of holes in Blast No. 6

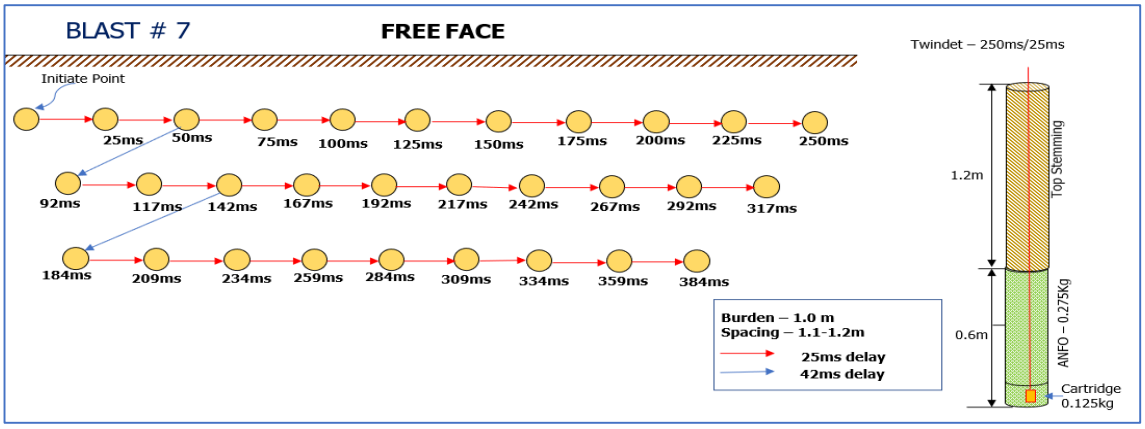


Figure 5.3.10. Drilling, firing and charging pattern of holes in Blast No. 7

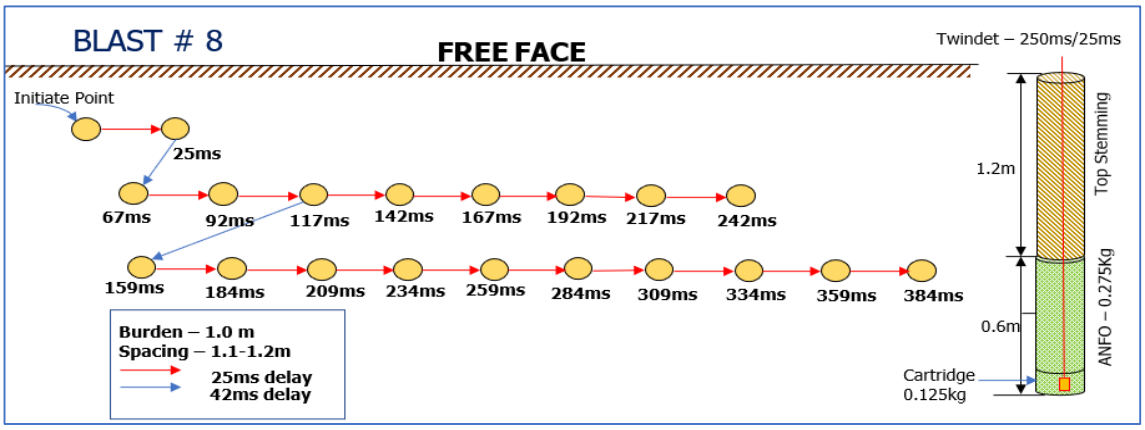


Figure 5.3.11. Drilling, firing and charging pattern of holes in Blast No. 8

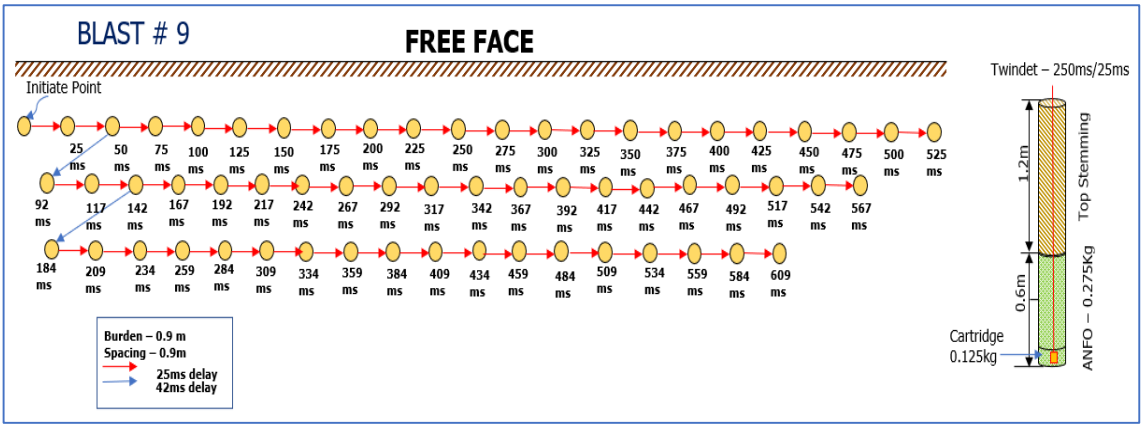


Figure 5.3.12. Drilling, firing and charging pattern of holes in Blast No. 9

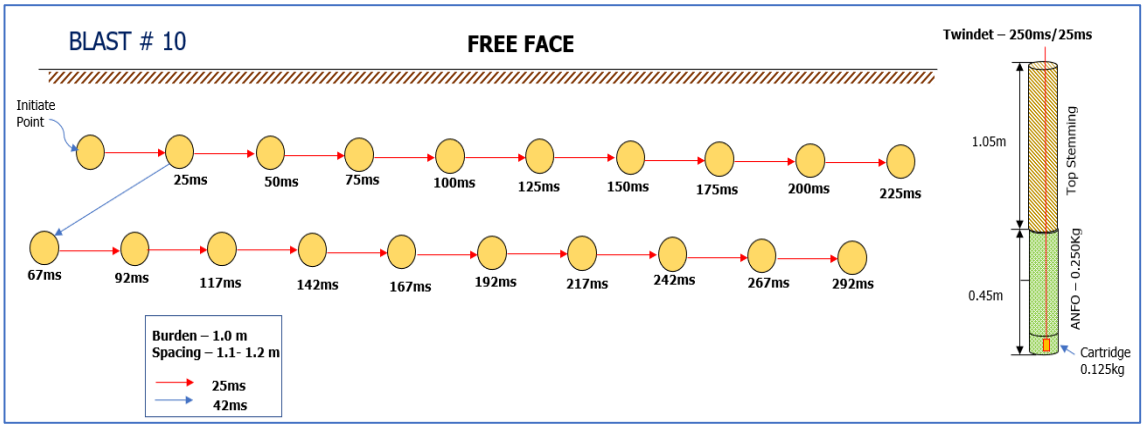


Figure 5.3.13. Drilling, firing and charging pattern of holes in Blast No. 10

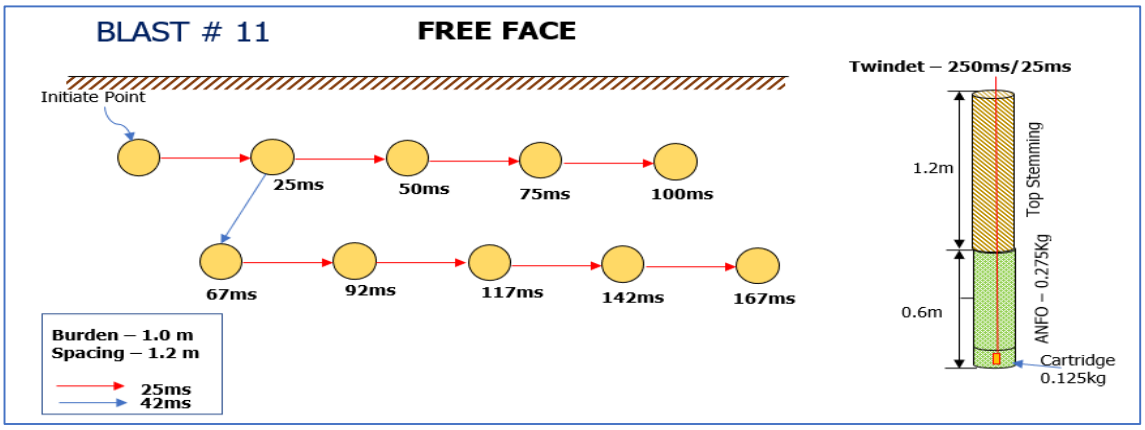


Figure 5.3.14. Drilling, firing and charging pattern of holes in Blast No. 11

5.3.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored at different distances from the blasting patches using eight number of seismographs. The monitoring locations were selected considering the objectives of study to know the magnitude of vibration at 50 m, 75 m, 100 m, 125 m, 150 m, 17 5m, 200 m, 225 m, 250 m and 500 m distances as well as considering the point of interests (viz. public houses). Garmin GPS having ±3 m accuracy was used to find the distances between blasting and monitoring locations. View of vibration monitoring points are given in Plates **5.3.11 to 5.3.17**. Details of all the magnitude of ground vibrations and air-overpressures recorded are given in **Table 5.3.2**.

Plate 5.3.11. View of vibration monitoring at back side of the free face in the quarry

Plate 5.3.12. View of vibration monitoring at back side of the free face (NE direction)

Plate 5.3.13. View of vibration monitoring at the Orphanage Home opposite to Ayiravalli – Tampura Temple in the S-W Direction

Plate 5.3.14. View of vibration monitoring near mine entry gate in N-W direction

Plate 5.3.15. View of vibration monitoring near the house of Mr. Suresh adjacent to Nettayam - Moonnammoodu Road in the S-W direction

Plate 5.3.16. View of vibration monitoring at backside of free face towards mine entry gate in the N-E direction

Plate 5.3.17. View of vibration monitoring at backside of free face towards the west direction

5.3.6 Ground Vibration and Air Overpressure Results

In total, eleven rounds of experimental blasts were conducted at the quarry, forty-eight ground vibration data were recorded at different locations in and around the quarry. No vibration data were recorded at the chosen monitoring stations near the residential structures/locations. The monitoring seismographs could not record the ground vibration at these locations, as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distances of vibration monitoring points, the magnitudes of recorded vibration varied from 0.524 to 8.21 mm/s. The monitoring distances from the blasting faces varied between 45 and 250 m. The graph plotted between vibration (PPV) recorded and concerned distances of the seismographs from the blasting patches is shown in **Figure 5.3.15**. This figure clearly shows that the magnitude of vibration recorded between 50 to 80 m distances from the blasting patches were less than 3.5 mm/s except in two cases where magnitudes were 8.21 mm/s at 50 m and 5.68 mm/s at 63 m. Further, vibrations magnitudes beyond 100 m were less than 2.1 mm/s. The details of recorded ground vibration data are given in **Table 5.3.2**. The waveform reports of some of the recorded ground vibration data are also given in **Annexure-3**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 8.21 mm/s with the associated dominant frequency of more than 230.0 Hz. This was recorded at 50 m distance from blast No. B #5 within the quarry. The maximum charge per delay (Q_{max}) was 0.4 kg whereas total explosive charge (Q_{total}) detonated in the blasting round was 16 kg. The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on

the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 47-249.5 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.3.16**. The FFT analyses reports of some of the vibration data are given in the **Annexure-3**.

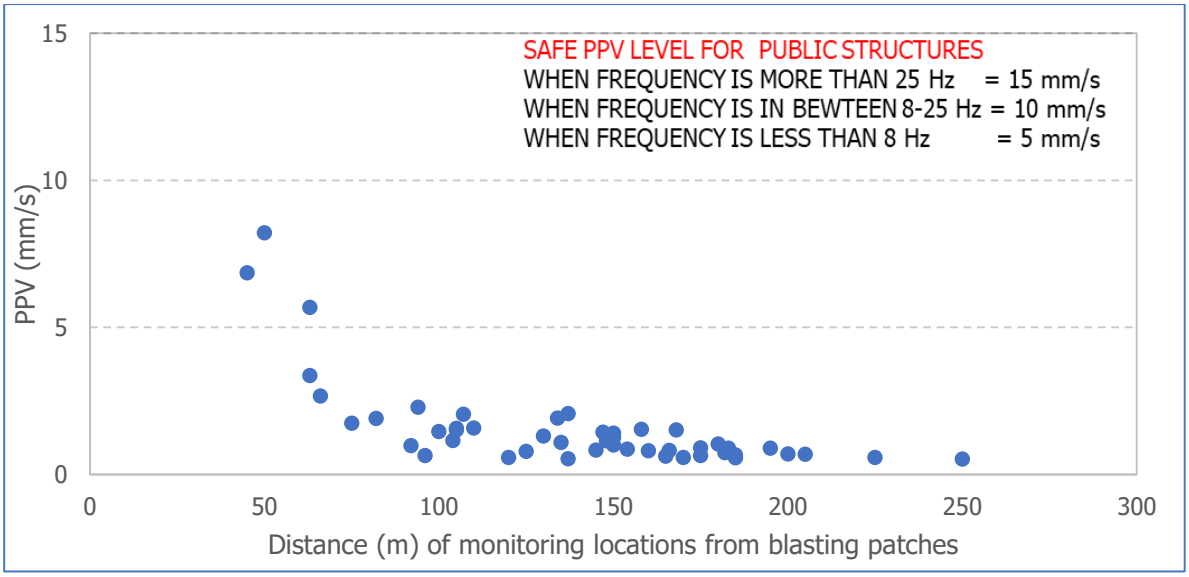


Figure 5.3.15. Plot between recorded vibration (PPV) and distances of seismographs from the blasting patches

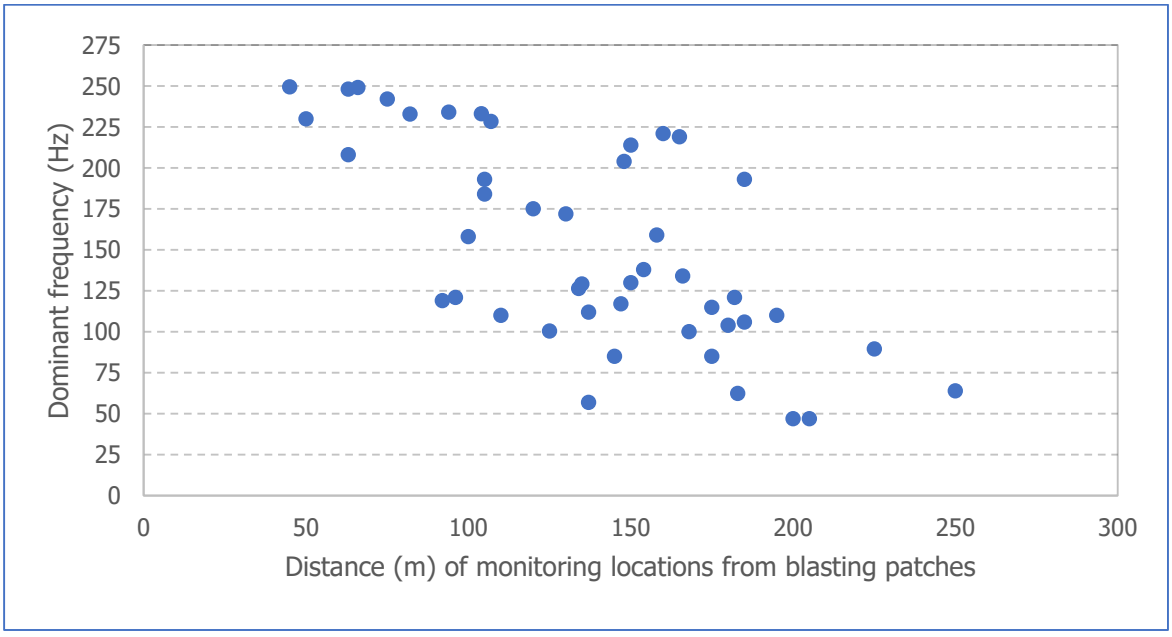


Figure 5.3.16. Plot between recorded frequency and distances of the seismographs from the blasting patches

Table 5.3.2. Blast induced vibration and air over pressure recorded at different locations due to the blast conducted at Granite Building Stone Quarry of M/s POABS Granites Pvt. Ltd., Trivandrum on 21.12.2022

Sl. No.	Location of blast	Max^{m} explosives weight per delay [kg]	Total explosives fired in the round [kg]	Location of vibration measuring transducer	Distance of monitoring from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dBL]
1	N 08°32′30.2″ E 77° 00′26.8″ 34.00 mRL (Lower Bench)	0.59	23.57	❖ Backside near the ramp	107	2.044	228.4	118.2
				❖ Backside near mine entry gate	195	0.898	110	109.9
				❖ Backside (West side)	110	1.58	110	109.9
				❖ Backside (West side)	150	1.26	>100	110.6
				❖ Adjacent to road	160	0.803	221	110.6
				❖ Near Orphanage	320	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	325	<0.5	NA	NA
				❖ In village near Mr. Suresh house	475	<0.5	NA	NA
2	N 08°32′30.9″ E 77° 00′27.2″ 36.00 mRL (Lower Bench)	0.57	11.50	❖ Backside near the ramp	66	2.664	249.0	116.6
				❖ Backside near mine entry gate	154	0.861	138.0	107.0
				❖ Backside (West side)	105	1.51	193.0	111.8
				❖ Backside (West side)	150	1.00	214.0	113.3
				❖ Adjacent to road	190	<0.5	NA	NA
				❖ Near Orphanage	357	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	322	<0.5	NA	NA
				❖ In village near Mr. Suresh house	507	<0.5	NA	NA
3	N 08°32′31.1″ E 77° 00′27.5″ 39.00 mRL (Lower Bench)	0.575	4.60	❖ Backside near the ramp	94	2.29	234.0	110.9
				❖ Backside near mine entry gate	182	0.741	121.0	98.8
				❖ Backside (West side)	100	1.46	158.0	106.0
				❖ Backside (West side)	145	0.823	85.0	112.0
				❖ Adjacent to road	180	<0.5	NA	NA
				❖ Near Orphanage	330	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	320	<0.5	NA	NA
				❖ In village near Mr. Suresh house	480	<0.5	NA	NA
4	N 08°32′30.6″ E 77° 00′26.8″ 34.00 mRL (Lower Bench)	0.57	17.25	❖ Backside near the ramp	75	1.737	242.0	119.6
				❖ Backside near mine entry gate	166	0.813	134.0	109.9
				❖ Backside (West side)	105	1.57	184.0	110.9
				❖ Backside (West side)	148	1.14	204.0	113.5
				❖ Adjacent to road	185	0.568	106.0	113.8

				❖ Near Orphanage	348	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	321	<0.5	NA	NA
				❖ In village near Mr. Suresh house	497	<0.5		
5	N 08°32'31.3" E 77° 00'28.6" 42.00 mRL (Lower Bench)	0.40	16.00	❖ Backside near the ramp	50	8.210	230.0	120.3
				❖ Backside near mine entry gate	135	1.092	129.1	108.8
				❖ Backside (West side)	125	0.783	100.5	113.1
				❖ Backside (West side)	175	0.648	85.0	115.2
				❖ Adjacent to road	180	<0.5	NA	NA
				❖ Near Orphanage	380	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	338	<0.5	NA	NA
				❖ In village near Mr. Suresh house	530	<0.5	NA	NA
6	N 08°32'30.8" E 77° 00'29.2" 44.00 mRL (Lower Bench)	0.37	15.00	❖ Backside near the ramp	63	5.680	248.1	121.1
				❖ Backside near mine entry gate	137	2.071	112.0	111.8
				❖ Backside (West side)	150	1.403	130.0	113.8
				❖ Backside (West side)	200	0.696	47.0	113.1
				❖ Adjacent to road	170	<0.5	NA	NA
				❖ Near Orphanage	376	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	365	<0.5	NA	NA
				❖ In village near Mr. Suresh house	533	<0.5	NA	NA
7	N 08°32'30.7" E 77° 00'29.5" 45.00 mRL (Lower Bench)	0.40	12.0	❖ Backside near the ramp	63	3.362	208.0	118.8
				❖ Backside near mine entry gate	134	1.913	126.4	104.9
				❖ Backside (West side)	158	1.535	159.0	109.9
				❖ Backside (West side)	205	0.690	47.0	113.1
				❖ Adjacent to road	165	0.622	219.0	108.0
				❖ Near Orphanage	378	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	370	<0.5	NA	NA
				❖ In village near Mr. Suresh house	534	<0.5	NA	NA
8	N 08°32'30.4" E 77° 00'29.6" 46.00 mRL (Lower Bench)	0.40	8.00	❖ Backside near the ramp	82	1.909	232.9	116.9
				❖ Backside near mine entry gate	147	1.442	117.0	106.0
				❖ Backside (West side)	175	0.907	115.0	109.2
				❖ Backside (West side)	225	0.582	89.5	112.3
				❖ Adjacent to road	145	<0.5	NA	NA
				❖ Near Orphanage	370	<0.5	NA	NA
				❖ Mine Boundary gate no. 2	388	<0.5	NA	NA
				❖ In village near Mr. Suresh house	530	<0.5	NA	NA

9	N °32'31.55" E 7°00'28.80" 43.00 mRL (Lower Bench)	0.40	24.00	❖ Backside near the ramp ❖ Backside near mine entry gate ❖ Backside (West side) ❖ Backside (West side) ❖ Adjacent to road ❖ Near Orphanage ❖ Mine Boundary gate no. 2 ❖ In village near Mr. Suresh house	45 130 120 170 175 375 333 525	6.85 1.31 0.582 0.582 <0.5 <0.5 <0.5 <0.5	249.5 172.0 175.0 >100 NA NA NA NA	124.8 111.5 109.9 115.9 NA NA NA NA
10	N 08°32'29.9" E 77° 00'30.0" 46.00 mRL (Lower Bench)	0.37	7.50	❖ Backside near the ramp ❖ Backside near mine entry gate ❖ Backside (West side) ❖ Backside (West side) ❖ Adjacent to road ❖ Near Orphanage ❖ Mine Boundary gate no. 2 ❖ In village near Mr. Suresh house	92 180 96 137 183 335 323 489	0.976 1.03 0.648 0.539 0.889 <0.5 <0.5 <0.5	119.0 104.0 121.0 57.0 62.3 NA NA NA	109.5 101.9 105.5 108.4 97.5 NA NA NA
11	N 08°32'29.7" E 77° 00'29.8" 46.00 mRL (Lower Bench)	0.40	4.00	❖ Backside near the ramp ❖ Backside near mine entry gate ❖ Backside (West side) ❖ Backside (West side) ❖ Adjacent to road ❖ Near Orphanage ❖ Mine Boundary gate no. 2 ❖ In village near Mr. Suresh house	104 168 185 250 125 348 403 500	1.150 1.51 0.660 0.524 <0.5 <0.5 <0.5 <0.5	233.1 100.0 193.0 64.0 NA NA NA NA	110.2 103.5 102.8 107.5 NA NA NA NA

Co-ordinate of ground vibration monitoring station

- ❖ Backside near the ramp, N 08°32'32.9" E 77° 00'29.0" 46.00 mRL
- ❖ Backside near mine entry gate, N 08°32'34.9" E 77° 00'31.0" 50.00 mRL
- ❖ Backside (West side), N 08°'32.33.1" E 77° 00'24.8" 33.00 mRL
- ❖ Backside (West side), N 08°'32.33.4" E 77° 00'23.0" 35.00 mRL
- ❖ Adjacent to road, N 08°'32.25.4" E 77° 00'29.5" 35.00 mRL
- ❖ Near Orphanage, N 08°32'20.3" E 77° 00'23.1" 29.00 mRL
- ❖ Mine Boundary gate no. 2, N 08°32'38.0" E 77° 00'19.4"111.00 mRL
- ❖ In village near Mr. Suresh house, N 08°32'16.6" E 77° 00'19.2" 18.00 mRL

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 97.5 at 183 m distances and 124.8 dB(L) at 45 m distances. A plot of air-overpressure of recorded with respect to their concerned monitoring distances are given in **Figure 5.3.17**.

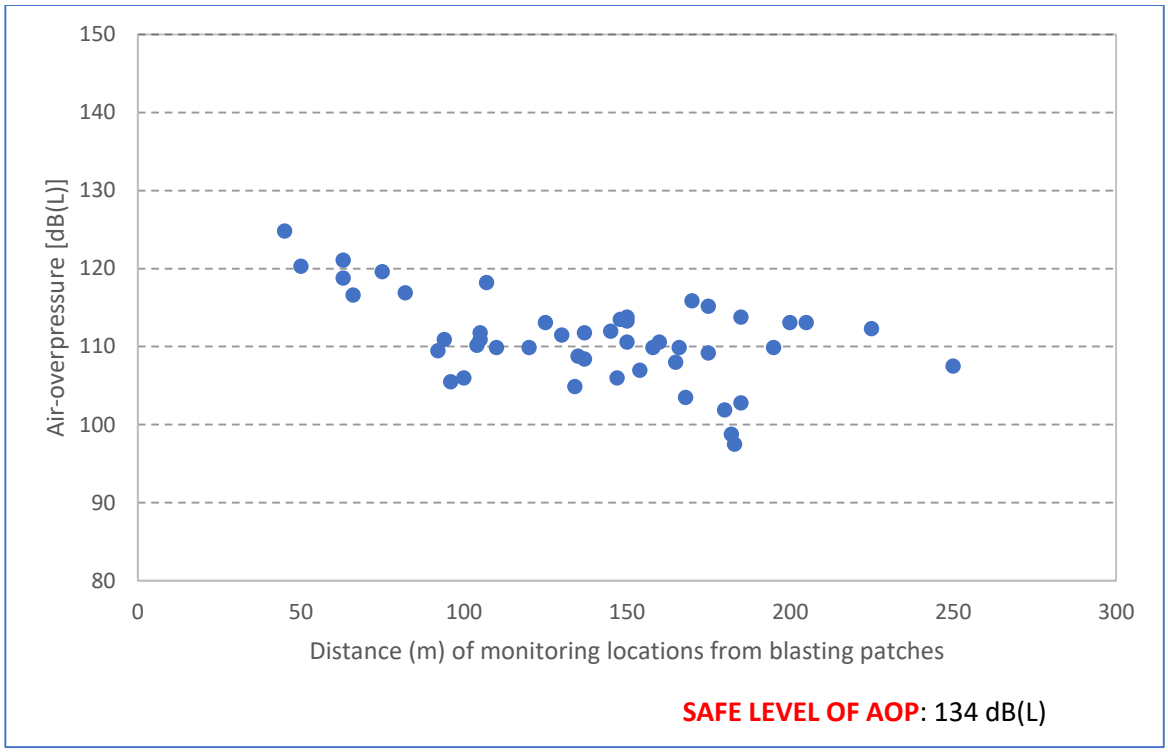


Figure 5.3.17. Plot of air-overpressure versus distance of monitoring locations from the blast faces

5.3.7 Flyrock Results and Observations

In all the experimental blasts, flyrock was controlled. Throws of the blasted materials were also controlled and within the blasting benches only. The use of mechanised crawler mounted drill machine enable to drill greater hole depths where control on flyrocks is better. The use Nonel initiation system also enabled the bottom initiation which provides better control on flyrock ejections. The sequence of rock movement recorded in Blast No. 4 of the experimental trials is shown in **Figure 5.3.18.**

1. Before Blast
2. Starting of Initiation
3. Initial Stage of Rock Movement
4. Middle Stage of Rock Movement
5. Last Stage of Rock Movement
6. Rock Movement Stopped

Figure 5.3.18. View of the sequences of rock movement in Blast No. 4 at granite building stone quarry of M/s POABS Granites Pvt. Ltd., Trivandrum

5.4 PARACKAL STONE QUARRY OF M/S PARACKAL GRANITE KERALA (P) LTD., ERNAKULAM DISTRICT

5.4.1 Brief Information of the Quarry

The Parackal Stone Quarry of M/s Parackal Granite Kerala Private Limited is located at Varapetty village, Kothamangalam Taluk, Ernakulam district of Kerala State. This stone quarry is located at 4.0 km from Kalamboor town and 20 km from Muvattupuzha town. The nearest railhead 'Aluva' is situated about 45 km whereas the nearest airport 'Cochin' is situated at about 65 km from this quarry. The owner of this stone quarry is Mr. P. K. Prasad and total lease area is 7.6606 Ha. This mine is categorized as open-cast-semi-mechanized. View of quarry is given in **Plate 5.4.1**. The field investigation at Parackal Stone Quarry was

carried out during the period of 26th to 29th December, 2022. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 5.4.1. view of Parackal Stone Quarry of M/s Parackal Granite Kerala Private Limited, Ernakulam District

5.4.2 Reconnaissance Survey

Reconnaissance survey was carried out on 26th and 27th December 2022 to identify different types of structures present within the radius of 500 m from the quarry. View of reconnaissance survey and assessment of human response of blasting at one of the houses within the 500 m zone of the quarry is shown in **Plate 5.4.2**. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 100 m from the quarry, there is no residential house or structure.
- The residential structures are available beyond 200 m from the experimental blasting patches.
- One PWD road passes in the NE direction at about 113 m from the mine boundary.

Plate 5.4.2. View of reconnaissance survey at Mrs. Leela Yohanna's house (220 m away from blasting patch) by CSIR-CIMFR and KSPCB team.

5.4.3 Study of Land Profile, Nature of Rock Deposits

The highest elevation of the mine area is 90 m MSL, in the SW central part and lowest is 45 m MSL, in the north direction. Topographically, the area is undulating. Main rock type in the mine area is granite building stone. At places where there are exposed, the granite building stone is medium to coarse grained with dark grey quartz. The soil and over burden thickness (soil-mixed boulders) in the mine area varies between 0.5 m to 5 m (**Plate 5.4.3**). The rebound hardness of rockmass tested using Schmidt hammer was in between 48 to 60 indicating hard rock mass. It was observed that some of the residential houses were located at higher level than the quarry operations.

Plate 5.4.3. Variation in top strata matrix at Parackal Stone Quarry

5.4.4 Experimental Blasts

At Parackal Stone Quarry, ten rounds of experimental blasts were conducted with the varying blast design patternsAll the blasts were conducted with 32 mm blast hole diameter. Marking of holes were carried out at the blasting patch to maintain the exact burden and spacing (**Plate 5.4.4**). Drilling operation using Jackhammer machine is shown in **Plate 5.4.5.** Special arrangement as shown in **Plate 5.4.6** was in practice to de-water the blast holes using compressed air as a prevention against flyrock. Matching small diameter emulsion cartridge explosives of 25 mm diameter, 125 gm weight per cartridge and ANFO wrapped in cartridge form of 25 mm diameter were used for the charging of the blastholes whereas Twin-det Nonel (shock tube) initiation system consisting of 250 ms DTH and 25 ms of TLD were used for the initiation of the charged blastholes (**Plate 5.4.7**). Additionally, TLDs of 42 ms were also used to connect between rows of holes. Coarse sand-mixed stone chips were also used as stemming material to provide sufficient confinement during blasting (**Plate 5.4.8**). Blast design parameters used during the experimental blasts at Parackal Stone Quarry is given in **Table 5.4.1**. Locations of all the blast faces has been demarcated in google map shown in **Figures 5.4.1 - 5.4.2**.

Plate 5.4.4. Marking of drill holes at Parackal Stone Quarry

Plate 5.4.5. Drilling of blast holes using Jackhammer drill machine at Parackal Stone Quarry

Plate 5.4.6. Arrangement to de-water the blast hole prior to charging of explosive

Plate 5.4.7. Emulsion explosive cartridge, ANFO cartridge and Twin-det Nonel detonators

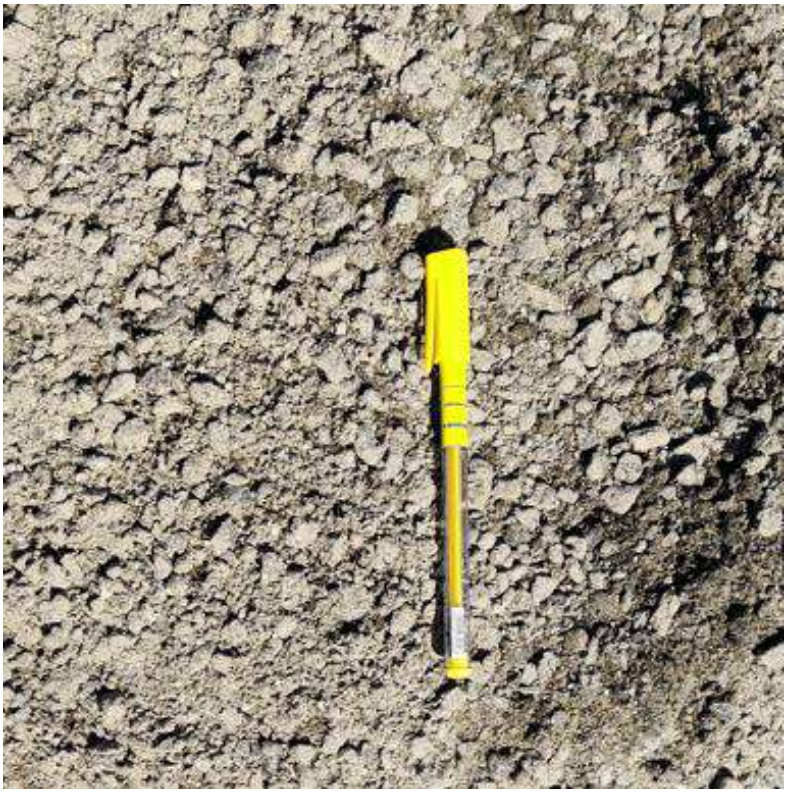


Plate 5.4.8. Stemming material for proper packing of the blast holes

Table 5.4.1. Location of blasts, blast design parameters and type of explosive & accessories used during the study at Parackal Stone Quarry of M/s Parackal Granite Kerala Private on 28.12.2022

S. No.	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Explosive and detonator consumption
									Explosives per hole [kg]	Total explosives detonated [kg]	
1.	N10°00'49.88" E 76° 38'36.66" , 32 mRL	11	32	1.8	1.0	1.2	03	1.1	0.37	4.0	25 mm dia. of Emulsion cartridge explosive, wt. 125 gm, 25 mm ANFO cartridge with Nonel initiation system (DTH/TLD 250/25 ms)
2.	N10°00'49.11" E 76° 38'36.91", 37 mRL	22	32	1.8	1.0	1.0	03	1.1	0.346	7.625	
3.	N10°00'49.86" E 76° 38'36.64", 33 mRL	40	32	1.8	1.0	1.2	04	1.1	0.366	14.625	
4.	N10°00'49.14" E 76° 38'36.88", 35 mRL	22	32	1.8	0.9	0.9	02	1.3	0.295	6.50	
5.	N10°00'48.96" E 76° 38'36.97", 40 mRL	47	32	1.8	1.0	1.2	04	0.9	0.362	17.00	
6.	N10°00'49.33" E 76° 38'37.24", 46 mRL	19	32	1.8	1.0	1.0	03	1.2	0.304	5.775	
7.	N10°00'48.24" E 76° 38'37.04", 50 mRL	55	32	1.8	1.0-1.2	1.2-1.5	06	1.2	0.345	19.00	
8.	N10°00'48.85" E 76° 38'37.09", 48 mRL	20	32	1.5	1.0	1.2	02	0.9	0.368	7.375	
9.	N10°00'48.07" E 76° 38'37.07" , 51 mRL	20	32	1.8	1.0	1.0	03	1.1	0.368	7.375	
10.	N10°00'48.81" E 76° 38'37.07", 48 mRL	11	32	1.8	1.1	1.2	02	1.1	0.363	4.00	

Figure 5.4.1. Goggle map showing location of blasts at Parackal Stone Quarry M/s Parackal Granite Kerala Private Ernakulam District

Figure 5.4.2. Goggle map showing location of blasts and ground vibration monitoring points at Parackal Stone Quarry M/s Parackal Granite Kerala Private Ernakulam District

During the study, it was communicated to the investigating team that twenty numbers of holes of 1.8 m depths with burden varying from 1.0 to 1.2 m and spacing varying from 1.0 to 1.2 m are in practice normally. Considering the existing practices of mine, the experimental blasts were also planned. During the study, the number of holes varied between 11 and 55, hole depth varied from 1.5 to 1.8 m, burden varied from 0.9 to 1.2 and spacing varied from 0.9 to 1.5 m. The average explosive charge per hole varied from 0.30 to 0.37 kg whereas maximum charge per delay varied from 0.3125 to 0.375 kg. The total explosive charge varied from 4.0 to 19.0 kg. Charging of explosive into the blast holes and stemming of holes are shown in **Plate 5.4.9.** A blasting patch ready in all respect prior to blast is shown in **Plate 5.4.10**. The drilling, firing and charging pattern of blasting rounds are depicted in **Figures 5.4.3 to 5.4.12**.

Plate 5.4.9. Charging of explosive into the blast hole and stemming of the charged blast hole

Plate 5.4.10. View of blasting patch, ready to fire

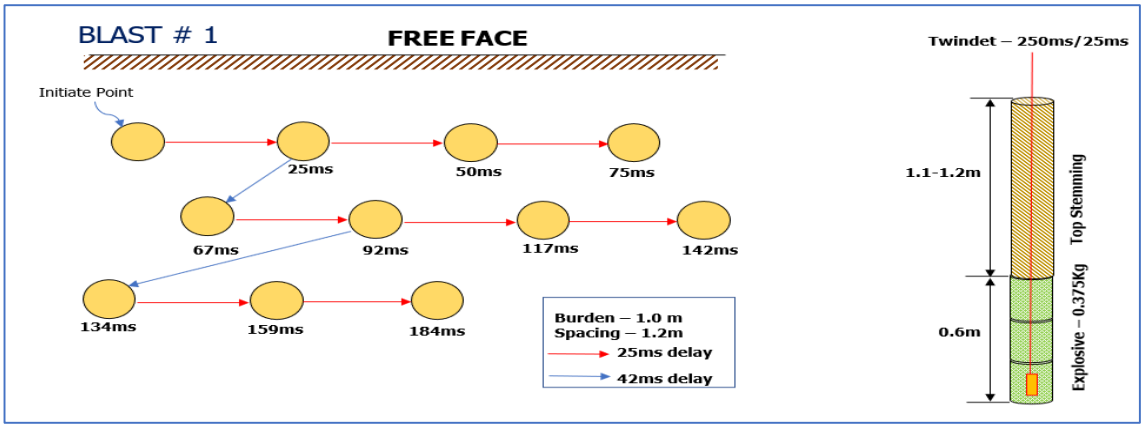


Figure 5.4.3. Drilling, firing and charging pattern of holes in Blast No. 1

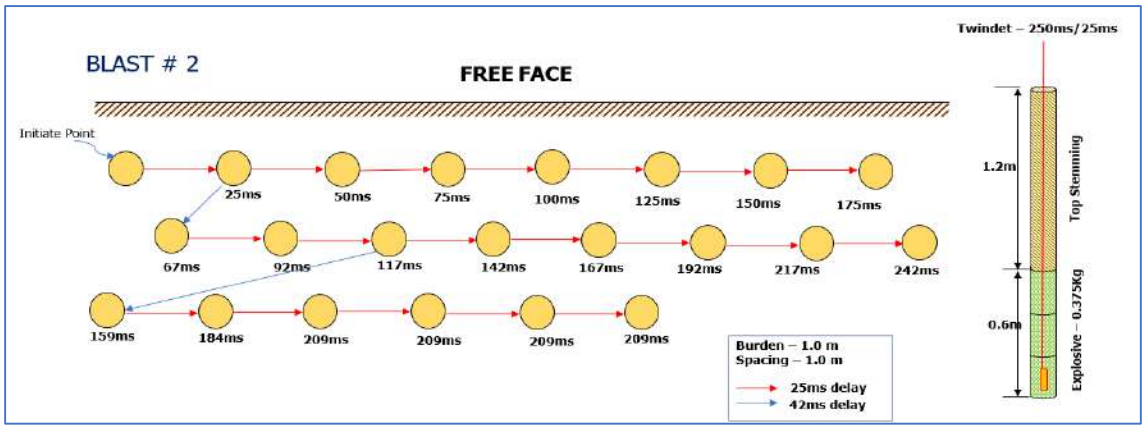


Figure 5.4.4. Drilling, firing and charging pattern of holes in Blast No. 2

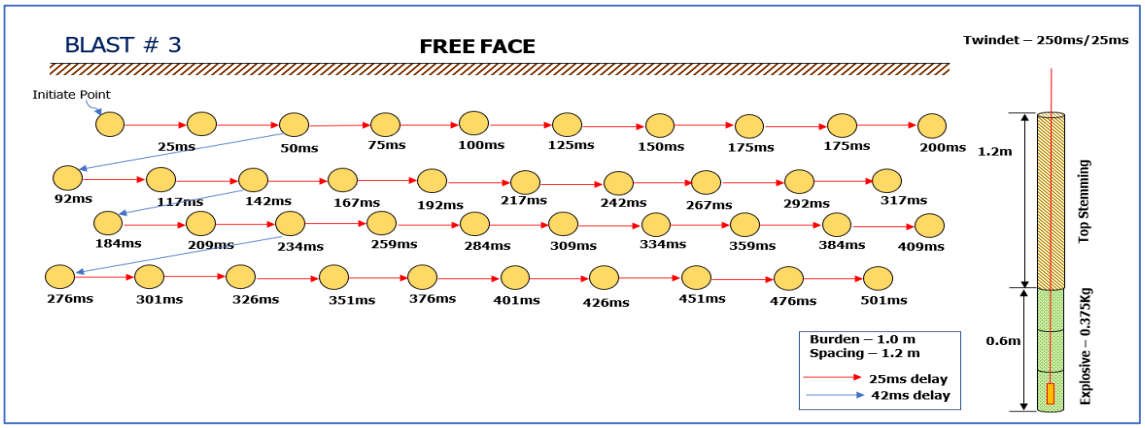


Figure 5.4.5. Drilling, firing and charging pattern of holes in Blast no. 3

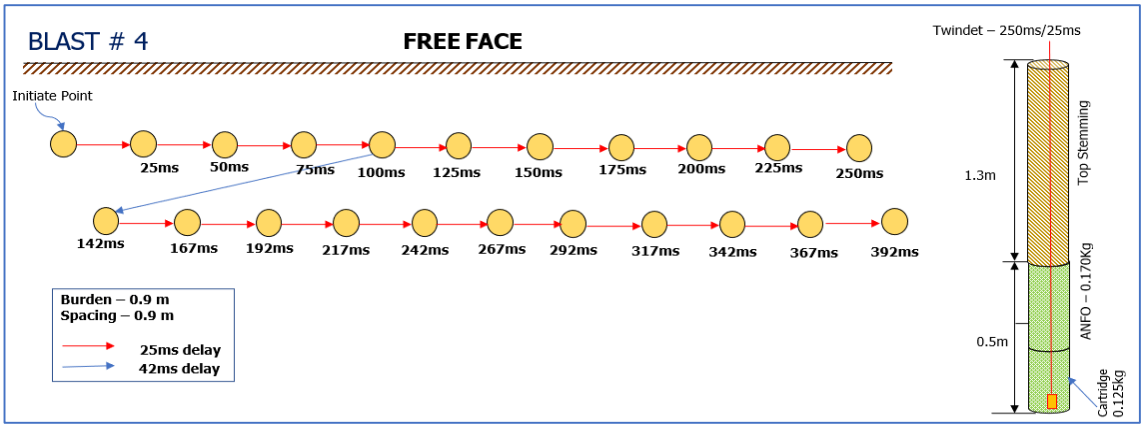


Figure 5.4.6. Drilling, firing and charging pattern of holes in Blast No. 4

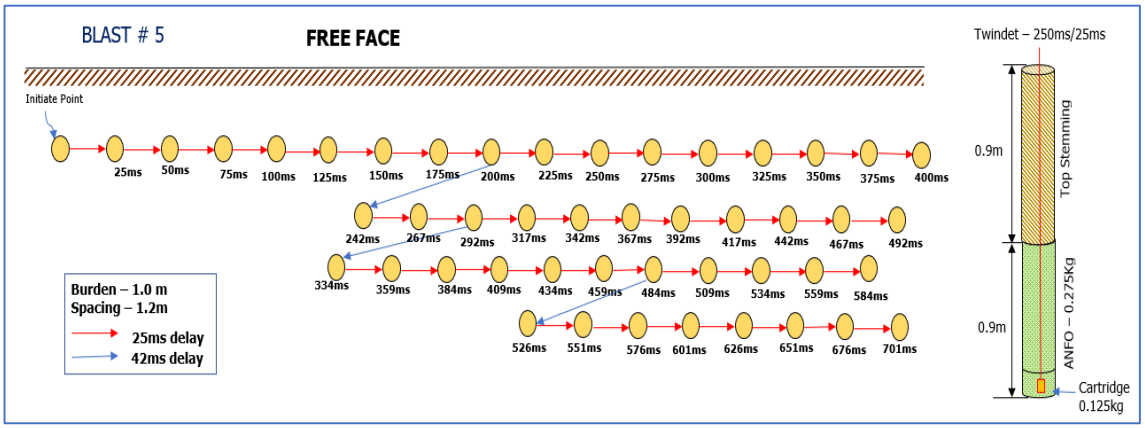


Figure 5.4.7. Drilling, firing and charging pattern of holes in Blast No. 5

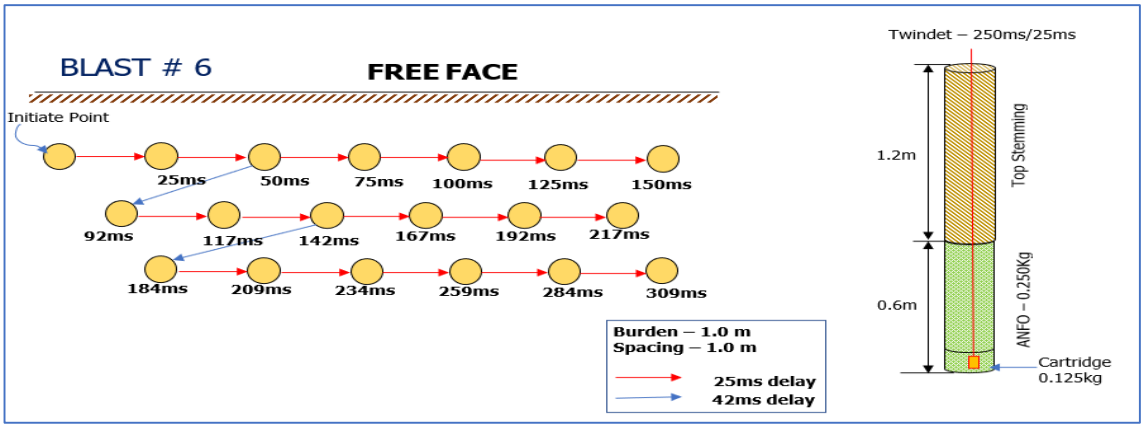


Figure 5.4.8. Drilling, firing and charging pattern of holes in Blast No. 6

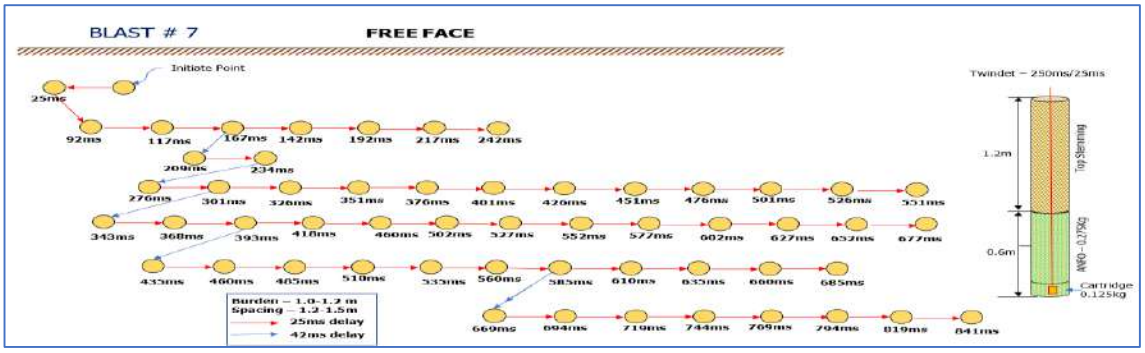


Figure 5.4.9. Drilling, firing and charging pattern of holes in Blast No. 7

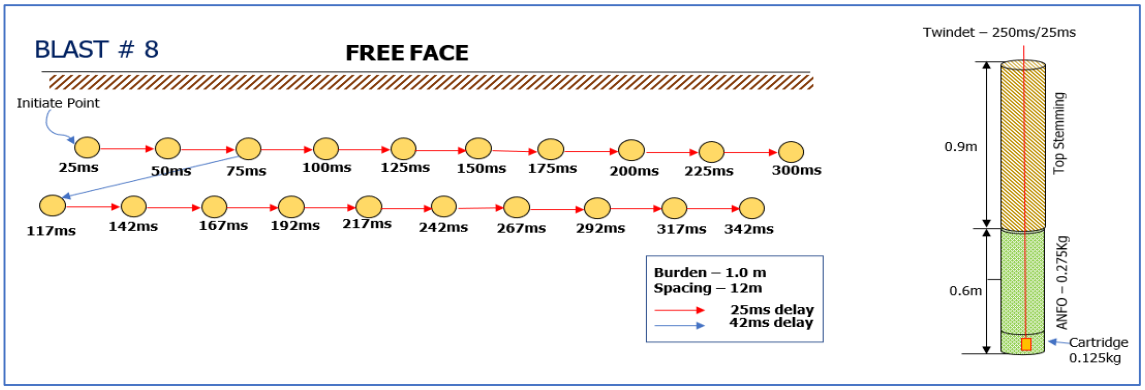


Figure 5.4.10. Drilling, firing and charging pattern of holes in Blast No. 8

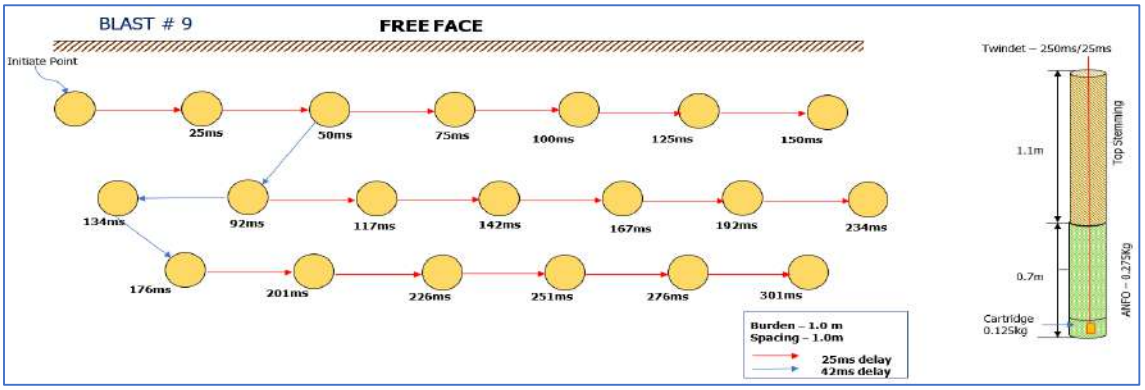


Figure 5.4.11. Drilling, firing and charging pattern of holes in Blast No. 9

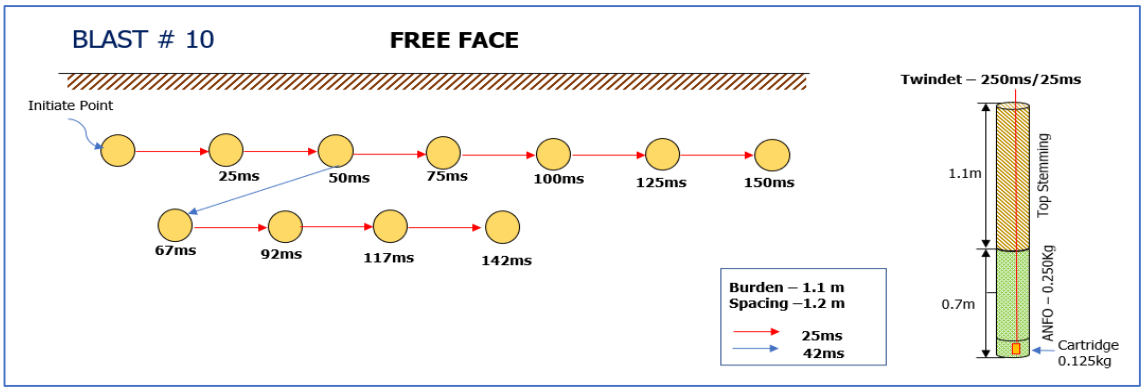


Figure 5.4.12. Drilling, firing and charging pattern of holes in Blast No. 10

5.4.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored at different distances from the blasting patches using eight number of seismographs. The monitoring locations were selected considering the objectives of study to know the magnitude of vibration at 50 m, 75 m, 100 m, 125 m, 150 m, 17 5m, 200 m, 225 m, 250 m and 500 m distances as well as considering the point of interests (viz. public houses). Garmin GPS having ±3 m accuracy was used to find the distances between blasting and monitoring locations. View of vibration monitoring points are given in **Plates 5.4.11 to 5.4.18**. Details of the recorded magnitude of ground vibrations and air-overpressures are given in **Table 5.4.2**.

Plate 5.4.11. Monitoring of ground vibration and air overpressure within the quarry area

Plate 5.4.12. Monitoring of ground vibration and air overpressure on the quarry roadway

Plate 5.4.13. Monitoring of ground vibration and air overpressure near AN mixing Centre

Plate 5.4.14. Monitoring of ground vibration and air overpressure behind AN store

Plate 5.4.15. Monitoring of ground vibration and air overpressure at Jeans' house

Plate 5.4.16. Monitoring of ground vibration and air overpressure at Anthru's house

Plate 5.4.17. Monitoring of ground vibration and air overpressure at Leela's house

Plate 5.4.18. Monitoring of ground vibration and air overpressure in the Latex Garden of Leela's house

Table 5.4.2. Blast induced vibration and air over pressure recorded at different locations at Parackal Stone Quarry, M/s Parackal Granite Kerala Private Limited, Ernakulam District on 28.12.2022.

Blast No.	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dBL]
1.	N10°00'49.88" E 76° 38'36.66"	4.0	0.375	❖Near blasting shelter	55	2.508	141.9	114.8
				❖On the quarry road	62	2.899	108.1	107.5
				❖AN mixing Centre	129	0.813	24.0	104.9
				❖Near AN store	182	<0.5	-	-
				❖Jeans' house	244	<0.5	-	-
				❖Leela's house	219	0.730	64.13	100.0
				❖Latex garden of Leela's house	261	<0.5	-	-
				❖Anthru's house	478	<0.5	-	-
2.	N10°00'49.11" E 76° 38'36.91"	7.625	0.375	❖Near blasting shelter	51	2.750	167.1	114.4
				❖On the quarry road	73	3.334	112.8	107.0
				❖AN mixing Centre	111	1.198	23.38	106.5
				❖Near AN store	163	<0.5	-	-
				❖Jeans' house	228	0.568	63.88	100.0
				❖Leela's house	234	<0.5	-	-
				❖Latex garden of Leela's house	275	0.648	64.88	91.48
				❖Anthru's house	498	<0.5	-	-
3.	N10°00'49.86" E 76° 38'36.64"	14.625	0.375	❖Near blasting shelter	56	4.361	214.0	118.2
				❖On the quarry road	64	4.829	128.0	111.5
				❖AN mixing Centre	130	1.212	24.63	109.2
				❖Near AN store	183	<0.5	-	-
				❖Jeans' house	245	<0.5	-	-
				❖Leela's house	220	0.683	68.63	100.0
				❖Latex garden of Leela's house	262	0.648	60.75	91.48
				❖Anthru's house	479	<0.5	-	-
4.	N10°00'49.14" E 76° 38'36.88"	6.50	0.375	❖Near blasting shelter	51	1.805	195.3	114.4
				❖On the quarry road	73	1.535	110.0	103.5
				❖AN mixing Centre	112	0.635	62.50	97.50
				❖Near AN store	164	<0.5	-	-
				❖Jeans' house	230	<0.5	-	-
				❖Leela's house	233	<0.5	-	-
				❖Latex garden of Leela's house	274	<0.5	-	-
				❖Anthru's house	496	<0.5	-	-

5.	N10°00'48.96" E 76° 38'36.97"	17.00	0.375	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	51 77 107 157 225 242 279 501	5.882 5.585 1.611 0.718 <0.5 0.826 0.813 <0.5	150.6 81.88 23.88 27.13 - 76.63 63.25 -	123.4 117.9 111.2 - - 100.0 97.5 -
6.	N10°00'49.33" E 76° 38'37.24"	5.775	0.3125	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	41 64 106 156 223 222 264 486	4.355 2.968 1.576 0.942 <0.5 0.762 0.582 <0.5	109.9 26.0 25.0 25.75 - 75.63 34.75 -	115.7 109.2 104.9 - - 100.0 91.48 -
7.	N10°00'48.24" E 76° 38'37.04"	19.00	0.375	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	62 96 98 144 212 261 296 518	2.420 1.926 1.867 0.958 0.751 0.953 0.539 <0.5	176.0 26.50 22.88 26.50 61.75 70.00 42.63 -	119.0 114.4 109.2 - 103.5 106.0 97.50 -
8.	N10°00'48.85" E 76° 38'37.09"	7.375	0.375	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	51 78 104 152 220 244 280 502	1.773 1.150 1.845 0.862 <0.5 0.540 <0.5 <0.5	118.9 106.5 24.88 25.25 - 72.63 - -	121.9 115.2 111.8 - - 100.0 - -

9.	N10°00'48.07" E 76° 38'37.07"	7.375	0.375	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	67 100 97 143 210 264 300 523	5.042 3.619 2.495 1.077 <0.5 1.032 0.696 <0.5	117.5 117.9 23.50 23.25 - 39.88 36.0 -	117.1 108.0 103.5 - - 100.0 <88 -
10.	N10°00'48.81" E 76° 38'37.07"	4.00	0.375	❖Near blasting shelter ❖On the quarry road ❖AN mixing Centre ❖Near AN store ❖Jeans' house ❖Leela's house ❖Latex garden of Leela's house ❖Anthru's house	50 80 103 152 219 245 281 503	3.265 2.067 1.576 0.752 <0.5 1.048 <0.5 <0.5	115.4 28.0 23.38 45.75 - 63.63 - -	116.3 110.9 105.5 - - 100.0 - -

Co-ordinate of ground vibration monitoring station

- ❖ Backside near the ramp, N 08°32'32.9" E 77° 00'29.0" -10.93 mRL
- ❖ Backside near mine entry gate, N 08°32'34.9" E 77° 00'31.0" 2.42 mRL
- ❖ Backside (West side), N 08°'32.33.1" E 77° 00'24.8" 11.09 mRL
- ❖ Backside (West side), N 08°'32.33.4" E 77° 00'23.0" 3.93 mRL
- ❖ Adjacent to road, N 08°'32.25.4" E 77° 00'29.5" 19.78 mRL
- ❖ Near Orphanage, N 08°32'20.3" E 77° 00'23.1" 31.04 mRL
- ❖ Mine Boundary gate no. 2, N 08°32'38.0" E 77° 00'19.4" 118.33 mRL
- ❖ In village near Mr. Suresh house, N 08°32'16.6" E 77° 00'19.2" 21.69 mRL

5.4.6 Ground Vibration and Air Overpressure Results

In total, fifty-two ground vibration data were recorded at different locations in and around the quarry. At few instances, specially near the residential structures/locations situated beyond 150 distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, the magnitude of recorded vibration varied from 0.539 to 5.882 mm/s. The monitoring distances from the blasting faces varied between 41 and 300 m. The graph plotted for vibration (PPV) recorded and concerned distances of seismographs from the blasting patches is shown in **Figure 5.4.13**. The figure clearly shows that the magnitude of vibration recorded between 50 and 80 m distances from the blasting patches were less than 5 mm/s except in three cases where magnitudes were 5.042, 5.585 and 5.882 mm/s. Further, vibration magnitude recorded between 110 and 300 m distance were less than 1.25 mm/s. Magnitude of vibration recorded at the nearest public structures i.e., at Mrs. Leela's house and Jeans's house were less than 1.1 mm/s. The details of recorded ground vibration data are given in **Table 5.4.2**. The waveform reports of some of the ground vibration data are also given in **Annexure-4**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 5.882 mm/s with the associated dominant frequency of more than 150.6 Hz. This was recorded at 51 m distance from blast No. B #5 within the quarry. The maximum charge per delay (Q_{max}) in the blast was 0.375 kg whereas, total explosive charge (Q_{total}) detonated in the blasting round was 17 kg. The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 22.88 and 214 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.4.14**. The FFT analyses reports of the vibration data are given in the **Annexure-4**.

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied from 91.5 to 123.4 dB(L). A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.4.15**.

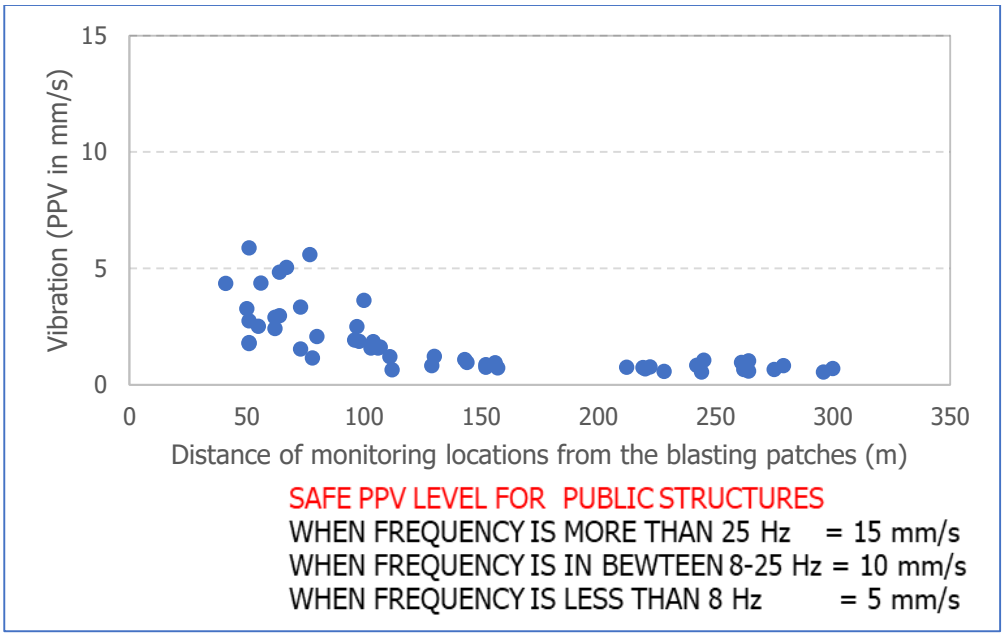


Figure 5.4.13. Plot between PPV and distance of seismographs from the blasting patches

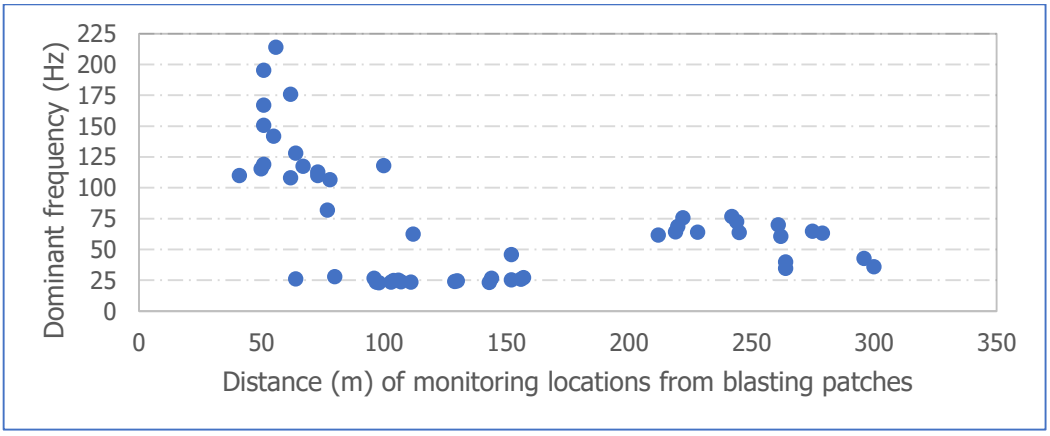


Figure 5.4.14. Plot between frequency and distance of seismographs from the blasting patches

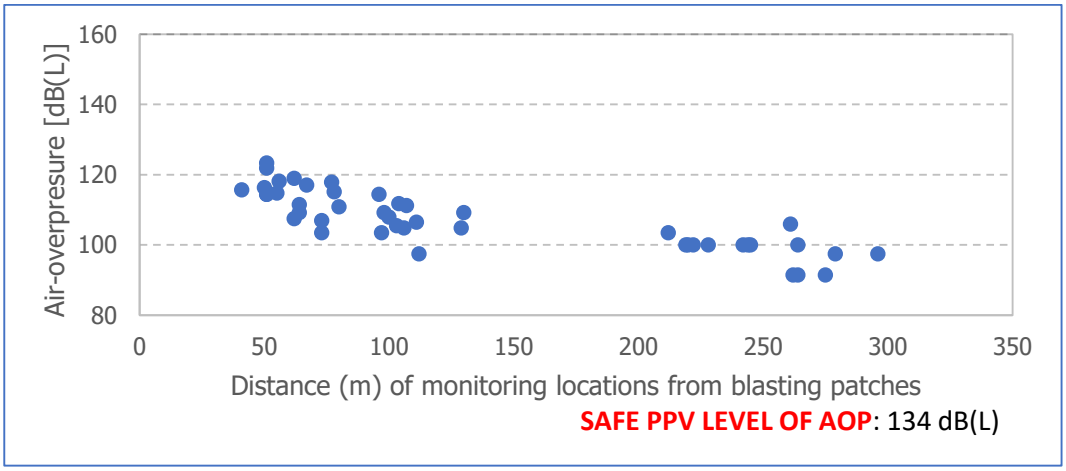


Figure 5.4.15. Plot of air-overpressure versus distance of instruments from the blasting patches

5.4.7 Flyrock Results and Observations

In order to study and analyse the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera. In all the trial blasts conducted during study, no flying fragments were observed or recorded. The throw of blasted materials was controlled and restricted within the blasting area only. **Figure 5.4.16** shows the analysis of rock movement at different stages for one of the experimental blast. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges.

(A) Before Blast

(B) Starting of Rock movement

(C) Initial Stage of Rock movement

(D) Middle Stage of Rock movement

(E) Last Stage of Rock movement

(F) Rock Movement Stopped

Figure 5.4.16. Sequences of rock movements in the experimental blast B-10

5.5 RUBBLE STONE QUARRY OF M/S UNITED GRANITES & METALS PVT. LTD., IDUKKI DISTRICT

5.5.1 Brief Information of the Quarry

The Rubble Stone Quarry of M/s United Granites & Metals Private Limited is located at Manakkad village over an extent of 12.2987 Ha in Thodupuzha Taluk, Idukki district of Kerala State. This stone quarry was started in the year 1998 and is located at 15 km from Thodupuzha town. The nearest railhead 'Aluva' is situated about 45 km in NW direction whereas the nearest airport 'Cochin' is situated at about 40 km in NW direction. This mine is categorized as open-cast-semi-mechanized using drilling and blasting methodology. View of quarry is given in **Plate 5.5.1**. The field investigation at Rubble Stone Quarry was carried out during the period of 1st to 4th January, 2023. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 5.5.1. View of Rubble Stone Quarry of M/s United Granites & Metals Private Limited, Idukki District

5.5.2 Reconnaissance Survey

Reconnaissance survey was carried out on 1st and 2nd January 2023 to identify different types of structures present within the radius of 500 m from the quarry. The lease hold area is surrounded by good vegetation and there are a few houses outside the lease boundary. View of reconnaissance survey and assessment of human response of blasting at two of the houses within the 500 m zone of the quarry are shown in **Plates 5.5.2 and 5.5.3**. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 100 m from the quarry, there is no residential house or structure.
- The residential structures are available beyond 200 m from the quarry.

Plate 5.5.2. View of reconnaissance survey of the nearby structure of Rubble Stone Quarry by CIMFR and KSPCB team.

Plate 5.5.3. View of reconnaissance survey at Rubble Stone Quarry by CIMFR and KSPCB team.

5.5.3 Study of Land Profile, Nature of Rock Deposits

Study on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces was also conducted. Topographically, the area is undulating. The highest elevation of the mine area is 145 m MSL and lowest is 35 m MSL. The drainage of the mine area is towards S, SW to N and NE direction. Main rock type in the mine area is granite building stone. The granite building stone is medium to coarse grained with dark grey quartz. The

soil and over burden thickness (soil-mixed boulders) in the mine area varies between 0.2 m to 3 m (**Plate 5.5.4**). The rock mass was mostly massive with dominance of two sets of joints. Assessment of rebound hardness and joint mapping in this quarry is shown in **Plate 5.5.5**. The joint spacing varied between 0.5 to more than 3 m and indicating massive rock formation. The rebound hardness of rock mass tested on the fresh rock surfaces using Schmidt hammer was in between 55 to 65 indicating hard rock mass (**Plate 5.5.6**). It was observed that some of the residential houses were located at higher level than the present quarry operations.

Plate 5.5.4 Variation in top strata matrix at Rubble Stone Quarry

Plate 5.5.5. Assessment of joints at Rubble Stone Quarry

Plate 5.5.6. Assessment of rebound hardness at Rubble Stone Quarry

5.5.4 Experimental Blasts

At Rubble Stone Mine, ten rounds of experimental blasts were conducted with the varying blast design patterns. The view of blasting faces plotted on google map is shown in **Figure 5.5.1.** All the blasts were conducted with 32 mm blast hole diameter. Drilling operation using Jackhammer machine is shown in **Plate 5.5.7.** Matching small diameter emulsion cartridge explosives of 25 mm diameter, 125 gm weight per cartridge and ANFO were used for the charging of the blastholes, whereas Twin-det Nonel (shock tube) initiation system consisting of 250 ms DTH and 25 ms of TLD were used for the initiation of the charged blastholes (**Plate 5.5.8**). Additionally, TLDs of 42 ms were also used to connect the initiation front between rows. Coarse sand-mixed stone chips were used as stemming material to provide sufficient confinement during blasting (**Plate 5.5.9**).

Plate 5.5.7. Drilling of blast holes at Rubble Stone Quarry

Figure 5.5.1. Google map showing location of blasts and vibration monitoring points at Rubble Stone Quarry of M/s United Granites Pvt. Ltd., Idukki District


Plate 5.5.8. ANFO, Nonel detonators and cartridge explosive used for charging in blast holes at Rubble Stone Quarry

Plate 5.5.9. Stemming material (coarse sand) to fill the blast hole

During the study, it was communicated to the investigating team that the usually mine management conduct a blasting round of maximum 25 to 30 holes of 1.8 m depths with burden varying from 1.0 to 1.1 m and spacing varying from 1.0 to 1.2 m as well as 0.375-0.4 kg of explosive in each hole. Considering the existing practices of mine, the experimental blasts were planned. For some of the blasts, the existing practices were modified to assess the impacts of bigger blasts. The modification in the pattern was done by increasing the

depth of holes from 1.8 to 2.4 m, number of holes from 25 to 60 and charge per hole from 0.375 kg to 0.79 kg. During the study, the number of holes varied between 14 to 60, hole depth varied between 1.5 to 2.4 m, burden varied from 0.9 to 1.2 and spacing varied from 0.9 to 1.25 m. The average explosive charge per hole varied from 0.375 to 0.79 kg whereas maximum charge per delay varied from 0.375 to 1.3 kg. The total explosive charge varied from 5.3 to 23.725 kg. The drilling, firing and charging pattern of blasting rounds are depicted in **Figures 5.5.2 to 5.5.11**. Blast design parameters used during the experimental blasts at Rubble Stone Quarry is given in **Table 5.5.1**. In one of the blasts, muffling of entire blasting patch using blasting mat was also carried out to observe the impact of muffling to restrict the flyrock during the blasting (**Plate 5.5.10**).

Further to minimise the dust generation during the blasting, all the blasting patches along with additional area of anticipated throw of blasts were sprinkled with water using the mobile tanker as shown in **Plate 5.5.11**. Water mist creation arrangements were installed along the South-eastern boundaries of quarry to have water curtain during the blasting period. This facility would certainly minimise the flow of dust outside the quarry area.

Plate 5.5.10. Muffling of blasting patch using blasting mat

Table 5.5.1. Location of blasts, blast design parameters and type of explosive & accessories used during the study at Rubble Stone Quarry of M/s United Granites Pvt. Ltd., Idukki District on 03.01.2023

S. No.	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		**Type of explosive and accessories used**
									Explosives per hole [kg]	Total explosives detonated [kg]	
1.	N 09°53'44.39" E 76° 38'27.46", 53 mRL	41	32	2.4	1.0	1.2	03	1.4	0.646	26.525	Emulsion cartridge explosive (25 mm dia. 125 gm weight), ANFO and Twin-det (250ms/25 ms) & TLD-42
2.	N 09°53'44.00" E 76° 38'27.13", 53 mRL	27	32	2.4	1.0	1.2	03	1.4	0.625	16.90	
3.	N 09°53'43.85" E 76° 38'26.64", 53 mRL	27	32	2.4	1.0	1.2	03	1.42	0.625	16.90	
4.	N 09°53'43.86" E 76° 38'25.95", 54 mRL	19	32	1.8	1.0	1.2	03	1.0	0.522	9.925	
5.	N 09°53'43.75" E 76° 38'25.61", 54 mRL	30	32	2.4	1.1	1.25	03	1.2	0.790	23.725	
6.	N 09°53'43.12" E 76° 38'24.92", 54 mRL	60	32	1.8	1.0	1.2	03	1.1	0.422	25.375	
7.	N 09°53'42.37" E 76° 38'24.80", 54 mRL	30	32	1.8	0.9	1.0	03	1.2	0.375	11.25	Emulsion cartridge explosive and Twin-det (250ms/25 ms) & TLD-42
8.	N 09°53'44.26" E 76° 38'25.29", 66 mRL	15	32	2.4	1.0	1.2	01	1.4	0.650	9.750	Emulsion cartridge explosive, ANFO and Twin-det (250ms/25 ms)
9.	N 09°53'43.93" E 76° 38'24.83", 66 mRL	17	32	1.8	1.0	1.2	01	1.0	0.422	7.175	
10.	N 09°53'43.47" E 76° 38'24.34", 66 mRL	14	32	1.8	1.0	1.2	01	1.1	0.378	5.30	Emulsion cartridge explosive, ANFO and DTH-250ms & TLD-42

Plate 5.5.11 Water sprinkling arrangement to minimise the dust generation during blasting

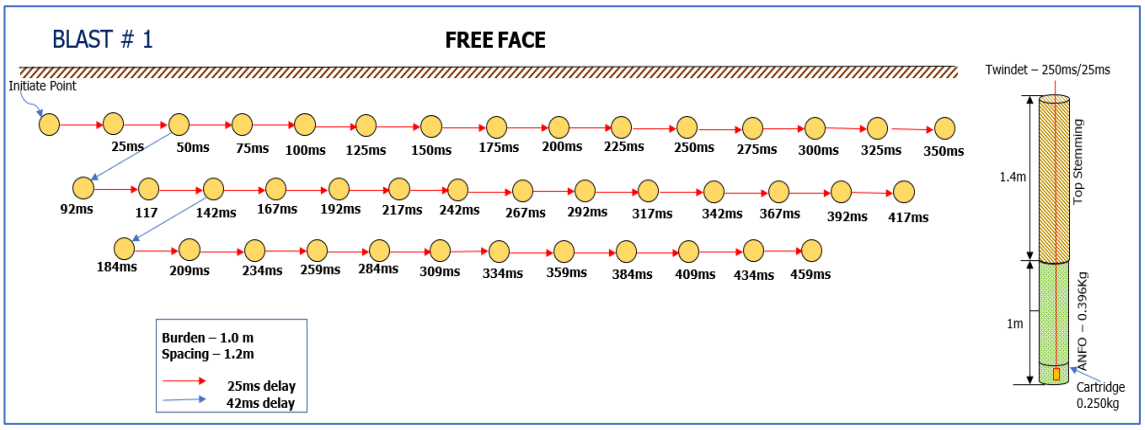


Figure 5.5.2. Drilling, firing and charging pattern of holes of Blast No. 1

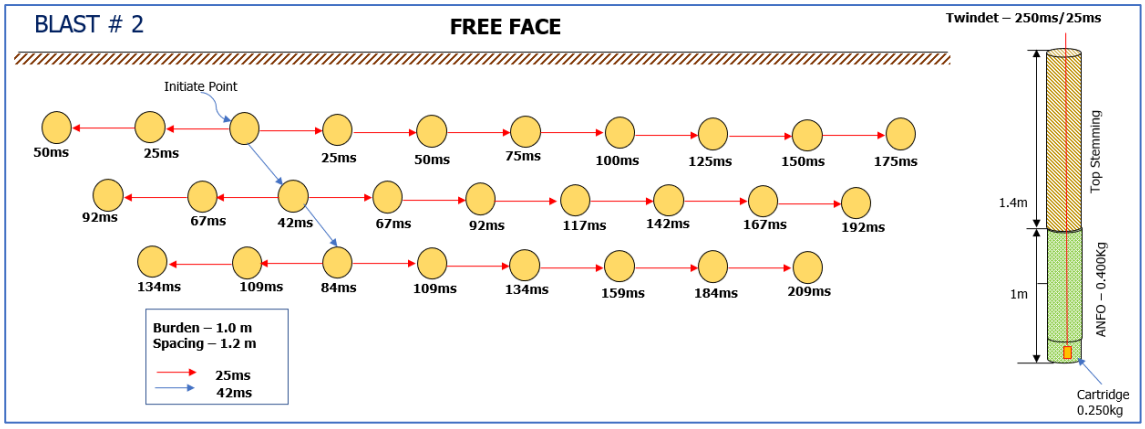


Figure 5.5.3. Drilling, firing and charging pattern of holes of Blast No. 2

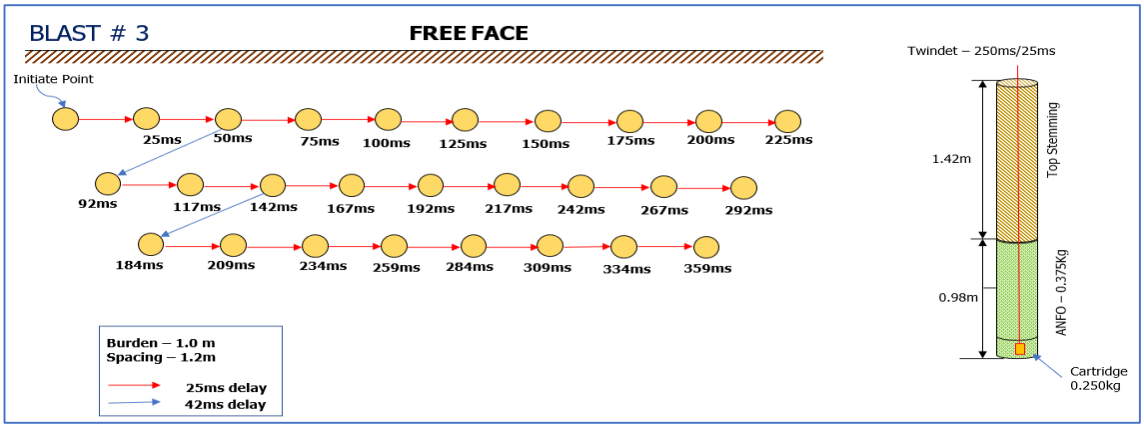


Figure 5.5.4. Drilling, firing and charging pattern of holes of Blast No. 3

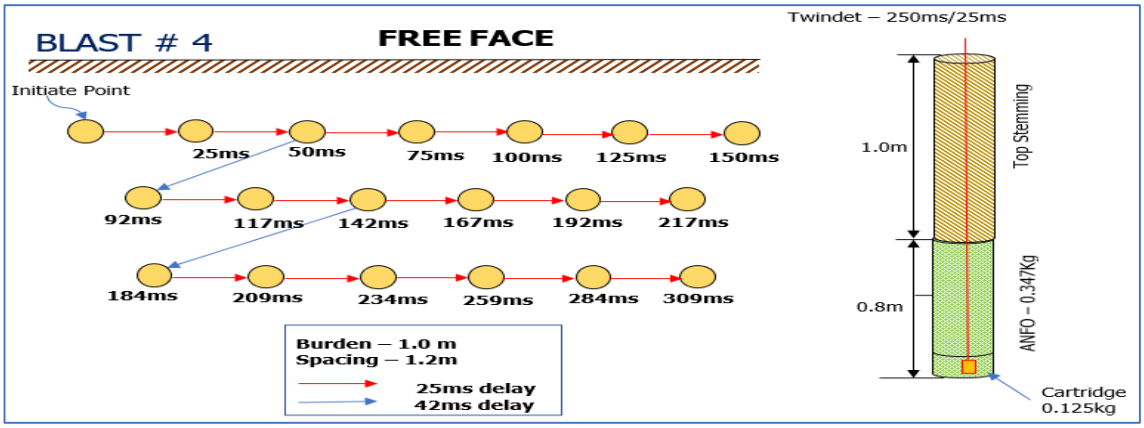


Figure 5.5.5. Drilling, firing and charging pattern of holes of Blast No. 4

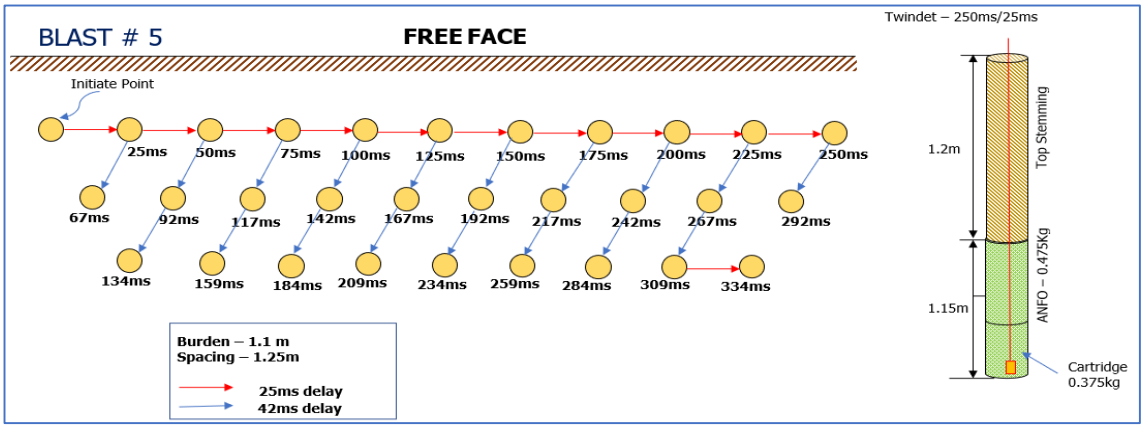


Figure 5.5.6. Drilling, firing and charging pattern of holes of Blast No. 5

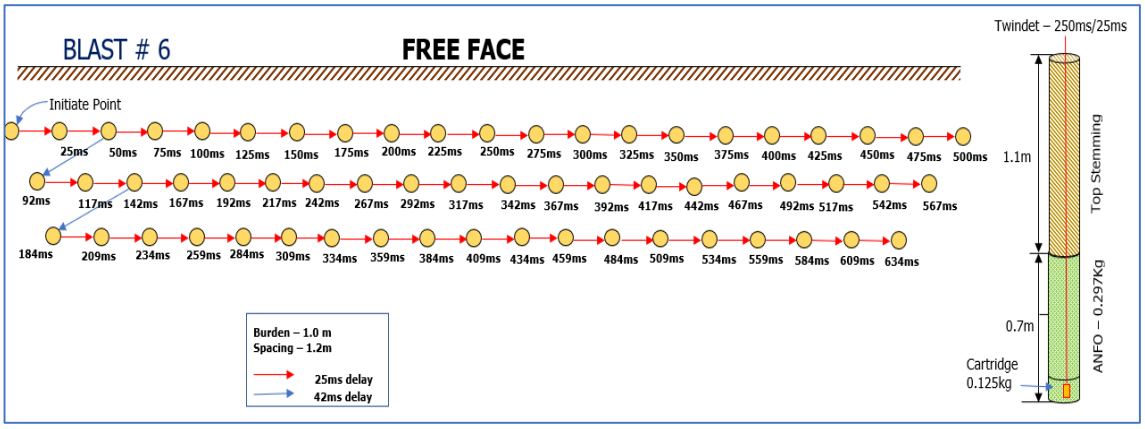


Figure 5.5.7. Drilling, firing and charging pattern of holes of Blast No. 6

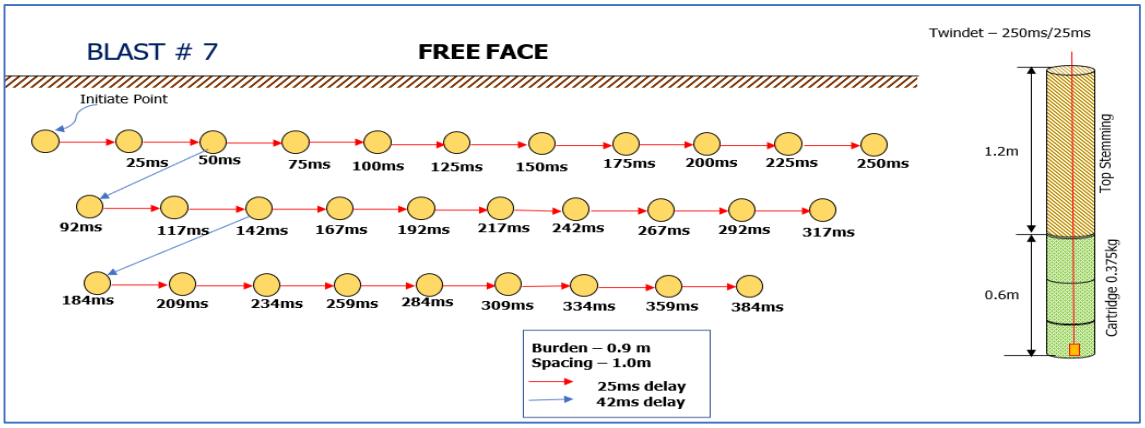


Figure 5.5.8. Drilling, firing and charging pattern of holes of Blast No. 7

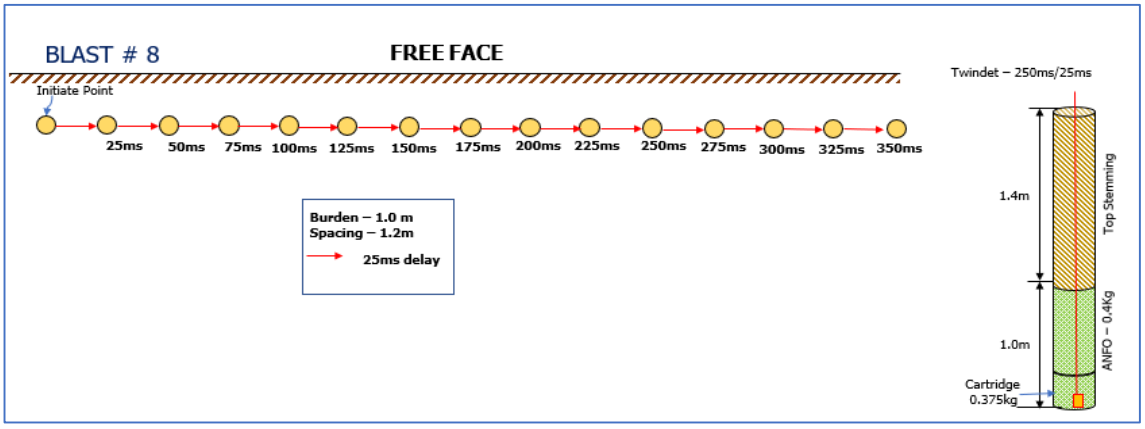


Figure 5.5.9. Drilling, firing and charging pattern of holes of Blast No. 8

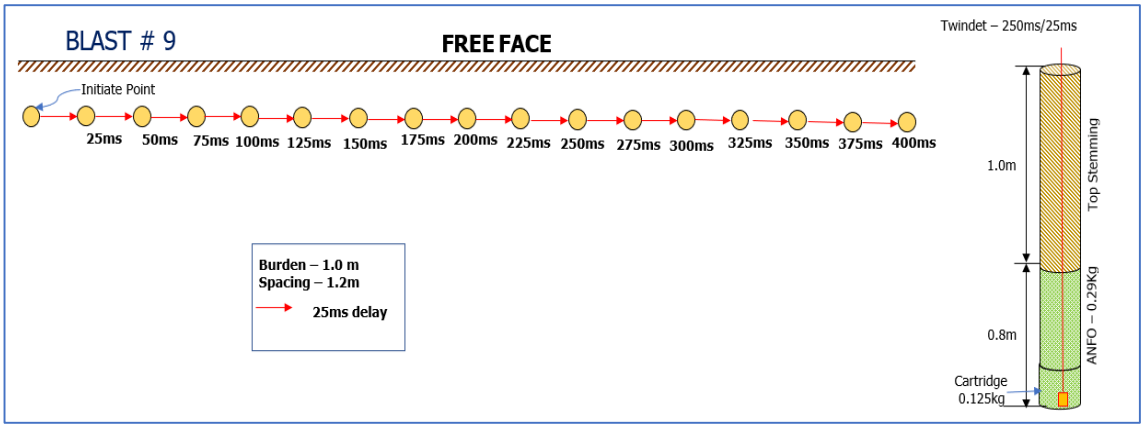


Figure 5.5.10. Drilling, firing and charging pattern of holes of Blast No. 9

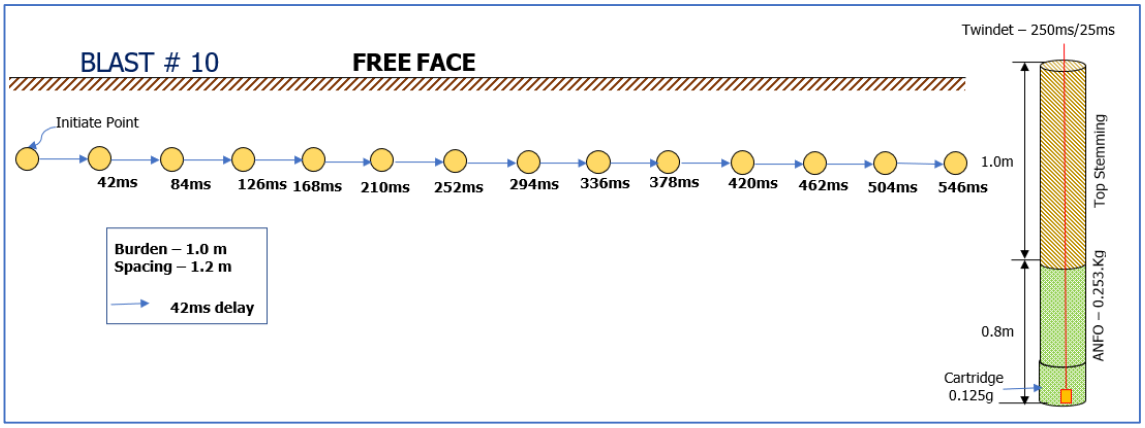


Figure 5.5.11. Drilling, firing and charging pattern of holes of Blast No. 10

5.5.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored at different distances from the blasting patches using eight number of seismographs. The monitoring locations were selected considering the objectives of study to know the magnitude of vibration at 50 m, 75 m, 100 m, 125 m, 150 m, 17 5m, 200 m, 225 m, 250 m and 500 m distances as well as considering the point of interests (viz. public houses). Garmin GPS having ±3 m accuracy was used to find the distances between blasting and monitoring locations. View of vibration monitoring points are given in **Plates 5.5.12 to 5.5.19**. Details of all the recorded ground vibrations with associated dominant frequencies and air-overpressures are given in **Table 5.5.2**.

Plate 5.5.12. Monitoring of ground vibration and air overpressure near mine office

Plate 5.5.13. Monitoring of ground vibration and air overpressure near mine canteen

Plate 5.5.14. Monitoring of ground vibration and air overpressure near crusher plant

Plate 5.5.15. Monitoring of ground vibration and air overpressure in latex garden near MD's house

Plate 5.5.16. Monitoring of ground vibration and air overpressure at Jacob's house

Plate 5.5.17. Monitoring of ground vibration and air overpressure at Thomas' house

Plate 5.5.18. Monitoring of ground vibration and air overpressure at Mary's house

Plate 5.5.19. Monitoring of ground vibration and air overpressure near view point

Table 5.5.2. Blast induced vibration and air over pressure recorded at different locations due to the blast conducted at Rubble Stone Quarry of M/s United Granites Pvt. Ltd., Idukki District on 03.01.2023.

Blast No.	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dB(L)]
1.	N 09°53'44.39" E 76° 38'27.46" 53 mRL	26.525	0.65	❖Near canteen	129	1.545	65.25	108.4
				❖Near crusher plant	185	0.648	50.25	98.84
				❖Near mine office	245	<0.5	NA	NA
				❖Latex garden of MD's house	287	<0.5	NA	NA
				❖Near view point	222	0.925	65.00	113.1
				❖Jacob's house	376	<0.5	NA	NA
				❖Thomas' house	409	<0.5	NA	NA
				❖Mary's house	440	<0.5	NA	NA
2.	N 09°53'44.00" E 76° 38'27.13" 53 mRL	16.90	1.3	❖Near canteen	119	2.148	65.63	107.5
				❖Near crusher plant	178	0.648	33.00	100.0
				❖Near mine office	230	<0.5	NA	NA
				❖Latex garden of MD's house	279	0.556	39.50	100.0
				❖Near view point	226	1.024	64.00	113.1
				❖Jacob's house	359	<0.5	NA	NA
				❖Thomas' house	400	<0.5	NA	NA
				❖Mary's house	443	<0.5	NA	NA
3.	N 09°53'43.85" E 76° 38'26.64" 53 mRL	16.90	0.65	❖Near canteen	105	2.556	68.63	109.5
				❖Near crusher plant	164	0.889	68.00	98.84
				❖Near mine office	215	0.679	56.13	NR
				❖Latex garden of MD's house	265	0.635	74.13	100.0
				❖Near view point	238	1.092	76.25	110.9
				❖Jacob's house	345	<0.5	NA	NA
				❖Thomas' house	385	<0.5	NA	NA
				❖Mary's house	455	<0.5	NA	NA
4.	N 09°53'43.86" E 76° 38'25.95" 54 mRL	9.925	0.475	❖Near canteen	84	1.972	70.63	108.8
				❖Near crusher plant	144	0.648	63.13	98.84
				❖Near mine office	196	<0.5	NA	NA
				❖Latex garden of MD's house	244	<0.5	NA	NA
				❖Near view point	256	0.648	71.13	108.0
				❖Jacob's house	330	<0.5	NA	NA
				❖Thomas' house	364	<0.5	NA	NA
				❖Mary's house	472	<0.5	NA	NA

5.	N 09°53'43.75" E 76° 38'25.61" 54 mRL	23.725	0.85	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	75 136 186 235 265 320 354 483	4.229 1.205 1.045 0.826 0.823 0.696 0.651 <0.5	63.63 93.13 25.25 39.13 68.50 63.00 77.63 NA	112.8 103.5 NR 100.0 113.3 91.48 100.0 NA
6.	N 09°53'43.12" E 76° 38'24.92" 54 mRL	25.375	0.425	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	62 124 159 218 279 291 335 495	2.808 1.670 0.795 0.921 0.648 0.596 <0.5 <0.5	83.38 125.90 56.38 34.88 65.13 69.38 NA NA	112.8 101.0 NR 100.0 116.6 91.48 NA NA
7.	N 09°53'42.37" E 76° 38'24.80" 54 mRL	11.25	0.375	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	76 131 148 222 276 272 333 490	1.611 1.000 0.682 <0.5 <0.5 <0.5 <0.5 <0.5	88.13 43.50 52.00 NA NA NA NA NA	109.2 95.92 NR NA NA NA NA NA
8.	N 09°53'44.26" E 76° 38'25.29" 66 mRL	9.750	0.65	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	63 119 183 223 280 323 242 498	4.214 1.114 0.668 0.587 0.582 <0.5 <0.5 <0.5	63.88 46.25 25.13 46.75 83.38 NA NA NA	111.5 109.2 NR <88 108.4 NA NA NA

9.	N 09°53'43.93" E 76° 38'24.83" 66 mRL	7.175	0.425	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	50 108 165 211 290 307 327 505	3.448 1.448 0.857 1.651 0.696 <0.5 <0.5 <0.5	95.38 43.88 56.00 38.75 67.38 NA NA NA	113.8 101.9 NR 100.0 109.2 NA NA NA
10.	N 09°53'43.47" E 76° 38'24.34" 66 mRL	5.30	0.425	❖Near canteen ❖Near crusher plant ❖Near mine office ❖Latex garden of MD's house ❖Near view point ❖Jacob's house ❖Thomas' house ❖Mary's house	42 99 141 199 299 287 312 514	3.497 1.332 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	65.50 117.9 NA NA NA NA NA NA	116.6 104.2 NA NA NA NA NA NA

- ❖ Near canteen : N 9°53'44.24"; E 76° 38'22.66"; 89 mRL
- ❖ Near crusher plant : N 9°53'44.76"; E 76° 38'21.52"; 79 mRL
- ❖ Near mine office : N 9°53'41.22"; E 76° 38'20.04"; 75 mRL
- ❖ Latex garden of MD house : N 9°53'44.84"; E 76° 38'17.99"; 58 mRL
- ❖ Near view point : N 9°53'40.63"; E 76° 38'33.60"; 66 mRL
- ❖ Jacob's house : N 9°53'36.52"; E 76° 38'18.09"; 60 mRL
- ❖ Thomas' house : N 9°53'44.46"; E 76° 38'14.28"; 45 mRL
- ❖ Mary's house : N 9°53'35.35"; E 76° 38'40.09"; 85 mRL

5.5.6 Ground Vibration and Air Overpressure Results

In total, forty-three ground vibration data were recorded at different locations in and around the quarry. At few instances, specially near the residential structures/locations situated beyond 150 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, the magnitudes of recorded vibration varied from 0.556 to 4.229 mm/s. The monitoring distances from the blasting faces varied between 42 and 354 m. The graph plotted between vibration (PPV) recorded and concerned distances from the blasting patch is shown in **Figure 5.5.12**. This figure shows that the magnitude of vibration recorded at 42 to 354 m distances from the blasting patches were less than 4.3 mm/s. Further, vibrations magnitude beyond 120 m distances were less than 2 mm/s. The details of recorded ground vibration data are given in **Table 5.5.2**. The waveform reports of some of the recorded ground vibration data are given in **Annexure-5**.

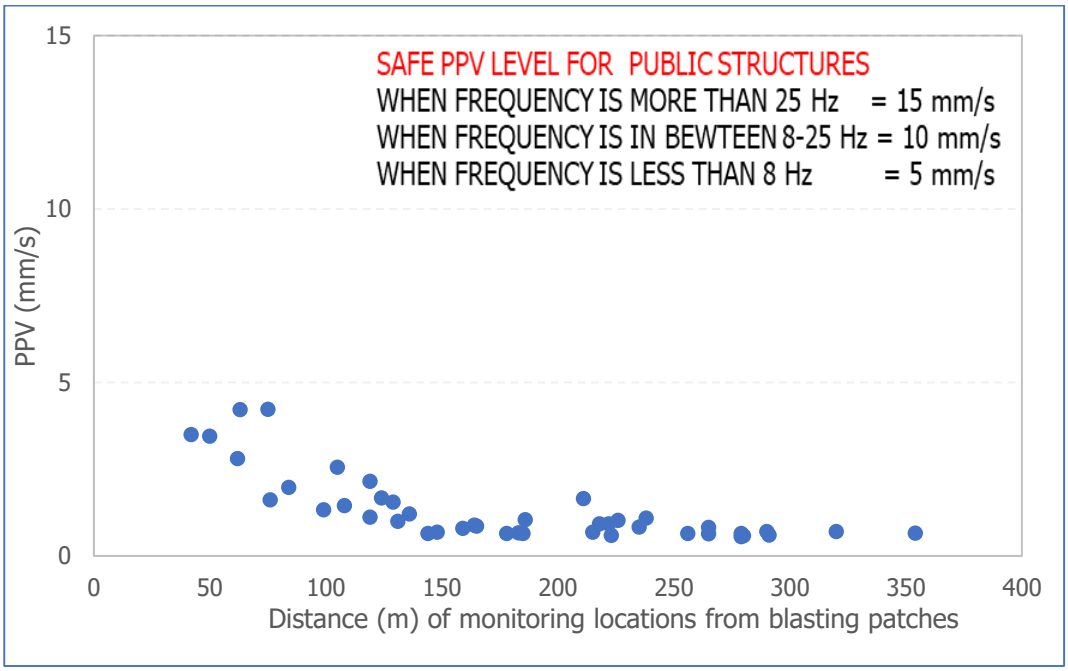


Figure 5.5.12. Plot between recorded vibration (PPV) and distances of the seismographs from the blasting patches

The maximum magnitude of ground vibration recorded from all the experimental blasts was 4.229 mm/s with the associated dominant frequency of more than 63.63 Hz. This was recorded at 75 m distance from blast No. B #5 within the quarry. The maximum charge per delay (Q_{max}) in the blast was 0.85 kg whereas total explosive charge (Q_{total}) detonated in the blasting round was 23.725 kg. With the same blast No. 5, magnitude of vibration recorded near the public structures i.e., at Mr. Jacob's house and Thomas's house were 0.696 mm/s and 0.651 mm/s respectively. The Fast Fourier Transform (FFT) analyses of all the recorded

vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 25.13 and 125.9 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.5.13**. The FFT analyses reports of some of the vibration data are given in the **Annexure-5**.

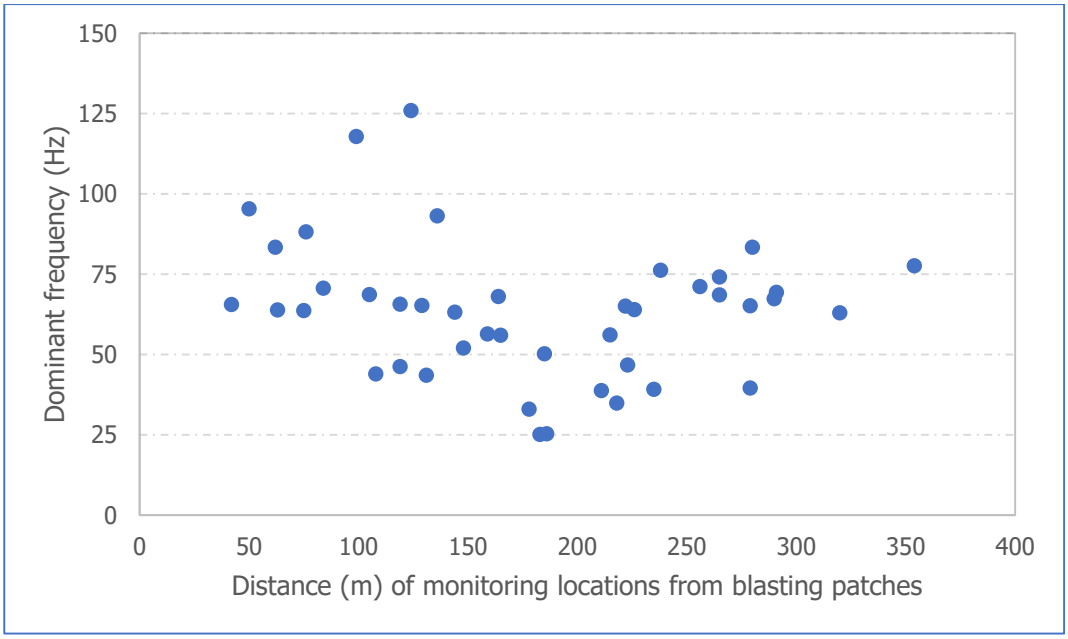


Figure 5.5.13. Plot between dominant frequency and distance of the instruments from the blasting patches

The air overpressure/air-blast levels recorded from the different experimental blasts varied between 91.48 and 116.6 dB(L). A plot of air-overpressure of recorded with respect to their concerned monitoring distances are given in **Figure 5.5.14.**

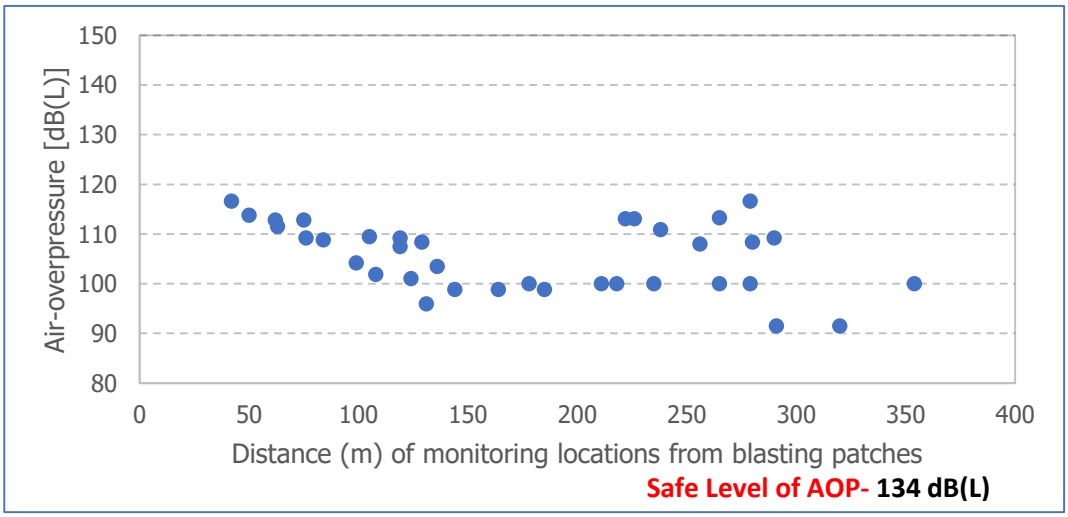
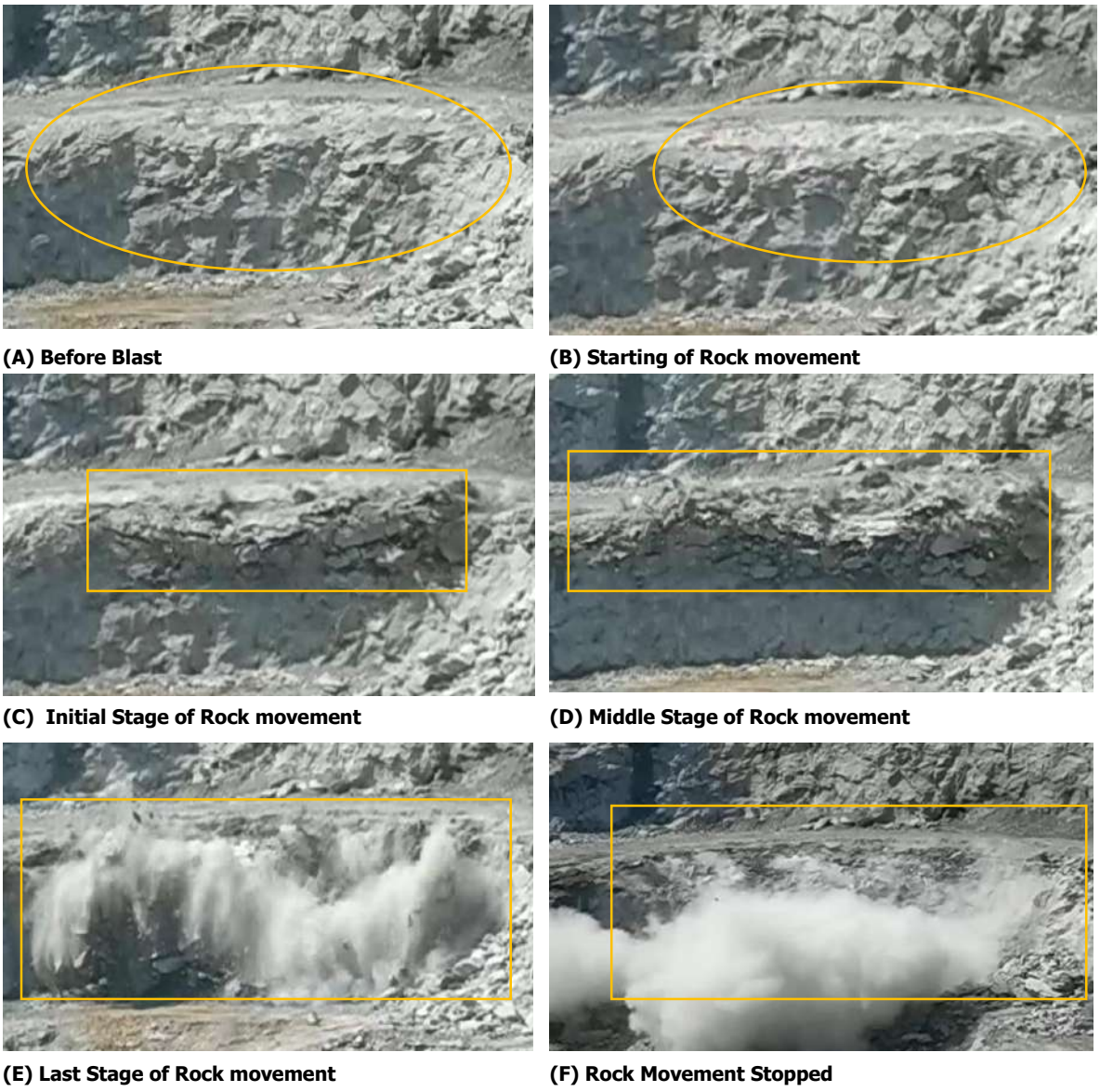


Figure 5.5.14. Plot of air-overpressure with the distance of the instruments from the blasting faces

5.5.7 Flyrock Results and Observations

In order to study and analyze the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera. In all the trial blasts conducted during study period, no flying fragments were recorded. The throw of blasted materials was controlled and restricted within the blasting area only. The recorded sequence of rock movements for one of the experimental blast is shown in **Figure 5.5.15**. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges.



(A) Before Blast **(B) Starting of Rock movement**

(C) Initial Stage of Rock movement **(D) Middle Stage of Rock movement**

(E) Last Stage of Rock movement **(F) Rock Movement Stopped**

Figure 5.5.15. Sequences of rock movements in the experimental blast No. B#6 (60 holes)

5.6 GRANITE STONE QUARRY OF M/S COCHIN BLUE METAL INDUSTRIES LTD., KOTTAYAM DISTRICT

5.6.1 Brief Information of the Quarry

The Granite Stone Quarry of M/s Cochin Blue Metal Industries Limited is located at Ramapuram village over an extent of 4.891 Ha in Meenachil Taluk, Kottayam district of Kerala State. The nearest town adjacent to this quarry is Poovakkulam. This stone quarry is situated at about 28 km from Vaikom Road railway station and Cochin airport is situated about 55 km in NW direction. This mine is categorized as open-cast-semi-mechanized using drilling and blasting methodology. View of quarry is given in **Plate 5.6.1**. The field investigation at this stone quarry was carried out during the period of 5th to 7th January, 2023. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 5.6.1. View of Granite Stone Quarry of M/s Cochin Blue Metal Industries Ltd.

5.6.2 Reconnaissance Survey

Reconnaissance survey was carried out on 5th and 6th January 2023 to identify different types of structures present within the radius of 500 m from the quarry. The lease hold area is surrounded by good vegetation and there are a few houses outside the lease boundary. View of reconnaissance survey and assessment of human response of blasting at two of the houses

within the 500 m zone of the quarry are shown in **Plates 5.6.2 and 5.6.3**. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 100 m from the quarry, there is no residential house or structure.
- A few residential structures are available beyond 200 m from the present workings of the quarry.

Plate 5.6.2. View of reconnaissance survey at Joshi's house by CIMFR and KSPCB team

Plate 5.6.3. View of reconnaissance survey at Shiv Bhawan

5.6.3 Study of Land Profile, Nature of Rock Deposits

Study on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces was also conducted. The project site and buffer zone fall in the Survey of India Toposheet No.58C/9. Topographically, the area is undulating. The drainage of the mine area is towards NW to SE direction. The soil and over burden thickness (soil-mixed boulders) in the mine area varies between 0.1 m to 1 m. Main rock type in the mine area is granite building stone. The rockmass is mostly massive with dominance of three sets of joints. The joint spacing varied between a few centimeters to more than 25 m and indicating massive rock formation. View of different joints and its persistence in the quarry is shown in **Plate 5.6.4**. The rebound hardness of rockmass tested on the fresh rock surfaces using Schmidt hammer was in between 60 to 70 indicating hard rockmass (**Plate 5.6.5**).

Plate 5.6.4. View of different joint sets at Granite stone quarry of M/s Cochin Blue Metal

Plate 5.6.5. Assessment of rebound hardness of insitu rockmass

5.6.4 Experimental Blasts

In total, ten rounds of experimental blasts were conducted with the varying blast design patterns. All the blasts were conducted with 32 mm blast hole diameter. Drilling operation

using Jackhammer machine is shown in **Plate 5.6.6.** Matching small diameter emulsion cartridge explosives of 25 mm diameter, 125 gm weight per cartridge was used for the charging of the blastholes, whereas Twin-det Nonel (shock tube) initiation system consisting of 250 ms DTH and 25 ms of TLD were used for the initiation of the charged blastholes (**Plate 5.6.7**). Due to absence of different time delay series of TLDs at this quarry, 25 ms delay TLD was used to connect the initiation front between rows of holes. Drill cuttings were used as stemming material to provide sufficient confinement during blasting of holes.

Further to minimise the dust generation during the blasting, all the blasting patches along with additional area of anticipated throw of blasts were sprinkled with water using the mobile tanker as well as flexible water pipe line as shown in **Plate 5.6.8**.

Plate 5.6.6. View of drilling of blastholes

Plate 5.6.7. Nonel detonators and cartridge explosive used for charging in blastholes at the quarry

Plate 5.6.8. Water sprinkling arrangement to minimise the dust generation during blasting

During the study, considering the existing practices of mine, the experimental blasts were planned. In some of the blasts, the modifications in the patterns were done to assess the impacts under varying design patterns. The modifications were done by increasing the number of holes and charge per hole. The number of holes varied between 10 to 46, hole depth was 1.5 m, burden varied from 0.9 to 1.1 and spacing varied from 0.9 to 1.2m. The average explosive charge per hole varied from 0.25 to 0.5 kg whereas maximum charge per delay varied from 0.25 to 0.6875 kg. The total explosive charge varied from 2.5 to 14.375 kg. The drilling, firing and charging pattern of blasting rounds are depicted in **Figures 5.6.1 to 5.6.10**. Google maps showing location of experimental blasts and vibration monitoring points are given in **Figure 5.6.11**. Blast design parameters used during the experimental blasts at this Stone Quarry is given in **Table 5.6.1.**

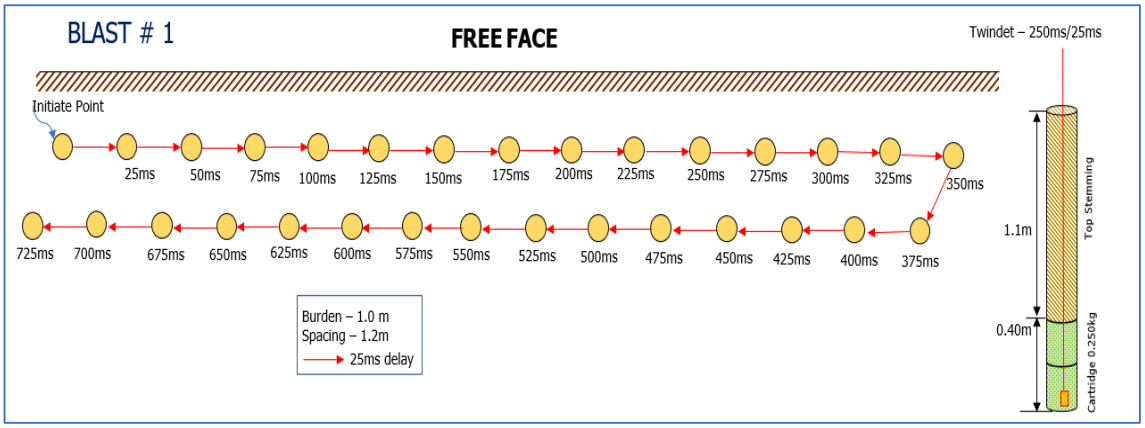


Figure 5.6.1. Drilling, firing and charging pattern of holes in Blast No. 1

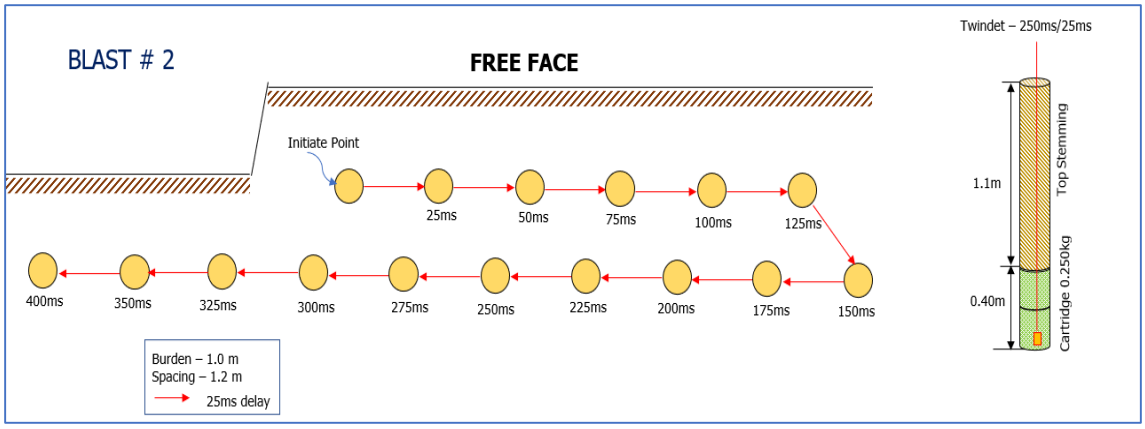


Figure 5.6.2. Drilling, firing and charging pattern of holes in Blast No. 2

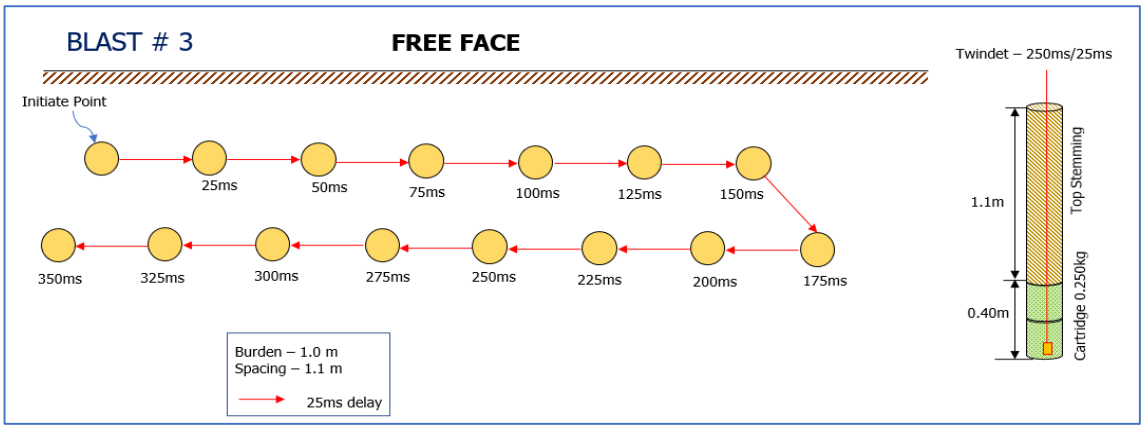


Figure 5.6.3. Drilling, firing and charging pattern of holes in Blast No. 3

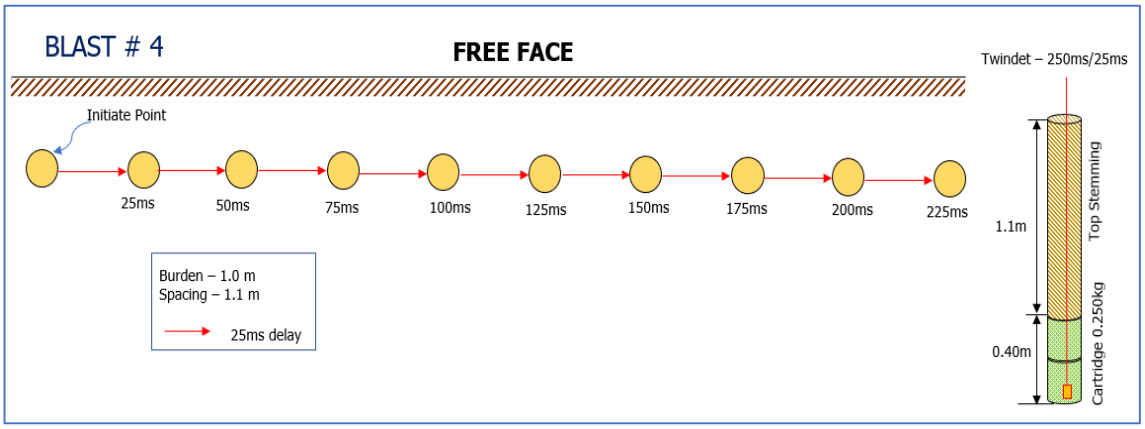


Figure 5.6.4. Drilling, firing and charging pattern of holes in Blast no. 4

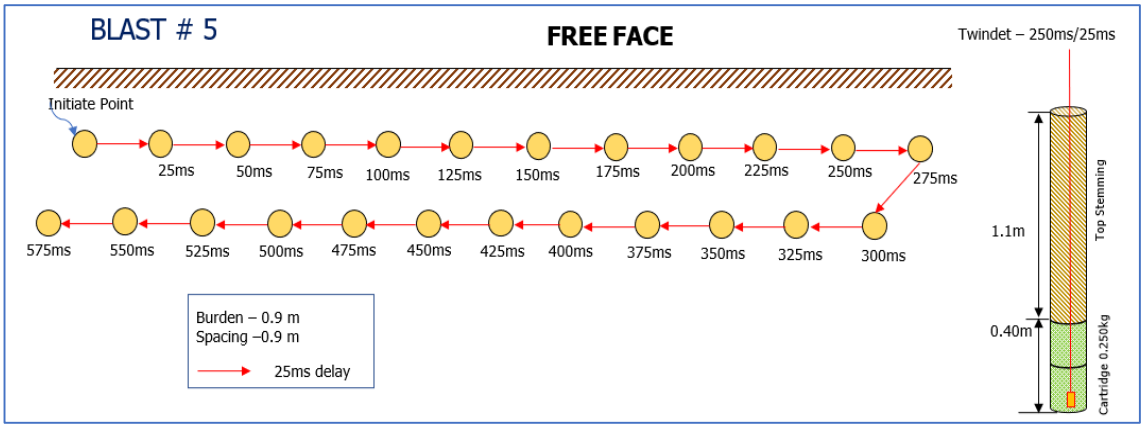


Figure 5.6.5. Drilling, firing and charging pattern of holes in Blast No. 5

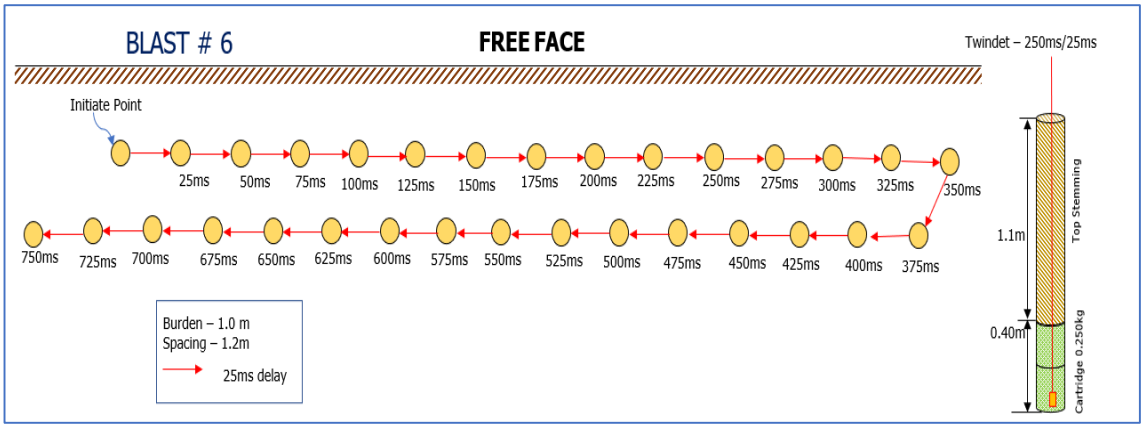


Figure 5.6.6. Drilling, firing and charging pattern of holes in Blast No. 6

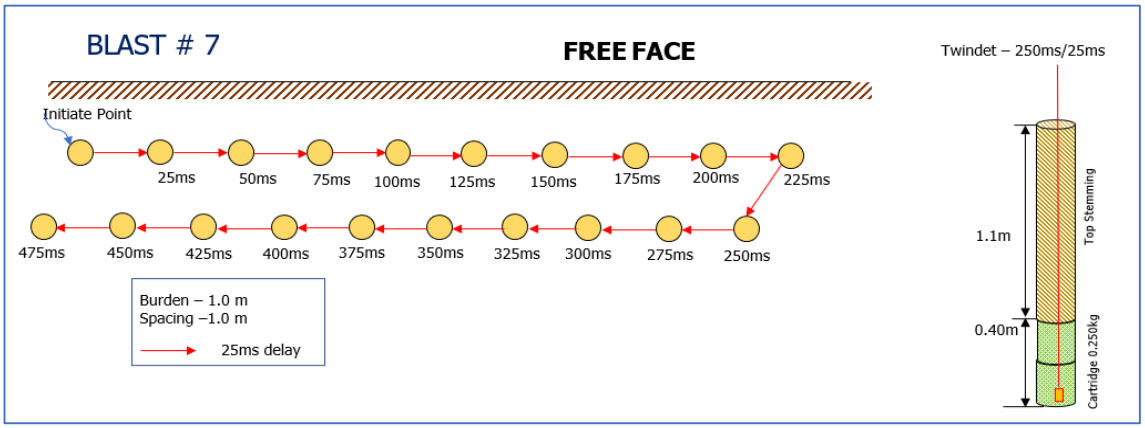


Figure 5.6.7. Drilling, firing and charging pattern of holes in Blast No. 7

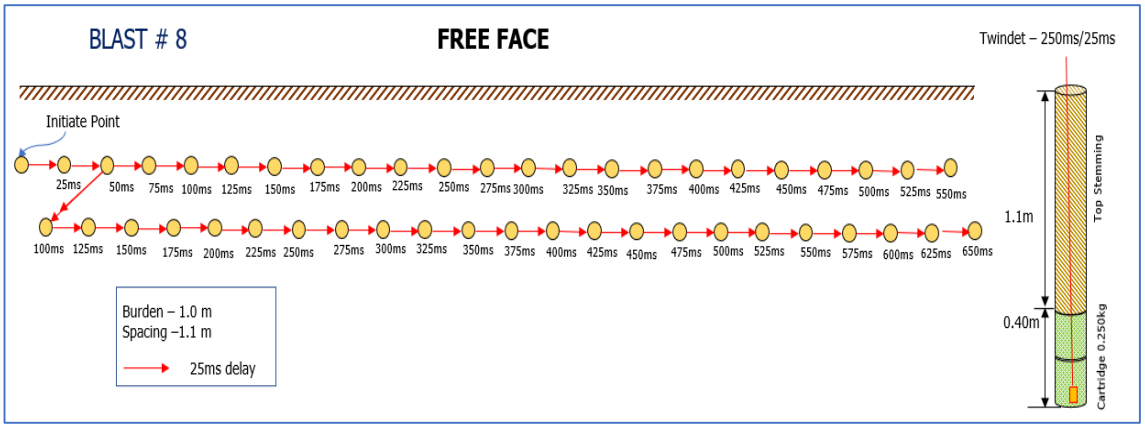


Figure 5.6.8. Drilling, firing and charging pattern of holes in Blast No. 8

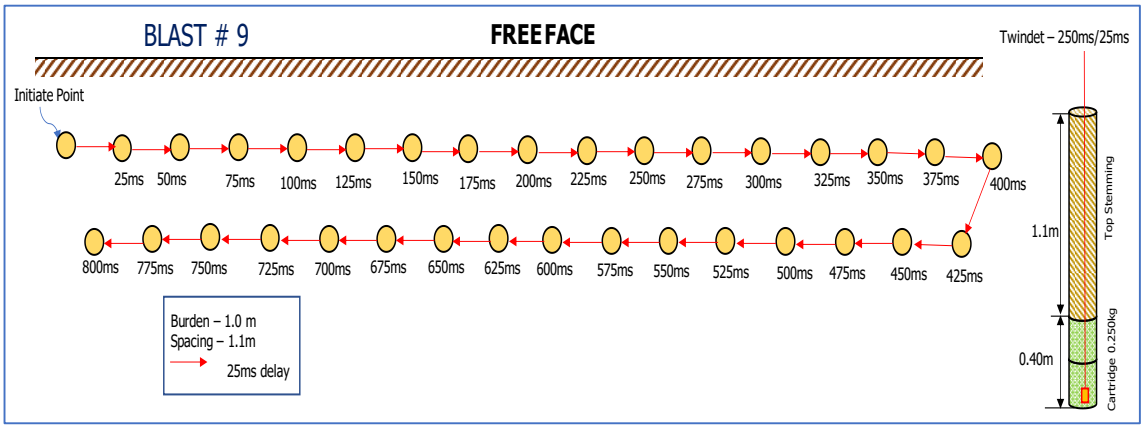


Figure 5.6.9. Drilling, firing and charging pattern of holes in Blast No. 9

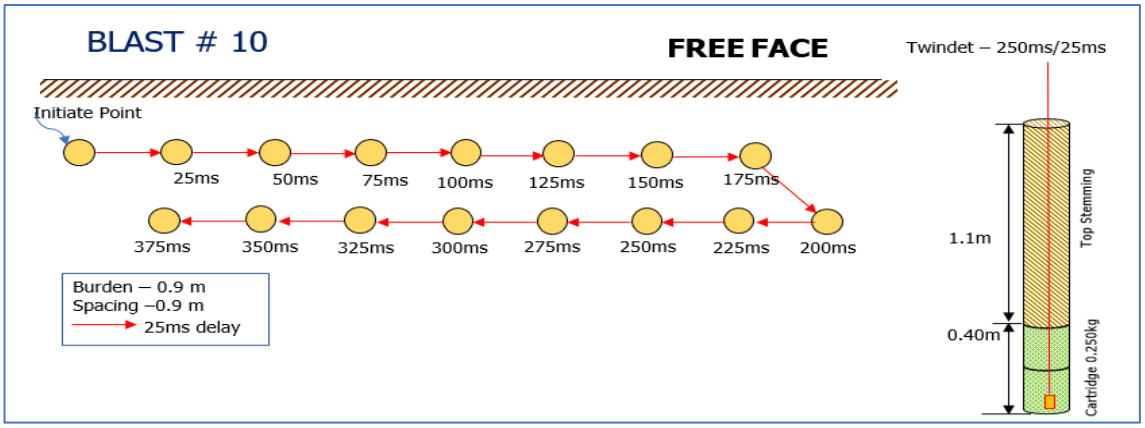


Figure 5.6.10. Drilling, firing and charging pattern of holes in Blast No. 10

Table 5.6.1. Location of blasts, blast design parameters and type of explosive & accessories used during the study at Granite Stone Quarry of M/s Blue Metal Industries Limited, Kottayam District on 06.01.2023

S. No.	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Type of explosive and accessories used
									Av. Explosives per hole [kg]	Total explosives detonated [kg]	
1.	N 09°50′38.58″ E 76° 38′03.41″, 125 mRL	30	32	1.5	1.0	1.2	02	1.1	0.25	7.50	Emulsion cartridge explosive (25 mm dia. 125 gm weight) and Twin-det (250ms/25 ms)
2.	N 09°50′40.31″ E 76° 38′06.13″, 136 mRL	16	32	1.5	1.0	1.1	02	1.1	0.25	4.00	
3.	N 09°50′39.51″ E 76° 38′04.81″, 136 mRL	15	32	1.5	1.0	1.1	02	1.1	0.25	3.75	
4.	N 09°50′41.03″ E 76° 38′04.78″, 136 mRL	10	32	1.5	1.0	1.1	01	1.1	0.25	2.50	
5.	N 09°50′39.81″ E 76° 38′06.57″, 132 mRL	24	32	1.5	0.9	0.9	02	1.1	0.286	6.875	
6.	N 09°50′38.13″ E 76° 38′04.40″, 139 mRL	31	32	1.5	1.0	1.2	02	1.1	0.254	7.875	
7.	N 09°50′38.94″ E 76° 38′04.94″, 136 mRL	20	32	1.5	1.0	1.0	02	1.1	0.25	5.00	
8.	N 09°50′41.80″ E 76° 38′04.61″, 147 mRL	46	32	1.5	1.0	1.1	02	1.0	0.375	17.25	
9.	N 09°50′39.90″ E 76° 38′06.94″, 145 mRL	33	32	1.5	1.1	1.1	02	0.9	0.4356	14.375	
10.	N 09°50′40.20″ E 76° 38′06.43″, 145 mRL	16	32	1.5	0.9	0.9	02	1.1	0.367	5.875	

Figure 5.6.11. Google map showing location of blasts and ground vibration monitoring points at Granite Stone Quarry of M/s Blue Metal Industries Limited Kottayam District

5.6.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored at different distances from the blasting patches using eight number of seismographs. Garmin GPS having ±3 m accuracy was used to find the distances between blasting and monitoring locations. View of vibration monitoring points are given in **Plates 5.6.9 to 5.6.16**. Details of all the magnitude of ground vibrations with associated dominant frequencies and air-overpressures recorded are given in **Table 5.6.2**.

Plate 5.6.9. Monitoring of ground vibration and air overpressure at 5th Bench of the quarry

Plate 5.6.10. Monitoring of ground vibration and air overpressure inside the quarry

Plate 5.6.11. Monitoring of ground vibration and air overpressure near compressor

Plate 5.6.12. Monitoring of ground vibration and air overpressure near Settunath's house

Plate 5.6.13. Monitoring of ground vibration and air overpressure at Shiv Bhavan

Plate 5.6.14. Monitoring of ground vibration and air overpressure near Joshi's house

Plate 5.6.15. Monitoring of ground vibration and air overpressure near crusher plant

Plate 5.6.16. Monitoring of ground vibration and air overpressure Antony's house

Table 5.6.2. Blast induced vibration and air over pressure recorded at different locations due to the blast conducted at Granite Stone Quarry of M/s Blue Metal Industries Limited, Kottayam District on 06.01.2023

Blast No.	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dBL]
1.	N 09°53'44.39" E 76° 38'27.46" 53 mRL	7.50	0.25	❖5th Bench of the quarry	126	1.636	231.3	116.1
				❖District boundary inside the quarry	159	0.648	146.1	104.9
				❖Near compressor	183	<0.5	NA	NA
				❖Near crusher plant	164	0.582	41.50	106.5
				❖Settunath's house	351	<0.5	NA	NA
				❖Shiv Bhavan	345	<0.5	NA	NA
				❖Joshi's house	307	<0.5	NA	NA
				❖Antony's house	575	<0.5	NA	NA
2.	N 09°53'44.00" E 76° 38'27.13" 53 mRL	4.00	0.25	❖5th Bench of the quarry	34	5.145	209.9	116.9
				❖District boundary inside the quarry	69	1.374	96.0	106.5
				❖Near compressor	93	0.700	31.50	NR
				❖Near crusher plant	167	<0.5	NA	NA
				❖Settunath's house	262	<0.5	NA	NA
				❖Shiv Bhavan	305	<0.5	NA	NA
				❖Joshi's house	216	<0.5	NA	NA
				❖Antony's house	493	<0.5	NA	NA
3.	N 09°53'43.85" E 76° 38'26.64" 53 mRL	3.75	0.3125	❖5th Bench of the quarry	55	4.376	194.8	115.0
				❖District boundary inside the quarry	94	1.178	105.8	104.9
				❖Near compressor	115	0.675	35.88	NR
				❖Near crusher plant	172	<0.5	NA	NA
				❖Settunath's house	280	<0.5	NA	NA
				❖Shiv Bhavan	325	<0.5	NA	NA
				❖Joshi's house	241	0.813	95.50	<88
				❖Antony's house	505	<0.5	NA	NA

4.	N 09°53'43.86" E 76° 38'25.95" 54 mRL	2.50	0.25	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	60 193 112 201 275 350 242 498	4.058 1.438 0.781 <0.5 <0.5 <0.5 <0.5 <0.5	223.0 111.3 64.0 NA NA NA NA NA	115.4 104.9 NR NA NA NA NA NA
5.	N 09°53'43.75" E 76° 38'25.61" 54 mRL	6.875	0.3125	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	37 73 98 149 263 279 213 298	2.261 0.933 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	223.9 151.4 NA NA NA NA NA NA	120.3 106.0 NA NA NA NA NA NA
6.	N 09°53'43.12" E 76° 38'24.92" 54 mRL	7.875	0.3125	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	104 145 168 132 333 305 287 565	2.762 1.492 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	232.4 154.3 NA NA NA NA NA NA	117.8 106.5 NA NA NA NA NA NA
7.	N 09°53'42.37" E 76° 38'24.80" 54 mRL	5.00	0.25	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	82 121 144 145 309 310 264 540	0.539 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	249.1 NA NA NA NA NA NA NA	117.9 NA NA NA NA NA NA NA

8.	N 09°53'44.26" E 76° 38'25.29" 66 mRL	17.25	0.6875	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	69 94 110 220 268 365 236 480	4.623 1.497 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	166.8 116.4 NA NA NA NA NA NA	115.2 104.2 NA NA NA NA NA NA
9.	N 09°53'43.93" E 76° 38'24.83" 66 mRL	14.375	0.50	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	28 67 86 149 255 271 200 485	10.42 3.215 1.188 <0.5 <0.5 <0.5 1.024 <0.5	170.3 92.63 53.13 NA NA NA 103.4 NA	126.8 112.0 NR NA NA NA 93.98 NA
10.	N 09°53'43.47" E 76° 38'24.34" 66 mRL	5.875	0.25	❖5th Bench of the quarry ❖District boundary inside the quarry ❖Near compressor ❖Near crusher plant ❖Settunath's house ❖Shiv Bhavan ❖Joshi's house ❖Antony's house	26 67 87 161 250 294 206 484	6.185 1.773 <0.5 <0.5 <0.5 <0.5 <0.5 <0.5	198.6 99.88 NA NA NA NA NA NA	119.0 108.0 NA NA NA NA NA NA

- ❖ 5th Bench of the quarry: N 9°50'41.07"; E 76° 38'06.89"; 161 mRL
- ❖ District boundary inside the quarry: N 9°50'41.73"; E 76° 38'07.80"; 164 mRL
- ❖ Near compressor: N 9°50'42.41"; E 76° 38'08.26"; 173 mRL
- ❖ Near crusher plant: N 9°50'35.13"; E 76° 38'07.62"; 147 mRL
- ❖ Settunath's house: N 9°50'46.01"; E 76° 38'12.52"; 103 mRL
- ❖ Shiv Bhavan: N 9°50'34.22"; E 76° 38'13.65"; 120 mRL
- ❖ Joshi's house: N 9°50'43.69"; E 76° 38'12.45"; 139 mRL
- ❖ Antony's house: N 9°50'53.13"; E 76° 38'15.74"; 93 mRL

5.6.6 Ground vibration and Air Overpressure Results

In total, ten rounds of experimental blasts were conducted at the quarry, twenty-six ground vibration data were recorded at different locations in and around the quarry. At many locations, specially near the residential structures/locations situated beyond 150 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, the magnitudes of recorded vibration varied from 0.539 to 10.42 mm/s. The monitoring distances from the blasting faces varied between 28 and 241 m. The graph plotted between the recorded vibration (PPV) and concerned distances of the monitoring points from the blasting patch is shown in **Figure 5.6.13**. This figure shows that the magnitude of recorded vibration between 50 to 105 m distances from the blasting patches were less than 5 mm/s. Further, vibrations magnitude beyond 110 m distances were less than 2 mm/s. The details of recorded ground vibration data are given in **Table 5.6.2**. The waveform reports of some of the recorded ground vibration data are also given in **Annexure-6**.

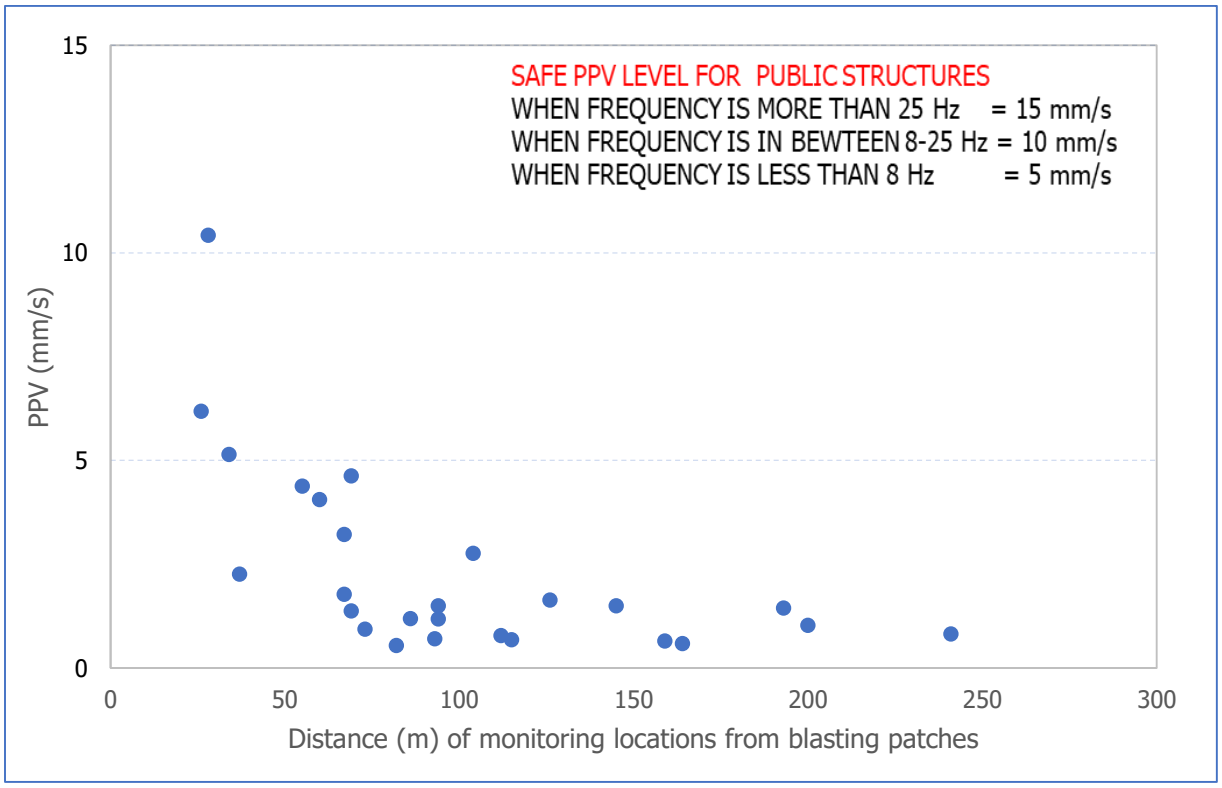


Figure 5.6.13. Plot between recorded vibration (PPV) and distances of seismographs from the blasting patches

The maximum magnitude of ground vibration recorded from all the experimental blasts was 10.42 mm/s with the associated dominant frequency of more than 170.3 Hz. This was

recorded at 28 m distance from blast No. B #9 on 5th Bench within quarry. The maximum charge per delay (Q_{max}) in the blast was 0.5 kg whereas total explosive charge (Q_{total}) detonated in the blasting round was 14.375 kg. With the same blast No. 9, magnitude of vibration recorded at Mr. Joshi's house situated at 200 m was 0.1.024 mm/s. The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 31.5 - 249.1 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.6.14**. The FFT analyses reports of some of the vibration data are also given in the **Annexure-6**.

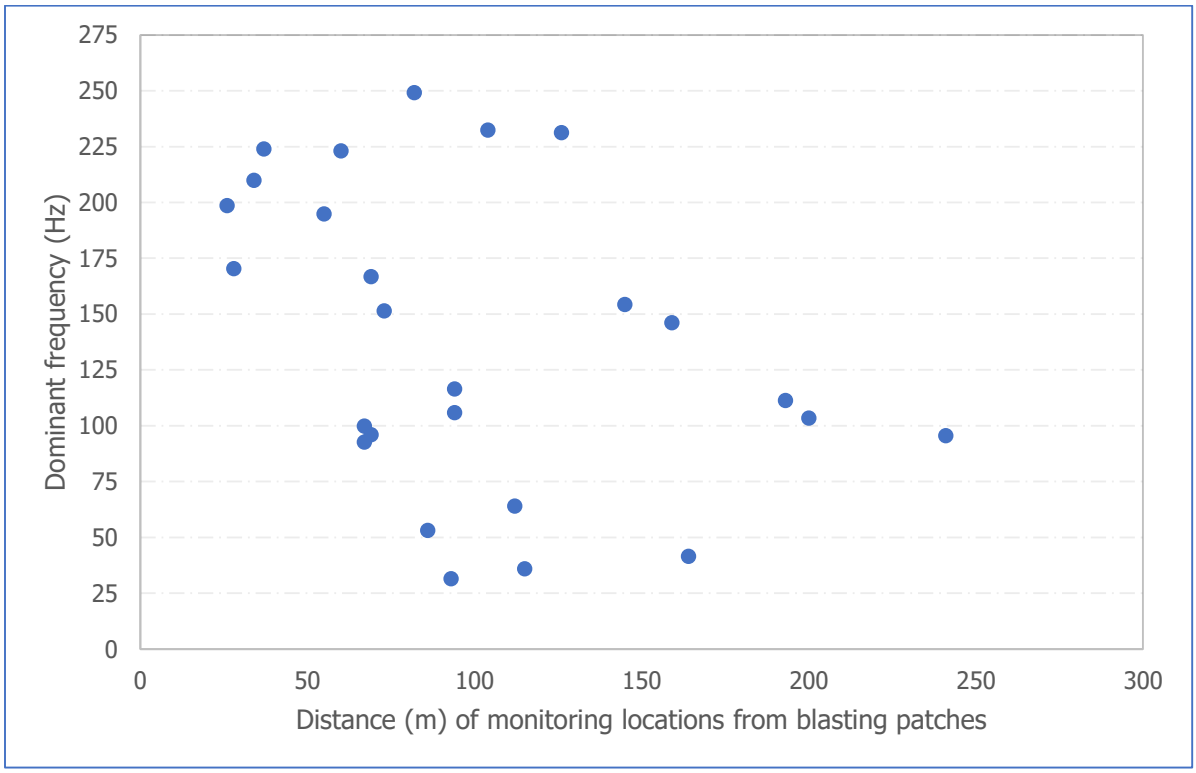


Figure 5.6.14. Plot between dominant frequency of vibration and distances of the seismographs from the blasting patches

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 93.98 and 126.8 dB(L). A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.6.15**.

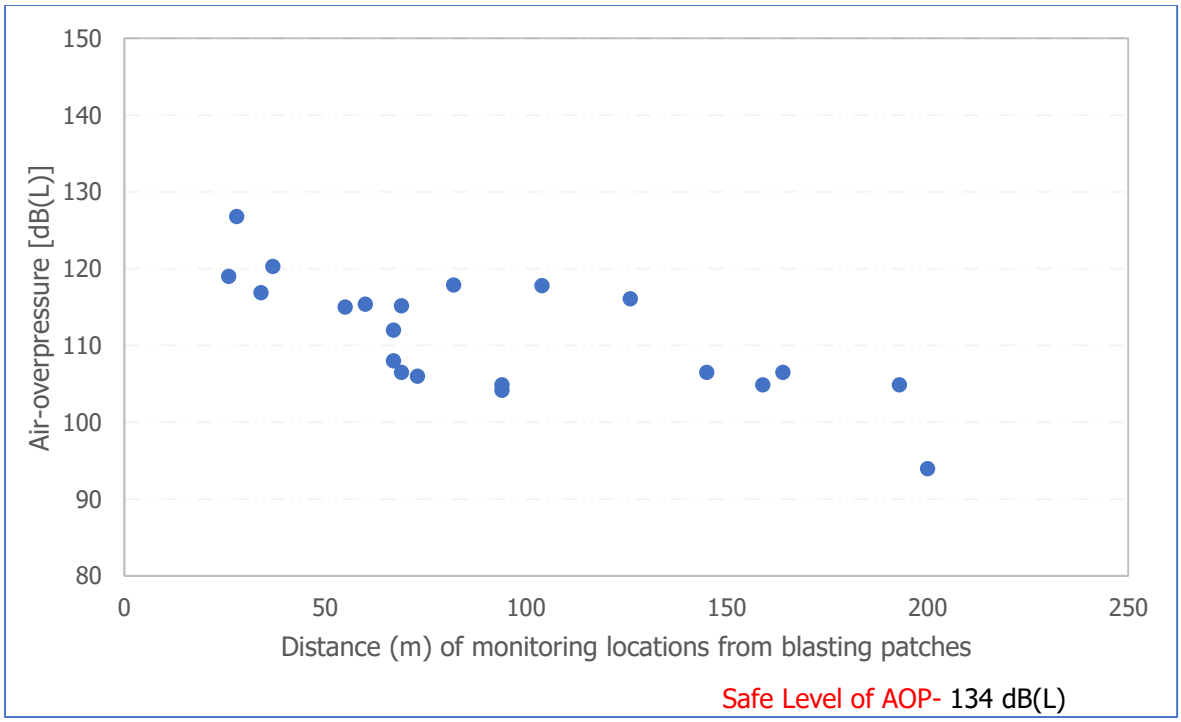


Figure 5.6.15. Plot of recorded air-overpressure versus distance of monitoring locations from the blasting faces

5.6.7 Flyrock Results and Observations

In order to study and analyze the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera to observe any occurrence of flyrock and its source. In one blast, (Blast No. 8), flyrock occurred due to face burst. However, the approximate distance of flyrock was within 25 m. The throw and flyrock of blasted materials were within the blasting area only (**Figure 5.6.16**). In rest of the blasts, throw of blasted materials and flyrock were controlled and restricted within desired limit. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges.

(A) Before Blast

(B) Starting of Rock movement

(C) Initial Stage of Rock movement

(D) Middle Stage of Rock movement

(E) Last Stage of Rock movement with flyrock

(F) Rock Movement Stopped

Figure 5.6.16 Sequences of rock movements in the experimental blast No. B#8 (46 holes)

5.7 GRANITE STONE QUARRY OF M/S PENTA GRANITES, PALAKKAD DISTRICT

5.7.1 Brief Information of the Quarry

Shri Joshy P. J., Managing Director of M/s Penta Granite (Building Stone) Quarry, is operating a Stone Quarry of 4.1371 Ha (10.223 Acres) at Kizhakkencheri – 2 village, Palakkad District of Kerala State. This granite building stone quarry is located at Kizhakkencheri – 2 village in Alathur Taluk. The nearest railway station is Palakkad Railway Station at 55 km whereas the nearest airport is Nedumbassery Airport situated at a distance of 125 km from the quarry. The NH-544 (47) Vadakkanchery is situated at a distance of 25 Km from the quarry.

As per the mine plan prepared by Mr. V. K. Roy, DMG/Kerala/RQP/4/2016, Thiruvananthapuram, the lease area is a private land and comprises in Re-Survey no. 278/21, 278/31 PT, 278/33PT, 278/35 & 278/PT in Kizhakkencheri-2 Village, Alathur Taluk, Palakkad District, Kerala for an area of 4.1371 Ha. The geographical location of the quarry lease area having Latitude of N10°31´10.80″ to N10°31´18.52″ and longitude E76°30´12.24″ to E76°30´20.07″. Topographically, the area is undulating and the topography of the surrounding lease area is an elevated terrain having highest elevation of 180 m and lowest elevation of 120 m from the Mean Sea Level (MSL). The drainage of the lease area is towards west direction. The main rock type in the area is of medium to coarse grained Charnockite with dark grey quartz. The Penta Granite Building Stone quarry in being operated by semi

mechanized open cast mining method. For excavation of hard rock strata, controlled blasting as per "MMR – 1961" is being followed. The drilling of blast holes is being carried out using 32 mm drill rod, Jack Hammer and Air Compressor of 100 Cfm capacity.

To fulfil the objective of the study, first field investigation was carried out at Penta Granite (Building Stone Quarry) Kizhakkencheri – 2 village owned by Shri Joshey P. J. during the period of 9th to 12th January, 2023. Google Earth view of Granite Building Stone Quarry is depicted in **Figure 5.7.1**. The investigational work conducted at this quarry have been briefly discussed in the following sub-sections.

Figure 5.7.1. Google Earth view of Granite (Building Stone) Quarry of M/S Penta Granites Kizhakkencheri – 2 village, Palakkad District of Kerala State

5.7.2 Reconnaissance Survey

Reconnaissance survey was carried out on 9th and 10th January 2023 to identify different types of structures present within the radius of 500 m from the quarry. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 100 m from the quarry, one house for Latex processing of Mr. Roy Abraham is located at 35 m from the quarry boundary in the N-E direction.
- Another house of Mr. Roy Abraham is located at distance of 100 m from the quarry boundary in the N-E direction.
- Only residential house of Mr. Chako P. K. was present within 500 m from the quarry boundary in S-E direction.
- St. Joseph Church is located at 384 m from the quarry in the North direction.

5.7.3 Study of Land Profile, Nature of Rock Deposits

Studies on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces were conducted during the study. The land profile is undulatory as the area is a hilly terrain. The current working benches of the quarry were having elevations between 125 m and 140 m. Two of the houses were located at higher level than the quarry operations at 144 m and 175 m MSL. The rock deposits are found to be massive in nature with limited joints **(Plates 5.7.1 & 5.7.2)**.

Plate 5.7.1. View of rock deposition in Granite (Building Stone) Quarry of M/S Penta Granites Kizhakkencheri – 2 village, Palakkad District of Kerala State

Plate 5.7.2. View of rebound hardness testing on rock surface at Granite (Building Stone) Quarry of M/S Penta Granites, Palakkad District of Kerala State

5.7.4 Experimental Blasts

At Granite (Building Stone Quarry) of M/S Penta Granites, ten rounds of experimental blasts with varying design parameters were conducted. The blasts were conducted at two working benches of the quarry. All the blasts were conducted with 32 mm blast hole diameter, drilled

with Jack Hammer drilling machines **(Plate 5.7.3)**. Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge was used as main explosive charge to fragment the hard rockmass. Nonel (shock tube) initiation system of 200 ms Down-the Hole Delay (DTH) and 25 ms of noiseless Trunkline Delay (TLD) were used for true bottom initiation of all the charged holes and surface initiation of each hole in a round of blast. The details of design parameters of the experimental blasts are given in **Table 5.7.1**. The locations of the experimental blast faces and vibration monitoring points are shown on google map in **Figures 5.7.2- 5.7.3.**

In the experimental blasts, hole depths of 1.8 m with burden varying from 0.8 to 1.2 m and spacing varying from 1.0 to 1.2 m were used. The explosive charge per hole varied from 0.25 to 0.375 kg. The number of holes varied from 8 to 24 and the total explosive charge varied from 2.0 to 9.875 kg. Charging of explosive into the blast holes is shown in **Plate 5.7.4.** The drilling, firing and charging pattern of all the experimental blasts are depicted in **Figures 5.7.4 to 5.7.13**.

Plate 5.7.3. Drilling of blast holes using Handheld Jackhammer drill machine at Granite (Building Stone) Quarry of M/S Penta Granites, Palakkad District of Kerala State

Table 5.7.1. Details of experimental blasts conducted at Stone Quarry of M/s Penta Granites, Palakkad District

S. No.	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Type of explosive and accessories used
									Explosives per hole [kg]	Total explosives detonated [kg]	
1.	N 10°31´14.2″ E 76°30´16.8″ 125 mRL	12	32	1.8	0.9	1.0	02	1.2	0.375	4.5	Emulsion cartridge explosive (25 mm dia. 125 gm weight) and Twin-det (250ms/25 ms)
2.	N 10°31´14.2″ E 76°30´16.6″ 126 mRL	12	32	1.8	0.9	1.0	02	1.2	0.375	4.5	
3.	N 10°31´14.4″ E 76°30´16.5″ 126 mRL	12	32	1.8	0.8	1.0	02	1.2	0.375	4.5	
4.	N 10°31´14.6″ E 76°30´16.5″ 126 mRL	10	32	1.8	0.8	1.0	02	1.2	0.375	3.75	
5.	N 10°31´16.7″ E 76°30´15.8″ 132 mRL	12	32	1.8	1.2	1.2	02	1.4	0.25	3.0	
6.	N 10°31´17.0″ E 76°30´15.7″ 131 mRL	8	32	1.8	1.2	1.2	02	1.4	0.25	2.0	
7	N 10°31´17.0″ E 76°30´15.5″ 135 mRL	10	32	1.8	1.2	1.2	02	1.4	0.25	2.5	
8.	N 10°31´17.2″ E 76°30´15.4″ 136 mRL	10	32	1.8	1.2	1.2	02	1.4	0.25	2.5	
9.	N 10°31´17.3″ E 76°30´15.2″ 139 mRL	12	32	1.8	0.8	1.0	02	1.2	0.375	4.875	
10.	N 10°31´17.4″ E 76°30´14.9″ 140 mRL	25	32	1.8	0.9	1.0	04	1.2	0.375	9.875	

Figure 5.7.2. Google map showing locations of experimental blasts at Granite (Building Stone) Quarry of M/s Penta Granites, Palakkad District of Kerala State

Figure 5.7.3. Google map showing locations of experimental blasts and vibration monitoring points at Granite (Building Stone) Quarry of M/s Penta Granites, Palakkad District of Kerala State

Plate 5.7.4. Charging of blast holes at Granite (Building Stone) Quarry, Palakkad District of Kerala State

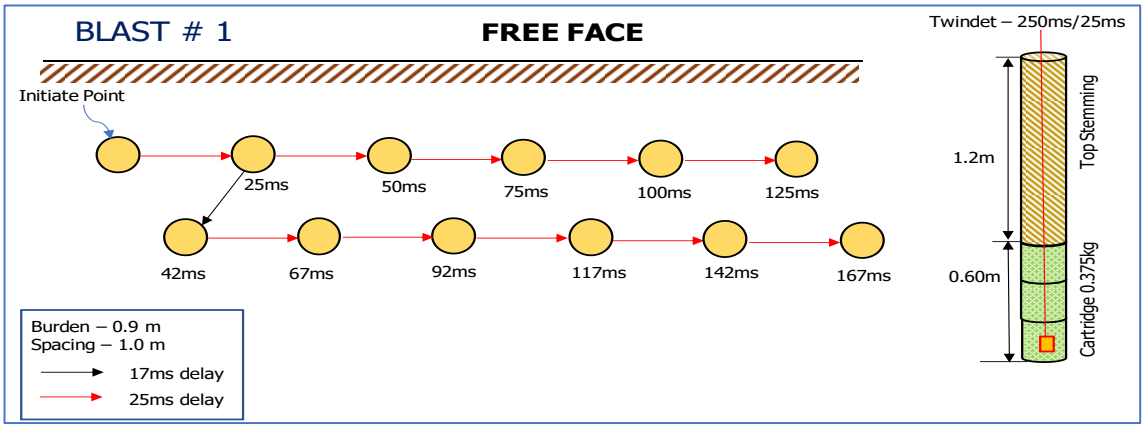


Figure 5.7.4. Drilling, firing and charging pattern of experimental Blast no. 1

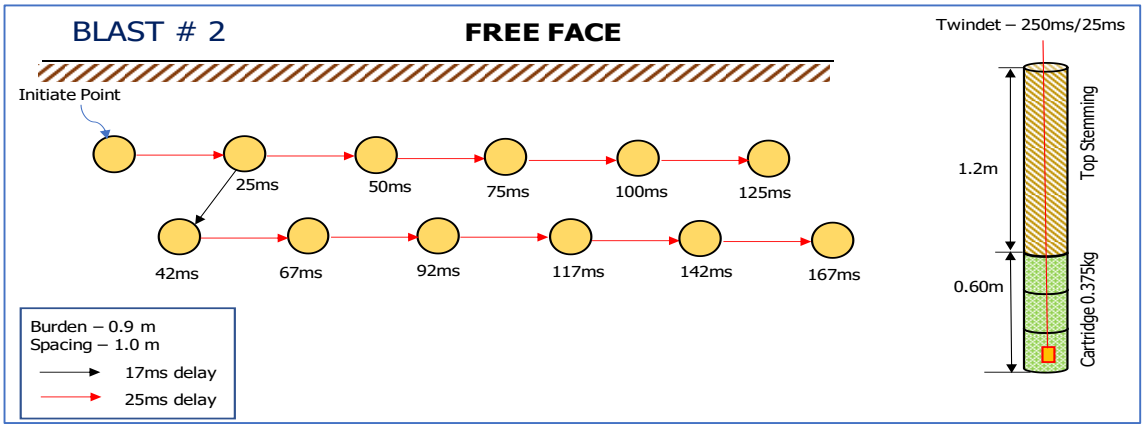


Figure 5.7.5. Drilling, firing and charging pattern of experimental Blast no. 2

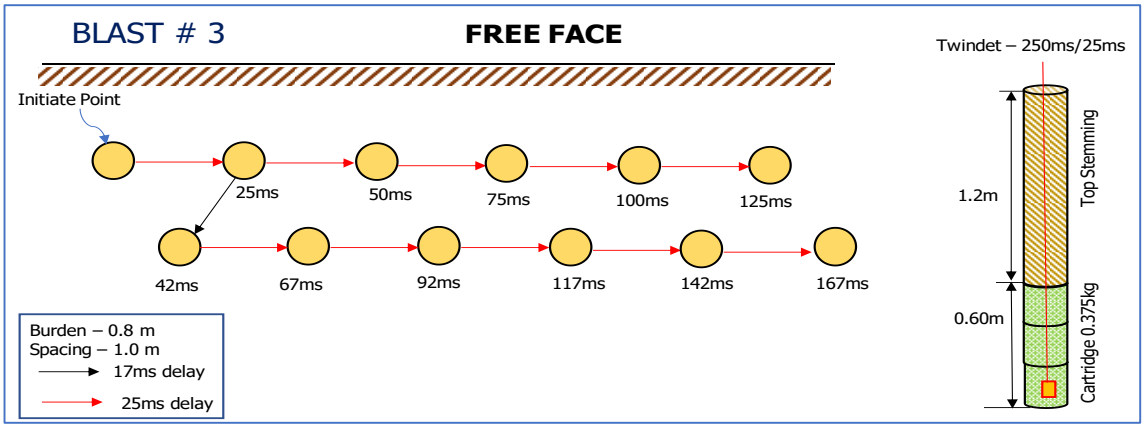


Figure 5.7.6. Drilling, firing and charging pattern of experimental Blast no. 3

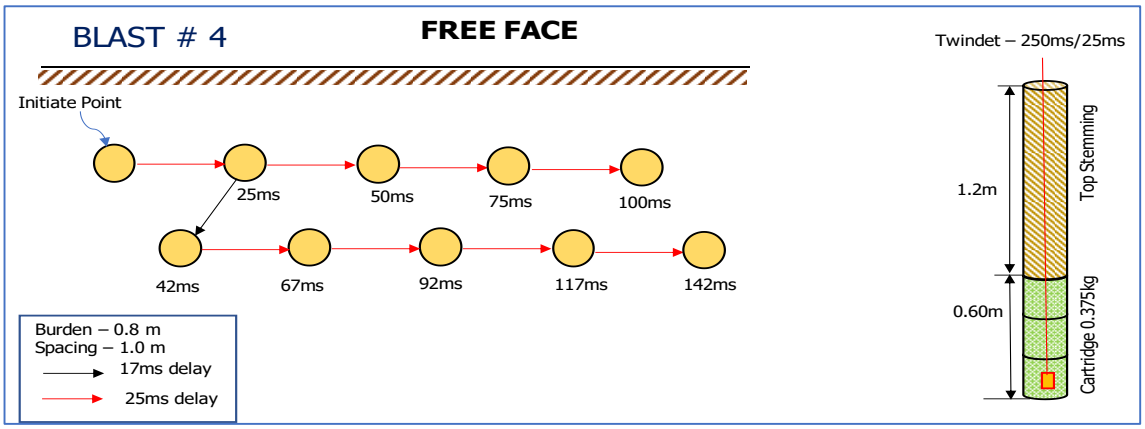


Figure 5.7.7. Drilling, firing and charging pattern of experimental Blast no. 4.

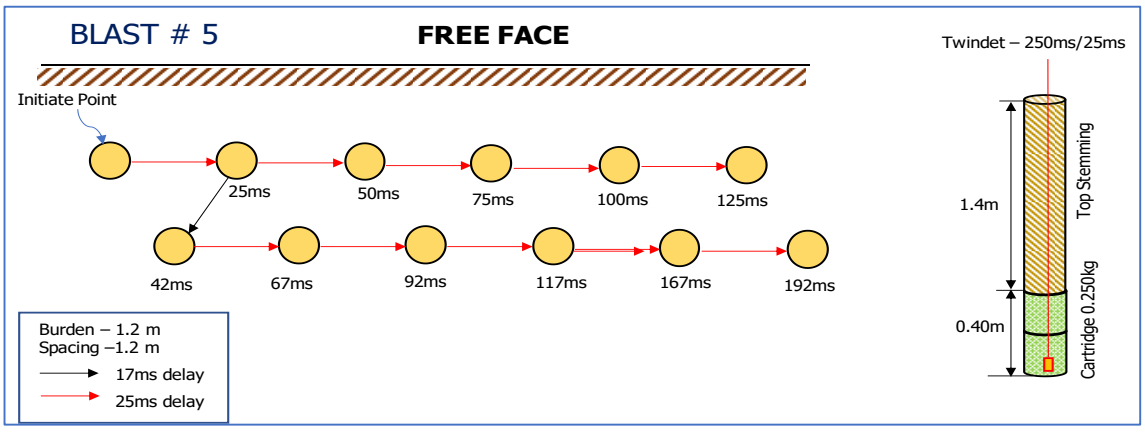


Figure 5.7.8. Drilling, firing and charging pattern of experimental Blast no. 5

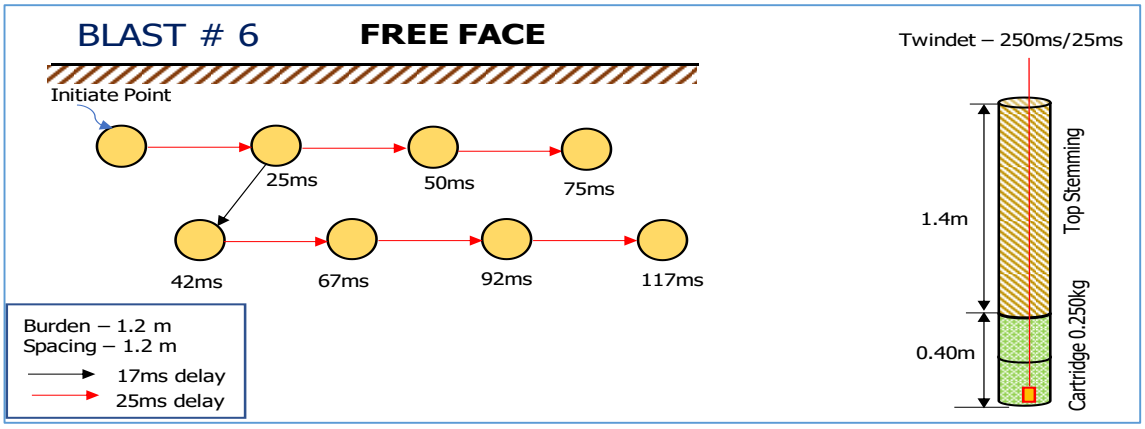


Figure 5.7.9. Drilling, firing and charging pattern of experimental Blast no. 6.

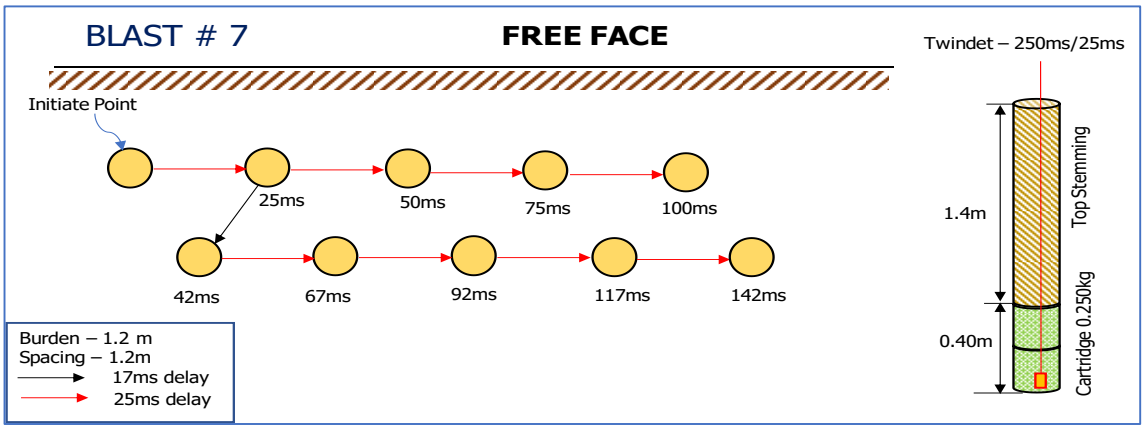


Figure 5.7.10. Drilling, firing and charging pattern of experimental Blast no. 7

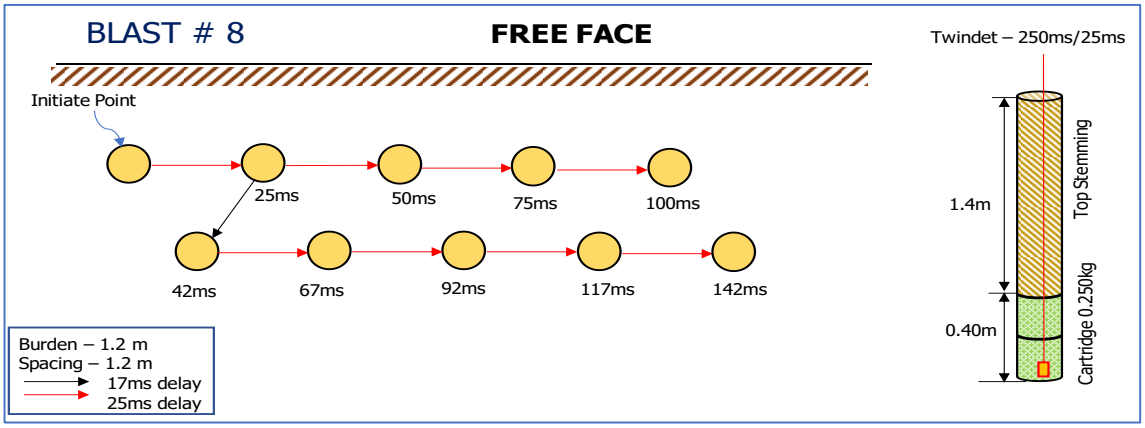


Figure 5.7.11. Drilling, firing and charging pattern of experimental Blast no. 8

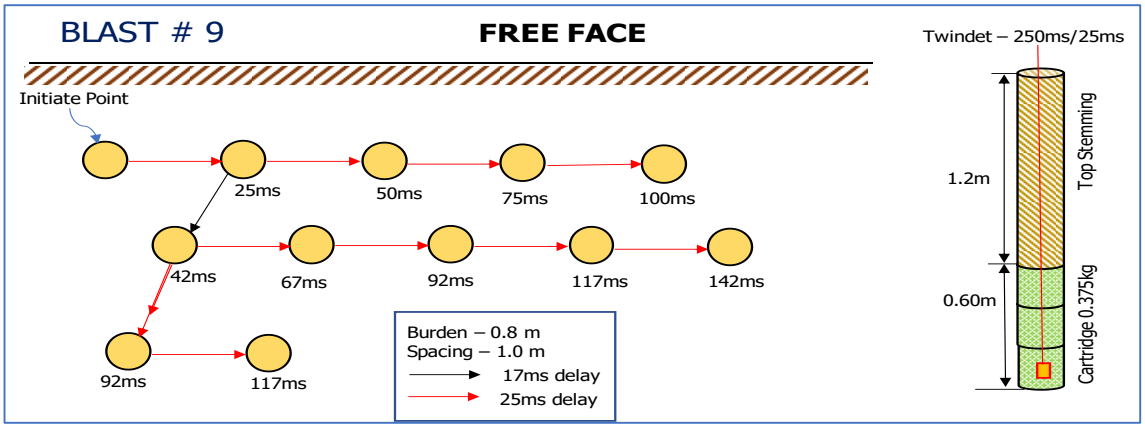


Figure 5.7.12. Drilling, firing and charging pattern of experimental Blast no. 9

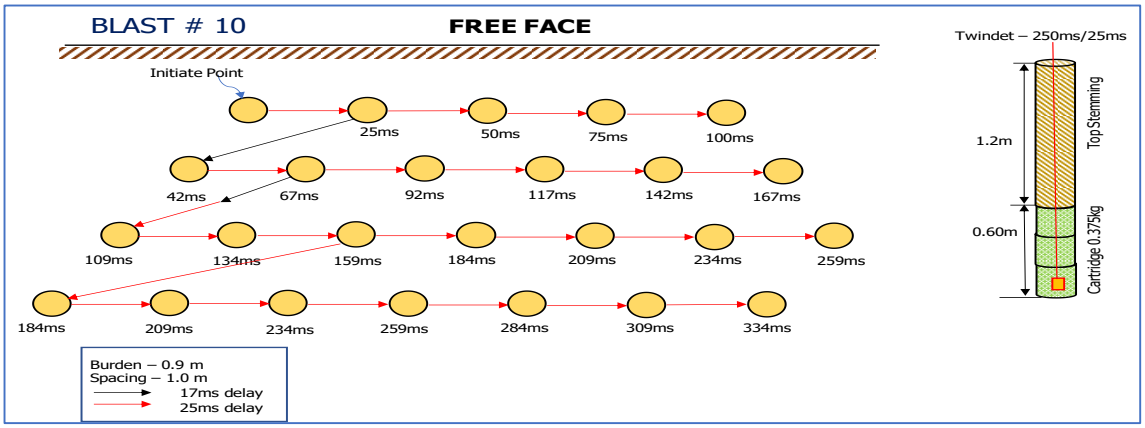


Figure 5.7.13. Drilling, firing and charging pattern of experimental Blast no. 10.

5.7.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored using eight number of seismographs. The monitoring points were selected considering the objectives, backside of free face of blasts as well as point of interests (viz. public houses). View of a few vibration monitoring points are given in **Plates 5.7.5 to 5.7.8**.

Plate 5.7.5. View of vibration monitoring at the house of Shri Roy Abraham

Plate 5.7.6. View of vibration monitoring at the house of Shri Chako P. K. (House no. 124)

Plate 5.7.7. View of vibration monitoring at Latex Garden behind blast face

Plate 5.7.8. View of vibration monitoring at St. Joseph Church, Neetipuram

5.7.6 Ground vibration and Air Overpressure Results

From the ten trial blasts conducted at the quarry, forty-five ground vibration data were recorded at different locations in and around the quarry. At many instances, specially near the residential structures/locations situated beyond 200 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, maximum charge per delay and the total number of holes used in the blasting round, the magnitudes of recorded vibration varied from 0.596 to 4.474 mm/s. The monitoring distances from the blasting faces varied between 35 and 466 m. The graph plotted between vibration (PPV) recorded and distances of the instruments from the blasting patches is shown in **Figure 5.7.14.** The details of recorded ground vibration data are given in **Table 5.7.2**. The waveform reports of some of the recorded ground vibration data are also given in **Annexure-7**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 4.474 mm/s with the associated dominant frequency of 64.0 Hz. This was recorded at 35 m distance from blast No. B #5 inside the quarry. The maximum charge per delay (MCPD) in this blast was 0.5 kg whereas total explosive charge detonated in the blasting round was 2.5 kg. Further, magnitude of vibration recorded between 131 to 156 m from the blasting patches were less than 1 mm/s whereas between 196 and 456 m, it was less than 0.5 mm/s (i.e., the pre-set trigger level).

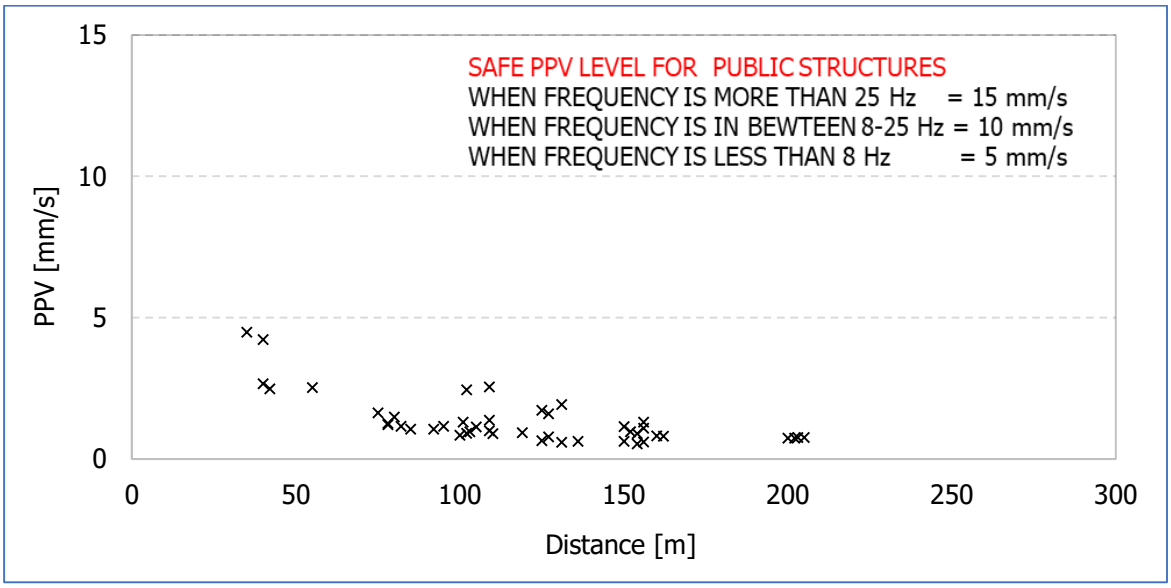


Figure 5.7.14. Plot between recorded vibration (PPV) and distances of seismographs from the blasting patches.

Table 5.7.2. Blast induced ground vibration and air over pressure recorded at different locations due to the blast conducted at Granite (Building Stone) Quarry of M/s Penta Granites, Palakkad District of Kerala on 11.01.2023.

Blast No.	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dB(L)]
1.	N 10°31´14.2″ E 76°30´16.8″ 125 mRL	4.5	0.75	❖1st House of Roy Abraham	40	2.657	49.75	NR
				❖2nd House of Roy Abraham	102	0.898	85.75	100.0
				❖2nd House of Roy Abraham (Structure)	102	2.445	43.38	100.0
				❖Latex garden behind blast face	109	1.362	25.75	101.9
				❖Latex garden behind blast face	162	0.803	25.13	93.98
				❖Latex garden behind blast face	202	0.730	14.50	< 88.0
				❖St. Joseph Church, Neetipuram	324	< 0.5	-	-
				❖House of Mr. Chako P K (House no. 124)	466	< 0.5	-	-
2.	N 10°31´14.2″ E 76°30´16.6″ 126 mRL	4.5	0.75	❖1st House of Roy Abraham	42	2.474	61.0	NR
				❖2nd House of Roy Abraham	125	0.635	40.5	104.2
				❖2nd House of Roy Abraham (Structure)	125	1.715	22.13	100.0
				❖Latex garden behind blast face	105	1.122	38.25	108.0
				❖Latex garden behind blast face	160	0.813	36.63	97.5
				❖Latex garden behind blast face	200	0.73	20.0	91.48
				❖St. Joseph Church, Neetipuram	326	< 0.5	-	-
				❖House of Mr. Chako P K (House no. 124)	464	< 0.5	-	-
3.	N 10°31´14.4″ E 76°30´16.5″ 126 mRL	4.5	0.75	❖1st House of Roy Abraham	55	2.514	79.13	NR
				❖2nd House of Roy Abraham	127	0.773	52.5	101.9
				❖2nd House of Roy Abraham (Structure)	127	1.588	45.25	100.0
				❖Latex garden behind blast face	103	0.959	45.25	106.0
				❖Latex garden behind blast face	150	0.622	52.13	95.92
				❖Latex garden behind blast face	205	0.751	35.38	91.48
				❖St. Joseph Church, Neetipuram	328	< 0.5	-	-
				❖House of Mr. Chako P K (House no. 124)	462	< 0.5	-	-

4.	N 10°31´14.6″ E 76°30´16.5″ 126 mRL	3.75	0.75	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neetipuram ❖House of Mr. Chako P K (House no. 124)	40 109 109 101 119 203 330 458	4.213 0.992 2.54 1.295 0.925 0.751 < 0.5 < 0.5	47.75 47.50 44.63 46.50 43.88 56.13 - -	NR 106.5 100.0 106.5 98.84 91.48 - -
5.	N 10°31´16.7″ E 76°30´15.8″ 132 mRL	3.0	0.5	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neetipuram ❖House of Mr. Chako P K (House no. 124)	35 131 131 156 196 235 332 456	4.474 0.582 1.921 0.596 < 0.5 < 0.5 < 0.5 < 0.5	64.0 25.38 64.13 36.88 - - - -	NR 111.5 100.0 107.0 - - - -
6.	N 10°31´17.0″ E 76°30´15.7″ 131 mRL	2.0	0.5	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neetipuram ❖House of Mr. Chako P K (House no. 124)	75 150 150 85 130 211 390 407	1.625 < 0.5 1.143 1.047 < 0.5 < 0.5 < 0.5 < 0.5	47.5 - 18.0 47.88 - - - -	NR - 100.0 108.8 - - - -
7.	N 10°31´17.0″ E 76°30´15.5″ 135 mRL	2.5	0.5	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neetipuram ❖House of Mr. Chako P K (House no. 124)	78 152 152 78 132 214 390 410	1.254 < 0.5 0.953 1.205 < 0.5 < 0.5 < 0.5 < 0.5	28.13 - 30.88 85 - - - -	NR - 100.0 108.8 - - - -

8.	N 10°31´17.2″ E 76°30´15.4″ 136 mRL	2.5	0.5	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neethipuram ❖House of Mr. Chako P K (House no. 124)	80 154 154 95 134 216 388 413	1.476 0.524 0.889 1.15 < 0.5 < 0.5 < 0.5 < 0.5	58.50 22.88 46.00 137.9 - - - -	NR 102.8 100.0 112.0 - - - -
9.	N 10°31´17.3″ E 76°30´15.2″ 139 mRL	4.875	0.75	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neetipuram ❖House of Mr. Chako P K (House no. 124)	110 156 156 92 136 218 386 415	0.886 < 0.5 1.08 1.047 < 0.5 < 0.5 < 0.5 < 0.5	18.75 - 17.5 15.38 - - - -	NR - 100 112.6 - - - -
10.	N 10°31´17.4″ E 76°30´14.9″ 140 mRL	9.875	0.75	❖1st House of Roy Abraham ❖2nd House of Roy Abraham ❖2nd House of Roy Abraham (Structure) ❖Latex garden behind blast face ❖Latex garden behind blast face ❖Latex garden behind blast face ❖St. Joseph Church, Neethipuram ❖House of Mr. Chako P K (House no. 124)	100 156 156 82 136 218 384 417	0.835 < 0.5 1.302 1.15 0.622 < 0.5 < 0.5 < 0.5	28.35 - 30 175.4 15.38 - - -	NR - 100 112.3 95.9 - - -

- ❖ 1st House of Roy Abraham: N10°31´15.7″; E 76°30´18″; 144 mRL
- ❖ 2nd House of Roy Abraham: N10°31´16.6″; E 76°30´20.8″; 175 mRL
- ❖ House of Roy Abraham (Structure): N10°31´16.6″; E 76°30´20.8″; 177 mRL
- ❖ Latex garden behind blast face: N10°31´18.4″; E 76°30´17.6″; 177 mRL
- ❖ Latex garden behind blast face: N10°31´19.9″; E 76°30´18.8″; 158 mRL
- ❖ Latex garden behind blast face: N10°31´22.2″; E 76°30´20.2″; 137 mRL
- ❖ St. Joseph Church, Neetipuram: N10°31´06.9″; E 76°30´23.8″; 126 mRL
- ❖ House of Mr. Chako P K (House no. 124): N10°31´30.0″; E 76°30´15.2″; 93 mRL

The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 14.5 – 174.4 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.7.15.** The FFT analyses reports of some of the vibration data are given in the **Annexure-7**.

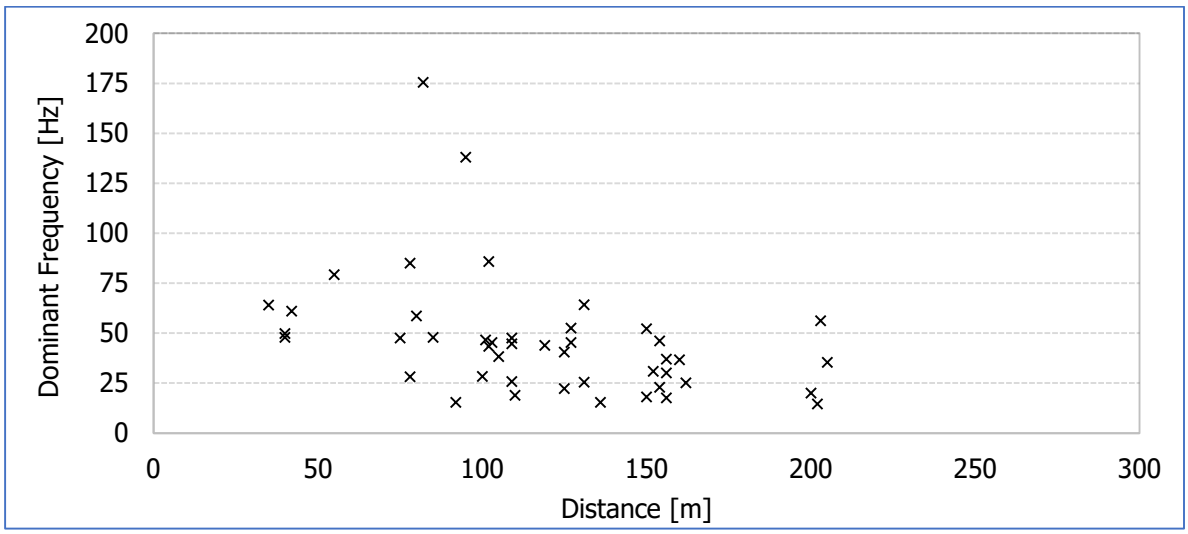


Figure 5.7.15. Plot between recorded frequencies of the ground vibration and distances of seismographs from the blasting patches.

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 91.48 and 112.6 dB(L). A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.7.16.**

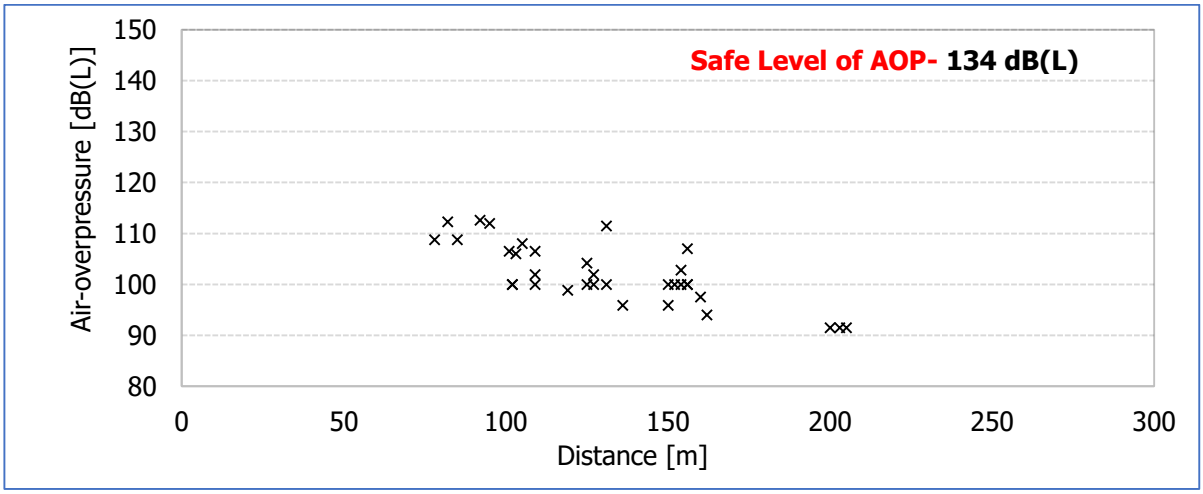


Figure 5.7.16. Plot of recorded air-overpressure versus distance of monitoring stations from the blasting faces

5.7.7 Flyrock results and Observations

In order to study and analyze the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera to observe any occurrence of flyrock and its source. In all the trial blasts conducted during study period, no flying fragments were observed or recorded. The throw of blasted materials was controlled and restricted within the blasting area only. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges. A view of analysis of the rock movements for one of the experimental blast is shown in **Figure 5.7.17**.

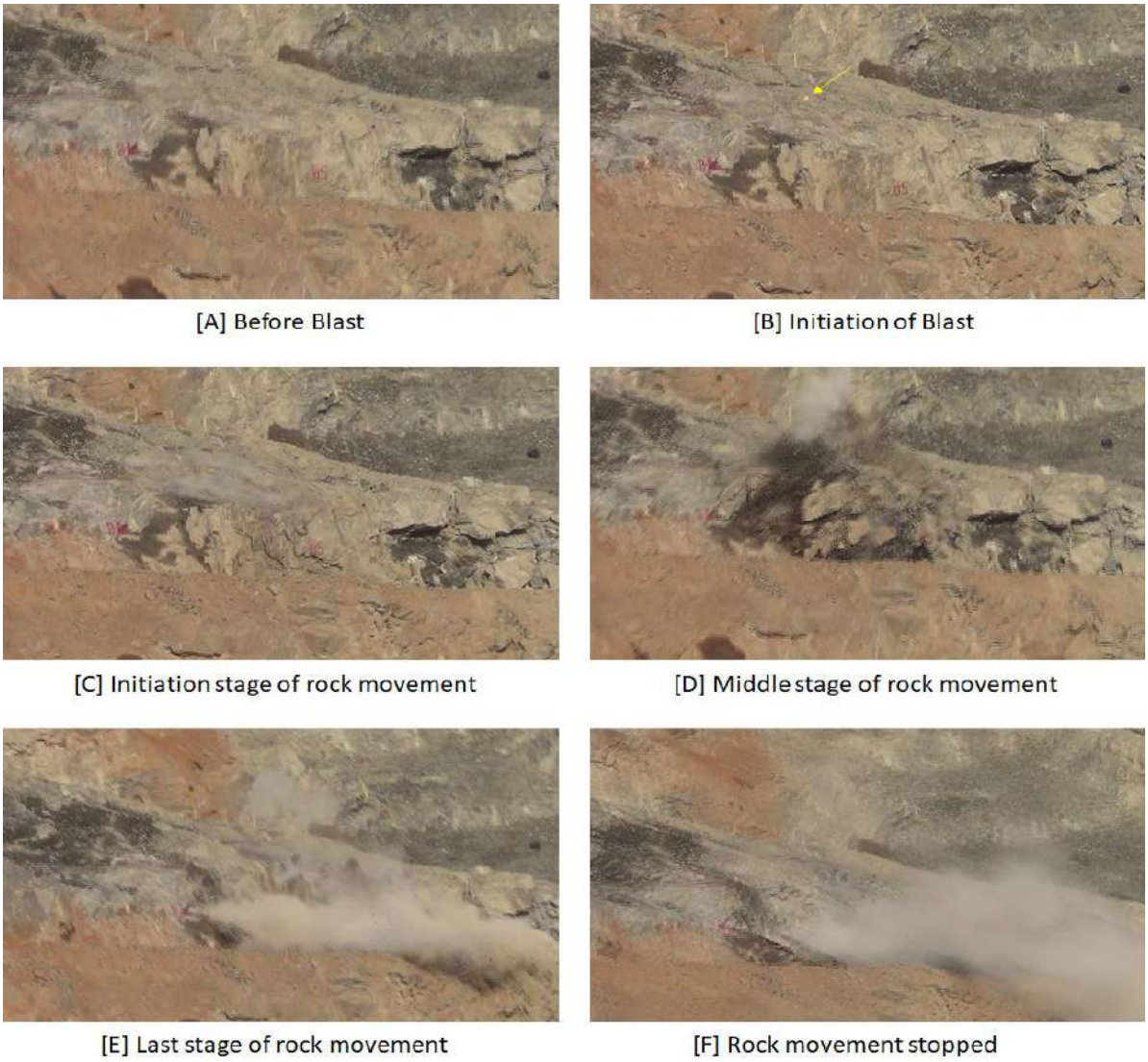


Figure 5.7.17. Sequences of rock movements in the experimental blast B-5.

5.8 GRANITE STONE QUARRY OWNED BY SUDHEESH A. T., VENGAPPALLY VILLAGE, WAYANAD DISTRICT

5.8.1 Brief Information of the Quarry

Shri Sudheesh A. T. is operating a Granite Stone Quarry of 2.7513 Ha (6.799 Acres) at Vengappally village, Vythiri Taluk, Wayanad District of Kerala State. The nearest railway station is Chemancheri Railway Station at 43.15 km in S-W direction whereas the nearest airport is Calicut International Airport situated at a distance of 54.9 km in S-W direction from the quarry. The SH-54 is situated at a distance of 1.57 km in the west from the quarry.

As per the mine plan prepared by Integrated Green Technologies Pvt. Ltd., Mr. Mahesh S., RQP/BNG/338/2014/A, Trivandrum, the lease area is a private land and comprises in Re-Survey no. 257/2/1, 257/2/3, 257/2/4, 257/3/1, 257/3/2 & 258/4 in Vengappally Village, Vythiri Taluk, Wayanad District, Kerala for an area of 2.7513 Ha. The geographical location of the quarry lease area having Latitude of N11°37´37.81″to N11°37´48.36″and longitude E76°02´38.36″ to E76°02´45.42″. Topographically, the lease area is hillock and the topography of the surrounding lease area is an elevated terrain having highest elevation of 780 m and lowest elevation of 750 m from the Mean Sea Level (MSL). The drainage of the lease area is towards N-W direction. This Granite Building Stone quarry in being operated by semi mechanized open cast mining method. For excavation of hard rock strata, controlled blasting as per "MMR – 1961" is being followed. The drilling of blast holes is being carried out using 32 mm drill rod, Jack Hammer and Air Compressor of 100 Cfm capacity.

The field investigation was carried out at GRANITE STONE QUARRY OWNED BY SUDHEESH A. T. during the period of 13th to 14th January, 2023. The overview of Granite Building Stone Quarry is depicted in **Plate 5.8.1**.

Plate 5.8.1. The overview of Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State

5.8.2 Reconnaissance Survey

Reconnaissance survey was carried out on 13th and 14th January 2023 to identify different types of structures present within the radius of 500 m from the quarry. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 100 m from the quarry, there is no any residential houses not belonging to the mine owner.
- Within the zone of 100 m to 200 m from the quarry, there was about four houses. The nearest house was of Mr. Velayudan at a distance of 105 m and Mr. Suresh Kumar at a distance of 112 m in the East direction at an elevation of 755 m and 770 m respectively from the quarry.
- Within the zone of 200 m to 550 m from the quarry, there were several houses. The nearest house was of Mrs. Devi T. G. at a distance of 250 m in the direction of west. The farthest house was of Mrs. Mini S Kumar at a distance of 550 m in the west direction at an elevation of 763 m. Three houses were in the direction of North in between 200 m to 250 m.

5.8.3 Study of Land Profile, Nature of Rock Deposits

Studies on the land profile, nature of rock deposit and rebound hardness on the fresh rock surfaces were conducted. The land profile is undulatory as the area is hilly terrain. The current working benches of the quarry were having elevations between 720 m and 746 m. Most of the houses were located at higher level than the quarry operations at 753 m to 775 m MSL. The rock deposits are found to be massive in nature with limited joints **(Plate 5.8.2)**.

Plate 5.8.2. View of rock deposition in Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State

5.8.4 Experimental Blasts

At Granite Stone Quarry owned by Sudheesh A. T., ten rounds of experimental blasts with varying design parameters were conducted. The blasts were conducted from bottom to top working benches of the quarry. All the blasts were conducted with 32 mm blast hole diameter, drilled with Jack Hammer drilling machines (**Plate 5.8.3**). Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge was used as main explosive charge to fragment the hard rockmass. Nonel (shock tube) initiation system of 200 ms Down-the Hole Delay (DTH) and 25 ms of noiseless Trunkline Delay (TLD) were used for true bottom initiation of all the charged holes and surface initiation of each hole in a round of blast. The details of blast design parameters used in all the experimental blasts are given in **Table 5.8.1**. The marked locations of blast faces and monitoring points on google map is shown in **Figure 5.8.1**.

In the experimental blasts, hole depths of 1.5 m with burden varying from 0.8 to 1.0 m and spacing varying from 0.9 to 1.5 m were used. The explosive charge per hole varied from 0.25 to 0.375 kg. The number of holes varied from 10 to 15 and the total explosive charge varied from 3.125 to 4.75 kg. Charging of explosive into the blast holes is shown in **Plate 5.8.4.** The drilling, firing and charging pattern of experimented blasting rounds are depicted in **Figures 5.8.2 and 5.8.11**.

Plate 5.8.3. Drilling of blast holes using Handheld Jackhammer drill machine at Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State

Table 5.8.1. Details of blasts conducted at Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala state

S. No.	Date of blast	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Explosive and Initiation type
										Explosives per hole [kg]	Total explosives detonated [kg]	
1.	14.01.2023	N 11°37´39.9″ E 76°02´42.7″ 720 mRL	15	32	1.5	0.8	0.9	02	0.9 - 1.1	0.25 - 0.375	4.75	25 mm dia. of Emulsion Cartridge explosive, wt. 125 gm with Nonel initiation system (DTH/TLD 200/25 ms)
2.	14.01.2023	N 11°37´40.8″ E 76°02´42.2″ 721 mRL	13	32	1.5	0.8	0.9	03	0.9 - 1.1	0.25 - 0.375	4.0	
3.	14.01.2023	N 11°37´41.2″ E 76°02´42.0″ 725 mRL	12	32	1.5	0.9	1.0	02	0.9 - 1.1	0.25 - 0.375	4.125	
4.	14.01.2023	N 11°37´41.4″ E 76°02´41.9″ 731 mRL	12	32	1.5	0.9	1.0	01	0.9 - 1.1	0.25 - 0.375	3.75	
5.	14.01.2023	N 11°37´41.6″ E 76°02´41.7″ 736 mRL	12	32	1.5	0.9	1.0	01	0.9 - 1.1	0.25 - 0.375	3.75	
6.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	10	32	1.5	1.0	1.5	01	0.9 - 1.1	0.25 - 0.375	3.125	
7.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	10	32	1.5	1.0	1.5	01	0.9 - 1.1	0.25 - 0.375	3.125	
8.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	10	32	1.5	1.0	1.5	01	0.9 - 1.1	0.25 - 0.375	3.125	
9.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	10	32	1.5	1.0	1.5	01	0.9 - 1.1	0.25 - 0.375	3.125	
10.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	10	32	1.5	1.0	1.5	01	0.9 - 1.1	0.25 - 0.375	3.125	

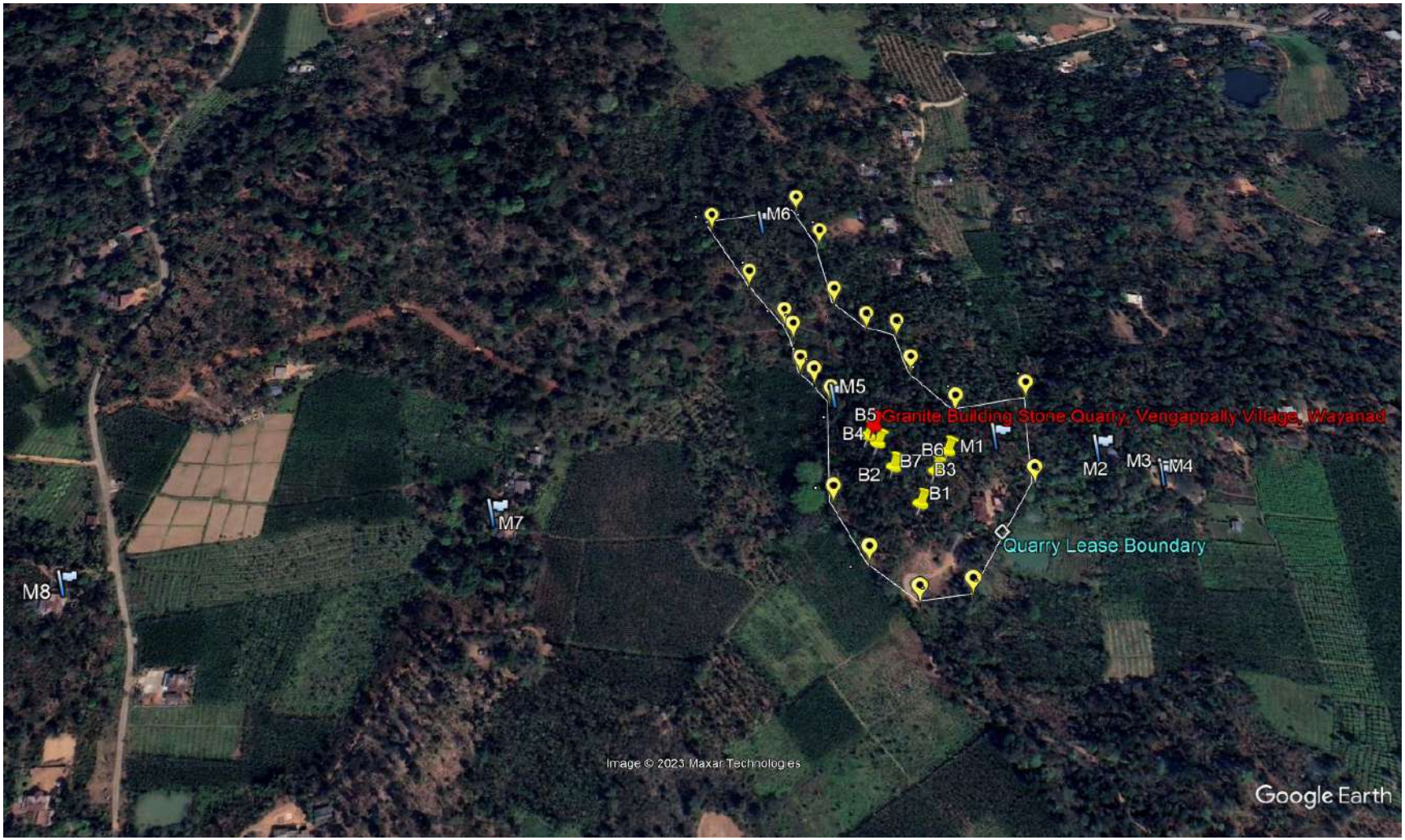


Figure 5.8.1. Google map showing locations of experimental blasts and vibration monitoring points at Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State

Plate 5.8.4. Charging of holes at Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State

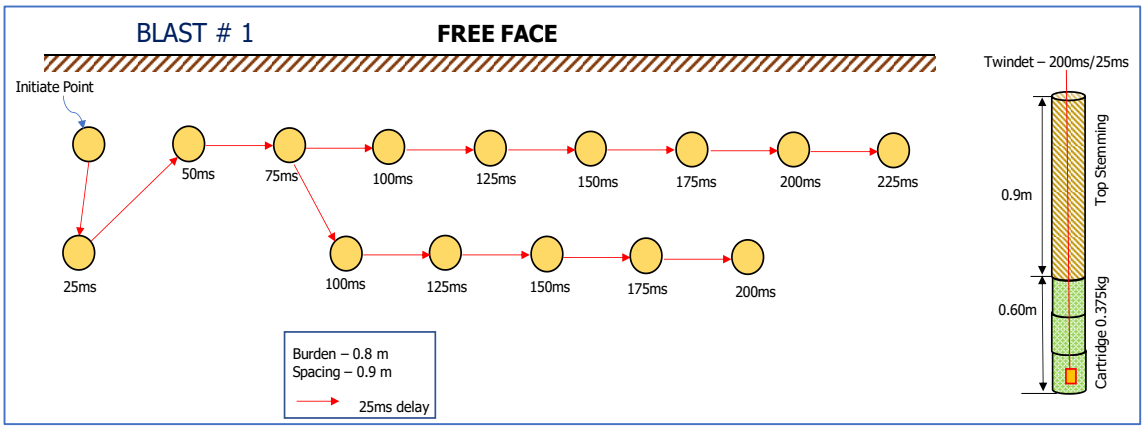


Figure 5.8.2. Drilling, firing and charging pattern of experimental Blast no. 1

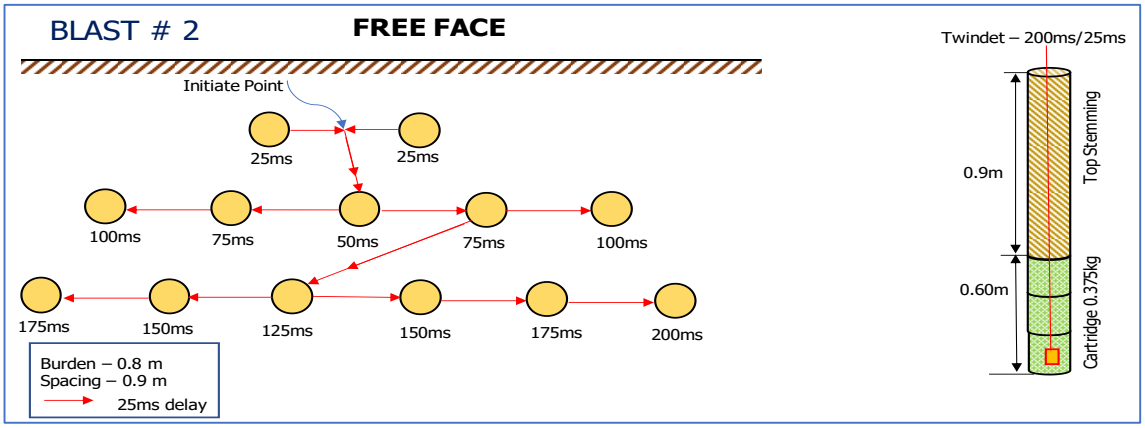


Figure 5.8.3. Drilling, firing and charging pattern of experimental Blast no. 2

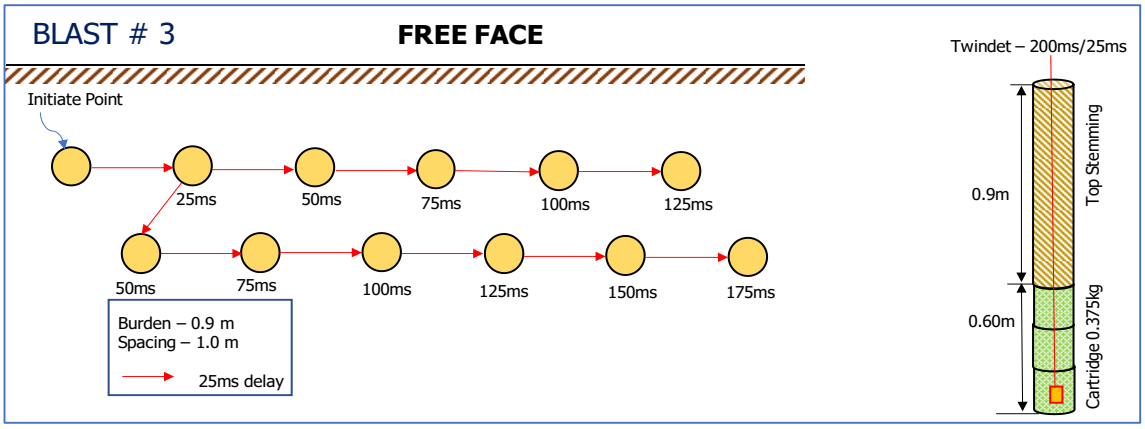


Figure 5.8.4. Drilling, firing and charging pattern of experimental Blast no. 3

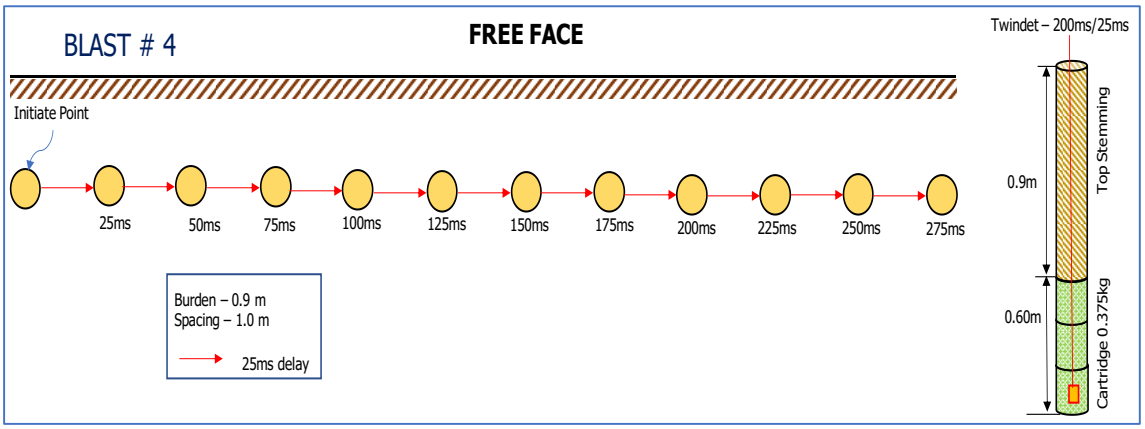


Figure 5.8.5. Drilling, firing and charging pattern of experimental Blast no. 4

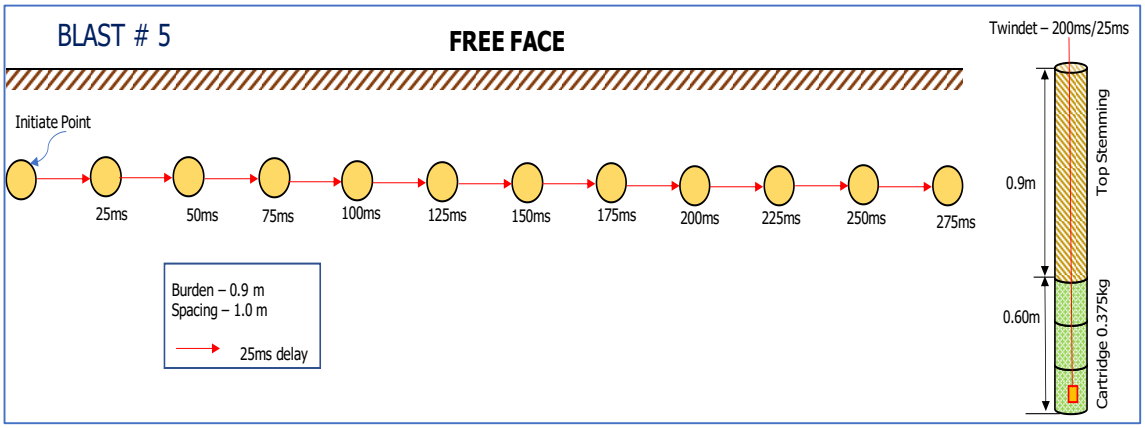


Figure 5.8.6. Drilling, firing and charging pattern of experimental Blast no. 5

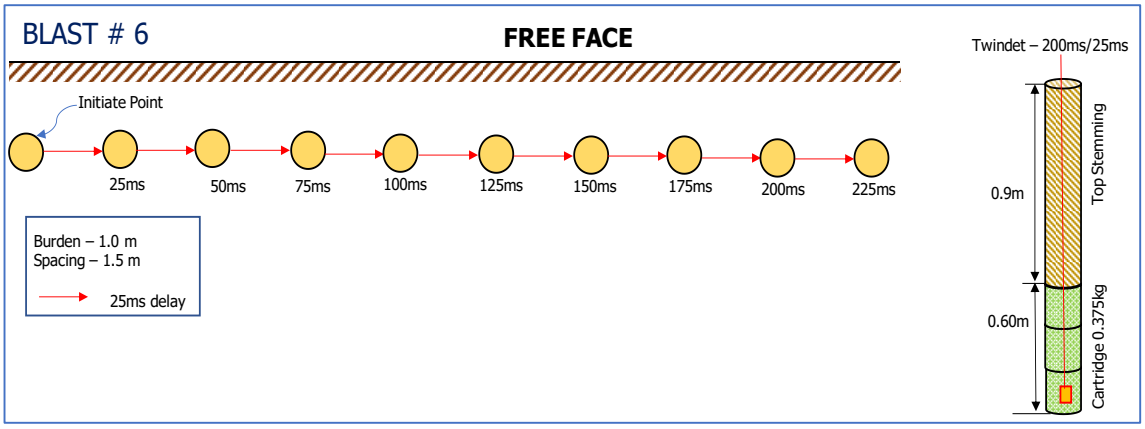


Figure 5.8.7. Drilling, firing and charging pattern of experimental Blast no. 6

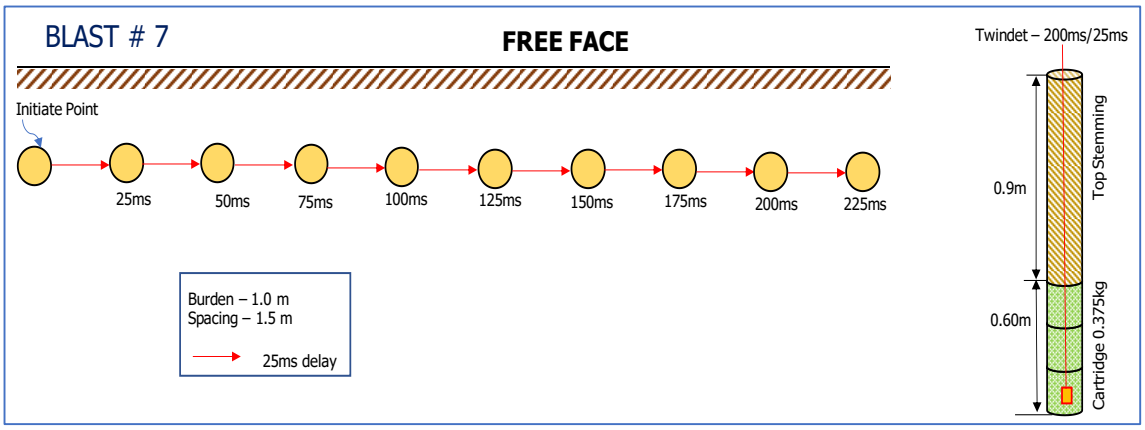


Figure 5.8.8. Drilling, firing and charging pattern of experimental Blast no. 7

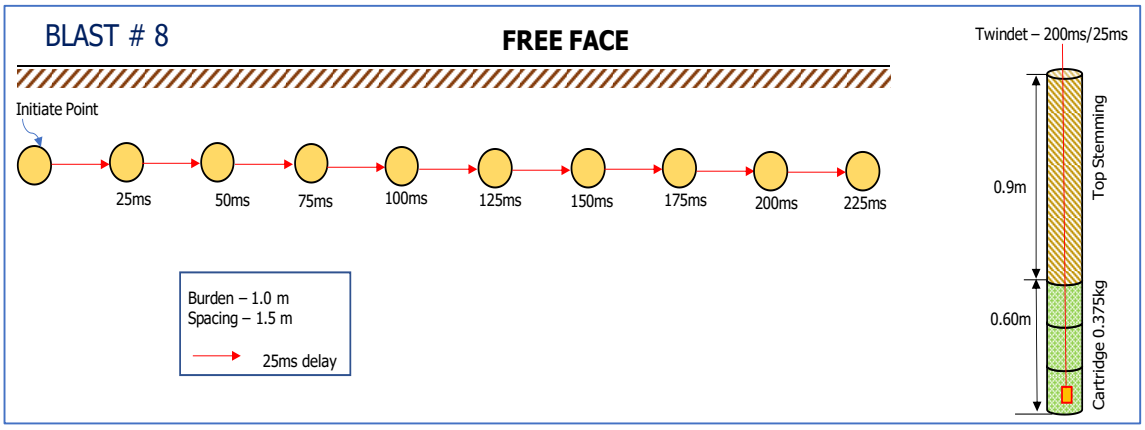


Figure 5.8.9. Drilling, firing and charging pattern of experimental Blast no. 8

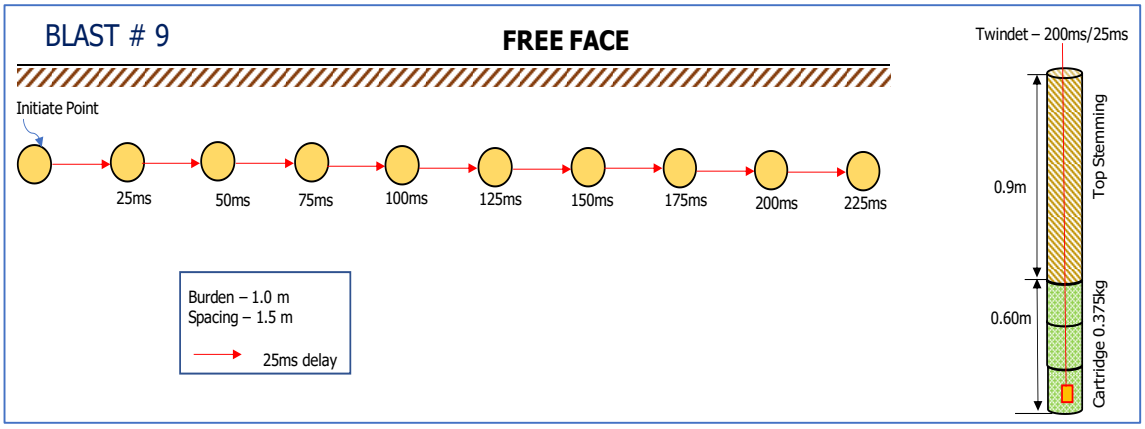


Figure 5.8.10. Drilling, firing and charging pattern of experimental Blast no. 9

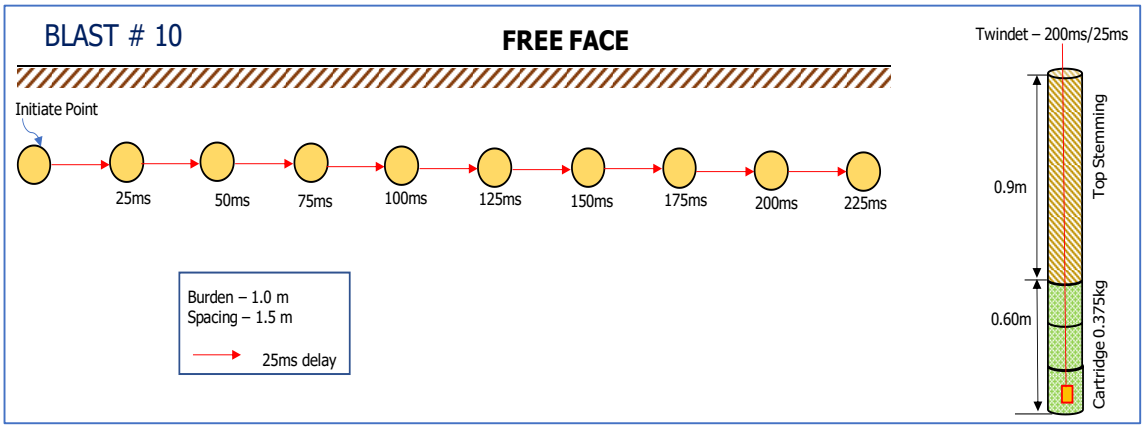


Figure 5.8.11. Drilling, firing and charging pattern of experimental Blast no. 10

5.8.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored using seven number of seismographs. The monitoring points were selected considering the objectives, backside of free face of blasts as well as point of interests (viz. public houses). View of a few vibration monitoring points are given in **Plates 5.8.5 to 5.8.10**.

Plate 5.8.5. View of vibration monitoring towards the house of Shri Suresh Kumar

Plate 5.8.6. View of vibration monitoring at the house of Shri Velayudhan

Plate 5.8.7. View of vibration monitoring at the house of Shri Suresh Kumar

Plate 5.8.8. View of vibration monitoring at the house of Smt. Mini S. Kumar

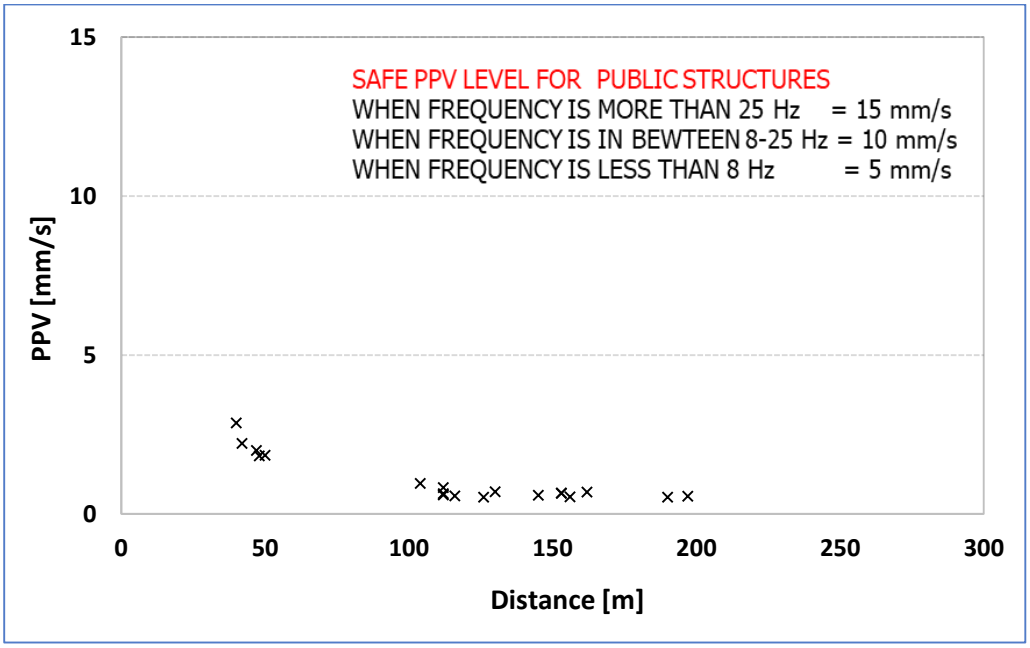
Plate 5.8.9. View of vibration monitoring at the house of Smt. Devi T. G.

Plate 5.8.10. View of vibration monitoring at the Mine office

5.8.6 Ground Vibration and Air Over Pressure Results

From the ten trial blasts conducted at the quarry, 19 ground vibration data were recorded at different locations in and around the quarry. At many instances, specially near the residential structures/locations situated beyond 156 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, maximum charge per delay and the total number of holes used in the blasting round, the magnitudes of recorded vibration varied from 0.524 to 2.865 mm/s. The monitoring distances from the blasting faces varied between 40 and 555 m. The graph plotted between the recorded vibration (PPV) and distances of the instruments from the blasting patches is shown in **Figure 5.8.12**. The details of recorded ground vibration data are given in **Table 5.8.2**. The waveform reports of some of the recorded ground vibration data are given in **Annexure-8**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 2.865 mm/s with the associated dominant frequency of 94.63 Hz. This was recorded at 40 m distance from blast No. B#9 towards the house of Shri Suresh Kumar. The maximum charge per delay (MCPD) in the blast was 0.375 kg whereas total explosive charge detonated in the blasting round was 3.125 kg. Further, magnitude of vibration recorded between 104 to 112 m from the blasting patches were less than 1 mm/s whereas between 170 and 554 m, it was less than 0.5 mm/s (i.e., the pre-set trigger level).



. Figure 5.8.12. Plot between recorded vibration (PPV) and distances of seismographs from the blasting patches

Table 5.8.2. Blast induced ground vibration and air over pressure recorded at different locations due to the blast conducted at Granite Stone Quarry owned by Sudheesh A. T., Wayanad District of Kerala State on 14.01.2023

Blast No.	Date of Blast	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dB(L)]
1.	14.01.2023	N 11°37´39.9″ E 76°02´42.7″ 720 mRL	4.75	0.750	❖Towards Sri Suresh Kumar House	112	0.635	52.5	108.0
					❖House of Sri Velayudhan	132	< 0.5	-	-
					❖House of Sri Suresh Kumar	168	< 0.5	-	-
					❖House of Sri Suresh Kumar (Structure – 4.5 m)	168	< 0.5	-	-
					❖Mine Office	179	< 0.5	-	-
					❖House of Smt. Devi T. G.	268	< 0.5	-	-
					❖House of Smt. Mini S. Kumar	540	< 0.5	-	-
2.	14.01.2023	N 11°37´40.8″ E 76°02´42.2″ 721 mRL	4.0	0.750	❖Towards Sri Suresh Kumar House	130	0.696	49.0	105.5
					❖House of Sri Velayudhan	143	< 0.5	-	-
					❖Mine Office	149	< 0.5	-	-
					❖House of Sri Suresh Kumar	180	< 0.5	-	-
					❖House of Sri Suresh Kumar (Structure – 4.5 m)	180	< 0.5	-	-
					❖House of Smt. Devi T. G.	260	< 0.5	-	-
					❖House of Smt. Mini S. Kumar	531	< 0.5	-	-
3.	14.01.2023	N 11°37´41.2″ E 76°02´42.0″ 725 mRL	4.125	0.750	❖Towards Sri Suresh Kumar House	145	0.582	86.63	116.9
					❖Mine Office	133	< 0.5	-	-
					❖House of Sri Velayudhan	151	< 0.5	-	-
					❖House of Sri Suresh Kumar	188	< 0.5	-	-
					❖House of Sri Suresh Kumar (Structure – 4.5 m)	188	< 0.5	-	-
					❖House of Smt. Devi T. G.	255	< 0.5	-	-
					❖House of Smt. Mini S. Kumar	528	< 0.5	-	-
4.	14.01.2023	N 11°37´41.4″ E 76°02´41.9″ 731 mRL	3.75	0.375	❖Towards Sri Suresh Kumar House	86	< 0.5	-	-
					❖Mine Office	128	< 0.5	-	-
					❖House of Sri Velayudhan	154	< 0.5	-	-
					❖House of Sri Suresh Kumar	190	< 0.5	-	-
					❖House of Sri Suresh Kumar (Structure – 4.5 m)	190	0.524	14.2	103.5
					❖House of Smt. Devi T. G.	254	< 0.5	-	-
					❖House of Smt. Mini S. Kumar	527	< 0.5	-	-

5.	14.01.2023	N 11°37´41.6″ E 76°02´41.7″ 736 mRL	3.75	0.375	❖Towards Sri Suresh Kumar House ❖Mine Office ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	42 120 162 197 197 250 523	2.222 < 0.5 0.684 0.554 < 0.5 < 0.5 < 0.5	102.4 - 81.88 126.9 - - -	106.5 - 101.0 97.50 - - -
6.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	3.125	0.375	❖Towards Sri Suresh Kumar House ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖Mine Office ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	48 116 156 156 166 281 550	1.823 0.568 < 0.5 0.539 < 0.5 < 0.5 < 0.5	74.38 30.13 - 26.5 - - -	104.9 100.0 - 95.92 - - -
7.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	3.125	0.375	❖Towards Sri Suresh Kumar House ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖Mine Office ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	47 126 153 153 191 255 528	1.992 0.524 0.648 0.660 < 0.5 < 0.5 < 0.5	78.5 132.5 99.0 72.25 - - -	101.9 109.5 97.5 95.92 - - -
8.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	3.125	0.375	❖Towards Sri Suresh Kumar House ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖Mine Office ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	50 125 153 153 169 284 553	1.849 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5	33.5 - - - - - -	104.2 - - - - - -
9.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	3.125	0.375	❖Towards Sri Suresh Kumar House ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖Mine Office ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	40 104 112 112 170 285 554	2.865 0.959 0.833 0.596 < 0.5 < 0.5 < 0.5	94.63 38.63 87.88 17.38 - - -	104.2 104.2 100.0 102.8 - - -

10.	14.01.2023	N 11°37´40.7″ E 76°02´43.1″ 746 mRL	3.125	0.375	❖Towards Sri Suresh Kumar House ❖House of Sri Velayudhan ❖House of Sri Suresh Kumar ❖House of Sri Suresh Kumar (Structure – 4.5 m) ❖Mine Office ❖House of Smt. Devi T. G. ❖House of Smt. Mini S. Kumar	54 123 151 151 171 286 555	< 0.5 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5	- - - - - - -	- - - - - - -

Coordinates of blast vibration monitoring locations:

- Towards Sri Suresh Kumar House: N 11°37´41.5″; E 76°02´44.7″ 753 mRL
- Towards Mine Office: N 11°37´42.6″; E 76° 2´41.2″; 766 mRL
- House of Sri Velayudhan: N 11°37´41.2″; E 76° 2´46.9″; 755 mRL
- House of Sri Suresh Kumar: N 11°37´40.6″; E 76° 2´48.2″; 770 mRL
- House of Sri Suresh Kumar (Structure – 4.5 m): N 11°37´40.6″; E 76° 2´48.2″; 775 mRL
- Mine Office: N 11°37´44.7″; E 76° 2´39.7″; 760 mRL
- House of Smt. Devi T. G.: N 11°37´39.6″; E 76° 2´33.8″; 763 mRL
- House of Smt. Mini S. Kumar: N 11°37´38.0″; E 76° 2´25.1″; 763 mRL

The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 14.2 – 132.5 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.8.13.** The FFT analyses reports of some of the vibration data are given in the **Annexure-8**.

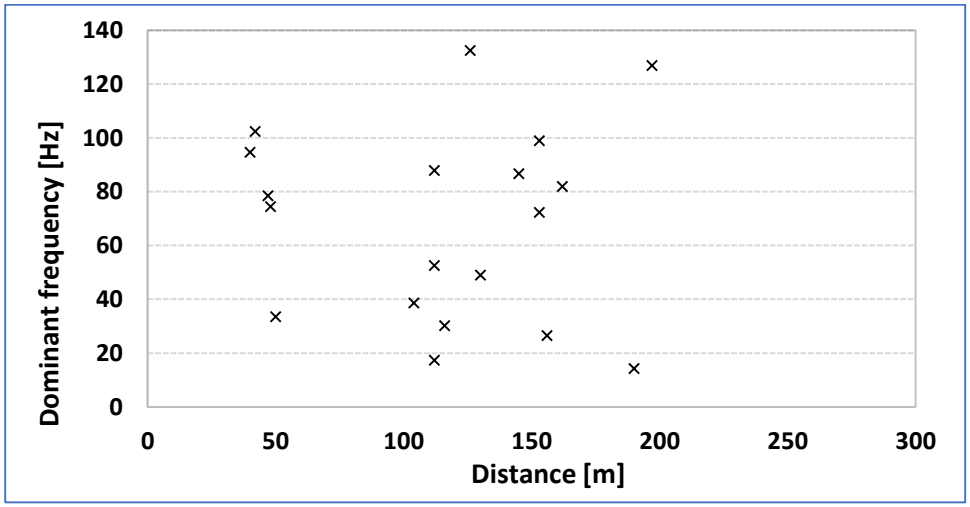


Figure 5.8.13. Plot between frequency of ground vibration and their respective monitoring distances

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 95.92 and 116.9 dB(L). A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.8.14.**

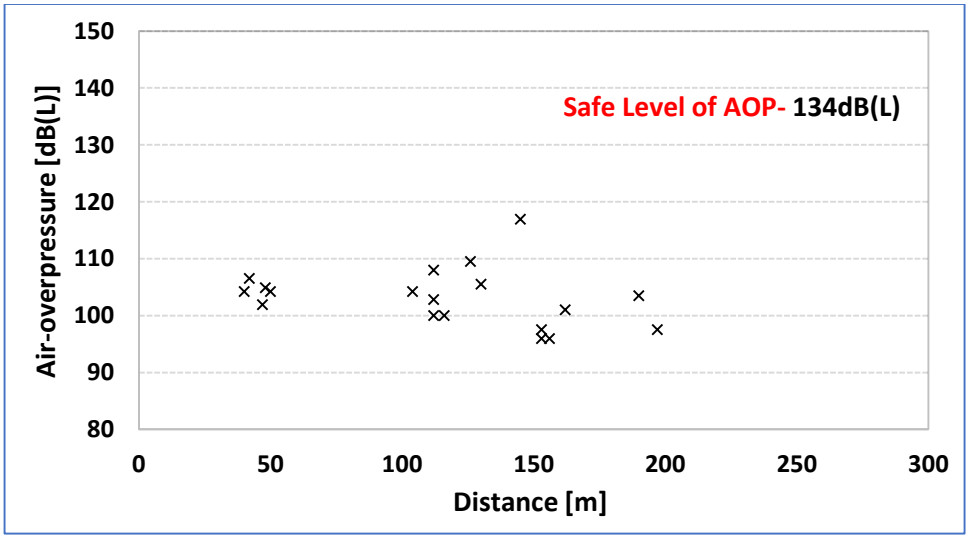


Figure 5.8.14. Plot of air-overpressure versus distance of monitoring locations

5.8.7 Flyrock Results and Observations

In order to study and analyze the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera to observe any occurrence of flyrock and its source. In all the trial blasts conducted during study period, no flying fragments were observed or recorded. The rock movement for one of the experimental blast is shown in **Figure 5.8.15.** The throw of blasted materials was controlled and restricted within the blasting area only. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges.

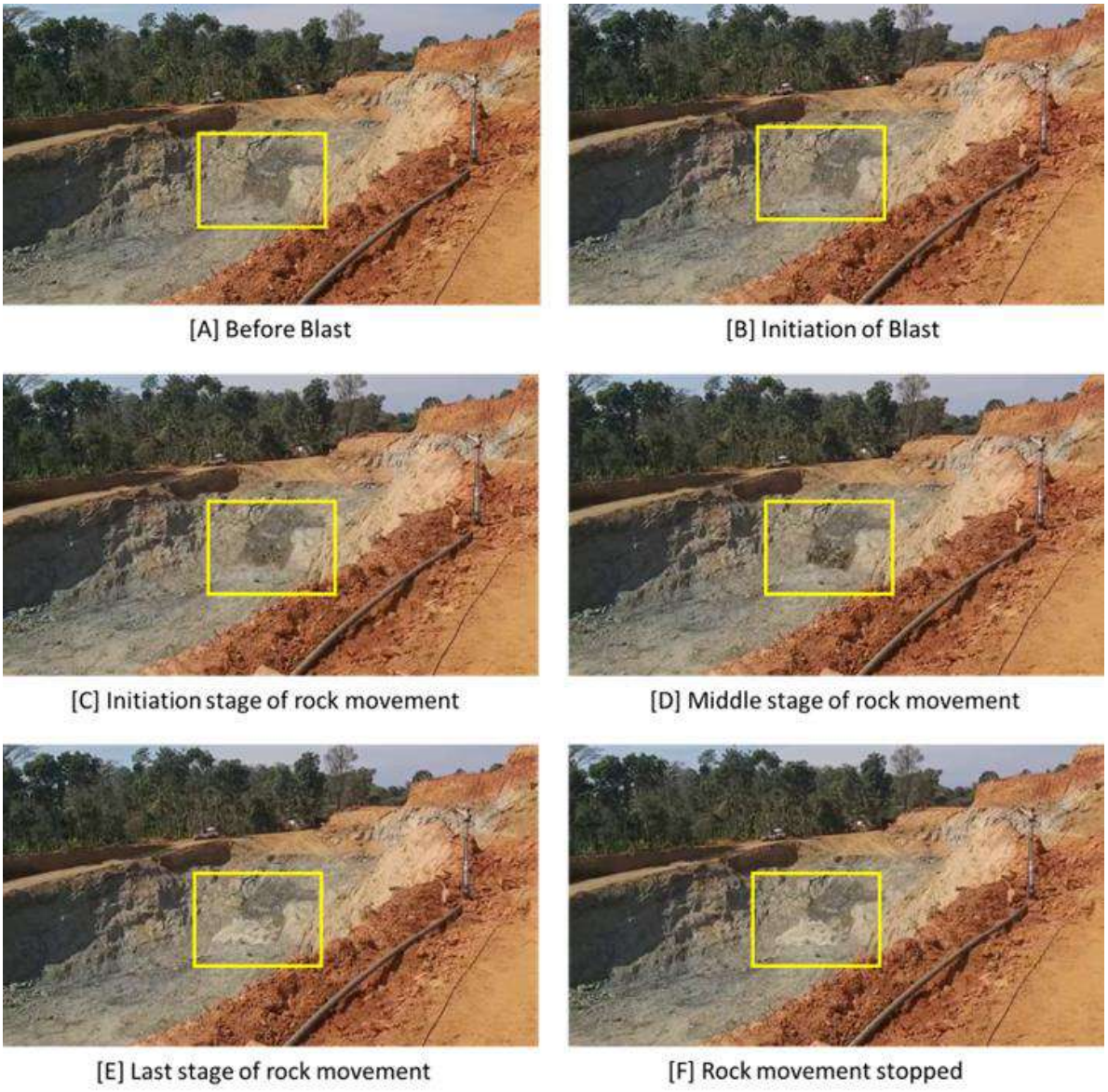


Figure 5.8.15. Sequences of rock movements in the experimental blast B#3.

5.9 GRANITE BUILDING STONE QUARRY OWNED BY P. M. ABDUL RAHMAN, KASARAGOD DISTRICT

5.9.1 Brief Information of the Quarry

Shri P. M. Abdul Rahman is operating a Granite Building Stone Quarry of 3.242 Ha (8.01116 Acres) at Thayannur village, Vellarikundu Taluk, Kasaragod District of Kerala State. The nearest railway station is Kanhangad Railway Station at 20 km and the nearest airport is Mangalore International Airport situated at a distance of 100 km from the quarry.

As per the modified mine plan prepared by M/s Global Environment and Mining Services, Mr. Cyriav Joseph, DGM/KERALA/RQP/15/2018, Bangalore, the lease area is a private land and comprises in Sy No. 428/pt in Thayannur Village, Vellarikundu Taluk, Kasaragod District, Kerala for an area of 3.242 Ha. The geographical location of the quarry lease area having Latitude of N12°22´3.71″to N12°22´13.84″and longitude E75°12´18.61″to E75°12´24.90″. Topographically, the lease area is located on the slope of the area gently dipping towards SE. The surrounding lease area is an elevated terrain having highest elevation of 380 m and lowest elevation of 315 m from the Mean Sea Level (MSL). The main rock type in the area is of medium to coarse grained Granite. The Granite Building Stone quarry in being operated by semi mechanized open cast mining method. For excavation of hard rock strata, controlled blasting as per "MMR – 1961" is being followed. The drilling of blast holes is being carried out using 32 mm drill rod, Jack Hammer and Air Compressor of 160 Cfm capacity.

To fulfil the objective of the study, first field investigation was carried out at this quarry during the period of 17th to 19th January, 2023. The Google Earth view of Granite Building Stone Quarry is depicted in **Figure 5.9.1**. The investigational work conducted at Granite (Building Stone) Quarry, Thayannur village is briefly discussed in the following sub-sections.

5.9.2 Reconnaissance Survey

Reconnaissance survey was carried out on 17th and 18th January 2023 to identify different types of structures present within the radius of 500 m from the quarry. The followings are the brief observations from the reconnaissance survey.

- Within the zone of 200 m from the quarry, there is no any residential house not belonging to the mine owner.
- Within the zone of 200 m to 400 m from the quarry, there were some houses. The nearest house was of Mr. Ravi at a distance of 200 m in NE Direction. The elevation of the house is 258 m.
- There is a temple of Goddess Sri Devi at a distance of 550 m from the quarry in the direction of NW having elevation of 314 m from the mean sea level (MSL).

Figure 5.9.1. The Google Earth view of Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

5.9.3 Study of Land Profile, Nature of Rock Deposits

Studies on the land profile, nature of rock deposition and rebound hardness on the fresh rock surfaces were done. The land profile is undulatory as the area is hilly terrain. The current working benches of the quarry were having elevations between 720 m and 746 m. Most of the houses were located at higher level than the quarry operations at 753 m to 775 m MSL. The rock deposits are found to be massive in nature with limited joints **(Plates 5.9.1 & 5.9.2)**.

Plate 5.9.1. View showing the nature of rock deposit in Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

Plate 5.9.2. View of rebound hardness testing on rock surface at Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

5.9.4 Experimental Blasts

At Granite Building Stone Quarry owned by P. M. Abdul Rahaman, ten rounds of experimental blasts with varying design parameters were conducted from bottom to top working benches of the quarry. All the blasts were conducted with 32 mm blast hole diameter, drilled with Jack Hammer drilling machines (**Plate 5.9.3**). Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge was used as main explosive charge to fragment the hard rockmass. Nonel (shock tube) initiation system of 200 ms Down-the Hole Delay (DTH) and 25 ms of noiseless Trunkline Delay (TLD) were used for true bottom initiation all the charged holes and surface initiation of each hole in a round of blast. The details of blast design parameters used during the experimental trials are given in **Table 5.9.1.** The locations of the blast faces along with the monitoring locations marked on google map is shown in **Figure 5.9.2.**

Plate 5.9.3. Drilling of blast holes using Handheld Jackhammer drill machine at Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

Table 5.9.1. Details of blasts conducted at Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District on 19.01.2023.

S. No.	Location of blast	No. of holes	Hole dia. [mm]	Hole depth [m]	Burden [m]	Spacing [m]	No. of rows	Average Top Stemming [m]	Explosives		Explosive and initiation type
									Explosives per hole [kg]	Total explosives detonated [kg]	
1.	N 12°22´11.1″ E 75°12´22.6″ 313 mRL	10	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	3.125	25 mm dia. of Emulsion Cartridge explosive, wt. 125 gm with Nonel initiation system (DTH/TLD 200/25 ms)
2.	N 12°22´10.9″ E 75°12´22.5″ 314 mRL	21	32	1.8	0.9	0.9	03	1.2 – 1.4	0.25 - 0.375	6.375	
3.	N 12°22´11.2″ E 75°12´23.0″ 310 mRL	10	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	3.125	
4.	N 12°22´11.5″ E 75°12´23.2″ 310 mRL	15	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	5.125	
5.	N 12°22´11.6″ E 75°12´23.3″ 311 mRL	10	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	3.437	
6.	N 12°22´11.7″ E 75°12´23.4″ 314 mRL	14	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	4.813	
7.	N 12°22´11.6″ E 75°12´23.1″ 314 mRL	18	32	1.8	0.9	1.0	02	1.2 – 1.4	0.25 - 0.375	6.188	
8.	N 12°22´10.9″ E 75°12´22.3″ 314 mRL	5	32	1.8	0.9	1.0	02	1.4	0.25	1.25	
9.	N 12°22´11.2″ E 75°12´22.5″ 310 mRL	11	32	1.5	0.9	0.9	02	1.1	0.25	2.75	
10.	N 12°22´11.5″ E 75°12´23.2″ 310 mRL	14	32	1.5 – 1.8	0.8- 0.9	1.0-1.1	02	1.1 – 1.2	0.25 - 0.375	3.938	

Figure 5.9.2. Google map showing locations of experimental blasts and vibration monitoring points at Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

In the experimental blasts, hole depths of 1.5 to 1.8 m with burden varying from 0.8 to 0.9 m and spacing varying from 0.9 to 1.0 m were used. The explosive charge per hole varied from 0.25 to 0.375 kg. The number of holes varied from 05 to 21 and the total explosive charge varied from 1.25 to 6.375 kg. Charging of explosive into the blast holes is shown in **Plate 5.9.4.** The drilling, firing and charging pattern of experimented blasting rounds are depicted in **Figures 5.9.3 and 5.9.12**.

Plate 5.9.4. Charging of holes at Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State

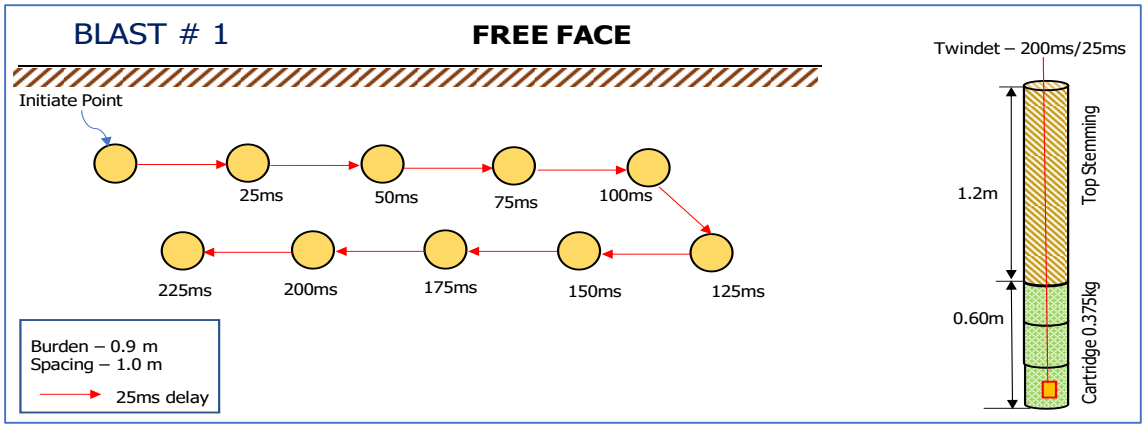


Figure 5.9.3. Drilling, firing and charging pattern of experimental Blast no. 1

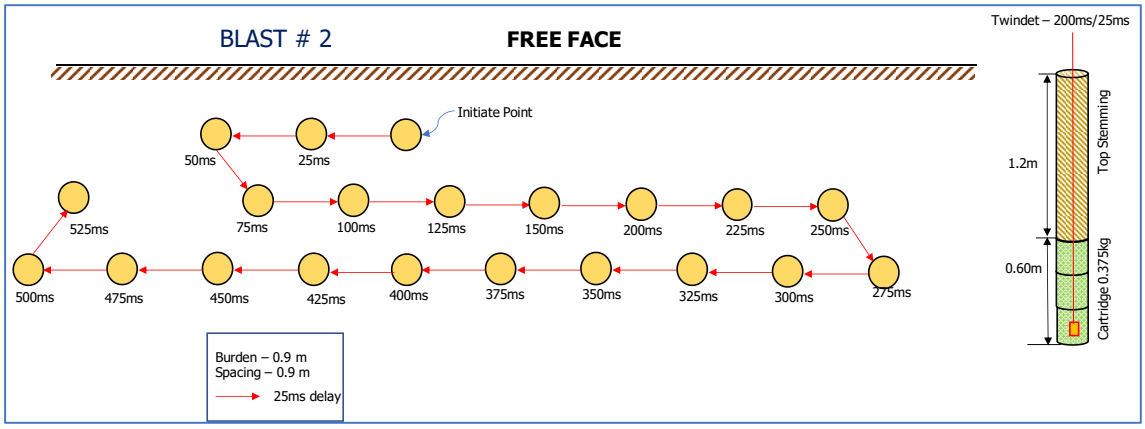


Figure 5.9.4. Drilling, firing and charging pattern of experimental Blast no. 2

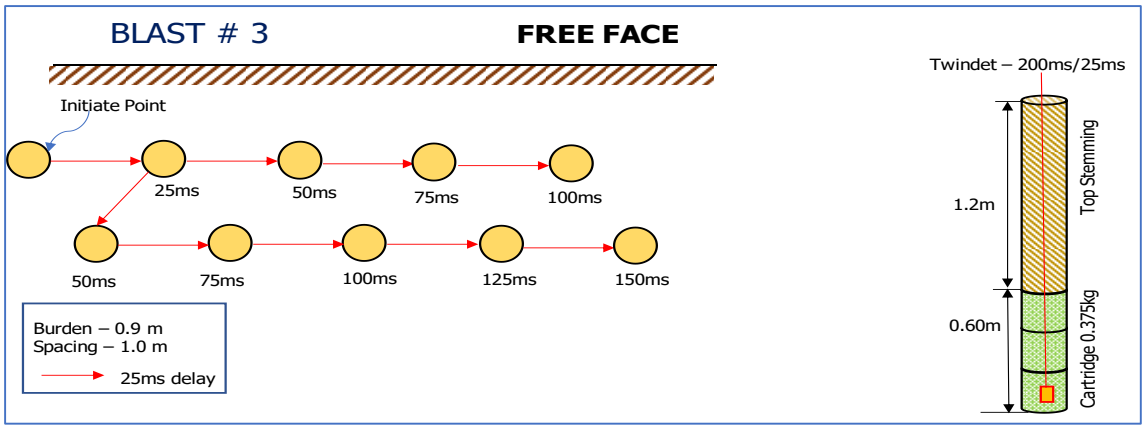


Figure 5.9.5. Drilling, firing and charging pattern of experimental Blast no. 4

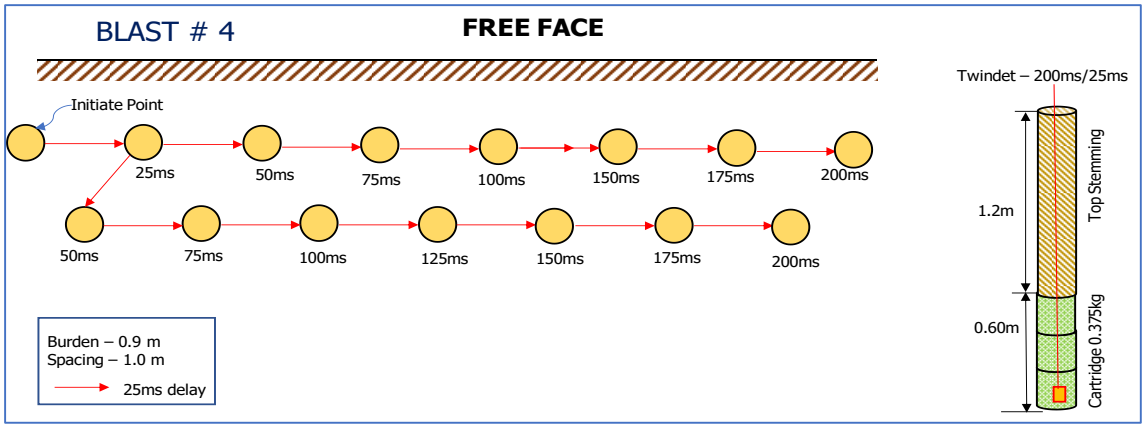


Figure 5.9.6. Drilling, firing and charging pattern of experimental Blast no. 4

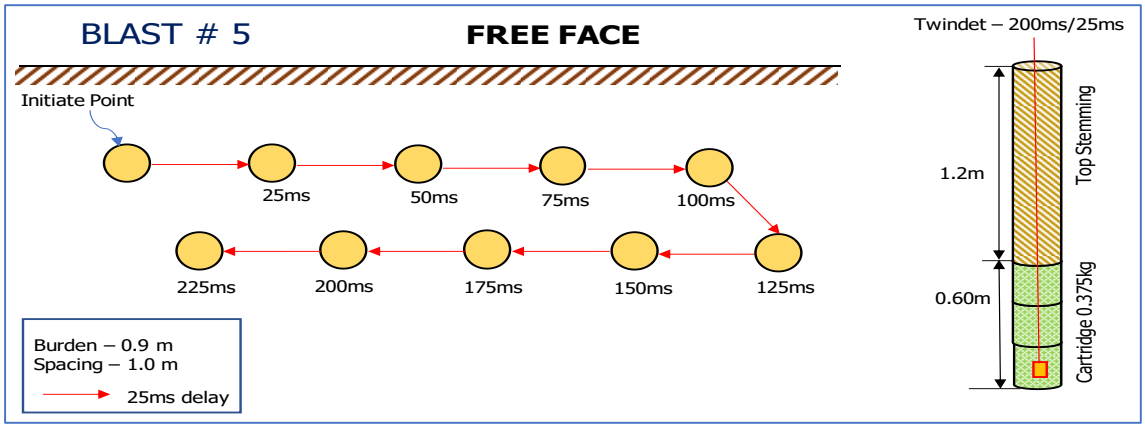


Figure 5.9.7. Drilling, firing and charging pattern of experimental Blast no. 5

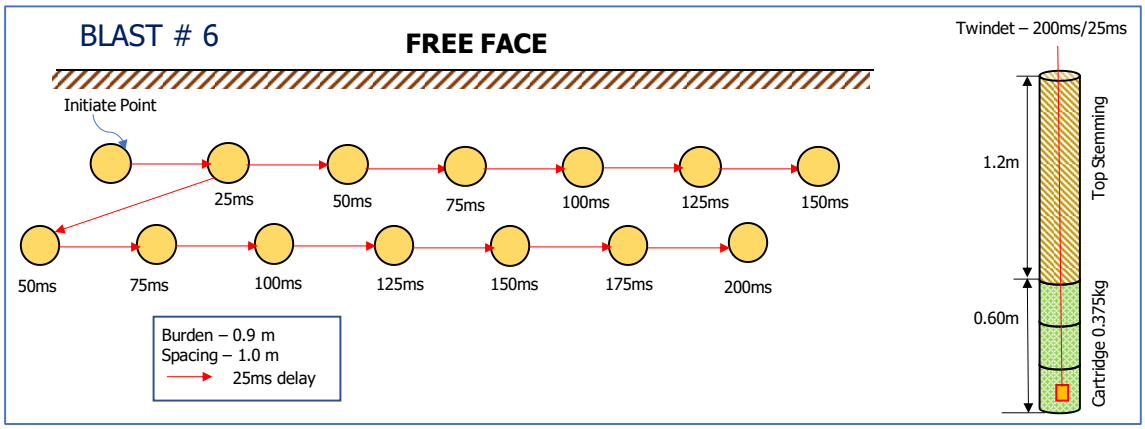


Figure 5.9.8. Drilling, firing and charging pattern of experimental Blast no. 6

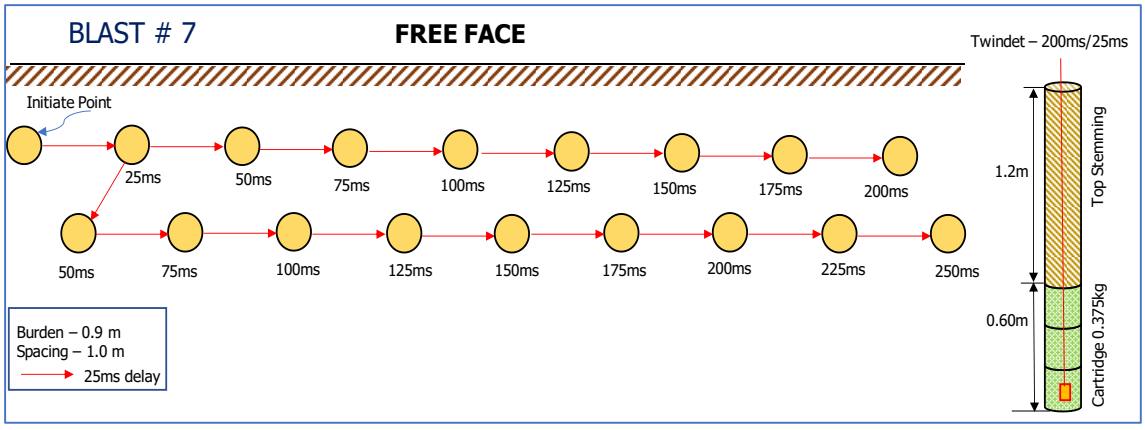


Figure 5.9.9. Drilling, firing and charging pattern of experimental Blast no. 7

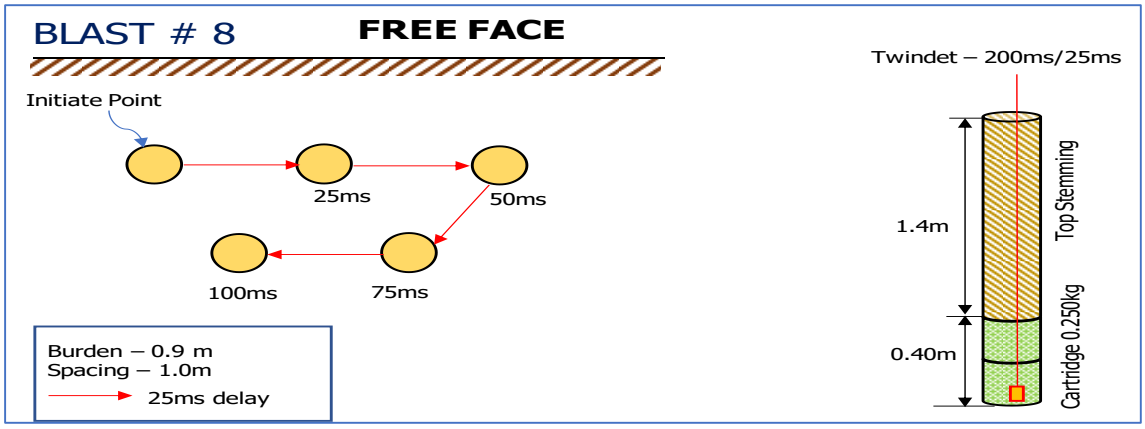


Figure 5.9.10. Drilling, firing and charging pattern of experimental Blast no. 8

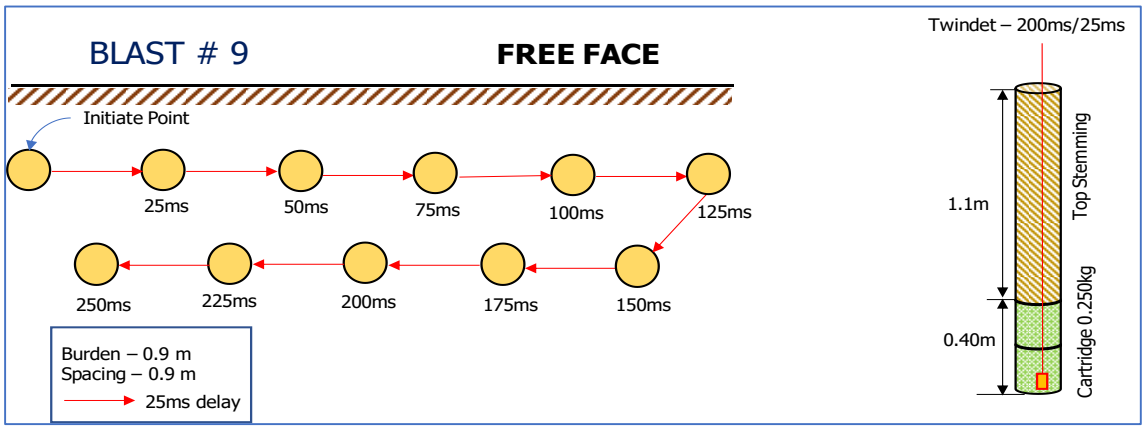


Figure 5.9.11. Drilling, firing and charging pattern of experimental Blast no. 9

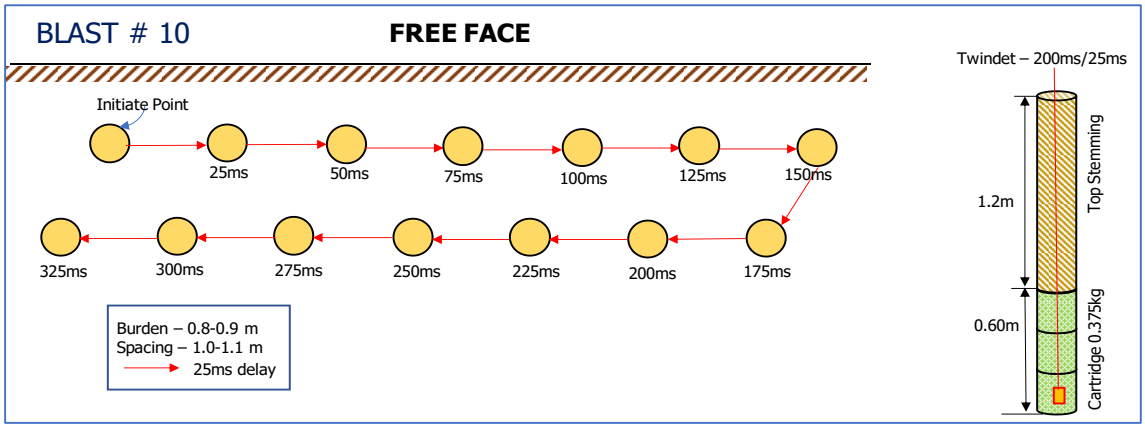


Figure 5.9.12. Drilling, firing and charging pattern of experimental Blast no. 10

5.9.5 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air-overpressures were monitored using eight number of seismographs. The monitoring points were selected considering the objectives, backside of free face of blasts as well as point of interests (viz. public houses). View of a few vibration monitoring points are given in **Plates 5.9.5 to 5.9.8**.

Plate 5.9.5. View of vibration monitoring behind blast face (towards Sri devi Temple)

Plate 5.9.6. View of vibration monitoring behind blast face

Plate 5.9.7. View of vibration monitoring at the house of Shri Ravi

Plate 5.9.8. View of vibration monitoring on the roof of the house Sri Ravi

5.9.6 Ground Vibration and Air Overpressure Results

From the ten trial blasts conducted at the quarry, altogether 33 ground vibration data were recorded at different locations in and around the quarry. At many instances, specially near the residential structures/locations situated beyond 100 m distances from the blasting patches, the monitoring seismograph could not record the ground vibration as the magnitude of vibration was less than the pre-set trigger level of the instrument i.e., 0.5 mm/s. Depending on the distance of vibration monitoring points, maximum charge per delay and the total number of holes used in the blasting round, the magnitudes of recorded vibration varied from 0.524 to 4.664 mm/s. The monitoring distances from the blasting faces varied between 35 and 576 m. The graph plotted between vibration (PPV) recorded and concerned monitoring distances from the blasting patch is shown in **Figure 5.9.13**. The details of recorded ground vibration data are given in **Table 5.9.2**. The waveform reports of some of the recorded ground vibration data are also given in **Annexure-9**.

The maximum magnitude of ground vibration recorded from all the experimental blasts was 4.664 mm/s with the associated dominant frequency of 107.6 Hz. This was recorded at 35 m distance from blast No. B#7 behind the blast face. The maximum charge per delay (MCPD) in the blast was 0.75 kg whereas total explosive charge detonated in the blasting round was 6.188 kg. Further, magnitude of vibration recorded beyond 112m from the blasting patches were less than 0.5 mm/s (i.e., the pre-set trigger level).

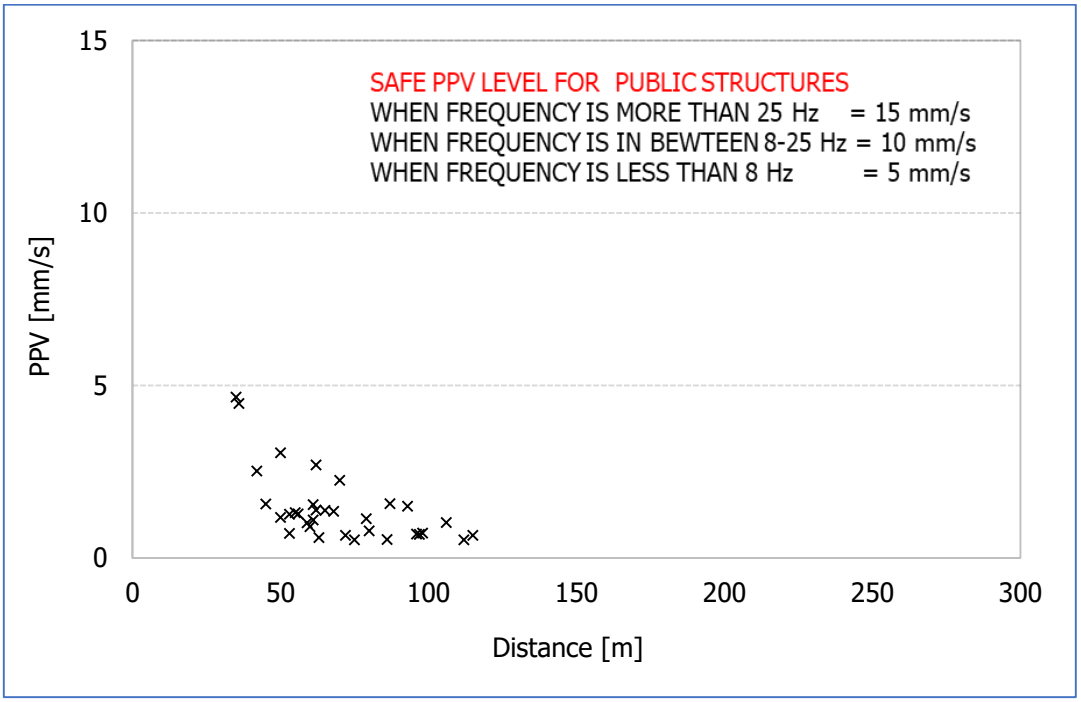


Figure 5.9.13. Plot between recorded vibration (PPV) and monitoring distances

Table 5.9.2. Blast induced ground vibration and air over pressure recorded at different locations at Granite Building Stone Quarry owned by P. M. Abdul Rahaman, Kasargod District of Kerala State on 19.01.2023

Blast No.	Location of blast	Total explosives fired in the round [kg]	Max^{m} explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant Frequency [Hz]	AOP [dB(L)]
1.	N 12°22´11.1″ E 75°12´22.6″ 313 mRL	3.125	0.375	❖ Towards Mine Office	56	1.276	58.5	111.8
				❖ Behind blast face (Towards Sri Devi Temple)	59	1.017	236.1	NR
				❖ Behind blast face	85	< 0.5	-	-
				❖ Front of the blast face (Towards Sri Shiva Stone quarry)	103	< 0.5	-	-
				❖ Behind blast face	126	< 0.5	-	-
				❖ House of Sri Ravi	218	< 0.5	-	-
				❖ House of Sri Ravi (Structure – 4m)	218	< 0.5	-	-
				❖ Sri Devi Temple	572	< 0.5	-	-
2.	N 12°22´10.9″ E 75°12´22.5″ 314 mRL	6.375	0.375	❖ Towards Mine Office	50	1.178	64.5	114.8
				❖ Behind blast face (Towards Sri Devi Temple)	60	0.908	142.9	NR
				❖ Behind blast face	85	< 0.5	-	-
				❖ Front of the blast face (Towards Sri Shiva Stone quarry)	100	< 0.5	-	-
				❖ Behind blast face	129	< 0.5	-	-
				❖ House of Sri Ravi	225	< 0.5	-	-
				❖ House of Sri Ravi (Structure – 4m)	225	< 0.5	-	-
				❖Sri Devi Temple	571	< 0.5	-	-
3.	N 12°22´11.2″ E 75°12´23.0″ 310 mRL	3.125	0.75	❖ Behind blast face (Towards Sri Devi Temple)	62	1.391	77.38	112.8
				❖ Towards Mine Office	65	1.383	50.88	NR
				❖ Behind blast face	96	0.696	45.5	100.0
				❖ Behind blast face	112	0.524	74.0	104.9
				❖ Front of the blast face (Towards Sri Shiva Stone quarry)	124	< 0.5	-	-
				❖ House of Sri Ravi	208	< 0.5	-	-
				❖ House of Sri Ravi (Structure – 4m)	208	< 0.5	-	-
				❖ Sri Devi Temple	574	< 0.5	-	-

4.	N 12°22´11.5″ E 75°12´23.2″ 310 mRL	5.125	0.75	❖ Behind blast face (Towards Sri Devi Temple) ❖ Behind blast face ❖ Towards Mine Office ❖ Behind blast face ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	61 79 97 115 120 195 195 574	1.55 1.143 0.684 0.66 < 0.5 < 0.5 < 0.5 < 0.5	51.25 68.0 43.3 49.75 - - - -	NR 128.6 113.3 115.6 - - - -
5.	N 12°22´11.6″ E 75°12´23.3″ 311 mRL	3.437	0.375	❖ Behind blast face ❖ Behind blast face (Towards Sri Devi Temple) ❖ Towards Mine Office ❖ Behind blast face ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	42 68 80 98 121 194 194 576	2.519 1.35 0.783 0.718 < 0.5 < 0.5 - -	96.5 150.4 42.75 98.38 - - - -	NR 112.3 100.0 101.9 - - - -
6.	N 12°22´11.7″ E 75°12´23.4″ 314 mRL	4.813	0.75	❖ Behind blast face ❖ Behind blast face (Towards Sri Devi Temple) ❖ Towards Mine Office ❖ Behind blast face ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	36 50 62 70 143 191 191 575	4.475 3.053 2.7 2.25 < 0.5 < 0.5 < 0.5 < 0.5	60.88 85.0 74.88 63.5 - - - -	NR 112.3 103.5 108.0 - - - -
7.	N 12°22´11.6″ E 75°12´23.1″ 314 mRL	6.188	0.75	❖ Behind blast face ❖ Behind blast face (Towards Sri Devi Temple) ❖ Towards Mine Office ❖ Behind blast face ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	35 87 93 106 129 198 198 571	4.664 1.571 1.503 1.032 < 0.5 < 0.5 < 0.5 < 0.5	107.6 57.88 67.75 81.88 - - - -	NR 110.6 117.9 108.4 - - - -

8.	N 12°22´10.9″ E 75°12´22.3″ 314 mRL	1.25	0.25	❖ Towards Mine Office ❖ Behind blast face ❖ Behind blast face (Towards Sri Devi Temple) ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ Behind blast face ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	45 55 86 101 128 230 230 568	1.566 1.316 0.539 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5	55.88 139.4 50.0 - - - - -	113.5 NR 100.0 - - - - -
9.	N 12°22´11.2″ E 75°12´22.5″ 310 mRL	2.75	0.25	❖ Towards Mine Office ❖ Behind blast face ❖ Behind blast face (Towards Sri Devi Temple) ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ Behind blast face ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	53 63 75 111 119 217 217 565	0.714 0.596 0.524 < 0.5 < 0.5 < 0.5 < 0.5 < 0.5	56.5 92.0 45.0 - - - - -	NR 110.9 97.5 - - - - -
10.	N 12°22´11.5″ E 75°12´23.2″ 310 mRL	3.938	0.375	❖ Behind blast face ❖ Towards Mine Office ❖ Behind blast face (Towards Sri Devi Temple) ❖ Front of the blast face (Towards Sri Shiva Stone quarry) ❖ Behind blast face ❖ House of Sri Ravi ❖ House of Sri Ravi (Structure – 4m) ❖ Sri Devi Temple	53 61 72 115 118 210 210 568	1.267 1.1 0.66 < 0.5 < 0.5 < 0.5 - -	122.9 63.75 50.88 - - - - -	NR 121.8 108.4 - - - - -

The Fast Fourier Transform (FFT) analyses of all the recorded vibration data were carried out to obtain the dominant peak frequency content of the vibration waves. Based on the results of the FFT analysis, it was observed that the dominant peak frequencies of the recorded ground vibration waves ranged between 42.75 – 236.1 Hz. A plot of dominant peak frequencies of recorded ground vibration waves with respect to their concerned monitoring distances are given in **Figure 5.9.14.** The FFT analyses reports of some of the vibration data are given in the **Annexure-9**.

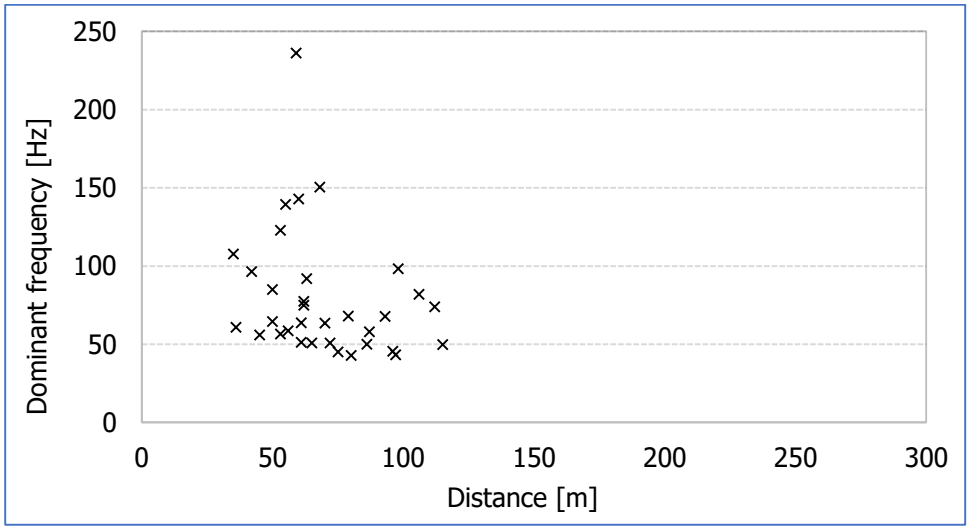


Figure 5.9.14. Plot between recorded frequency and monitoring distances from the blasting patches.

The air overpressure/air-blast levels recorded from the different experimental blasts during the period of field investigation varied between 97.5 and 128.6 dB(L). A plot of recorded air-overpressure with respect to their concerned monitoring distances are given in **Figure 5.9.15.**

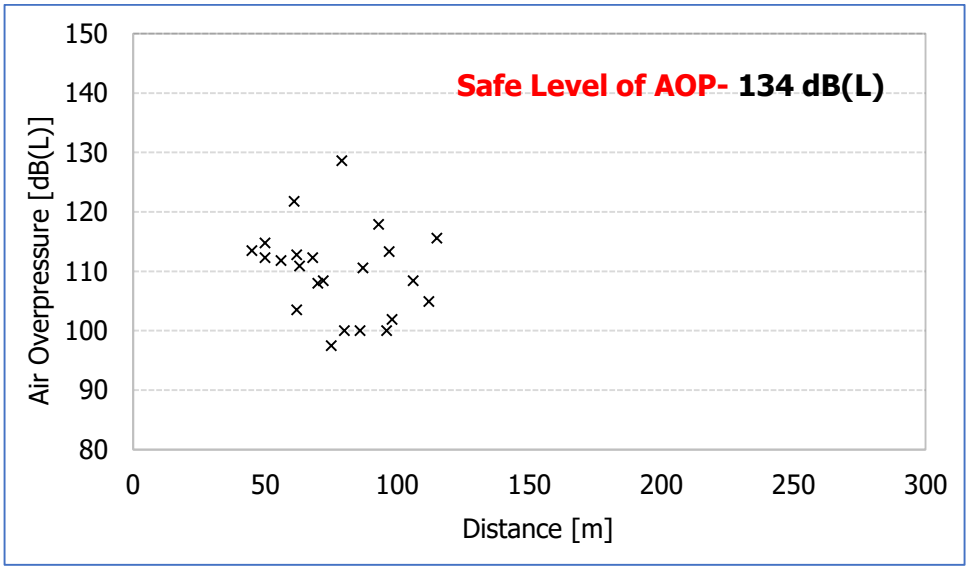


Figure 5.9.15. Plot of air-overpressure versus distance of monitoring location

5.9.7 Flyrock Results and Observations

In order to study and analyze the possible occurrences of flying fragments from the blast holes, all the experimental blasts were recorded using a digital video camera to observe any occurrence of flyrock and its source. During the study, flyrock ejections occurred only in one blast (#B10). However, the ejections were controlled upto a distance of 25 m. In rest of the the trial blasts, no flying fragments were observed or recorded. The recorded rock movement sequence for one of the experimental blast is shown in **Figure 5.9.16.** The throw of blasted materials was controlled and restricted within the blasting area only. The control on flyrock was achieved mainly by the proper blast design patterns and their implementation at the faces, effective stemming of holes and use of Nonel initiation system for bottom initiation of explosive charges.

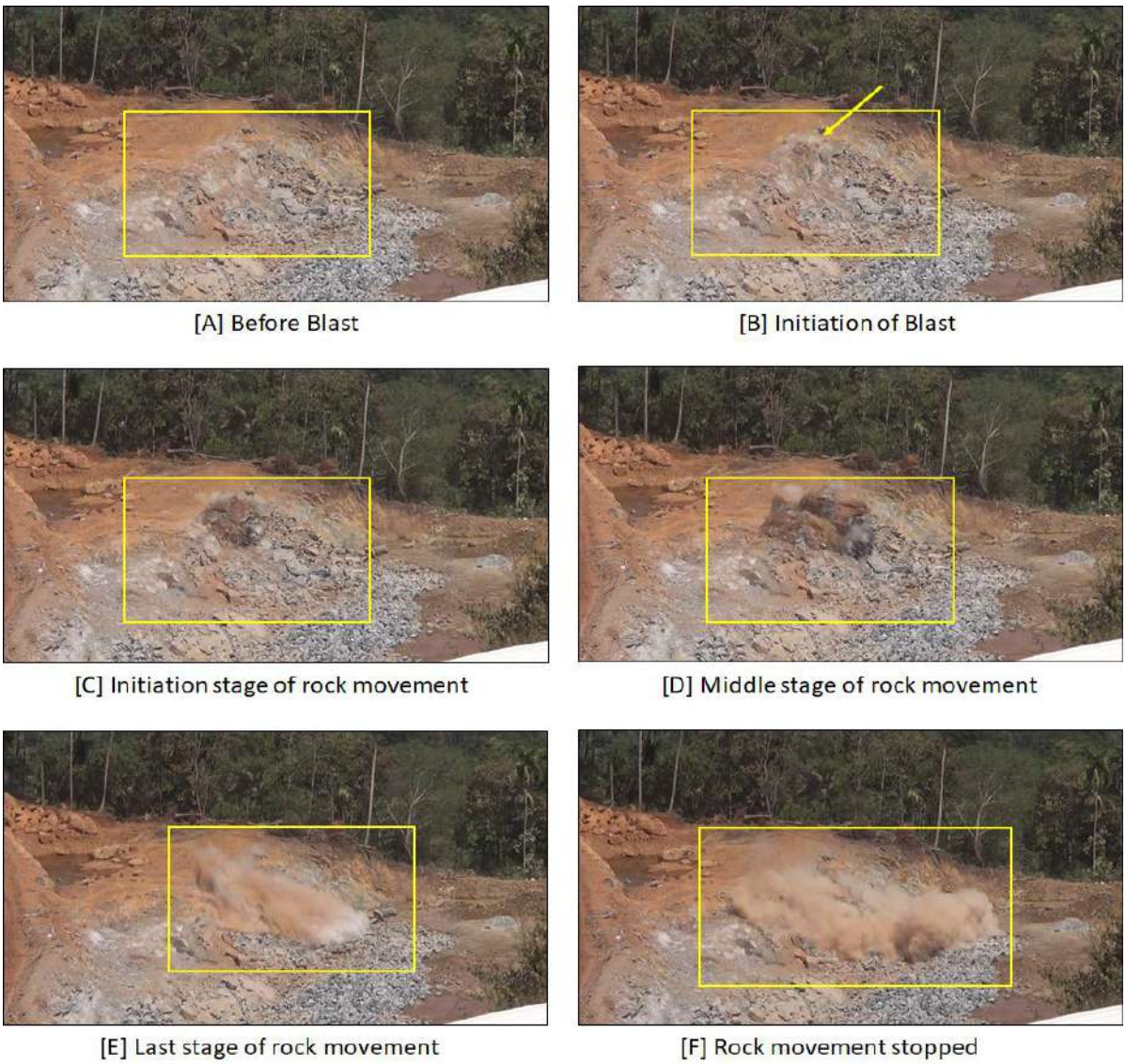


Figure 5.9.16. Sequences of rock movements in the experimental blast B#3

6.0 HUMAN RESPONSE TO BLASTING ACTIVITIES IN QUARRY

Human being is remarkably sensitive to vibration. The phenomena, by and large, is a mixture of physiological and psychological factor and varies from person to person. The audible and sub-audible parameters that alert human response and damage to structures are air-overpressure and blast-induced ground vibration. The characteristics of discomfort raised among local people depend upon position, age and education of an individual. The acceptable limit depends upon involvement of an individual with the source causing vibration, industrial relation the management is maintaining with local people and eco-social environment of the area.

6.1 SAFE LIMITS OF GROUND VIBRATION AND HUMAN PERCEPTIBILITY

The safe limits of the ground vibrations have been provided by different researchers based on the experiments. In Indian condition, DGMS circular 7 of 1997 **(Table 3.1)** is referred for determining the safe limits of ground vibration. The perceptible limit of ground vibration may be less than the stipulated safe limit of ground vibrations. The generalized perceptible limit for continuous vibration is listed in **Table 6.1**. Based on the study conducted at different opencast mines in India, Dhar et. al (1998) studied human response and the different perception level is given in **Table 6.2**. Hence, it is extremely difficult to establish a vibration level where nobody will complain. There may be some person in the society who will complain, no matter, how small is the disturbance. If some cracks appear in a house, located far away from mining/blasting area, the residents unhesitatingly accept it either as a natural cause (ground settlement) or a lack in the desired quality of construction. Conversely, if the village is nearer to the blasting site, the blasting sound usually creates fear psychosis and residents find enough reason to relate it with blast induced vibration. Many a times, one may feel the vibration and noise, but this may not cause damage to buildings. The term "noise" is generally defined as a negative response or attitude towards sound heard during blasting.

Table 6.1. Vibration Levels and Human Perception of Motion (Source: DIN 4150 Part 2-1975)

Approximate vibration levels (mm/s)	Degree of perception
0.10	Not felt
0.15	Threshold of perception
0.35	Barely noticeable
1.0	Noticeable
2.0	Easily noticeable
6.0	Strongly noticeable
14	Very strongly noticeable

Table 6.2. Effect of ground vibration on human (Dhar et. al., 1998)

Effect on human	Ground vibration level [mm/s]
Noticeable	0.5
Troublesome	5.0
Severe	15

6.2 SAFE LIMITS OF AIR OVERPRESSURE

The typical air overpressure limits as given by Oriard (2002) and the limits recommended by the United States Bureau of Mines (USBM) for surface mine blasting are given in **Table 6.3** and **Table 6.4** respectively. **Table 6.5** shows Central Pollution Control Board (CPCB), India's permissible levels for noise exposure for work zone area as prescribed under Model Rules of Factories Act, 1948.

Table 6.3. Typical air overpressure criteria (After Oriard, 2002)

171 dB	General window breakage
151 dB	Occasional window breakage
140 dB	Long-term history of application as a safe project specifications
134 dB	Bureau of Mines recommendation following a study of large-scale surface mine blasting

Table 6.4. Air overpressure limits recommended by USBM for surface mining (RI 8485)

134 dB	0.1 Hz high pass measuring system
133 dB	2.0 Hz high pass measuring system
129 dB	6.0 Hz high pass measuring system
105 dB	C-slow weighting scale on a sound level meter
(Events less than or equal to 2 – sec duration)	

Table 6.5. Central Pollution Control Board (CPCB) permissible levels for noise exposure for work zone area

Peak sound pressure in dB	Permitted number of impulse or impact/day
140	100
135	315
130	1000
125	3160
120	10000

Note:
1. No exposure in excess of 140 dB peak sound pressure level is permitted.
2. For any peak sound pressure level falling in between any figure and the next higher or lower figure as indicated in column 1, the permitted number impulses or impacts per day is to be determined extrapolation on a proportionate basis.

6.3 CAUSES OF STRUCTURAL DAMAGE OTHER THAN BLASTING

There are many reasons other than blast-induced ground vibrations to produce cracks in the house. Cracking is a normal occurrence in the walls and ceilings of structures, and the causes are multiple, ranging from poor construction to normal environmental stress, such as thermal stresses, wind, etc. The Small Home, published by the Architects Small House Service Bureau of the United States, Inc. 1925, gave a list of reasons for the development of cracks, which included the following:

(1) Building a house on a hill.
(2) Failure to make the footings wide enough.
(3) Failure to make the footings below the frost line.
(4) Width of footings not made proportional to the loads they carry.
(5) The posts in the basement not provided with separate footings.
(6) Failure to provide a base raised above the basement floor line for the setting of wooden posts.
(7) Not enough cement used in the concrete.
(8) Dirty sand or gravel used in the concrete.
(9) Failure to protect beams and sills from rotting through dampness.
(10) Setting floor joists one end on masonry over openings.
(11) Mortar, plaster, or concrete work allowed to freeze before setting.
(12) Braces omitted in wooden walls.
(13) Sheathing omitted in wooden walls (excepting in "back-plastered" construction).
(14) Drainage water from roof not carried away from foundations.
(15) Floor joists not bridged.
(16) Supporting posts too small.
(17) Cross beams too light.
(18) Sub-flooring omitted.
(19) Wooden walls not framed so as to equalize shrinkage.
(20) Poor materials used in plaster.
(21) Plaster applied too thin.
(22) Lath placed too close together.
(23) Lath run behind studs at corners.
(24) Metal reinforcement omitted in plaster at corners.
(25) Metal lath omitted in plaster at corners.
(26) Metal lath omitted on wide expanses of ceiling.
(27) Plaster applied directly on masonry at chimney stack.
(28) Plaster applied on lath that is too dry.
(29) Too much cement in the stucco.

(30) Stucco not kept wet until set.
(31) Subsoil drainage not carried away from walls.
(32) First coat of plaster not properly keyed to backing.
(33) Wood beams spanned too long between posts.
(34) Failure to use double joists under unsupported partitions.
(35) Too few nails used.
(36) Rafters too light or too far apart.
(37) Failure to erect trusses over wide wooden openings.

6.4 OBSERVATIONS FROM HUMAN RESPONSE SURVEY

During the field investigations at the nine selected quarries, human response studies were conducted. Questionnaire was prepared and survey were carried out amongst the nearby dwellers of the quarries. The responses obtained from different persons at different quarries are given in **Annexure-10 to 18**. Based on the data collected from the different quarry locations, pie charts have been drawn to understand the impact on human due to blasting (**Figures 6.1 to 6.4)**. As claimed by the residents, in majority of cases, blasting creates disturbances and annoyances to them. However, the actual data recorded during the field investigations had very low magnitudes of ground vibration and Air overpressures to create the disturbances. In some instances, the claim of the residents was that most of the time quarry management is not following the same blasting practices as practiced on the experimental blasting day. This claim may have merit in some cases, when the structure is within 100 m from the blasting faces. The proper reporting system for day-to-day actual consumption of explosives and rock excavation need to be framed to address such claims in the future. Sometimes the reported annoyance was even at a vibration level of less than 1 mm/s, such claims are unavoidable.

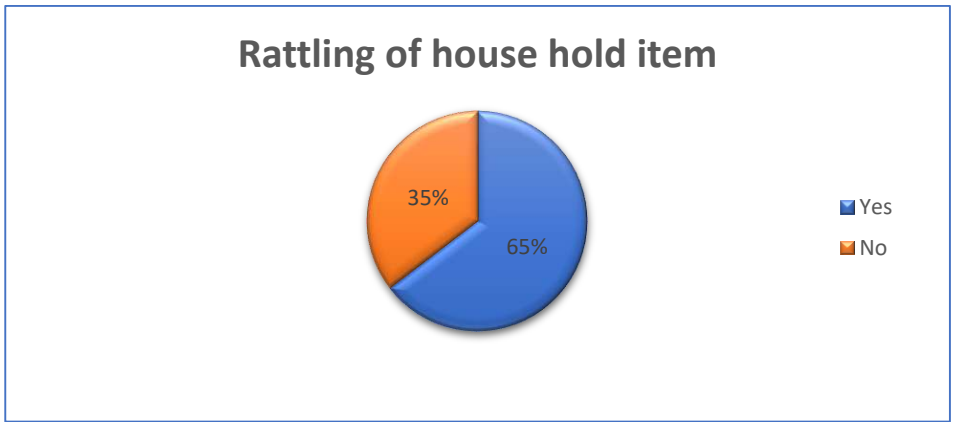


Figure 6.1. Pie-chart showing response against the rattling of house hold items due to blasting

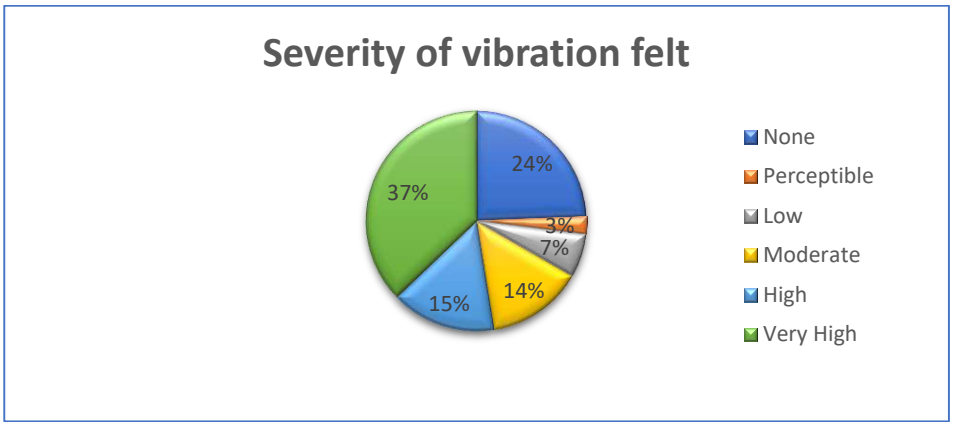


Figure 6.2. Pie-chart showing response against the severity of vibration felt due to blasting

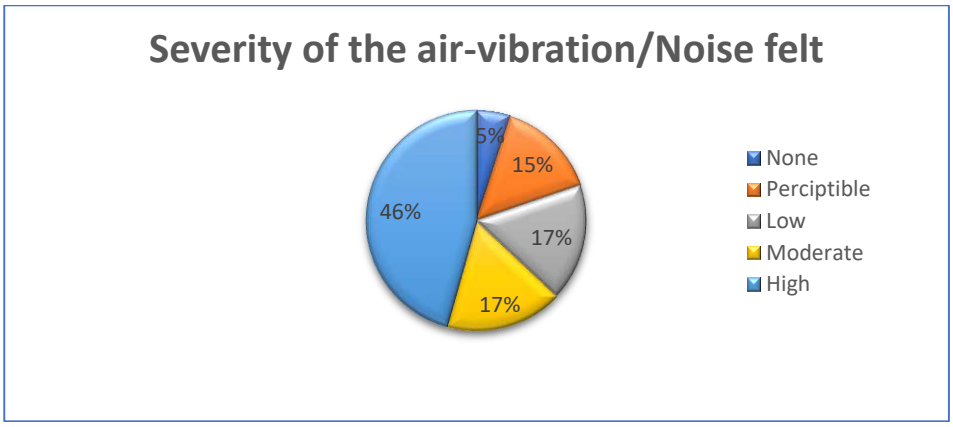


Figure 6.3. Pie-chart showing response against the Severity of the air-vibration/Noise felt due to blasting

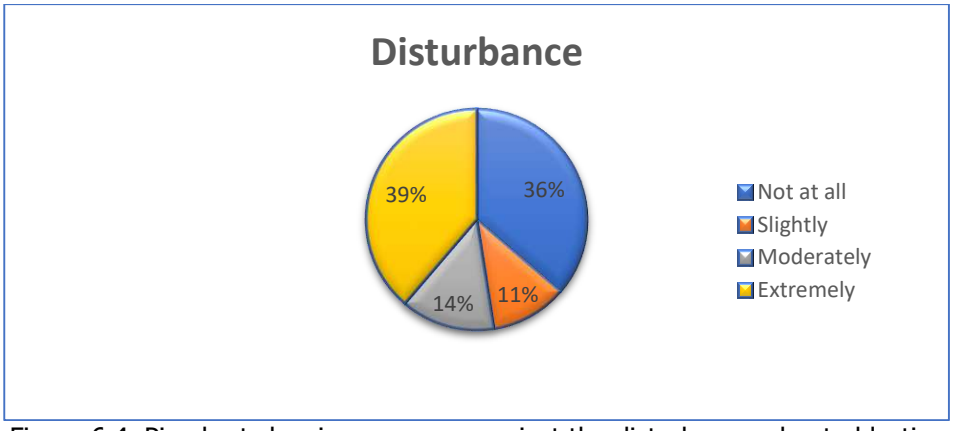


Figure 6.4. Pie-chart showing response against the disturbances due to blasting

7.0 ANALYSIS OF EXPERIMENTAL DATA

The ground vibration and air overpressure data were collected during experimentation by the installation of seismographs. The gathered experimental data were grouped together for the analysis. The analysis has been carried out using the Blastware module of M/s Instantel. The multivariate statistical analysis has also been carried out using the data analysis tool of Microsoft excel. The details regarding the analysed data and their outcomes has been discussed in this section.

7.1 SUMMARY OF RECORDED DATA

The ground vibration data were recorded as Peak Particle Velocity (PPV). Altogether 301 experimental data of PPV were generated during the study. The maximum PPV recorded during the study was 10.42 mm/s. This vibration data was recorded at a distance of 28 m from the blasting face. The maximum value of PPV recorded at a distance of 50 m from the blasting face was 8.21 mm/s. The dominance of ground vibration data recorded at a distance of 50 m, was below 5 mm/s. The recorded PPV at a distance of 50 m, was above 5 mm/s only in five cases. The maximum value of PPV recorded at a distance of 100 m from the blasting face, was 3.619 mm/s. All the PPV values recorded beyond 150 m from the blasting faces, were below 2 mm/s. A plot of recorded PPV data at different distances from the blasting faces is shown in **Figure 7.1**.

Geophones were also installed on the structures in some of the cases. The amplification/attenuation characteristics of ground vibration on structures have been analysed using these data. In most of the cases, the structures were at a distance of more than 200 m from the blasting faces. The ground/structural vibration couldn't be recorded in such cases. The structural vibration data recoded at the stone quarry of Waynad district, shows the attenuation of PPV from ground to structures. This is due to the high dominant frequency of the propagating ground vibration wave.

The air overpressure (AOP) data were also recorded during the study. The maximum value of AOP recorded during the study was 128.6 dB(L). This AOP data was recorded at a distance of 79 m from the blasting face. The dominance of AOP data recorded at a distance of 50 m, was in the range of 110 to 120 dB(L). The maximum value of AOP recorded at a distance of 100 m from the blasting face, was 122.2 dB(L). All the AOP values recorded beyond 150 m from the blasting faces, were below 120 dB(L). A plot of recorded AOP data at different distances from the blasting faces is shown in **Figure 7.2**.

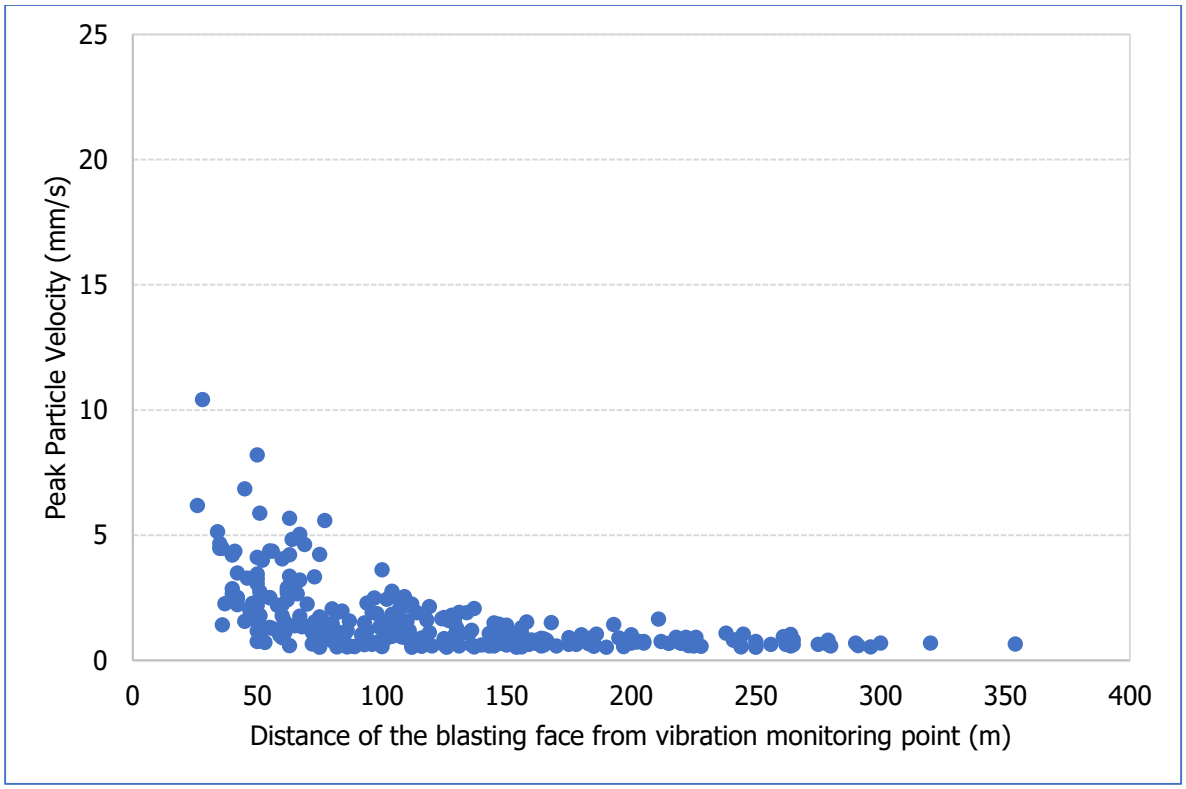


Figure 7.1. Recorded PPV at different distances from the blasting face during the experimental trials

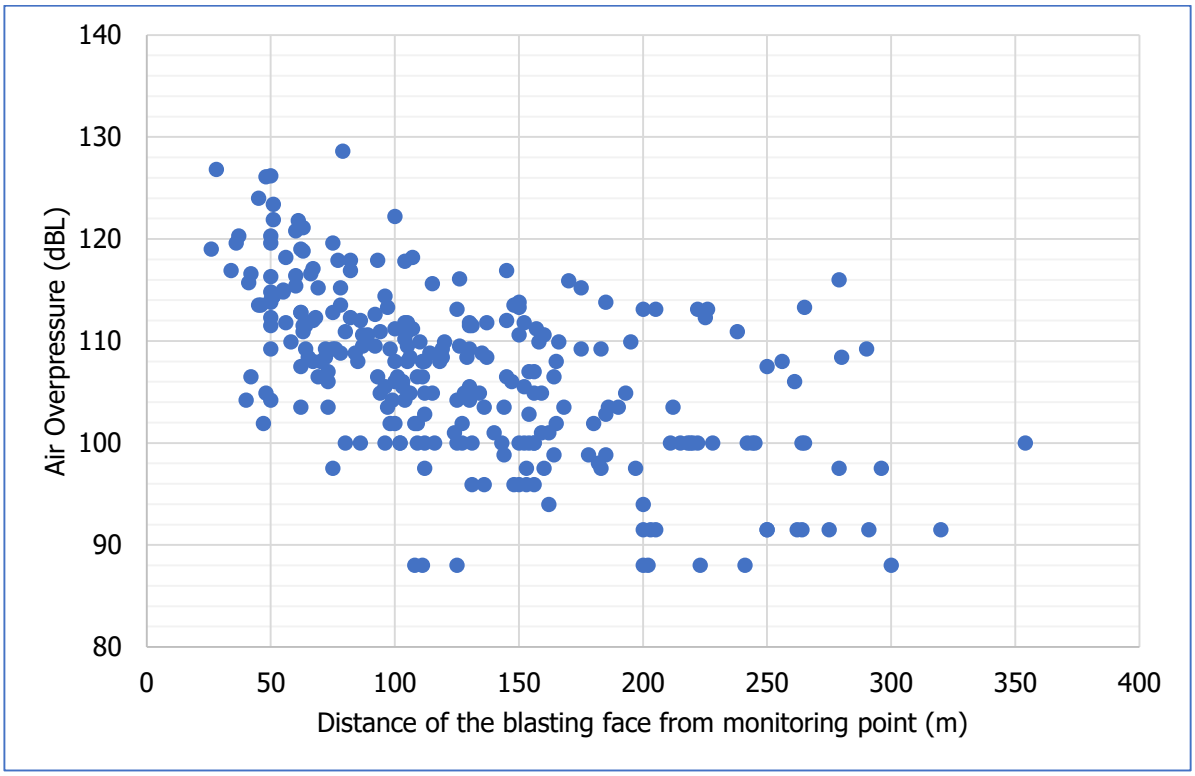


Figure 7.2. Recorded AOP at different distances from the blasting face during the experimental trials

7.2 ANALYSIS GROUND VIBRATION AND DEVELOPMENT OF PREDICTOR EQUATIONS

Ground vibration predictor equations are developed to devise the controlled blasting pattern for a mine. The most acceptable United State Bureau of Mines (USBM) predictor equation suggests the dependency of PPV on Maximum Explosive Charge Per Delay (MCPD) and distance of the blasting face from the structures (D). This equation is power in nature, and consists of two site constants. These site constants are dependent on the media of the vibration wave propagation.

The statistical analysis of the recorded PPV data were carried out to develop the USBM predictor equations. The equations were developed for each of the experimental mine site. The plots between PPV and scaled distance for nine quarries, to develop USBM predictor equations, are shown in **Figures 7.3 to 7.11**. The developed predictor equations for each quarry are summarised in **Table 7.1**. All of these developed predictor equations have confidence level of 95%.

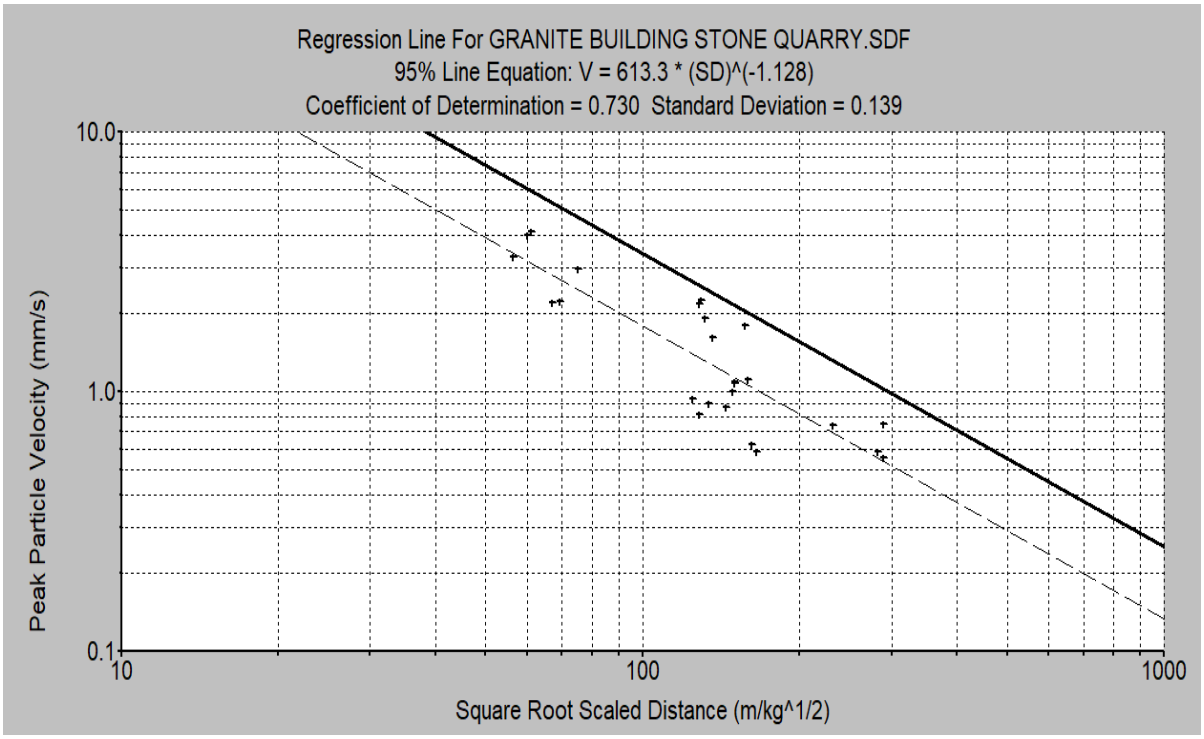


Figure 7.3. Regression plot of vibration data recorded at Stone Quarry of M/s Aducadu Granites Pvt. Ltd., Pathanamthitta District

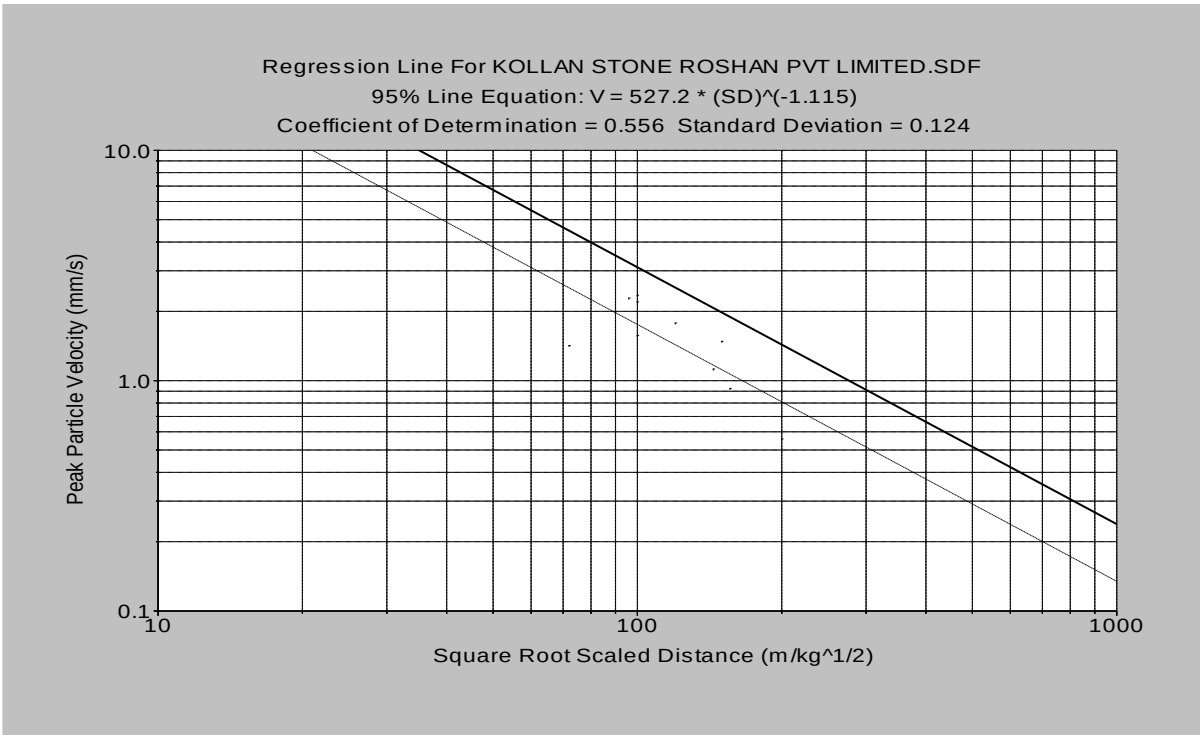


Figure 7.4. Regression plot of vibration data recorded at Quarry Unit of Mohammed Roshen, Kollam District

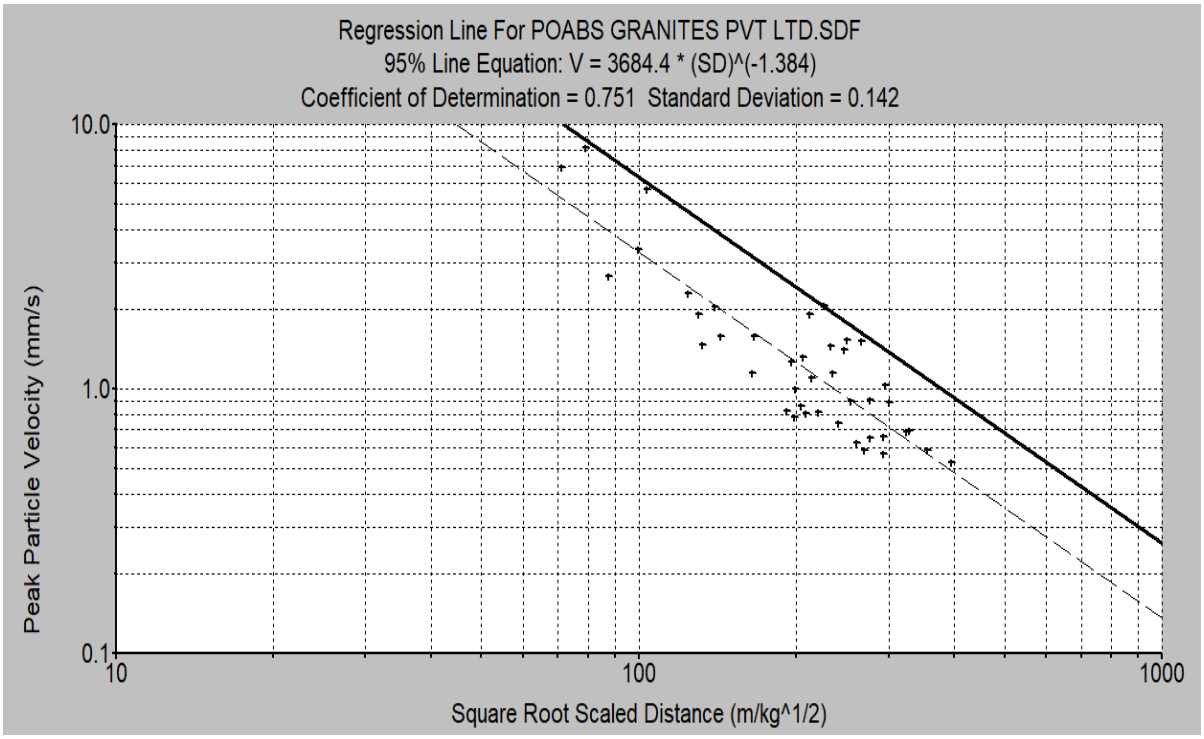


Figure 7.5. Regression plot of vibration data recorded at Stone Quarry of M/s POABS Granites Pvt. Ltd. Trivandrum District

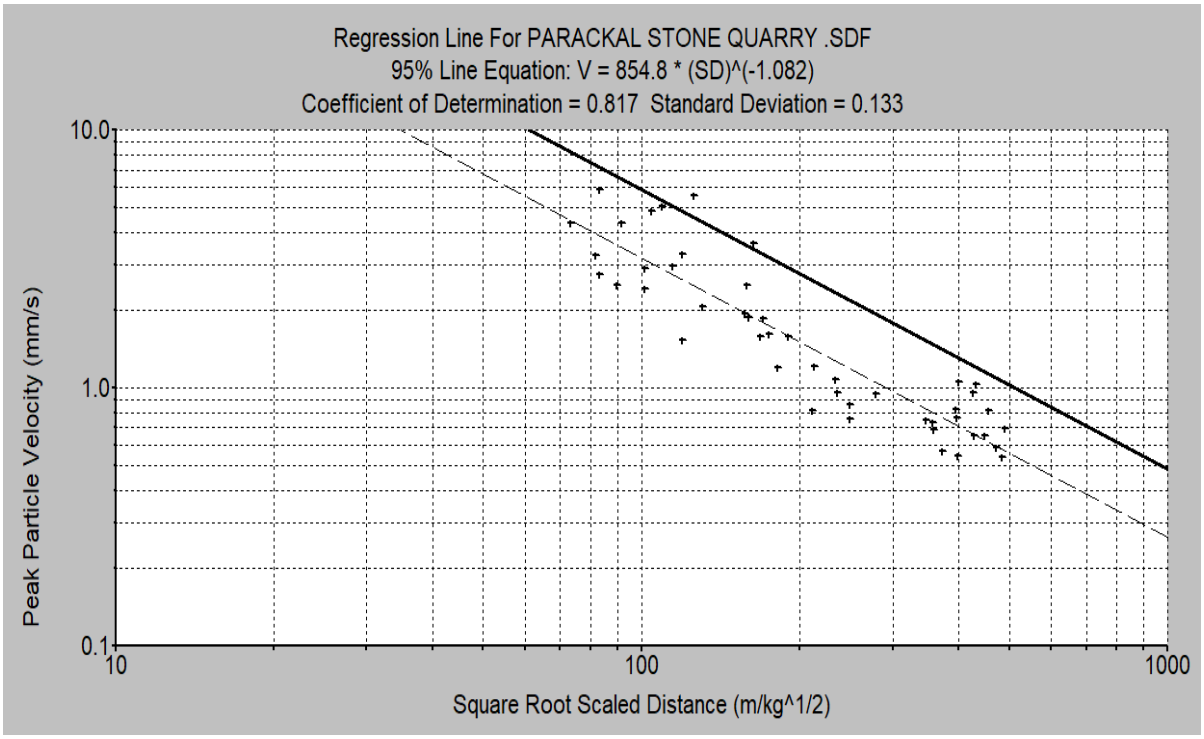


Figure 7.6. Regression plot of vibration data recorded at Parackal Stone Quarry of M/s Parackal Granite Kerala Private Limited, Ernakulam District

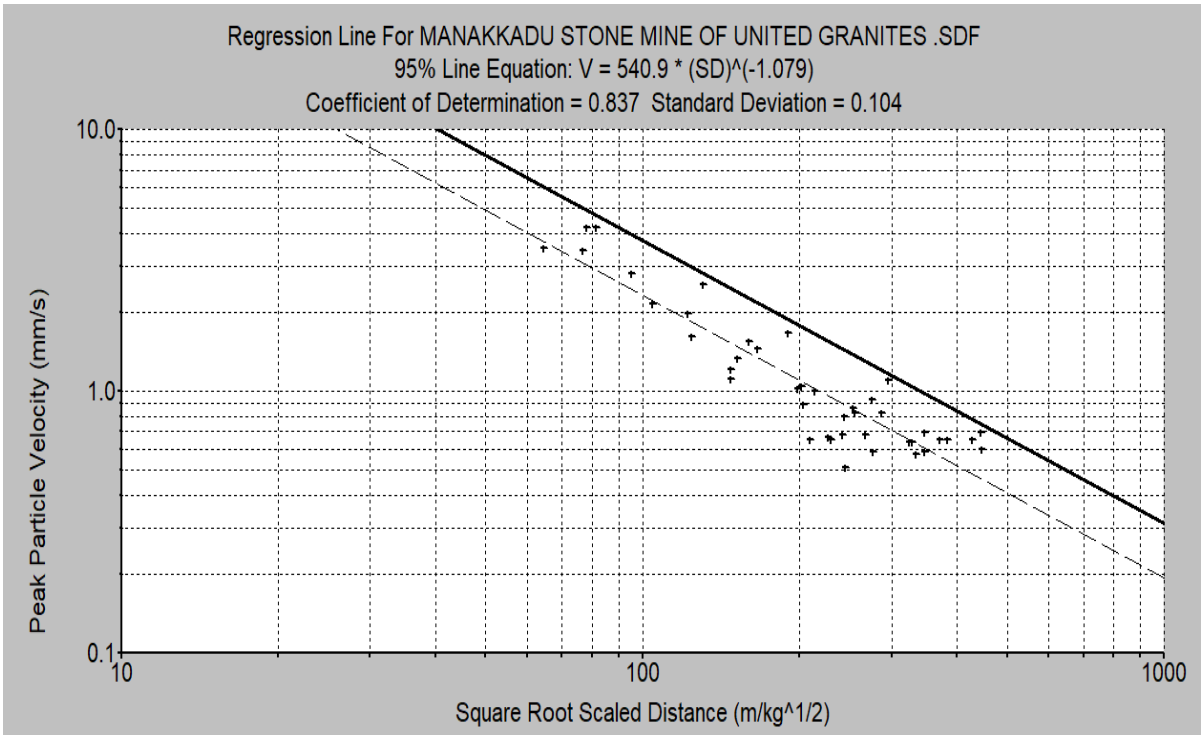


Figure 7.7. Regression plot of vibration data recorded at Manakkad Stone Quarry of M/s United Granites & Metals Private Limited, Idduki District

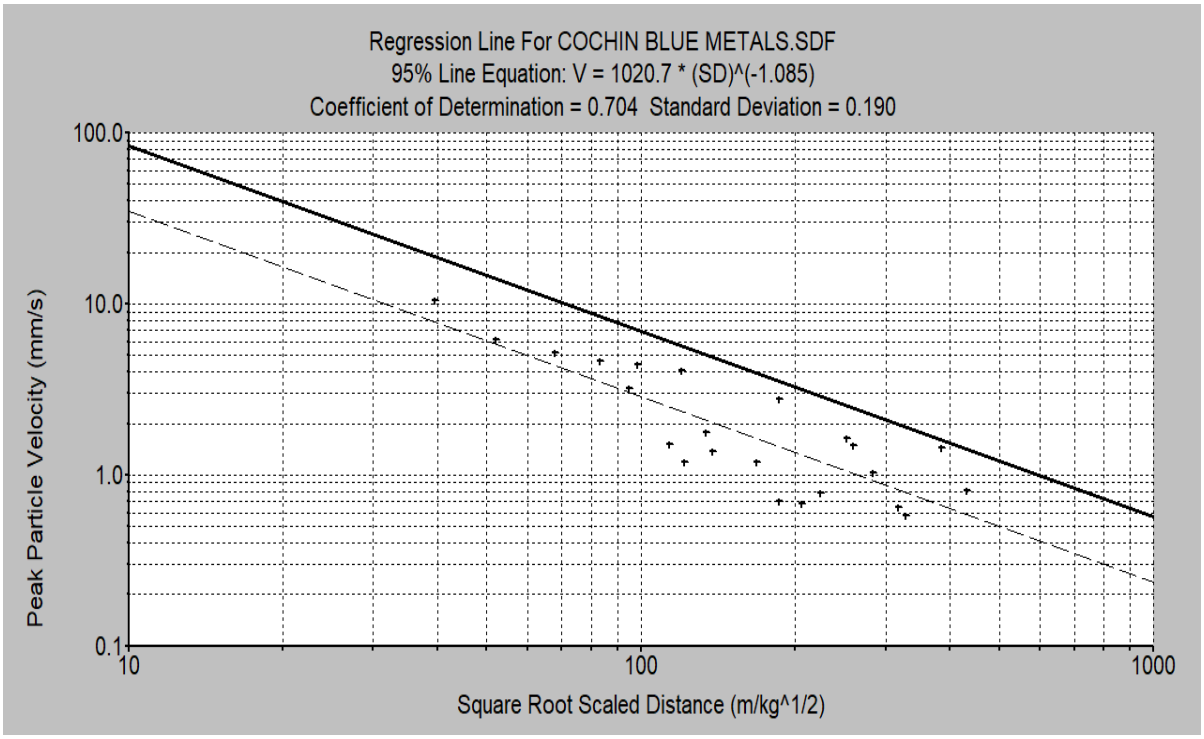


Figure 7.8. Regression plot of vibration data recorded at Stone Quarry of M/s Cochin Blue Metal Industries Limited, Kottayam District

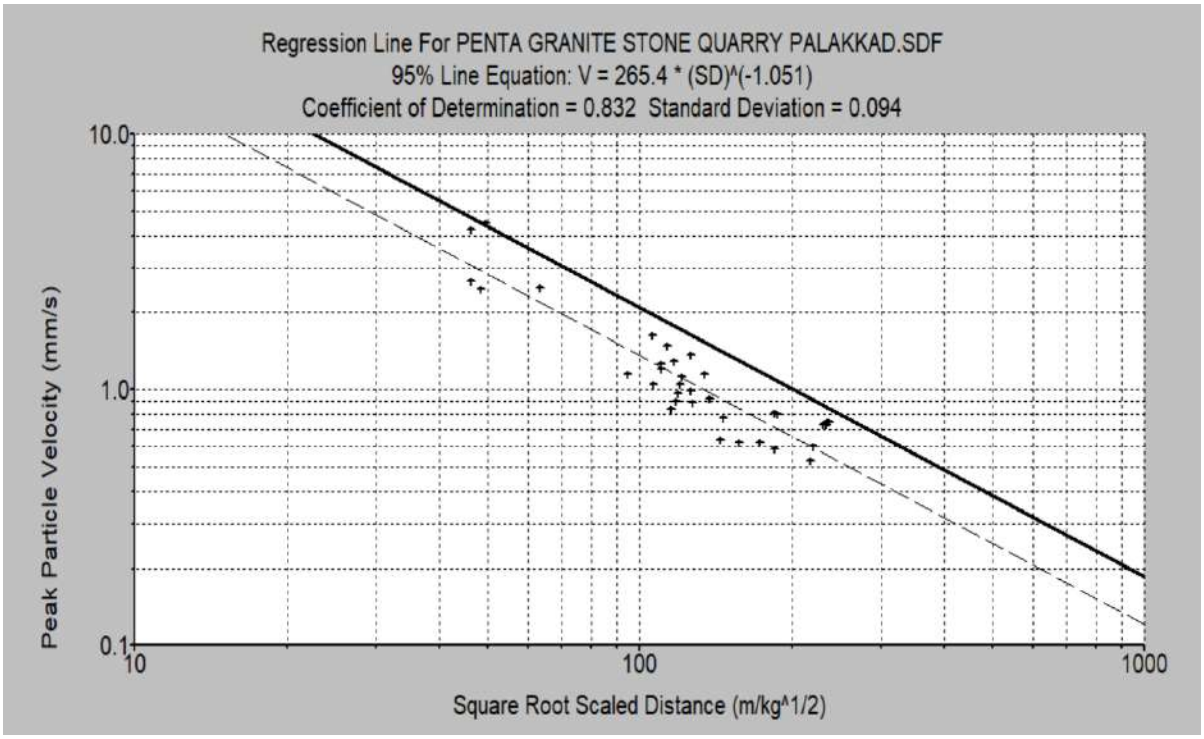


Figure 7.9. Regression plot of vibration data recorded at Quarry of M/s Penta Granite, Palakkad District

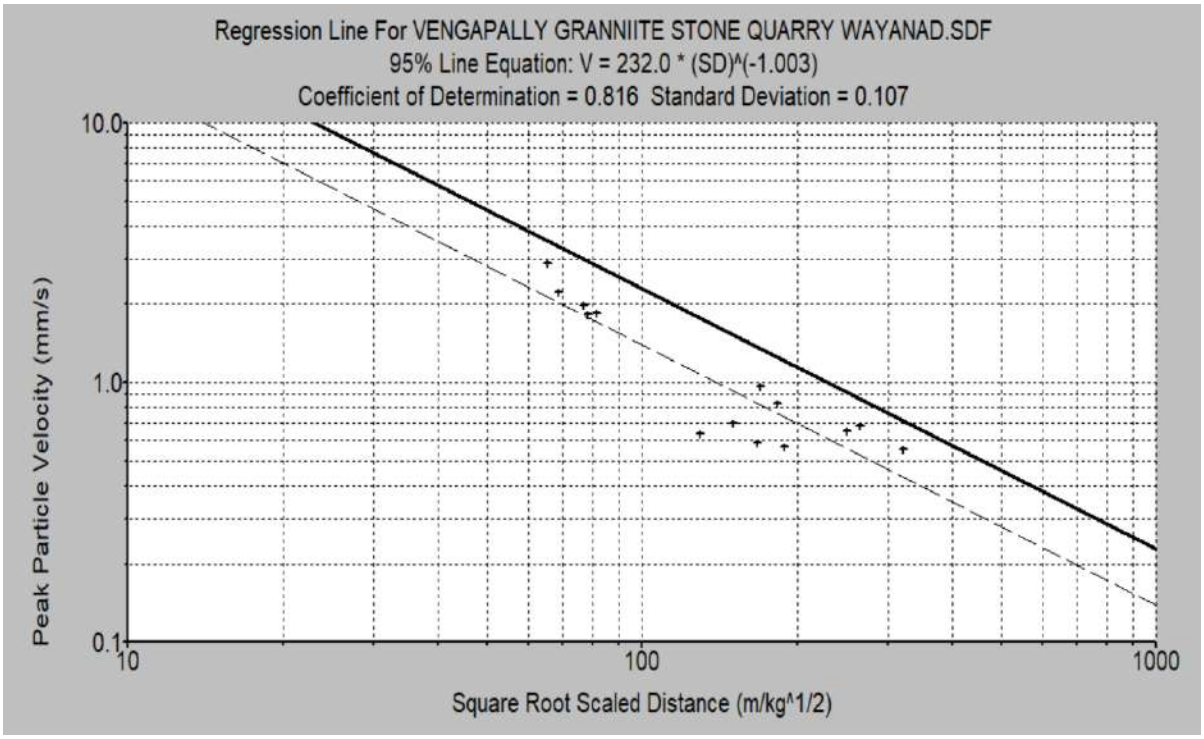


Figure 7.10. Regression plot of vibration data recorded at Vengapally granite stone Quarry of Shri Sudheesh A. T., Wayanad District

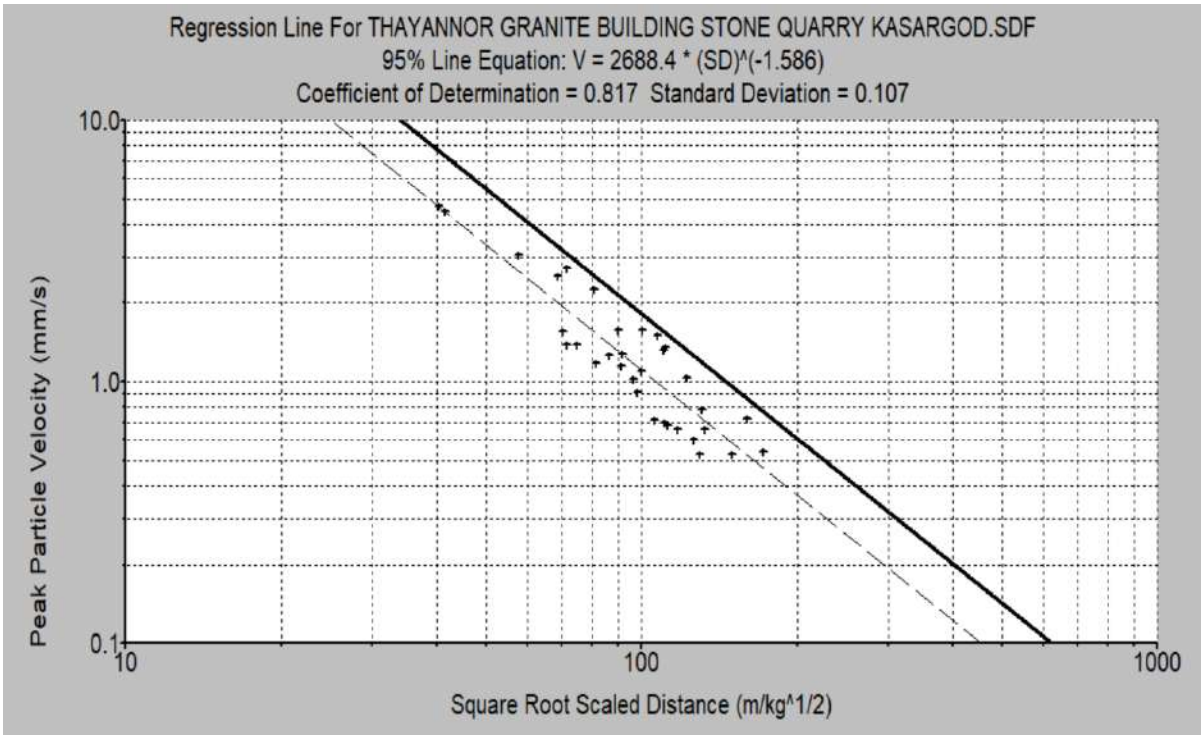


Figure 7.11. Regression plot of vibration data recorded at Granite (Building Stone) Quarry, Thayannur village of Shri P. M. Abdul Rahiman, Kasaragod District

Table 7.1. Developed USBM predictor equations for the different experimental stone quarries

District	Rock type	PPV predictor equation	
		Equation	R^2
Pathanamthitta	Charnockite	$PPV = 613.3\left(\frac{D}{\sqrt{Q}}\right)^{-1.128}$	0.73
Kollam	Charnockite	$PPV = 527.2\left(\frac{D}{\sqrt{Q}}\right)^{-1.115}$	0.556
Trivandrum	Garnet-Biotite Gneiss with Migmatite	$PPV = 3684.4\left(\frac{D}{\sqrt{Q}}\right)^{-1.384}$	0.751
Ernakulam	Hornblende Gneiss	$PPV = 854.8\left(\frac{D}{\sqrt{Q}}\right)^{-1.082}$	0.817
Idduki	Hornblende Gneiss	$PPV = 540.9\left(\frac{D}{\sqrt{Q}}\right)^{-1.079}$	0.837
Kottayam	Charnockite	$PPV = 1020.7\left(\frac{D}{\sqrt{Q}}\right)^{-1.085}$	0.704
Palakkad	Charnockite	$PPV = 265.4\left(\frac{D}{\sqrt{Q}}\right)^{-1.051}$	0.832
Wayanad	Hornblende Gneiss	$PPV = 232.0\left(\frac{D}{\sqrt{Q}}\right)^{-1.003}$	0.816
Kasargood	Garnet-Sillimanite Kyanite Gneiss	$PPV = 2688.4\left(\frac{D}{\sqrt{Q}}\right)^{-1.586}$	0.817
Where, PPV = Peak Particle Velocity (mm/s) D = Distance of the blast face from vibration monitoring point (m) Q = Maximum Explosive Charge Per Delay (kg)			

Further, the rock type wise predictor equations have also been developed. M/s Kerala State Pollution Control Board (KSPCB) provided the details of the rock types of different quarries. The experimental studies were carried out at four different rock types viz. Charnockite, Hornblende Gneiss, Garnet-Biotite Gneiss with Migmatite and Garnet-Sillimanite Kyanite Gneiss. The recorded vibration data while blasting in all of these rocks were grouped together for statistical analysis to develop the predictors. 'Garnet-Biotite Gneiss with Migmatite' rock type was present only at stone quarry of Trivandrum district. Hence the predictor equation for this rock type would be same as shown in **Figure 7.5.** Similarly, 'Garnet-Sillimanite Kyanite Gneiss' rock type was available only at the stone quarry of Kasargood district. Hence the predictor equation for this rock type would be same as shown in **Figure 7.11**. The regression plots to develop predictor equations for Charnockite and Hornblende-Gneiss rock type is shown in **Figures 7.12-7.13**. The developed rock type wise predictor equations are summarised in **Table 7.2**. All of these developed predictor equations have confidence level of 95%.

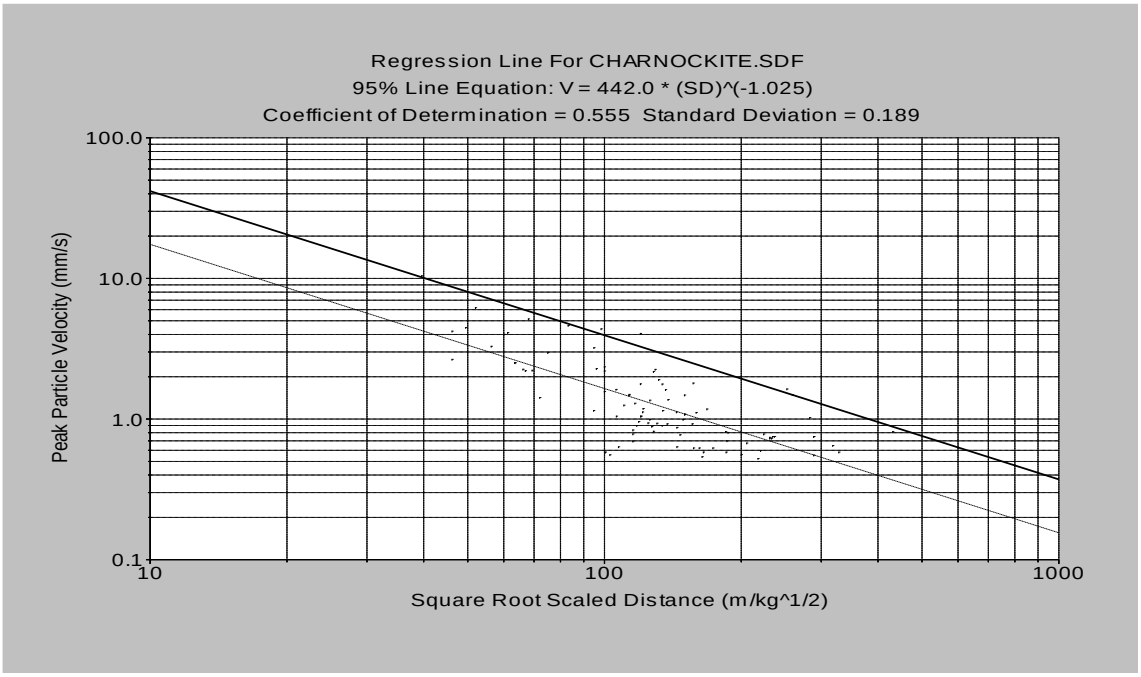


Figure 7.12. Regression plot of vibration data recorded at different stone quarries of Charnockite rock type in the state of Kerala

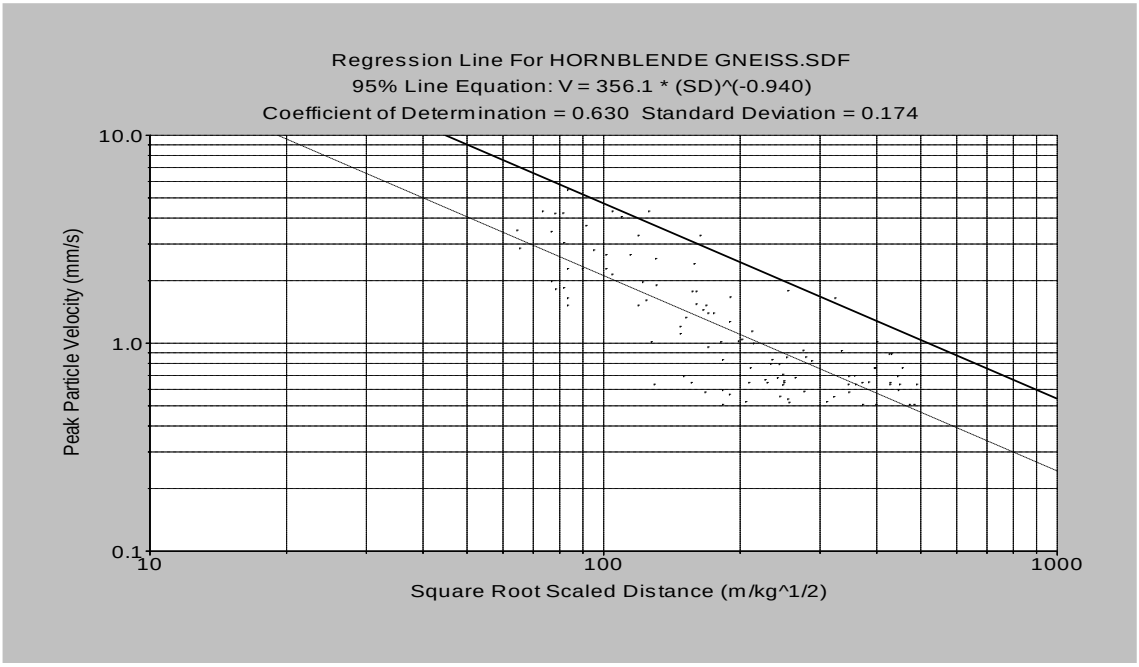


Figure 7.13. Regression plot of vibration data recorded at different stone quarries of Hornblende Gneiss rock type in the state of Kerala

Table 7.2. Developed USBM predictor equations for different rock types

Rock type	PPV predictor equation	
	Equation	R^2
Charnockite	$PPV = 442.0\left(\frac{D}{\sqrt{Q}}\right)^{-1.025}$	0.555
Garnet-Biotite Gneiss with Migmatite	$PPV = 1447.8\left(\frac{D}{\sqrt{Q}}\right)^{-1.213}$	0.658
Hornblende Gneiss	$PPV = 356.1\left(\frac{D}{\sqrt{Q}}\right)^{-0.940}$	0.630
Garnet-Sillimanite Kyanite Gneiss	$PPV = 2688.4\left(\frac{D}{\sqrt{Q}}\right)^{-1.586}$	0.817
Where, PPV = Peak Particle Velocity (mm/s) D = Distance of the blast face from vibration monitoring point (m) Q = Maximum Explosive Charge Per Delay (kg)		

Further, all the recorded ground vibration data were grouped together for the development of a generalised predictor equation for the state of Kerala. The regression plot of the developed generalised predictor equation is shown in **Figure 7.14**. The developed generalised predictor equation is given in **Equation 7.1.**

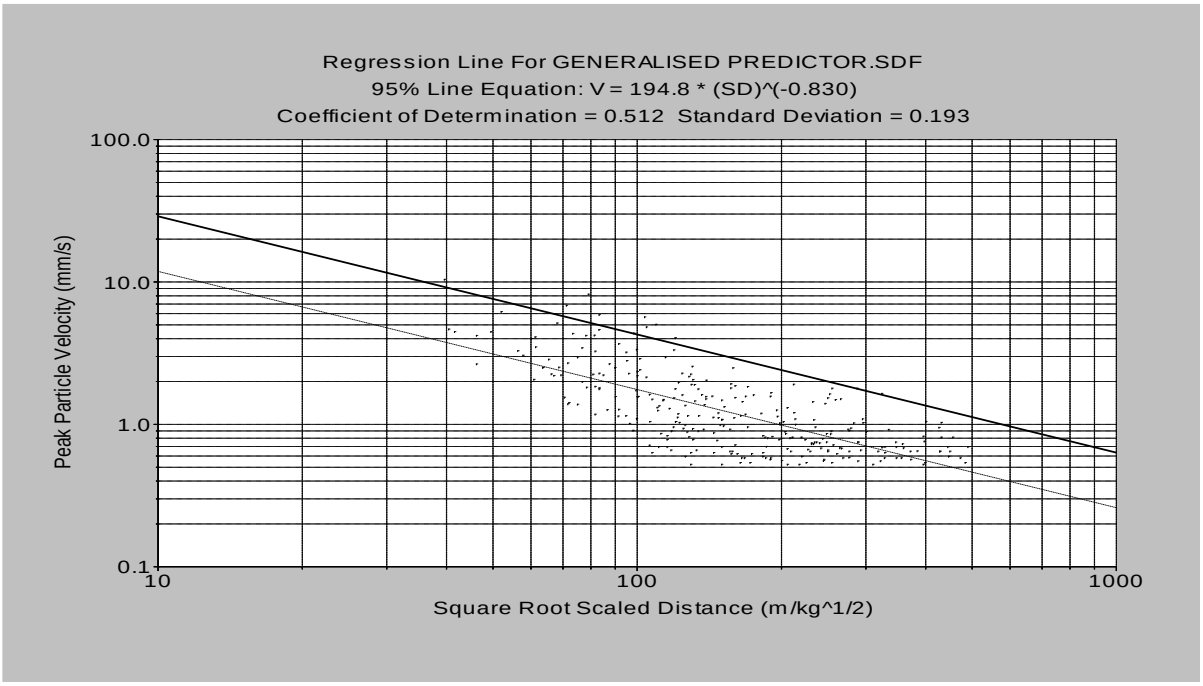


Figure 7.14. Regression plot of the generalised predictor equation for the state of Kerala

$$PPV = 194.8\left(\frac{D}{\sqrt{Q}}\right)^{-0.830}$$ .....Equation 7.1

$R^2 = 0.512$

Where,

PPV = Peak Particle Velocity (mm/s)

D = Distance of the blast face from vibration monitoring point (m)

Q = Maximum Explosive Charge Per Delay (kg)

7.2.1 Accuracy of the Developed Predictors

Researchers and the rock blasting practitioners have emphasised that the ground vibration predictor equations are site specific, and are dependent on the rock media instead of the rock type. However, the rock specific or generalised predictors may be accurate with acceptable error, if there is homogeneity in the rock media. To test the accuracy of the rock type wise predictors and generalised predictor, PPV was predicted for all the experimental data using mine specific predictors, rock specific predictors and generalised predictor. The predicted values of PPV using these three approaches were compared with the actual vibration data recorded during the experimentation. A plot of the actual versus predicted PPV using these three approaches are shown in **Figure 7.15**.

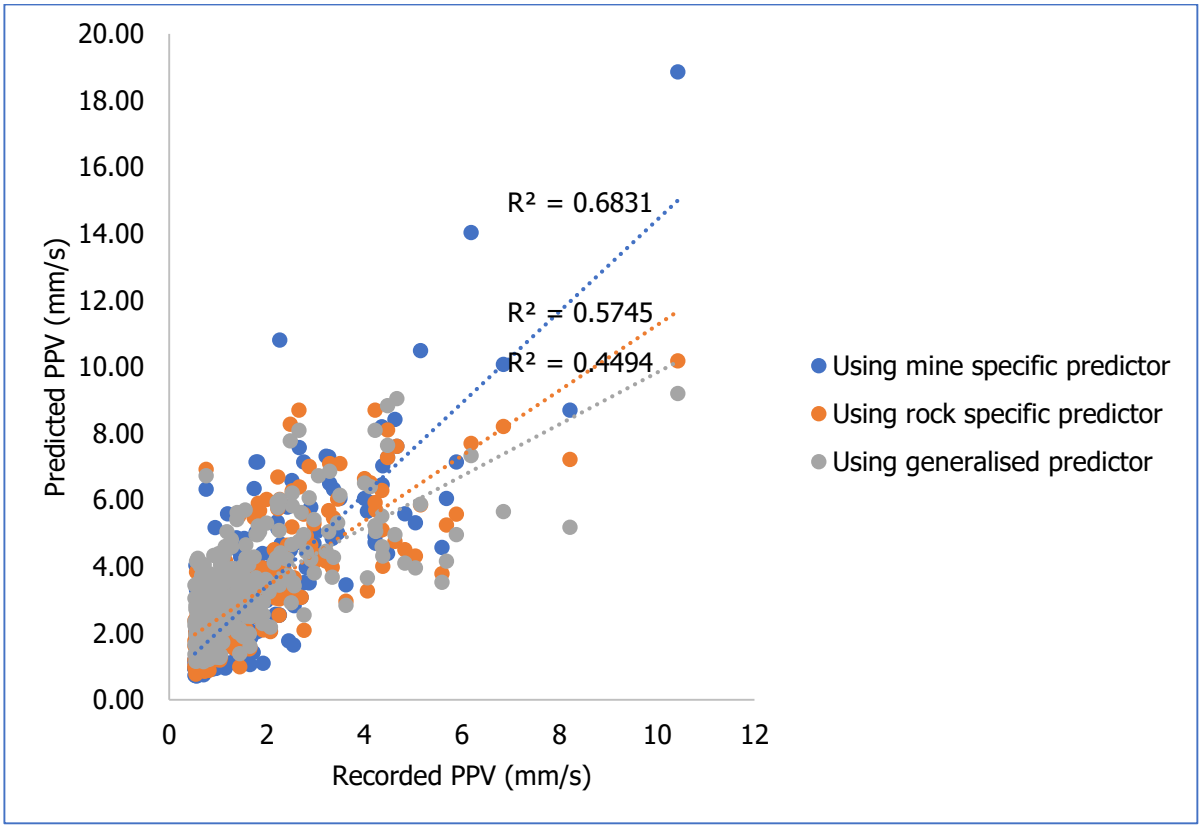


Figure 7.15. Plot of recorded versus predicted PPV using different predictors

This plot shows that the predictions using rock specific predictors and generalised predictors are comparatively on lower side to that of the mine specific predictors. This conclusion becomes more true, if the value of PPV is higher. The values of PPV would be higher at a distance closer to the blasting face. So, the use of rock specific or generalised predictors may not be suitable for the blasting faces in the close proximity to the structures. However, both rock specific or generalised predictors may be used, if the expected vibration is below 2 mm/s.

Further, the error in prediction of PPV using different approaches have been evaluated by computation of Root Mean Square Error (RMSE). The formula for computation of RMSE is given in **Equation 7.2**. The computed values of RMSE using all the three approaches are given in **Table 7.3**. It can be drawn from this table that error in predictions using rock specific predictors and generalized predictor as compared to the mine specific predictors are about 1% and 10% respectively.

$$RMSE = \sqrt{\left(\frac{1}{n}\sum_{j=1}^{n}(Predicted\ PPV - Recorded\ PPV)^2\right)}$$

.....Equation 7.2.

Table 7.3. RMSE values for PPV predictions using different approaches

USBM predictors	RMSE
Mine specific predictors	1.83
Rock specific predictors	1.81
Generalized predictor	2.01

7.3 ASSESSMENT FOR INFLUENCE OF OTHER BLAST DESIGN PARAMETERS ON PPV

Although, MCPD and D are the most dominating parameters influencing PPV. But the researchers have also outlined the influence of other blast design parameters on PPV. The influence of total explosive charge has specifically been highlighted in many literatures. So, the influence of other blast design parameters has also been investigated in this study. This investigation was carried out using the multi-variate statistical analysis approach. P-value based testing approach was used to identify the significance of different variables influencing PPV. The cut off P-value of 0.05 was taken to identify the significant variable. The outcomes of the analysis for the data of different quarries, rocks and generalised data are shown in **Table 7.4**. The significant variables in this table has been marked using √ sign. This table shows that in general, PPV has significant influence of number of blastholes, Burden, MCPD, Total Explosive and Distance. So, these parameters need to be designed properly to reduce the vibration, when the blasting has to be conducted in the close proximity to the structures.

Table 7.4. Identification of significant blast design parameters influencing PPV

Quarry district/rock type/generalized	Blast design parameters						
	No. of holes	Hole depth	Burden	Spacing	MCPD	Total explosive	Distance
Pathanmthitta					√		√
Kollam					√		√
Trivandrum					√		√
Ernakulam	√		√	√	√	√	√
Idduki					√		√
Kottayam	√			√	√	√	√
Palakkad					√		√
Wayanad				√	√		√
Kasargood	√	√	√	√	√	√	√
Charnockite	√			√	√	√	√
Hornblende Gneiss			√	√	√	√	√
Garnet-Biotite Gneiss with Migmatite					√		√
Garnet Sillimanite Kyanite Gneiss	√	√	√	√	√	√	√
Generalized	√		√		√	√	√

7.3.1 Influence of the total explosive charge in a blasting round on PPV

Literatures suggest that the total explosive charge in a blasting round also influences PPV. It is also evident from **Table 7.4** that the total explosive charge has influence on PPV. So, the multivariate ground vibration predictors have been developed considering total explosive charge and distance as the influencing parameters. The predictors with 50% and 95% confidence level were developed for this purpose. In some of the cases, the predictor equation with 95% confidence level predicts PPV with very high RMSE values. The equation with 50% confidence level has been considered in those cases. However, the generalised predictor has been developed at 95% confidence level to keep higher factor of safety while determination of the mining influence zone. The developed generalised total explosive based multivariate predictor is given in Equation 7.3.

$$PPV = 97.47\left(\frac{{Q_t}^{0.32}}{D^{0.83}}\right) \ldots\ldots \text{Equation 7.3}$$

$R^2 = 0.53$

Where,

PPV = Peak Particle Velocity (mm/s)

D = Distance of the blast face from vibration monitoring point (m)

Q_t = Total explosive charge in a blasting round (kg)

To test the accuracy of the rock type wise predictors and generalised predictor, PPV was predicted for all the experimental data using mine specific predictors, rock specific predictors

and generalised predictor. The predicted values of PPV using these three approaches were compared with the actual vibration data recorded during the experimentation. A plot of the actual versus predicted PPV using these three approaches are shown in **Figure 7.16**.

This plot shows that the predictions using generalised predictors are comparatively on lower side to that of the mine specific predictors. This conclusion becomes more true, if the value of PPV is higher. The values of PPV would be higher at a distance closer to the blasting face. So, the use of rock specific or generalised predictors may not be suitable for the blasting faces in the close proximity to the structures. However, both rock specific or generalised predictors may be used, if the expected vibration is below 2 mm/s.

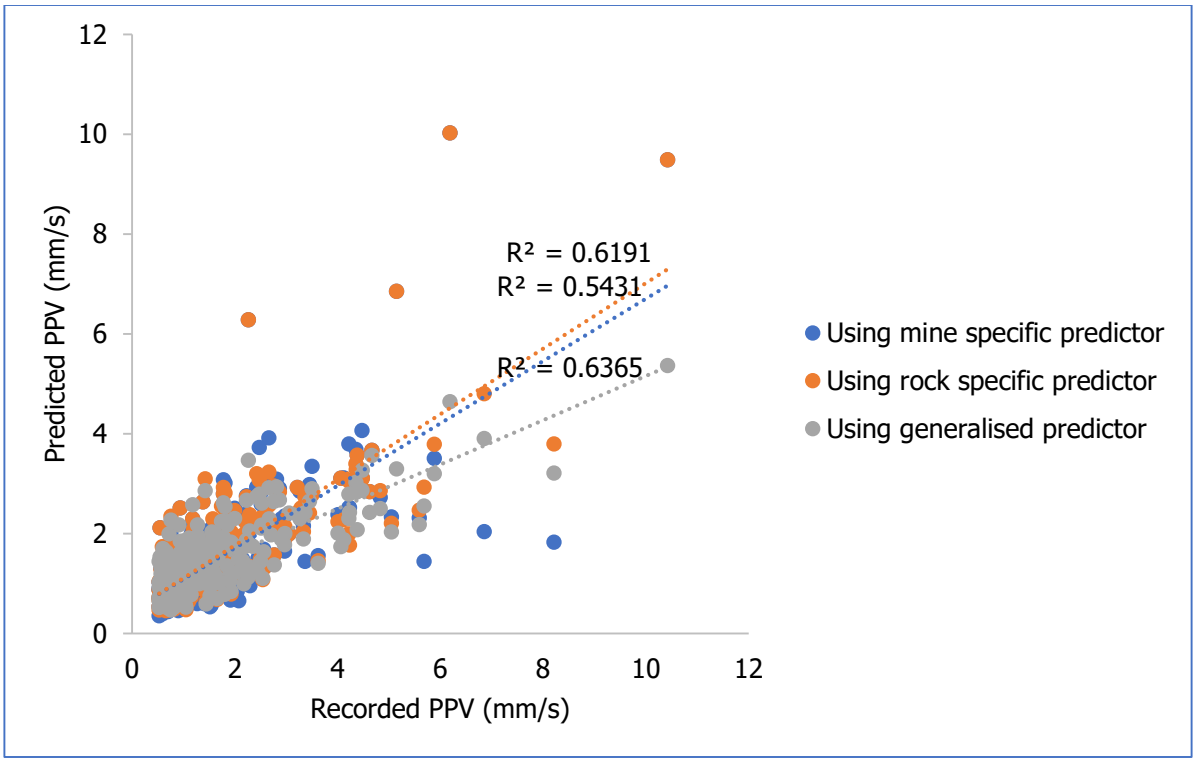


Figure 7.16. Plot of recorded versus predicted PPV using different total explosive charge based multivariate predictors

Further, the error in prediction of PPV using different approaches have been evaluated by computation of Root Mean Square Error (RMSE). The formula for computation of RMSE is given in **Equation 7.2.** The computed values of RMSE using all the three approaches are given in **Table 7.5**. It can be drawn from this table that error in predictions using rock specific predictors and generalized predictor as compared to the mine specific predictors are within 10%. Hence, the generalise predictor may be used for the development of the mining influence zone.

Table 7.5. RMSE values for PPV predictions using different approaches

USBM predictors	RMSE
Mine specific predictors	0.91
Rock specific predictors	0.82
Generalized predictor	0.87

7.4 PERMISSIBLE LIMIT OF GROUND VIBRATION

Different countries have adopted various ground vibration limits for the safety of the structures. In India, DGMS circular No. 07 of 1997 (**Table 3.1**), is followed to ensure the safety of the structures. The PPV limits in this circular for the domestic houses, has been fixed based on the frequency component of the vibration. It is 5 mm/s, 10 mm/s and 15 mm/s for the associated dominant frequency of <8Hz, 8-25 Hz and >25 Hz respectively. To assess the safe limits of the ground vibration, the recorded frequency of the vibration has been analysed. The plot of recorded frequency at different distances from the blasting faces is shown in **Figure 7.17**. This plot shows that the minimum frequency of recorded vibration data is 14.2 Hz. The dominance of the frequency lies in the range of 50-100 Hz. Considering even the minimum frequency value, the safe vibration limit as per DGMS circular is 10 mm/s. However, in the case of repeated blasting, the human behaviour will be annoying, if PPV is more than 5 mm/s (Dhar et al., 1998; **Table 6.2**) Hence, considering the human response to the blasting, the ground vibration limit for residential houses and other similar structures of permanent nature, not belonging to the owner may be taken as **5 mm/s**.

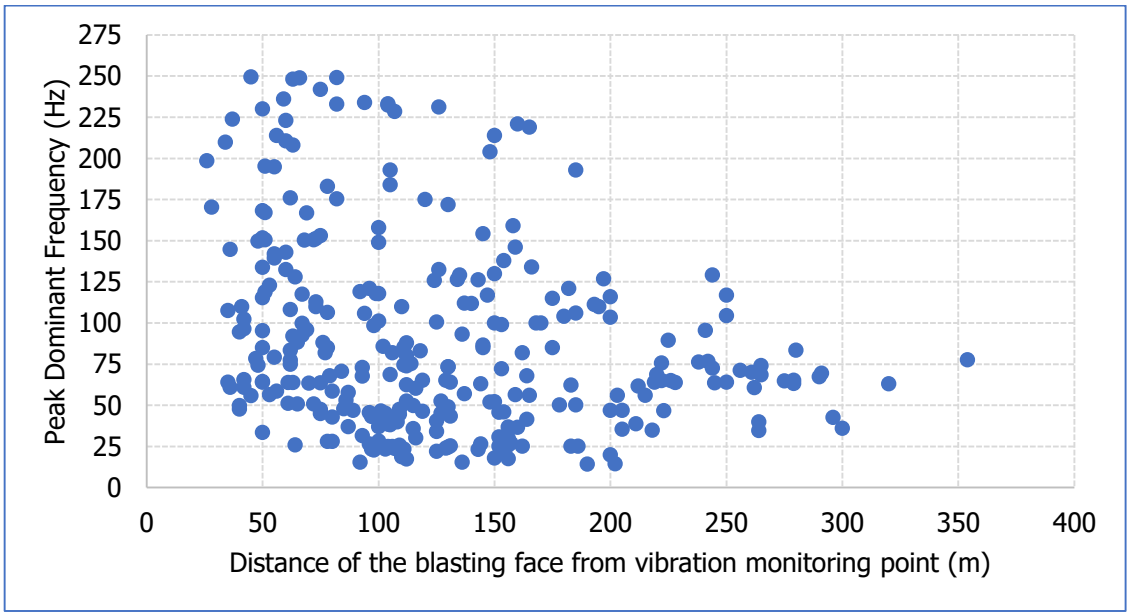


Figure 7.17. Plot of recorded frequency of ground vibration at different distances from the blasting faces.

7.5 SAFE VALUES OF MCPD AND TOTAL EXPLOSIVE CHARGE

MCPD and Total explosive charge are the main parameters influencing PPV. Considering the ground vibration limits of 5 mm/s, the safe values of MCPD and total explosive charge for different mines, different rock types and generalised for the state of Kerala may be computed using the developed predictor equations. Using the generalised predictor, the computed safe values of MCPD and total charge at different distances in the zone of 50-500 m is given in **Table 7.6**. This table has been used in the subsequent sections to determine the mining influence zone.

Table 7.6. Computed safe values of MCPD and Total Charge using the generalised predictors for the State of Kerala

Distance of the quarrying area from structure (m)	Maximum Explosive Charge Per Delay (kg)	Total Explosive Charge in a Blasting Round (kg)
Safe Vibration limit near structure- 5 mm/s		
50	0.37	2.38
75	0.83	6.80
100	1.47	14.34
125	2.30	25.58
150	3.31	41.05
175	4.50	61.23
200	5.88	86.57
225	7.44	117.50
250	9.18	154.42
275	11.11	197.73
300	13.23	247.80
325	15.52	304.97
350	18.00	369.60
375	20.67	442.03
400	23.51	522.58
425	26.54	611.57
450	29.76	709.30
475	33.16	816.08
500	36.74	932.21

7.6 ANALYSIS OF RECORDED AIR OVERPRESSURE DATA

Air overpressure (AOP) is another important hazards from the rock blasting. The higher magnitude of AOP affects the glass structures. United States Bureau of Mines (USBM) have recommended 134 dB(L) as the safe limit of AOP for mining/quarrying operation (**Table 6.3**). The plot of AOP given in Figure 7.2 shows that all the values recorded during the experimental trials were within 134 dB(L). However, the values of AOP may go high, if the controlled

blasting pattern is not practiced. During the experimentation, all the blasts were conducted using NONEL delay detonators. The AOP would be higher, if detonating fuse (DF) would be used in place of NONEL. There are other various blast design parameters, meteorological parameters and rock & explosive properties, which affects the magnitude of AOP. The influence of different blast design parameters on AOP was investigated in this study using P-value testing approach.

The outcomes of the analysis for the data of different quarries, rocks and generalised data are shown in **Table 7.7**. The significant variables in this table has been marked using √ sign. This table shows that in general, AOP has significant influence of number of MCPD, distance and top stemming column. So, these parameters need to be designed properly to reduce the AOP, specifically when the blasting has to be conducted in the close proximity to the structures. The top stemming column need to be maintained properly to reduce the AOP.

Table 7.7. Identification of significant blast design parameters influencing AOP

Quarry district/rock type/generalised	Blast design parameters						
	No. of holes	Burden	Spacing	Top stemming	MCPD	Total explosive	Distance
Pathanmthitta					√		√
Kollam					√		√
Trivandrum					√		√
Ernakulam				√	√		√
Idduki					√		√
Kottayam	√	√		√	√		√
Palakkad					√		√
Wayanad	√				√		√
Kasargood					√		√
Charnockite	√				√	√	√
Hornblende Gneiss				√	√	√	√
Garnet-Biotite Gneiss with Migmatite					√		√
Garnet Sillimanite Kyanite Gneiss					√		√
Generalised				√	√		√

8.0 DETERMINATION OF BLASTING INFLUENCE ZONES

The blasting influence zone for the State of Kerala has been determined based on the results of the experimental blasts, observations made and the outcomes of the experimental data analysis. The safe values of MCPD and total explosive charge using the generalised predictors have been used to delineate the influence zones. The specific technical and statutory guidelines have also been framed for the different zones. However, these recommendations have only been made considering ground vibration, AOP and flyrock. The results of the investigations of other hazards induced by blasting viz. dust, noise etc. need to be incorporated for the finalisation of the influence zones. The approach to delineate the influence zone and the detailed discussion regarding different zones have been made in this section.

8.1 APPROACH TO DELINEATE BLASTING INFLUENCE ZONE

The outcomes of the experimental data analysis have been used to delineate the blasting influence zones for the State of Kerala. **Figure 7.1** and **Table 7.6** has been relooked for the determination of the influence zones. The influence zones have been defined from the quarrying boundary. For this purpose, the mine management will mark the quarrying boundary along with the lease boundary in the mining plan.

It is evident from **Figure 7.1** that the values of PPV within a distance of 50 m, are dominantly above 5 mm/s. The AOP magnitude within 50 m would also be high. The flyrock ejections in this zone is mostly unavoidable. Hence, the blasting should not be conducted when the residential houses/structures are lying within the distance of 50 m from the quarrying boundary. The zone within a distance of 50 m have been termed as "**No Blasting Zone (Zone 0)**".

Further the ground vibration data recorded above 5 mm/s beyond a distance of 50 m, has been relooked **(Table 8.1)**. Altogether five such data were recorded during the experimentation. It is evident from this table that in four cases the blast design was modified to achieve the purpose of the experimentation. In one case, the recorded PPV was because of the existing practice of the quarry, but the total explosive charge used in this blast was more than the usual practice of the quarries in state of Kerala.

Table 8.1. Details of the PPV recorded beyond 50 m and having magnitude above 5.0 mm/s

S. No.	PPV (mm/s)	Frequency (Hz)	MCPD (kg)	Total Explosive charge (kg)	Distance (m)	Remarks
1.	5.882	150.6	0.375	17.0	51	Number of holes were increased to 47 as per the plan of the experiment. The total explosive charge was also increased from the existing practice of the quarry management.
2.	5.585	81.88	0.375	17.0	77	
3.	5.042	117.5	0.375	7.375	67	Existing practice of this quarry, but total charge is greater than the mean and mode values used by the quarries in Kerala.
4.	5.68	248.1	0.375	15.00	63	Number of holes were increased to 40 as per the plan of the experiment. The total explosive charge was also increased from the existing practice of the quarry management.
5.	8.21	230.0	0.40	16.00	50	Number of holes were increased to 40 as per the plan of the experiment. The total explosive charge was also increased from the existing practice of the quarry management.

The computed safe values of MCPD and total charge as given in **Table 7.6** has been compared with the experimental data to delineate the blasting zones. A summarised details of the experimental data is given in **Table 8.2**. A comparison of this summarised data with **Table 7.6** to delineate the mining influence zones is shown in **Table 8.3**.

Table 8.2. Summarised details of the experimental data of MCPD and Total explosive charge

	Maximum Explosive Charge Per Delay (kg)	Total Explosive Charge in a Blasting Round (kg)
Minimum	0.25	1.25
Maximum	1.30	26.52
Mean	0.51	8.36
Mode	0.375	4.50

Table 8.3. Comparison of computed safe values of MCPD and total charge with experimental data for the delineation of mining influence zones

Distance of the quarrying area from structure (m)	Maximum Explosive Charge Per Delay (kg)	Total Explosive Charge in a Blasting Round (kg)	Classification of Blasting Zone
Safe Vibration Limit for Structure - 5 mm/s			
Within 50 m	-	-	**No Blasting Zone (Zone 0)**
50	0.37	2.38	**Extremely sensitive zone (Zone 1)**
75	0.83	6.80	
100	**1.47 (>1.3)**	14.34	
125	2.30	25.58	**High sensitive zone (zone 2)**
150	3.31	**41.05 (>26.52)**	
175	4.50	61.23	**Moderately sensitive zone (Zone 3)**
200	5.88	86.57	
225	7.44	117.50	
250	**9.18 (>8.36)**	154.42	
275	11.11	197.73	**Buffer Zone (Zone 4)**
300	13.23	247.80	
325	15.52	304.97	
350	18.00	369.60	
375	20.67	442.03	
400	23.51	522.58	
425	**26.54 (>26.52)**	611.57	
450	29.76	709.30	
475	33.16	816.08	
500	36.74	932.21	
Beyond 500			**Safe Zone (Zone 5)**

Based on **Table 8.3**, the safe value of MCPD at a distance of 100 m, is 1.47 kg. This value is more than the maximum MCPD (1.3 kg) used during the experimental trials. So, the risk of getting vibration beyond 5 mm/s near the structures in the zone of 50-100 m from the blasting faces is high. Hence, the mining zone within a distance of 50-100 m from the structures, has been delineated as **Extremely Sensitive Zone (Zone 1)**. Considering the additional risk from the flyrock ejections and inaccuracy in the blast design pattern, **the blasting in this zone should be avoided**. However, if there is extreme requirement to conduct blasting in this zone, then it may be done under the complete supervision of a scientific organisation. The representative of the scientific organisation will supervise the day-to-day blasting activities as well as will monitor the induced hazards from the blasting. Since, the computed safe values of MCPD and total charge is based on the generalised predictors,

it is recommended to have fresh scientific study to develop mine specific predictor for the blasting in this zone.

The maximum value of total explosive used during the experimentation was 26.52 kg. At a distance of 150 m, the safe value of total explosive charge exceeded this maximum value. So another zone has been delineated within the distance of 100-150 m. This zone has been termed as **High Sensitive Zone (Zone 2)**. It is recommended to have fresh scientific study to develop mine specific predictor equations for this zone as well. The mine management should deploy seismograph to monitor the ground vibration and air overpressure for each blast, if the blasting has to be carried out in this zone.

The average explosive charge used during the experimental trials was 8.36 kg. In the worst case scenario, if all the delay detonators are not working or the blasting in-charge do not have proper knowledge of delay, then this total explosive charge will become MCPD. There would be risk of getting higher vibration near structures in such cases. The computed safe value of MCPD exceeded at a distance of 250 m. Hence, the zone between 150-250 m have been delineated as **Moderately Sensitive Zone (Zone 3).** For this zone, it is recommended to mention the appropriate proposed blast design pattern in the mining plan/scheme. The mining plan/scheme should be reviewed by a scientific organisation before approval in this case.

The blasting zone between distances of 250-500 m from the structures, has been delineated as **Buffer Zone (Zone 4)**. For this zone, the complete blast design patterns need to be mentioned in the mining plan for this zone. The proposed blast design patterns should be reviewed properly by a competent mining engineer before the approval of the mining plan.

The zone beyond 500 m from the structures, may be treated as **safe zone (Zone 5)**. The normal blasting practices using small diameter (25 mm) blastholes with maximum MCPD and total charge of 1.3 kg and 26.5 kg respectively, may be carried out in this zone.

8.2 TECHNICAL AND STATUTORY RECOMMENDATIONS FOR DIFFERENT BLASTING INFLUENCE ZONES

The specific technical and statutory recommendations for all the zones have been mentioned in **Table 8.4**. The MCPD and total explosive charge for all the blasting zones has been fixed as the maximum values used during the experimentation. The mine management may go for the higher values of MCPD and total explosive charge based on a fresh scientific study. The provision for a reporting system has also been mentioned in this table. The mine management have to maintain the records of the detailed blast design pattern, total explosive consumption and volume of rock excavated for each blast. These records should be submitted to a statutory body viz. DGMS, PESO, DMG, SPCB or other. The statutory body will assess the submitted records and will evaluate if there is any deviation from the approved mining plan.

Additionally, the engagement of a competent blasting incharge having Diploma/Degree in mining engineering is necessary to supervise the total blasting operations in zones 1-4. The whole blasting crew should be given training on the controlled blasting pattern, if the blasting operations has to be carried out in zones 1-3.

Table 8.4. Blasting influence zones for stone quarries in the State of Kerala vis-à-vis specific technical and statutory recommendations for different influence zones

Zones	Distance of the quarrying area from structures (m)	MCPD (kg)	Total Charge (kg)	Specific technical recommendations	Regulatory recommendations
No Blasting Zone (Zone 0)	0-50	**Blasting should not be carried out in this zone**			
Extremely sensitive zone (Zone 1)	50-100	0.37-1.30	2.38-14.34	▪ **Blasting should be avoided in this zone.** ▪ However, if it is extremely required, the blasting operation may be carried out in the continuous supervision of the representative of a reputed scientific organisation. ▪ Muffling arrangements should be used to control flyrocks. ▪ Accurate delay detonators should be used for blasting. The accuracy should be checked periodically. ▪ MCPD and total charge should be decided based on a fresh scientific study. ▪ Blast design parameters should be devised through a scientific study. ▪ Continuous monitoring of ground vibration and air overpressure should be carried out by the representative of a scientific organisation.	▪ Need for a scientific study, recommendations of the study should be included in Mining Plan/Mining Scheme. ▪ Engagement of blasting incharge having Diploma/Degree in mining engineering for day-to-day blasting. ▪ Training of the blasting crew on controlled blasting practices. ▪ Submission of monthly report on blast design pattern and detailed explosive consumption as well as volume of rock excavation to a statutory body viz. DGMS, DMG, PESO or SPCB. The recorded ground vibration for each blast should also be submitted in this report. The justification should be made , if there is deviation in the actual pattern from the approved mining plan.
High sensitive zone	100-150	< 1.30	< 26.50	▪ Muffling arrangements should be used to control flyrocks.	▪ Need for a scientific study, recommendations of the study should be included in Mining Plan/Mining Scheme.

(Zone 2)				▪ Accurate delay detonators should be used for blasting. The accuracy should be checked periodically. ▪ MCPD and total charge should be decided based on a fresh scientific study. ▪ Blast design parameters should be devised through a scientific study. ▪ Continuous monitoring of ground vibration and air overpressure. Mine management may record the ground vibration using their own seismographs.	▪ Engagement of blasting incharge having Diploma/Degree in mining engineering for day-to-day blasting. ▪ Training of the blasting crew on controlled blasting practices ▪ Submission of monthly report on blast design pattern and detailed explosive consumption as well as volume of rock excavation to a statutory body viz. DGMS, DMG, PESO or SPCB. The recorded ground vibration for each blast should also be submitted in this report. The justification should be made , if there is deviation in the actual pattern from the approved mining plan.
Moderately sensitive zone (Zone 3)	150-250	<1.3	<26.50	▪ MCPD and total charge should be fixed such that it shouldn't exceed 1.3 kg and 26.50 kg respectively. ▪ Blast design parameters should be mentioned in mining plan/scheme. It may be reviewed by a scientific body before approval. ▪ Fresh scientific study may be conducted if mine management wants to increase the MCPD and total explosive charge above 1.3 kg and 26.50 kg respectively. Continuous monitoring using seismograph should also be done in such cases by the mine management.	▪ Complete blasting plan need to be mentioned in the mining plan/scheme. The mining plan/scheme may be reviewed by a scientific organisation. The recommendations of scientific organisation need to be incorporated in the mining plan/scheme before its approval. ▪ Engagement of blasting incharge having Diploma/Degree in mining engineering for day-to-day blasting. ▪ Training of the blasting crew on controlled blasting practices. ▪ Submission of monthly report on blast design pattern and detailed explosive consumption as well as volume of rock excavation to a statutory body viz. DGMS, DMG, PESO or SPCB. The justification should be made, if there is deviation in the actual pattern from the approved mining plan. Report of recorded ground vibration need to be added in monthly report, if

					MCPD and total explosive charge for a blast exceeds 1.3 kg and 26.50 kg respectively.
Buffer zone (Zone 4)	250-500	<1.3	<26.50	▪ MCPD and total charge should be fixed such that it shouldn't exceed 1.3 kg and 26.50 kg respectively. ▪ Blast design parameters should be mentioned in mining plan/scheme. and may be reviewed by a competent mining engineer. ▪ Fresh scientific study may be conducted if mine management wants to increase the MCPD and total explosive charge above 1.3 kg and 26.50 kg respectively. Continuous monitoring using seismograph should also be done in such cases by the mine management.	▪ Complete blasting plan need to be mentioned in the mining plan/scheme. The mining plan/scheme may be reviewed by a competent mining engineer. ▪ Engagement of blasting incharge having Diploma/Degree in mining engineering for day-to-day blasting. ▪ Submission of monthly report on blast design pattern and detailed explosive consumption as well as volume of rock excavation to a statutory body viz. DGMS, DMG, PESO or SPCB. The justification should be made, if there is deviation in the actual pattern from the approved mining plan. Report of recorded ground vibration need to be added in monthly report, if MCPD and total explosive charge for a blast exceeds 1.3 kg and 26.50 kg respectively.
Safe zone (Zone 5)	Beyond 500	<1.3	<26.50	▪ MCPD and total charge should be fixed such that it shouldn't exceed 1.3 kg and 26.50 kg respectively. ▪ Fresh scientific study may be conducted if mine management wants to increase the MCPD and total explosive charge above 1.3 kg and 26.50 kg respectively. Continuous monitoring using seismograph should also be done in such cases by the mine management.	▪ Complete blasting plan need to be mentioned in the mining plan/scheme. ▪ Submission of monthly report on blast design pattern and detailed explosive consumption as well as volume of rock excavation to a statutory body viz. DGMS, DMG, PESO or SPCB. The justification should be made, if there is deviation in the actual pattern from the approved mining plan. Report of recorded ground vibration need to be added in monthly report, if MCPD and total explosive charge for a blast exceeds 1.3 kg and 26.50 kg respectively.

9.0 CONCLUSIONS AND RECOMMENDATIONS

To determine the zone of influence for blasting operations in granite/stone quarries in the State of Kerala, experimental blasts were conducted in nine representative quarries selected by the Joint Committee formed by Hon'ble National Green Tribunal. The blast induced ground vibration, air overpressure and flyrocks were monitored during the experimentation. The detailed analysis of the gathered data from the nine selected quarries was carried out to determine the influence zone. Howver, the influence zones in this report has been determined only be considering the impacts of rock blasting on ground vibrations, air over-pressure and flyrocks. The results of other blast induced hazards viz. dust, noise etc. need to be incorporated before the finalisation of the influence zones. The following conclusions and recommendations are made on the basis of the experimental blast results, observations and analysis results of the data for determination of blasting influence zone.

1. The experimental blasts were planned considering the prevailing blasting practices in the quarry and also with modified blast designs to have a larger impact of blasting on greater distances by increasing the depth of holes, explosive per hole, maximum explosive quantity per delay, number of holes, total explosive quantity in a round of blast.

2. A minimum of ten (10) rounds of experimental blasts were conducted in each quarry and the total experimental blasts was ninety-one. All the experimental blasts were carried out using 32 mm hole diameter using Jack hammer drill machines and crawler-mounted pneumatic drill machines.

3. The total number of holes in the blasting varied widely ranging from 05 to 60, hole depth varied from 1.5 to 2.4 m, burden varied from 0.8 to 1.6 m and spacing varied from 0.8 to 1.6 m. The explosive charge per hole varied from 0.25 to 0.79 kg whereas maximum charge per delay varied from 0.25 to 1.3 kg. The total explosive charge varied from 1.5 to 26.525 kg.

4. Small diameter emulsion cartridge of 25 mm diameter (125 gm weight per cartridge) were used in all the quarries. However, ANFO explosives were also used as main explosive charge in some quarries. Non-electric detonators (Nonel) were used in all the experimental blasts for in-hole explosive initiation and surface hole-to-hole firing. Different combinations of firing sequences were experimented to obtain ground vibrations with different range of magnitudes.

5. The ground vibrations and air overpressures generated from the experimental blasts were monitored at the distances of 28 to 576 m from the blasting sites. A total of 301 blast-induced ground vibration and air-overpressure data were recorded. The major finding from the ground vibration data are given below.

(a) The maximum magnitude of vibration recorded from all the nine quarries was 10.42 mm/s with the associated dominant excitation frequency of 170.3 Hz. This data was recorded at the distance of 28 m from the blasting face in Granite Stone Quarry of M/s Cochin Blue Metal Industries Pvt. Ltd., Kottayam District (Blast No. #9).

(b) The maximum value of vibration recorded at a distance of 50 m from the blasting face was 8.21 mm/s having dominant excitation frequency of 230 Hz (Granite Building Stone Quarry of M/s POABS Granite, Trivandrum District, Blast No. #5).

(c) The magnitude of vibrations recorded at the distances of 50 to 77 m distances from the different quarries were less than 5 mm/s except in five cases, where the vibration magnitudes were 8.21 mm/s (50 m distance), 5.882 mm/s (51 m distance), 5.68 mm/s (63 m distance), 5.585 mm/s (77 m distance) and 5.042 mm/s (69 m distance).

(d) the ground vibration data recorded above 5 mm/s beyond a distance of 50 m has been recorded in five cases. It is evident from the analysis that in four cases the blast design was modified to achieve the purpose of the experimentation. In one case, the recorded PPV was because of the existing practice of the quarry, but the total explosive charge used in this blast was more than the usual practice of the quarries in state of Kerala.

(e) The ground vibration data recorded at the distance raging between 78 m and 137 m were all less than 2.8 mm/s except in one case, where magnitude was 3.619 mm/s at 100 m distance.

(f) The maximum value of PPV recorded at a distance beyond 138 m distances from the blasting faces, were less than 1.66 mm/s in all the quarries.

(g) In most of the cases ground vibration data could not be recorded when the vibration monitoring points were more than 300 m.

6. In majority, higher dominant excitation frequencies of ground vibration waves were obtained ranging from 25 to 125 Hz. The minimum frequency of recorded vibration data was 14.2 Hz. Considering frequency values, the safe vibration limit as per DGMS Standard comes to 10 mm/s. Hence, the ground vibration data recorded near the public houses/structures in the different quarries are all within the safe limit as per DGMS standard.

7. Although the safe level of ground vibration is 10 mm/s based on the DGMS Standard, but considering human response to blasting nuisances as observed during the study

and globally available literature on this subject, the ground vibration limit for the state of Kerala may be considered as 5 mm/s.

8. The air-overpressures (AOP) data recorded were in the range of 91.48 dB(L) to 128.6 dB(L). The dominance of AOP data recorded at a distance of 50 m was in the range of 110 to 120 dB(L). The maximum value of AOP recorded at a distance of 100 m from the blasting face, was 122.2 dB(L). All the AOP values recorded beyond 150 m from the blasting faces, were below 120 dB(L). The threshold level of air-overpressure is **134 dB(L)** as per USBM standard. Considering the **134 dB(L)** as safe limits, the recorded values of AOP at all the quarries were within limit.

9. The blasting events were recorded using high speed video camera and digital camera. No flyrock was observed during the study except in two cases when flyrocks occurred (<25 m) but were within the blasting area only. Hence, it is recommended to do a careful inspection of blasting faces by the competent engineer prior to blast as and to use stone chips of size 2 mm to 4 mm to prevent vertical ejection through the stemming column.

10. According to human response surveys, there are mixed opinions regarding the disturbances created by blasting. A majority of resident's complaints were structural damages due to quarry blasting operations and dust coming out from the quarries. Further, their common grievances were the blasting activities carried out by quarry owners prior to the study conducted.

11. The propagation equation for the prediction of blast vibration has been established with 95% confidence level for all the nine quarries individually as well as in combination to establish a generalised equation. The permissible explosive weight per delay may be computed from the Equation to contain vibration within safe limits for distances of houses/structures concerned.

12. The error in prediction of vibration using different approaches was evaluated by computation of Root Mean Square Error (RMSE). The computed error values suggest that error in predictions using rock specific predictors and generalized predictor as compared to the mine specific predictors are about 1% and 10% respectively. So, the generalized predictor may be used for the determination of blasting influence zone.

13. The influence of other blast design parameters has also been investigated in this study. This investigation was carried out using the multivariate statistical analysis approach. P-value based testing approach was used to identify the significance of different

variables influencing vibration. The cutoff P-value of 0.05 was taken to identify the significant variable. The outcomes of the analysis shows that in general, vibration has significant influence of number of blastholes, burden, maximum explosive weight per delay, total explosive and distance. So, these parameters need to be designed properly to reduce the vibration, when the blasting has to be conducted in the proximity to the structures.

14. Mine-specific, rock-specific and generalised total explosive charge based predictor equations were also developed using the experimental data. Multivariate statistical analysis was done to develop the total explosive-based predictors. The developed generalised predictor is accurate with RMSE of 0.87. Hence, it has been used for the determination of influence zone.

15. The safe values of maximum explosive weight per delay and total explosive quantity have been computed using the generalised USBM and total explosive based PPV predictors. The computed values have been further compared with the experimental data to determine the influence zone.

16. Based on the outcomes of the experimental data analysis, six (6) blasting influence zones (Zone 0-5) have been delineated. Different technical and statutory recommendations have been made for day-to-day safe blasting in zones 1-5.

17. The expected values of PPV within a distance of 50 m, would be dominantly above 5 mm/s. The AOP magnitude within 50 m would also be high. The flyrock ejections in this zone is mostly unavoidable and will **require expert advice to control it within desired limit**. Hence, the blasting should not be **allowed** when the structures are lying within the distance of 50 m from the quarrying boundary. The zone within a distance of 50 m will be termed as "**No Blasting Zone (Zone 0)**".

18. The mining zone within a distance of 50-100 m from the structures, has been delineated as **Extremely Sensitive Zone (Zone 1)**. Considering the additional risk from the flyrock and inaccuracy in the blast design pattern, **the blasting in this zone should be avoided**. However, if there is extreme requirement to conduct blasting in this zone, then it may be done under the complete supervision of a reputed scientific organisation. The representative of the scientific organisation will supervise the day-to-day blasting activities as well as will monitor the induced hazards from the blasting. Since, the computed safe values of maximum explosive weight per delay and total charge is based on the generalised predictors, it is recommended to have fresh scientific study to develop mine specific predictor for the blasting in this zone.

19. Another zone has been delineated within the distance of 100-150 m. This zone has been termed as **High Sensitive Zone (Zone 2)**. It is recommended to have fresh scientific study to develop mine specific predictor equations for this zone as well. The mine management should deploy seismograph to monitor the ground vibration and air overpressure for each blast, if the blasting has to be carried out in this zone. **Complete muffling of blast patch is also required using heavy duty blasting mats**.

20. The zone between 150-250 m have been delineated as **Moderately Sensitive Zone (Zone 3).** For this zone, it is recommended to mention the appropriate proposed blast design pattern in the mining plan/scheme. The mining plan/scheme should be reviewed by a scientific organisation before approval in this case.

21. The blasting zone between distances of 250-500 m from the structures, has been delineated as **Buffer Zone (Zone 4)**. For this zone, the complete blast design patterns need to be mentioned in the mining plan for this zone. The proposed blast design patterns should be reviewed properly by a competent mining engineer before the approval of the mining plan.

22. The mining zone beyond 500 m from the structures, may be treated as **safe zone (Zone 5)**. The normal blasting practices using small diameter (25 mm) blastholes with maximum explosive weight per delay and total charge of 1.3 kg and 26.5 kg respectively may be carried out in this zone. The mine management may go for the higher values of maximum explosive weight per delay and total explosive charge based on a fresh scientific study.

23. Since the experiments for the determination of blasting influence zone was carried out using small diameter blastholes (32 mm) of maximum 2.4 m depths and NONEL delay detonators (DTH of 250/200 ms & TLD of 25 and 42 ms), this system of blasting or electronic detonators should be used for quarry operation in the State of Kerala. Any change in the system may be made only after a fresh scientific study.

24. The technical and statutory recommendations for different zones have been summarised in **Table 8.4** of this report. This table may be referred for day-to-day safe blasting operation in the stone quarries of the State of Kerala. The mentioned reporting system for blast design pattern, explosive consumption and volume of rock excavation should be framed to ensure safe blasting in the future.

ACKNOWLEDGEMENTS

Research team is thankful to the Kerala State Pollution Control Board and the Members of the Committee formed by Hon'ble National Green Tribunal for sponsoring the study to CSIR-CIMFR, Dhanbad. The help and cooperation of the officials of Kerala State Pollution Control Board and quarry management of different study sites is also thankfully acknowledged. Team is also thankful to the residents/inhabitants of the nearby houses of the study sites for their support and cooperation in carrying out field investigations. The support of residents in providing feedback during human response survey is also thankfully acknowledged.

ANNEXURE-1

Event and FFT Reports of Ground Vibration Recorded at Granite Building Stone Quarry of M/s Adukadu Granites Pvt. Ltd., Pathanamthitta District

Instantel

Event Report

Date/Time Long at 11:08:57 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1D.MX0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 3.350 Kg, Distance - 46 m

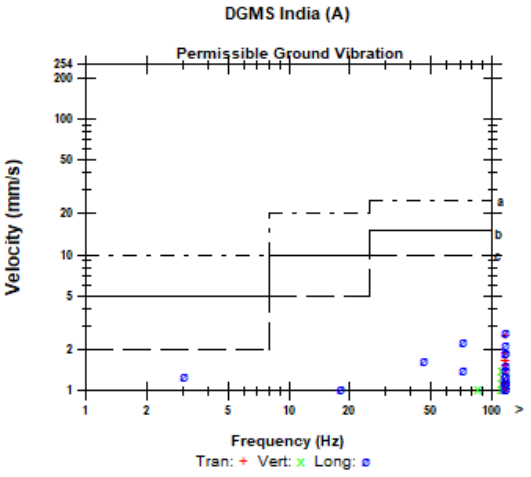
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

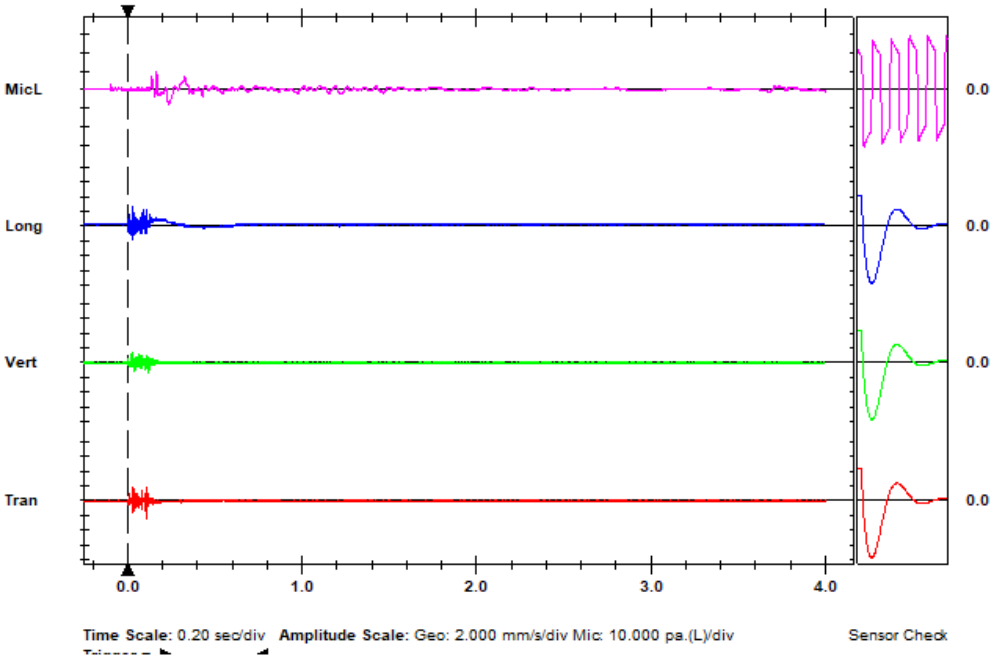
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 113.5 dB(L) at 0.166 sec
ZC Freq 37 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	2.540	1.397	2.667	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.105	0.031	0.029	sec
Peak Acceleration	0.305	0.133	0.292	g
Peak Displacement	0.002	0.002	0.057	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 3.287 mm/s at 0.029 sec





Printed: February 17, 2023 (V 10.72 - 10.72)

Instantel

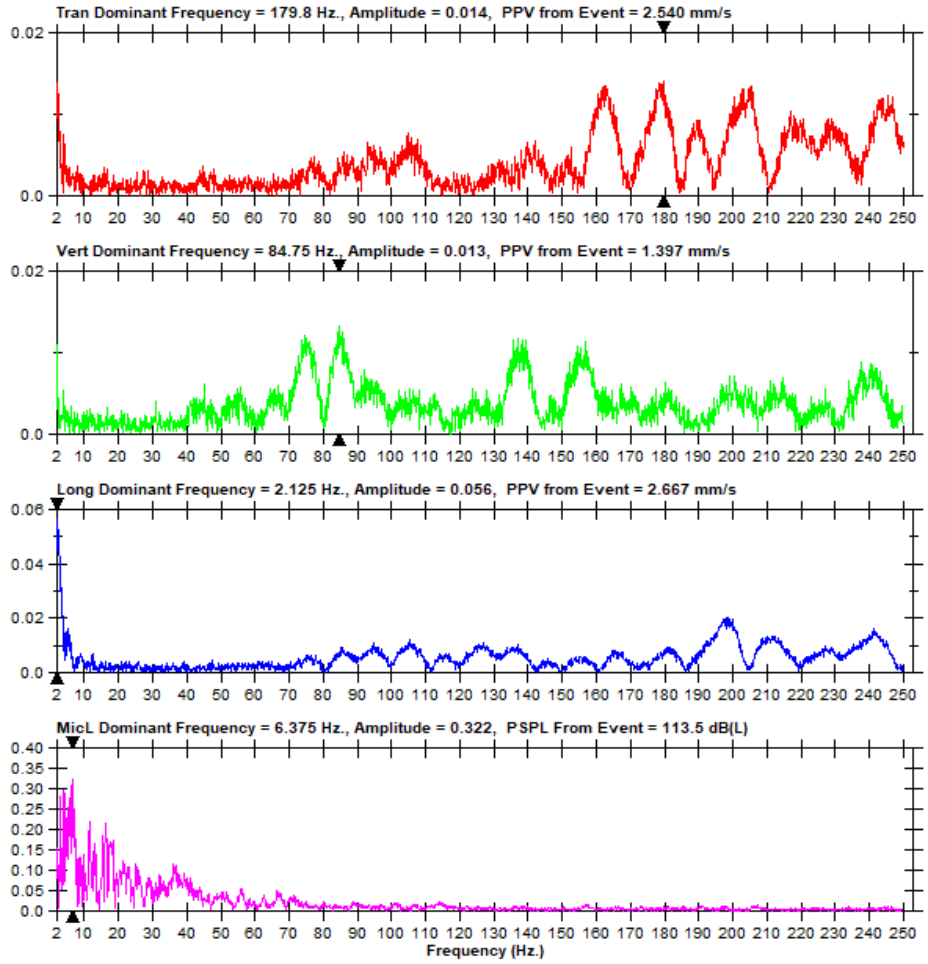
FFT Report

Date/Time	Long at 11:08:57 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1D.MX0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 3.350 Kg, Distance - 46 m



Printed: February 17, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 11:08:54 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

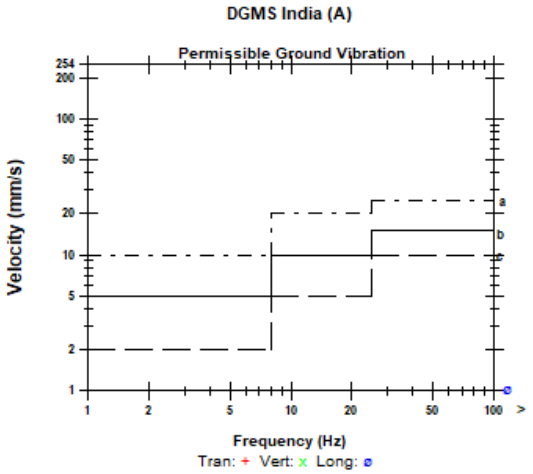
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

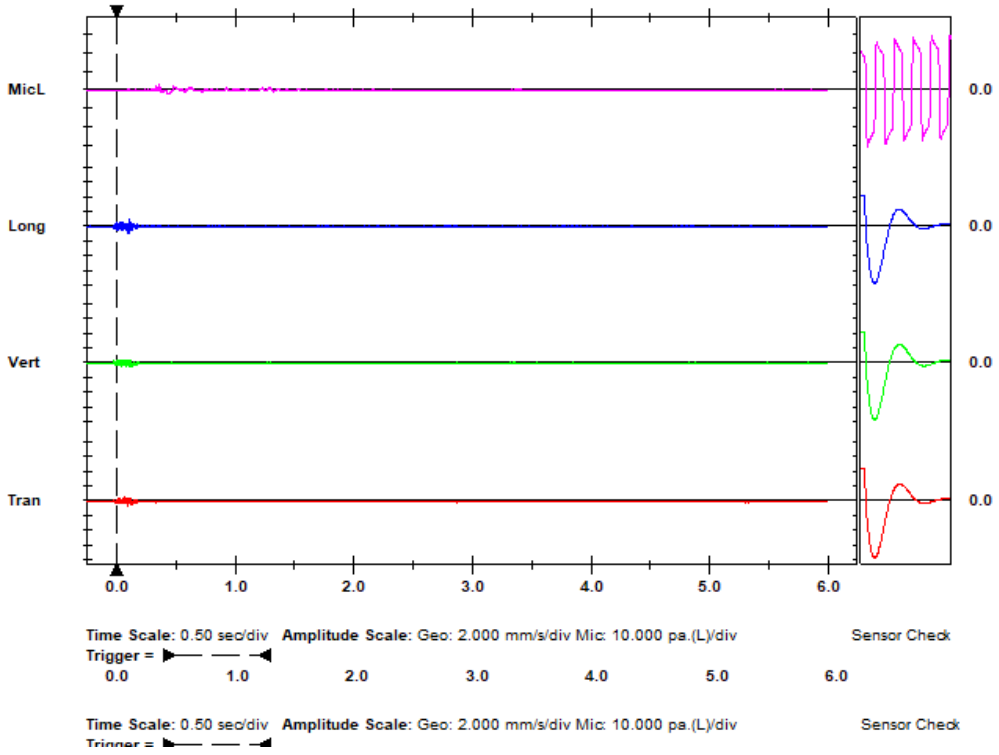
Microphone Linear Weighting
PSPL 104.2 dB(L) at 0.361 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	1.016	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.096	0.113	0.100	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 1.114 mm/s at 0.100 sec

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1D.MU0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 3.350 Kg, Distance - 130 m





Instantel

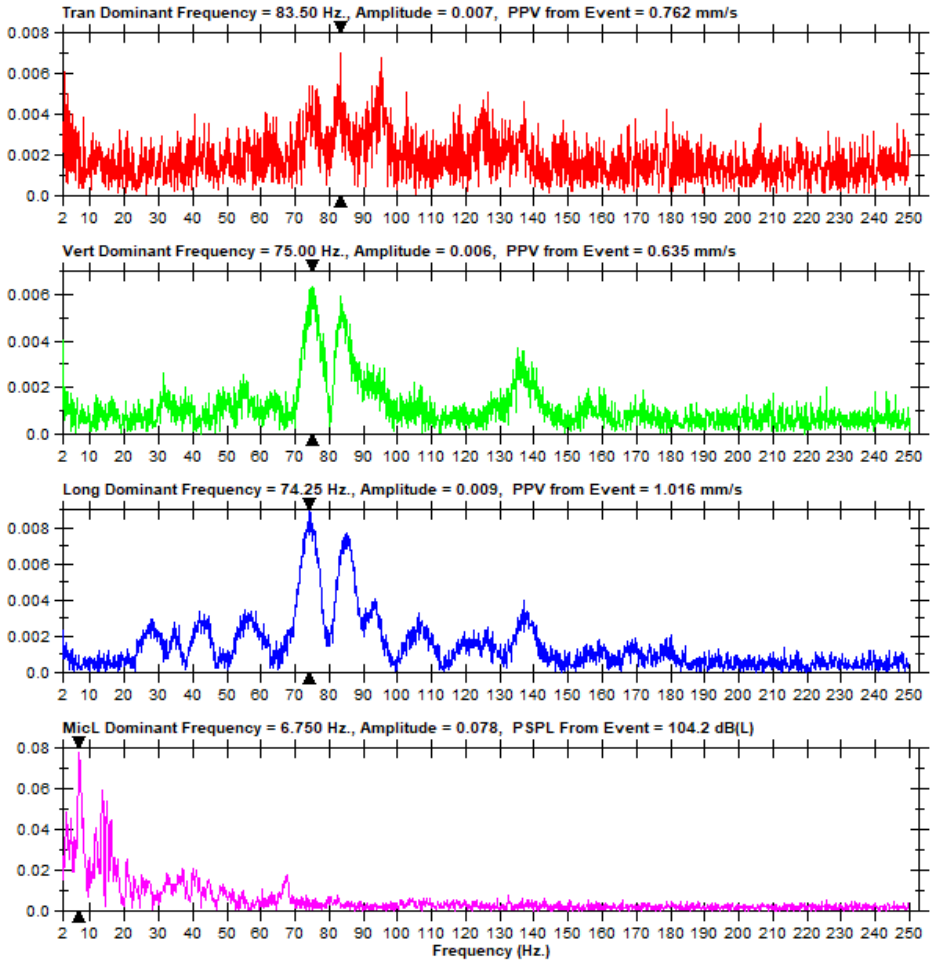
FFT Report

Date/Time	Long at 11:08:54 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1D.MU0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 3.350 Kg, Distance - 130 m



Printed: February 17, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 11:11:00 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

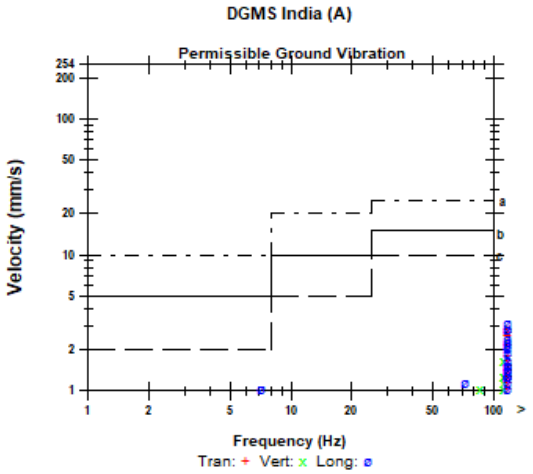
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 114.0 dB(L) at 0.181 sec
ZC Freq 16 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 474 mv)

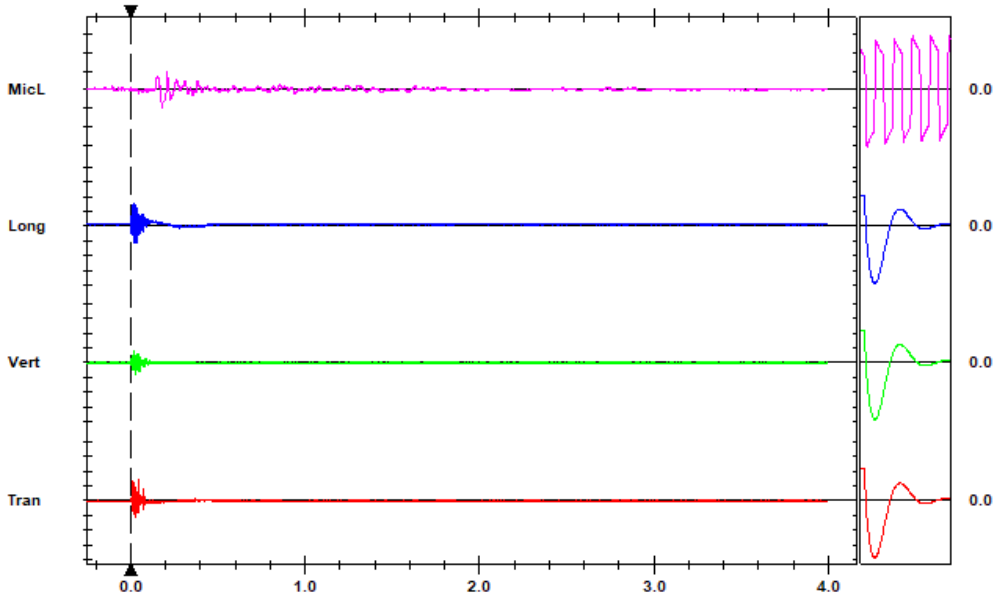
	Tran	Vert	Long	
PPV	2.794	1.651	3.175	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.047	0.023	0.021	sec
Peak Acceleration	0.331	0.172	0.318	g
Peak Displacement	0.002	0.002	0.031	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 4.115 mm/s at 0.021 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1D.QC0
Post Event Notes
Total No. of holes - 5, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 1.709 Kg, Distance - 50 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

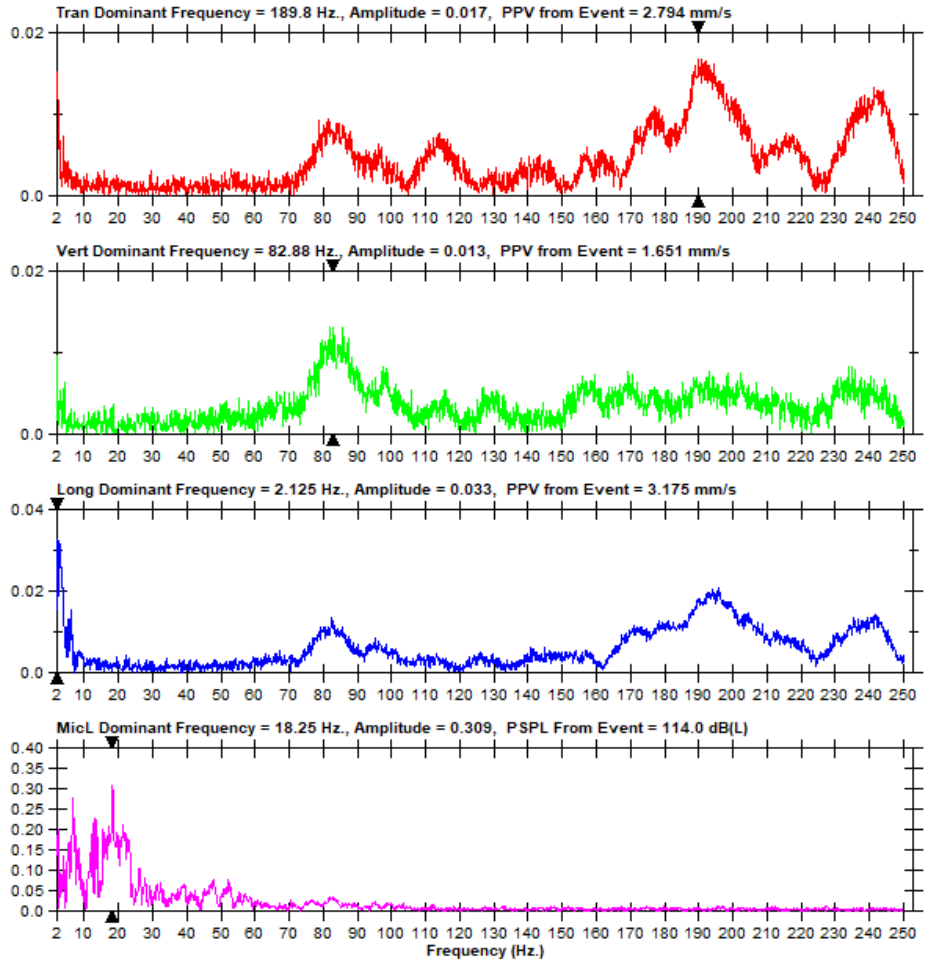
FFT Report

Date/Time	Long at 11:11:00 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1D.QC0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 5, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 1.709 Kg, Distance - 50 m



Printed: February 17, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 11:10:57 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

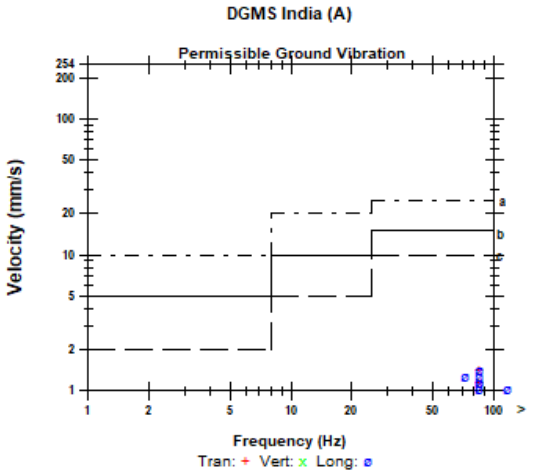
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

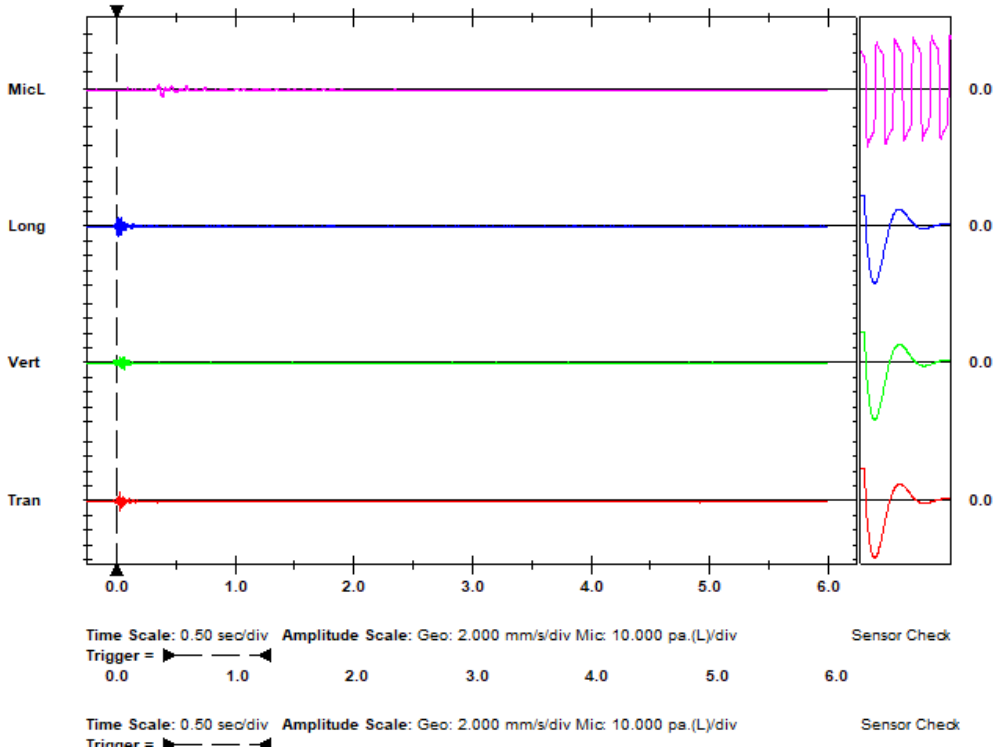
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.391 sec
ZC Freq 16 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	1.397	0.889	1.397	mm/s
ZC Freq	85	73	85	Hz
Time (Rel. to Trig)	0.025	0.061	0.021	sec
Peak Acceleration	0.066	0.053	0.093	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 1.801 mm/s at 0.025 sec

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1D.Q90
Post Event Notes
Total No. of holes - 5, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 1.709 Kg, Distance - 128 m





Instantel

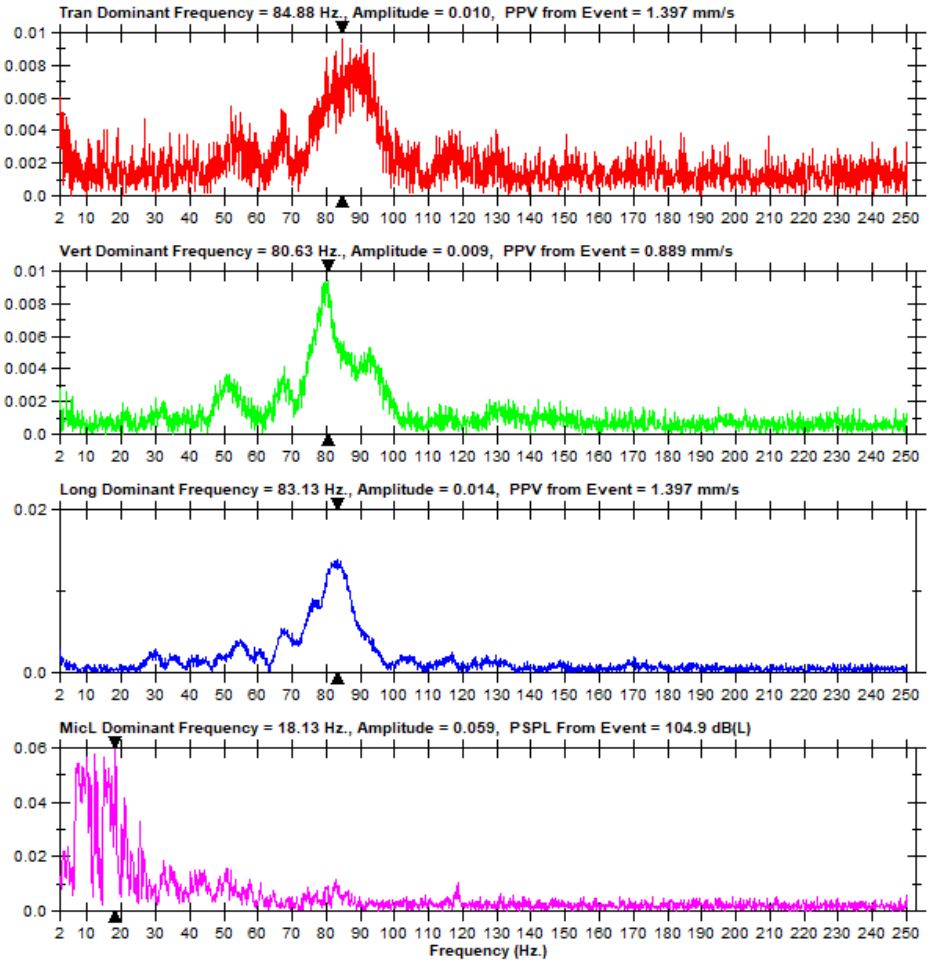
FFT Report

Date/Time	Long at 11:10:57 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1D.Q90

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 5, Hole Depth - 1.8 m, Charge/holes - 0.292 - 0.375 Kg, MCPD - 0.667 Kg, Total Charge - 1.709 Kg, Distance - 128 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 11:14:57 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

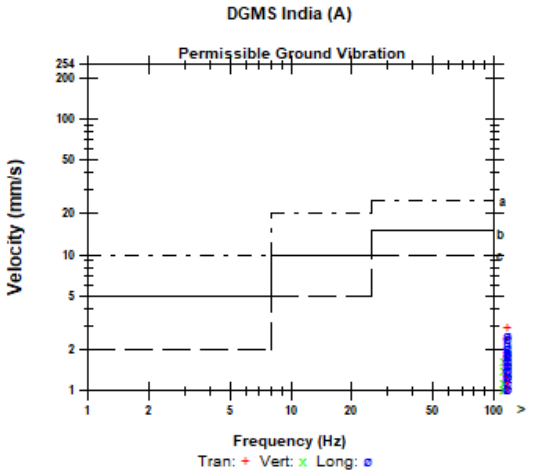
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

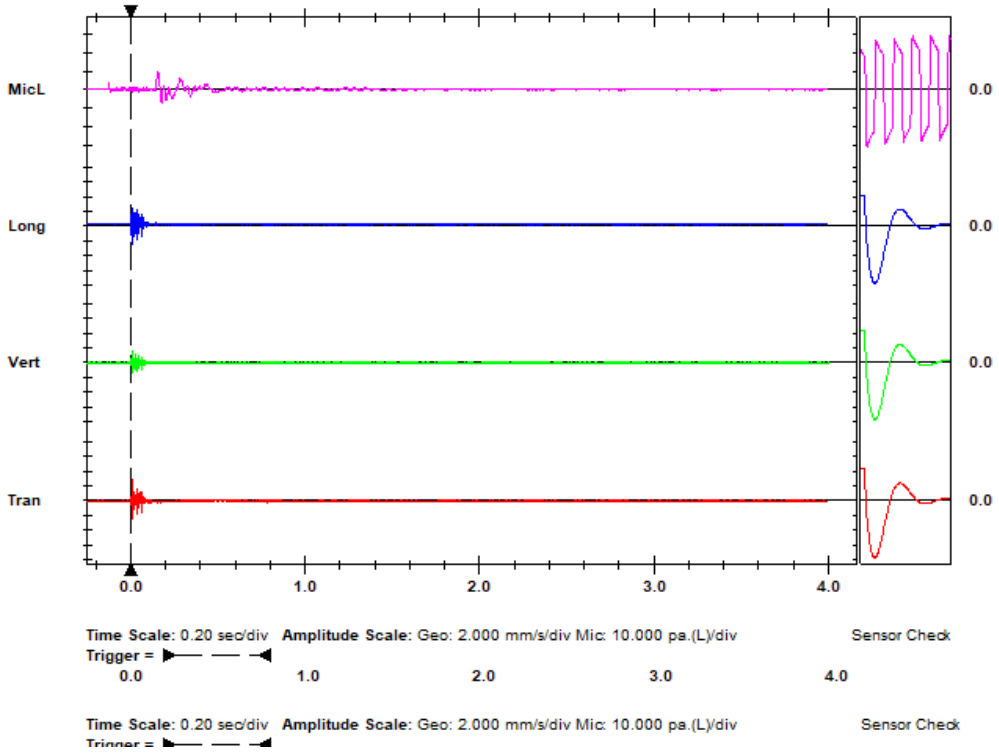
Microphone Linear Weighting
PSPL 113.8 dB(L) at 0.157 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	2.921	1.651	2.540	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.010	0.012	0.010	sec
Peak Acceleration	0.384	0.199	0.278	g
Peak Displacement	0.002	0.001	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 4.002 mm/s at 0.010 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1D.WX0
Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 52 m





Instantel

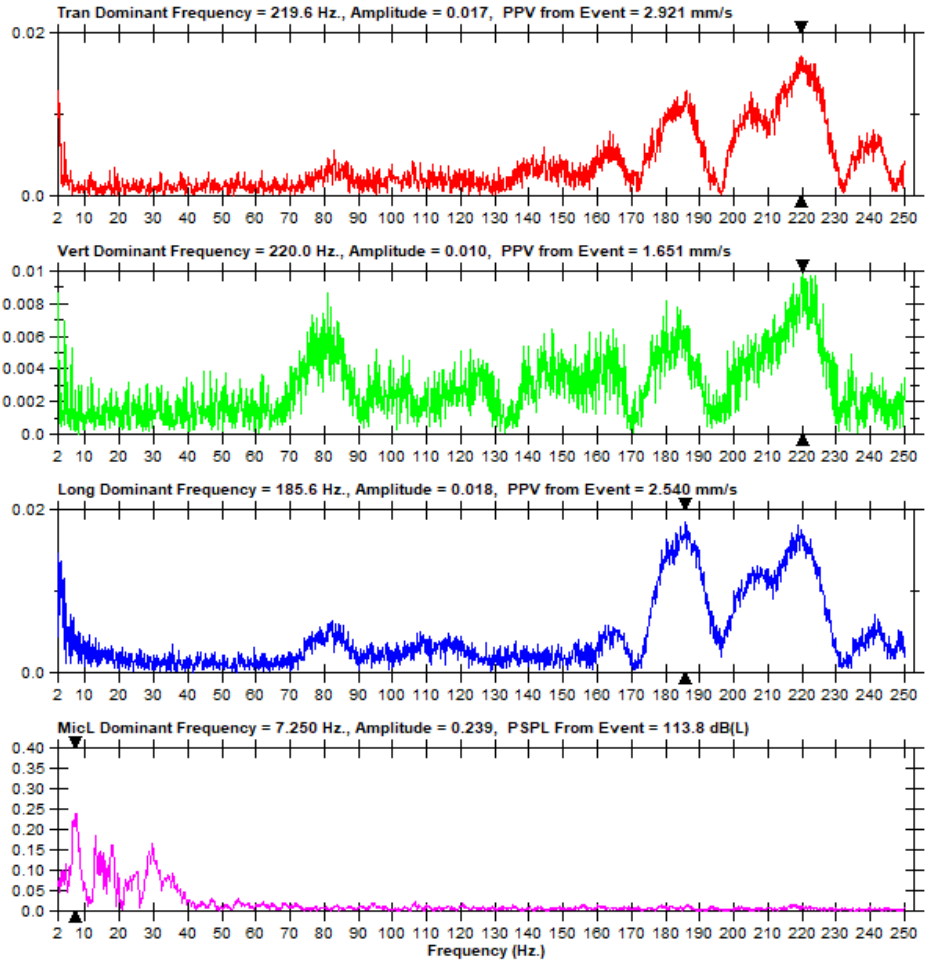
FFT Report

Date/Time	Long at 11:14:57 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1D.WX0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 52 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 11:14:54 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1D.WU0
Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 129 m

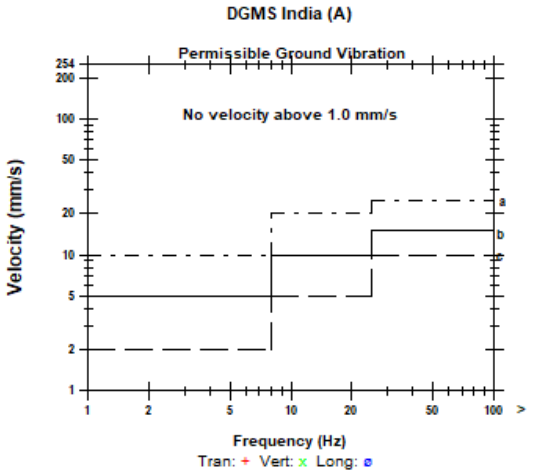
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

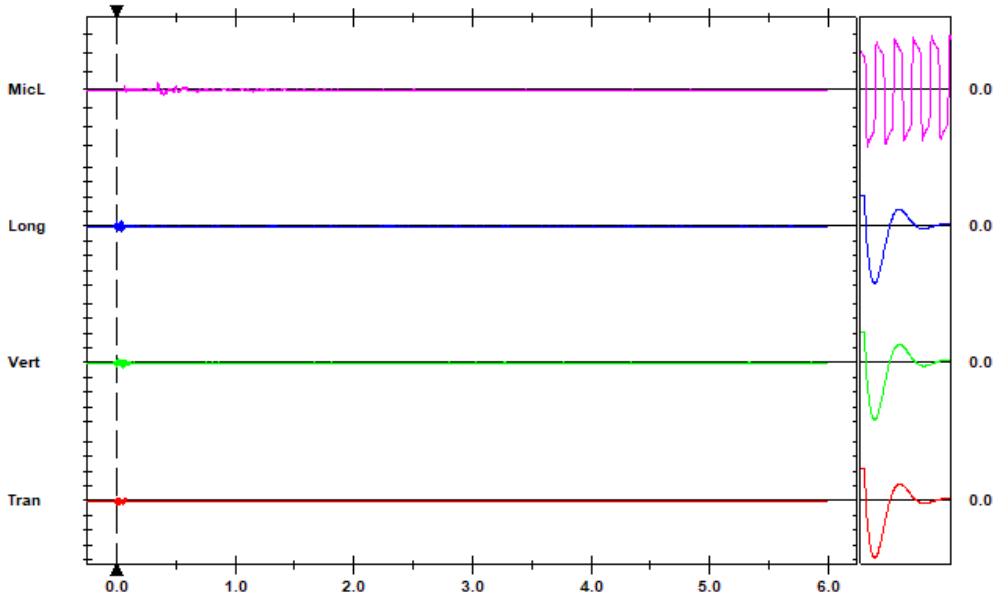
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.346 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	0.508	0.762	0.762	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.005	0.050	0.005	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 0.992 mm/s at 0.005 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

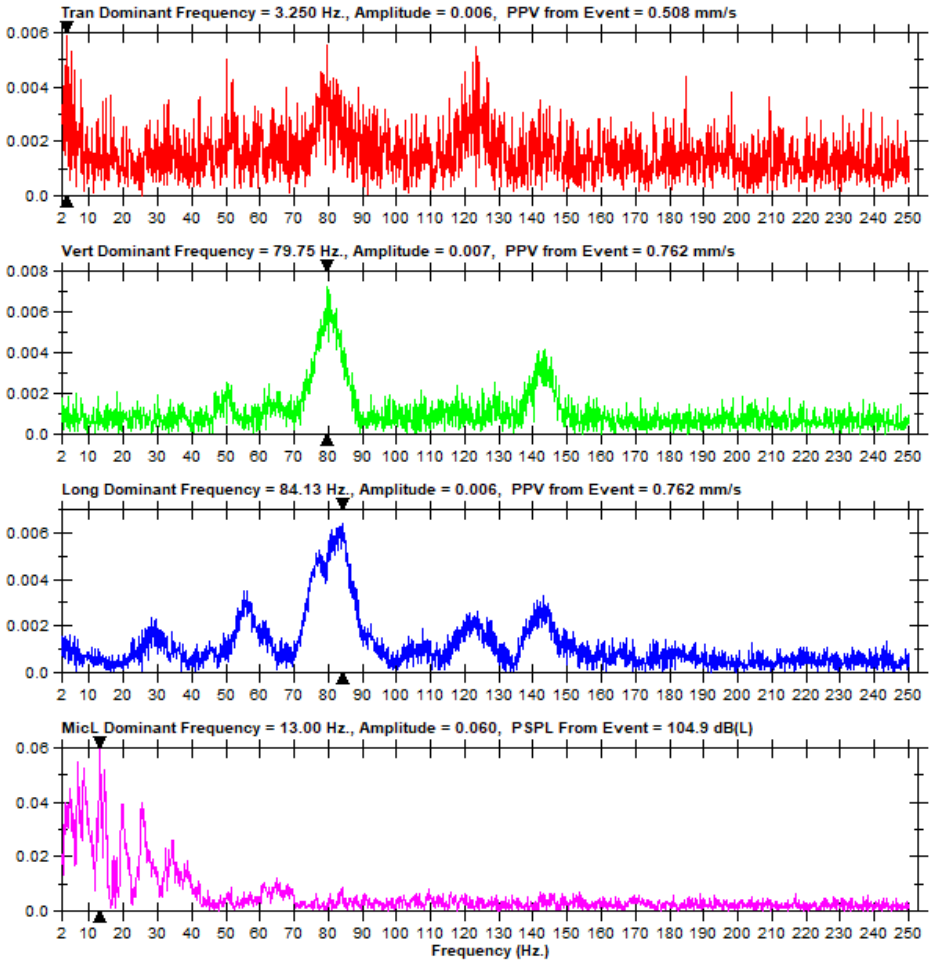
FFT Report

Date/Time	Long at 11:14:54 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1D.WU0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg,
MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 129 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 11:16:36 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

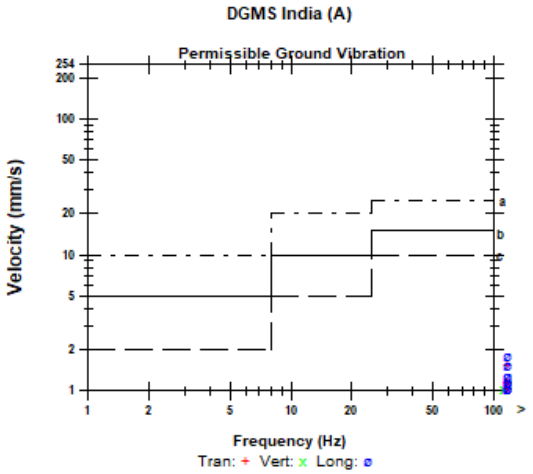
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

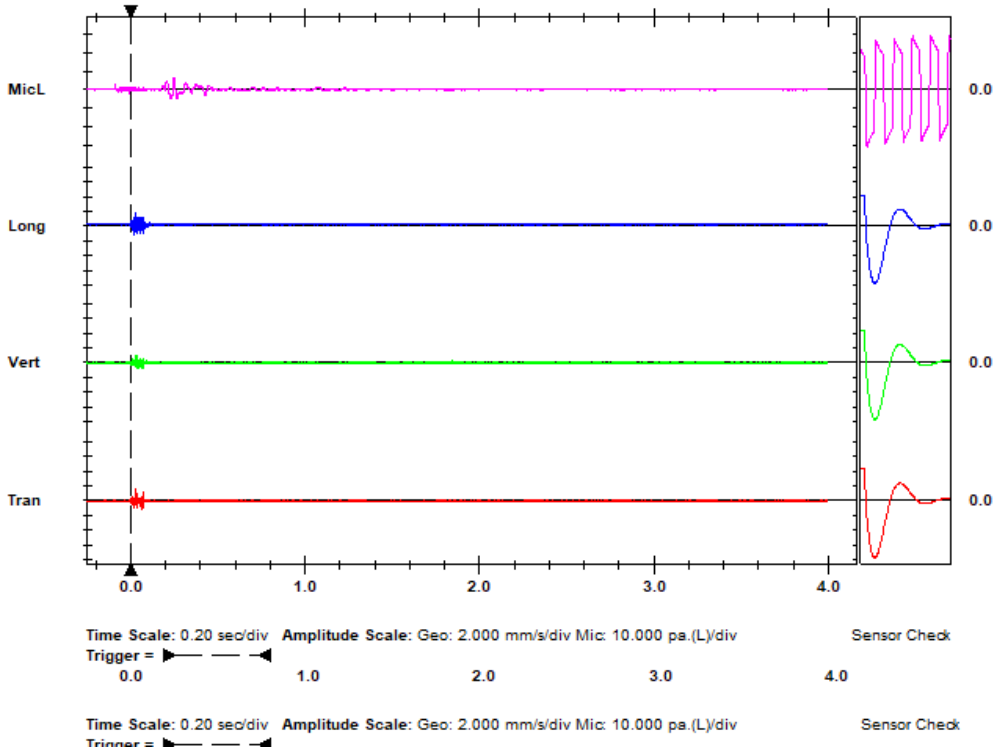
Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.247 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	1.524	1.016	1.778	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.026	0.027	0.025	sec
Peak Acceleration	0.172	0.106	0.212	g
Peak Displacement	0.001	0.001	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 2.207 mm/s at 0.025 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1D.ZO0
Post Event Notes
Total No. of holes - 6, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.250 Kg, Distance - 58 m





Instantel

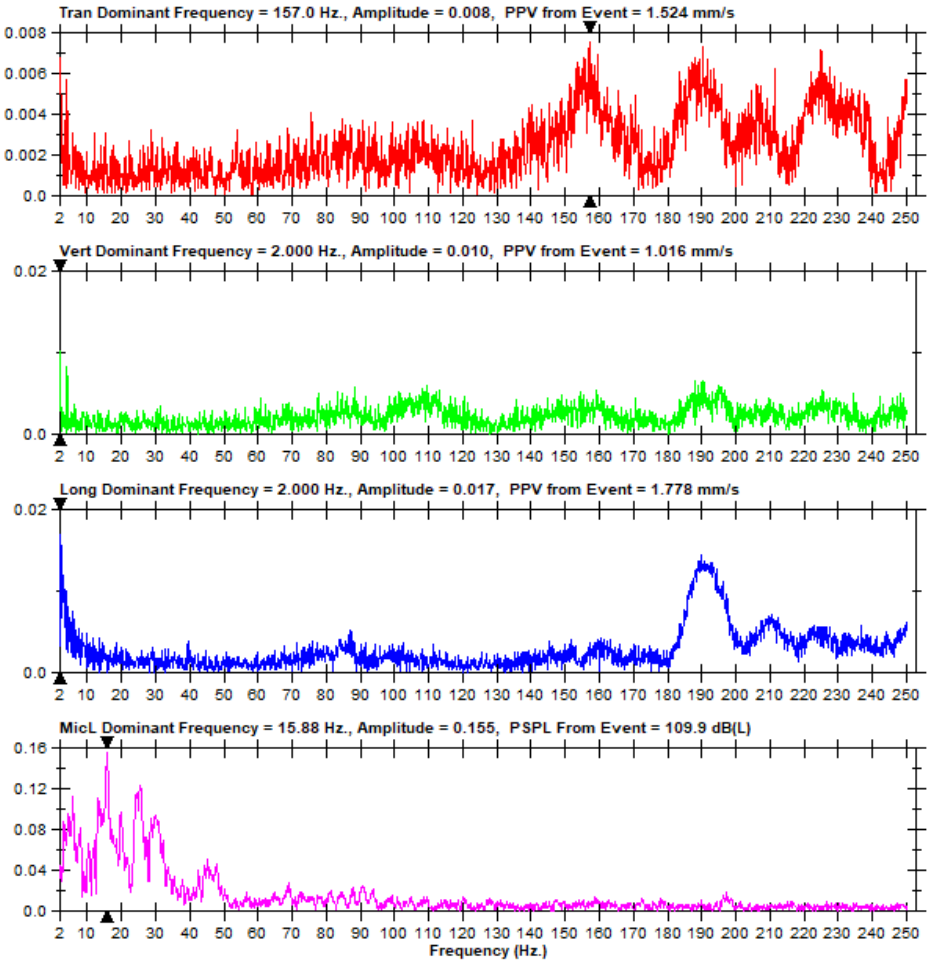
FFT Report

Date/Time	Long at 11:16:36 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1D.ZO0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 6, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.250 Kg, Distance - 58 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 11:16:34 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1D.ZM0
Post Event Notes
Total No. of holes - 6, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.250 Kg, Distance - 130 m

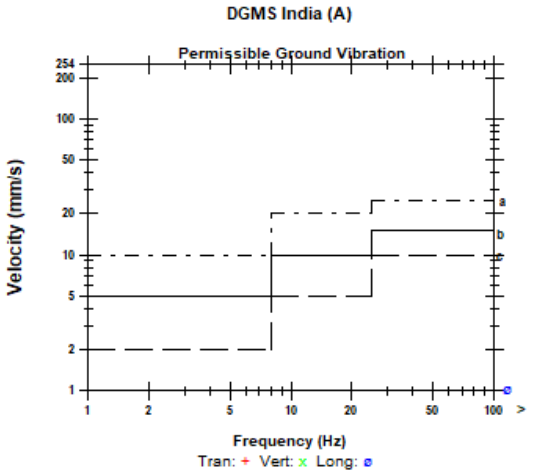
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

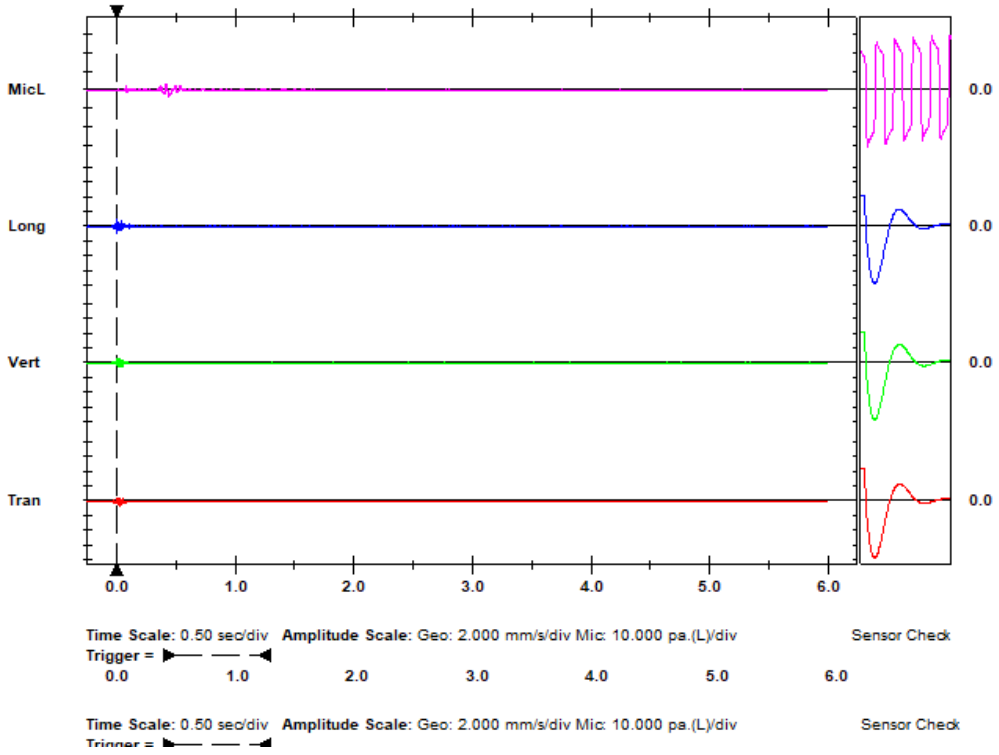
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.443 sec
ZC Freq 16 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.024	0.015	0.006	sec
Peak Acceleration	0.040	0.053	0.066	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 1.078 mm/s at 0.006 sec





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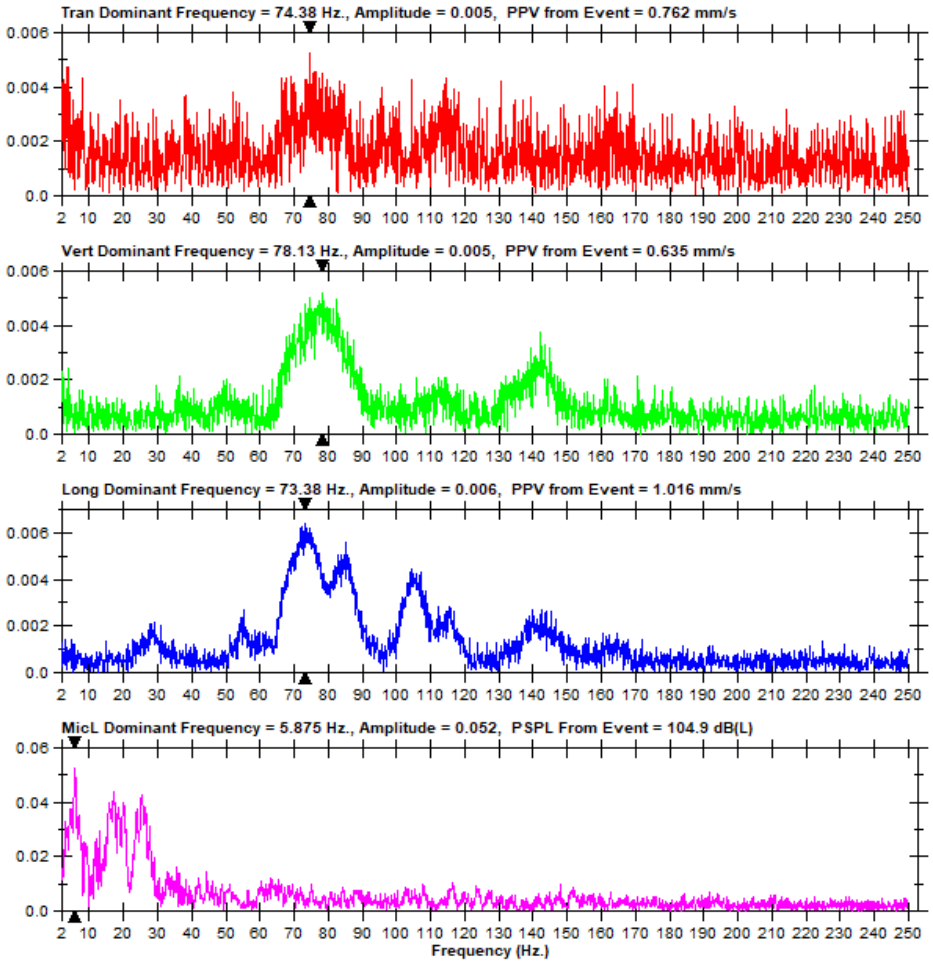
FFT Report

Date/Time	Long at 11:16:34 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1D.ZM0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 6, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg,
MCPD - 0.750 Kg, Total Charge - 2.250 Kg, Distance - 130 m



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Event Report

Date/Time Long at 11:20:49 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1E.6P0
Post Event Notes
Total No. of holes - 9, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.375 Kg, Distance - 60 m

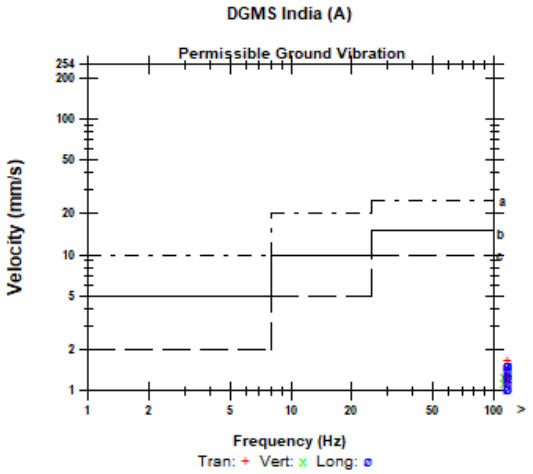
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

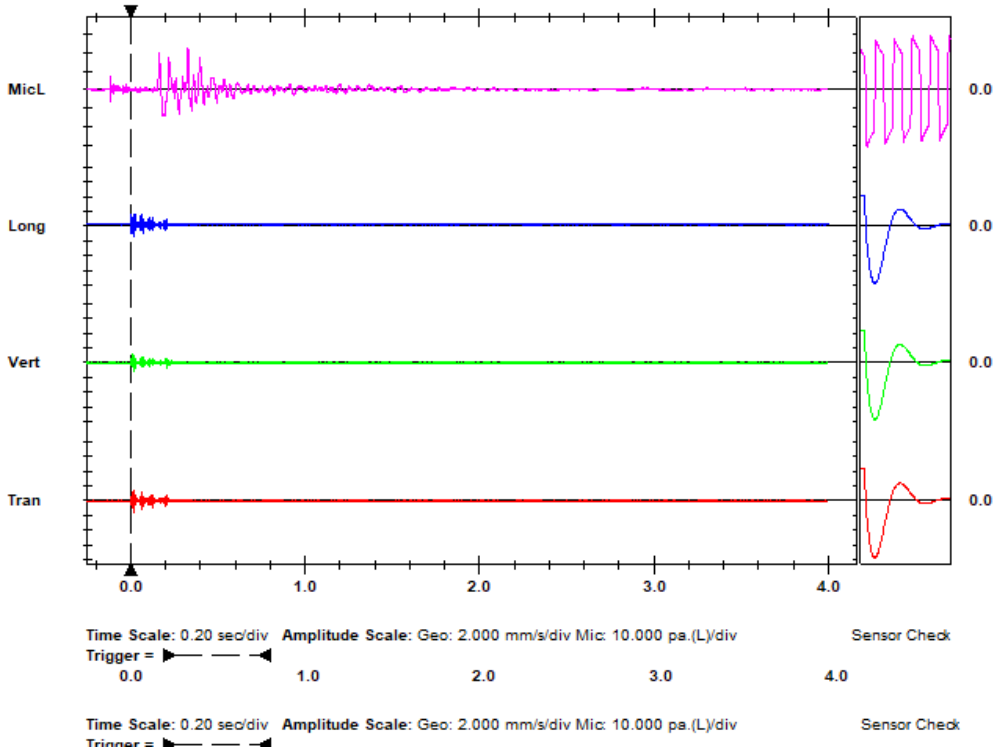
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 120.8 dB(L) at 0.329 sec
ZC Freq 23 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	1.651	1.270	1.524	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.018	0.013	0.005	sec
Peak Acceleration	0.199	0.159	0.186	g
Peak Displacement	0.001	0.001	0.025	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 2.222 mm/s at 0.020 sec





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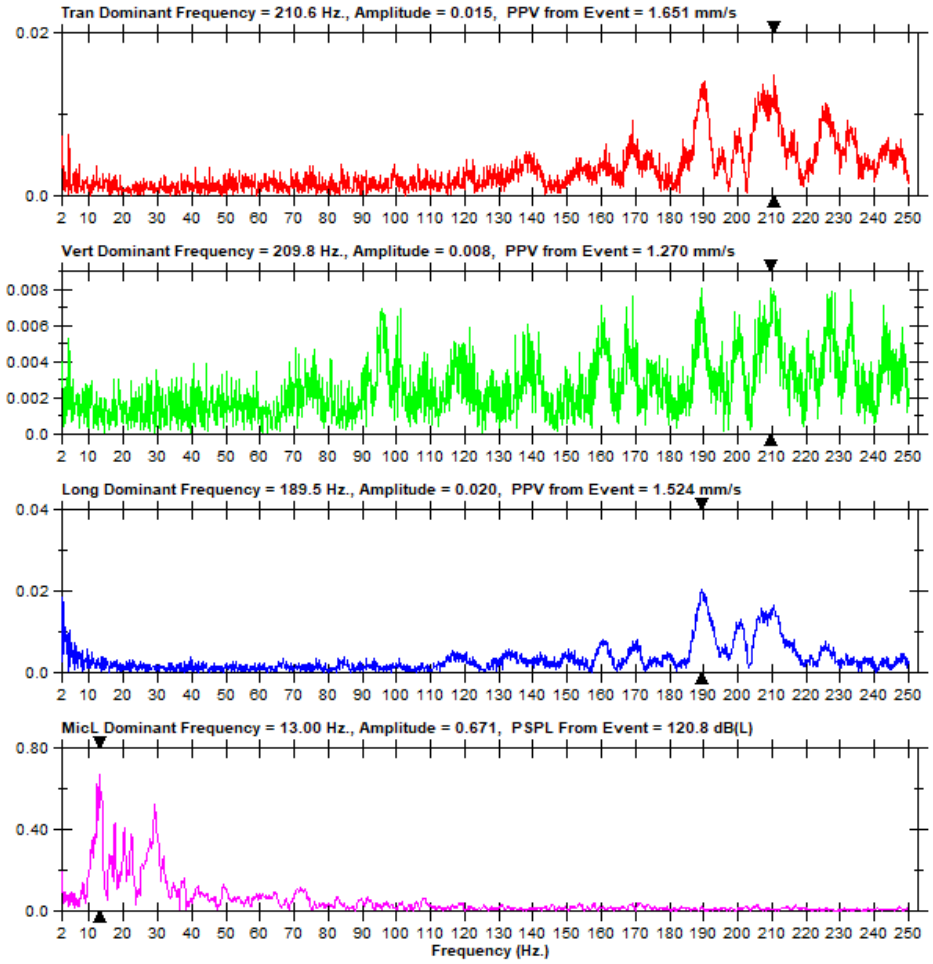
FFT Report

Date/Time	Long at 11:20:49 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1E.6P0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 9, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.375 Kg, Distance - 60 m



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Event Report

Date/Time Long at 11:20:47 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1E.6N0
Post Event Notes
Total No. of holes - 9, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.375 Kg, Distance - 130 m

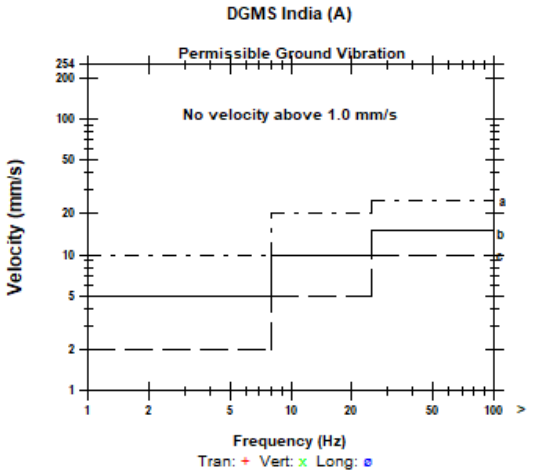
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

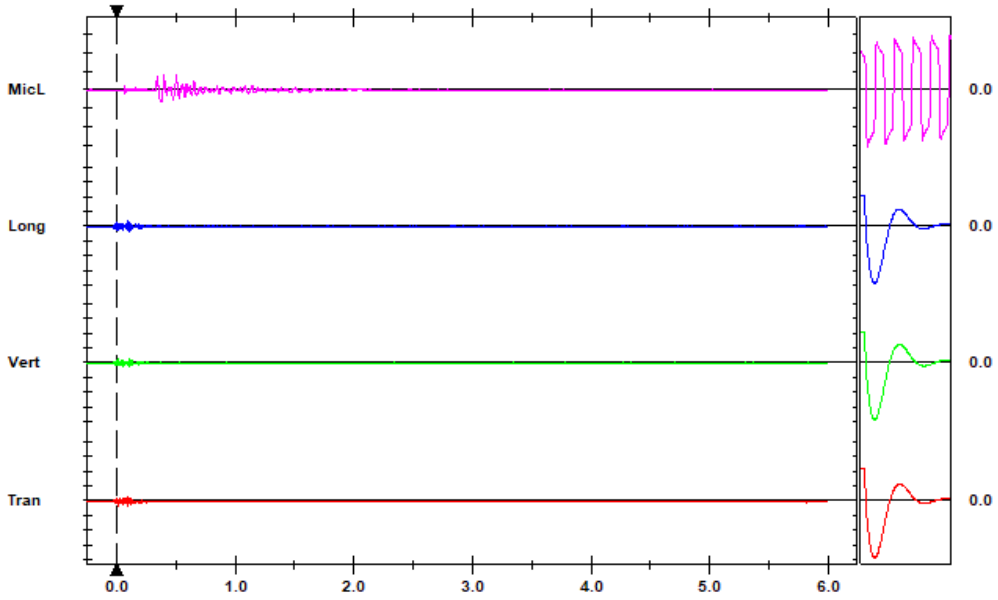
Microphone Linear Weighting
PSPL 111.8 dB(L) at 0.398 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	0.762	0.508	0.762	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.010	0.017	0.095	sec
Peak Acceleration	0.053	0.040	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 1.085 mm/s at 0.095 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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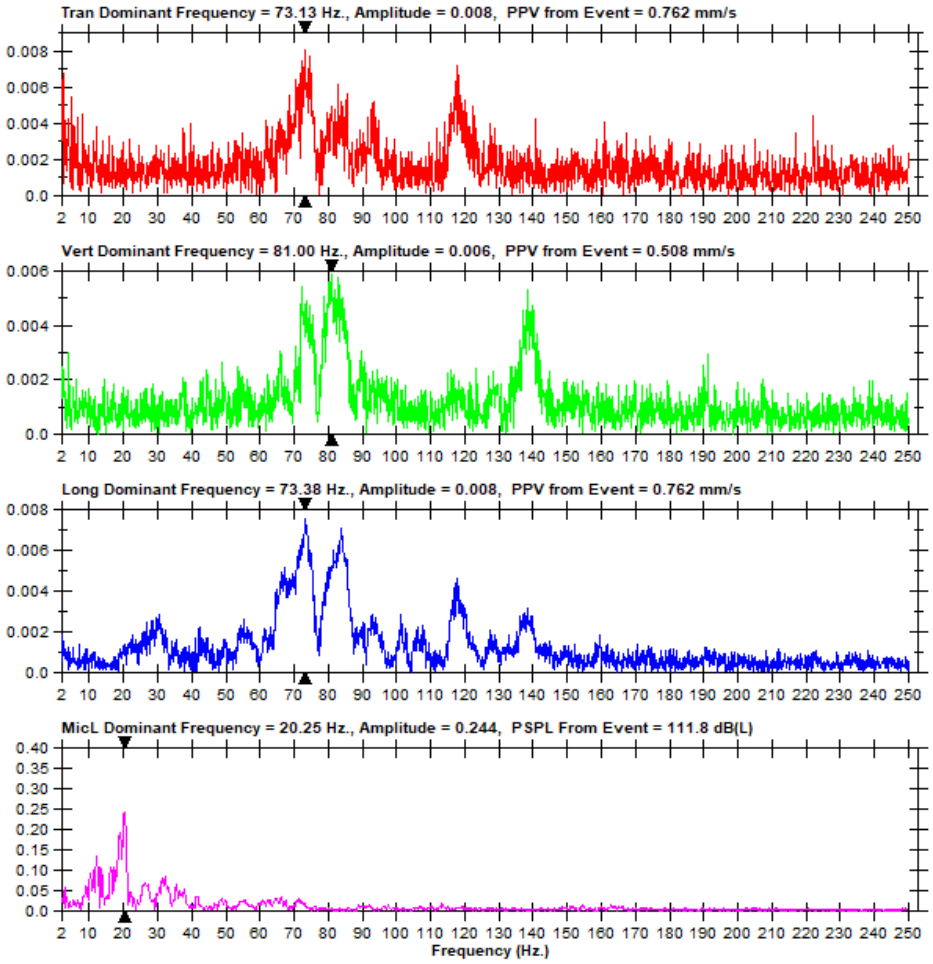
FFT Report

Date/Time	Long at 11:20:47 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1E.6N0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 9, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg,
MCPD - 0.750 Kg, Total Charge - 3.375 Kg, Distance - 130 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:38:52 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1Q.4S0
Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 100 m

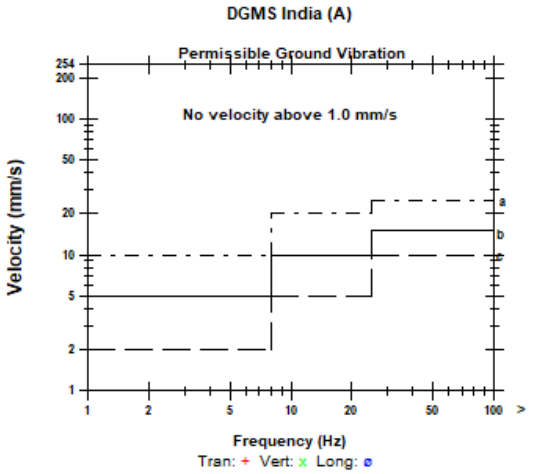
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

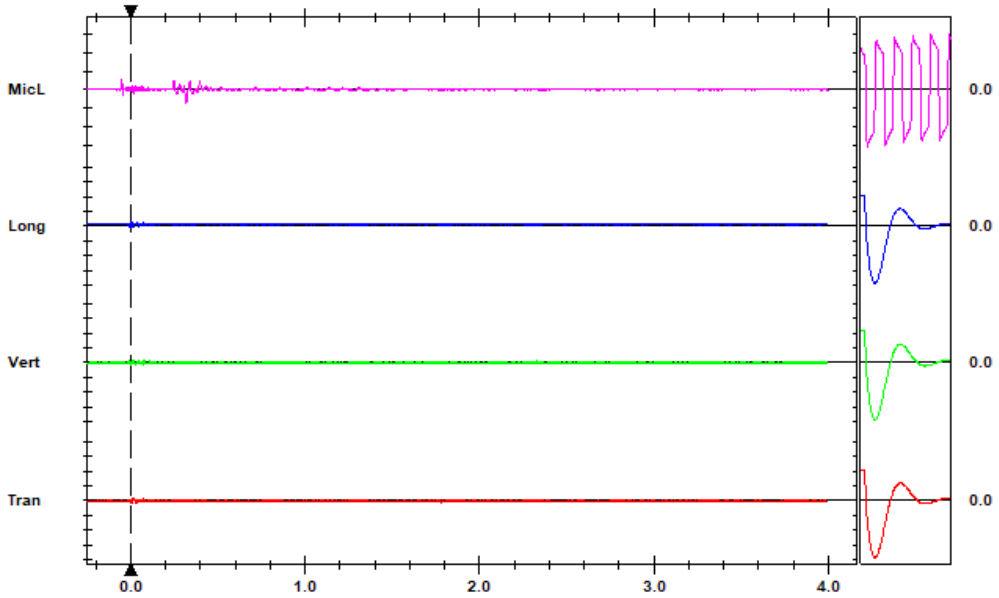
Microphone Linear Weighting
PSPL 111.2 dB(L) at 0.319 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 472 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	0.635	mm/s
ZC Freq	>100	>100	37	Hz
Time (Rel. to Trig)	0.004	-0.001	0.007	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.001	0.001	0.030	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.696 mm/s at 0.071 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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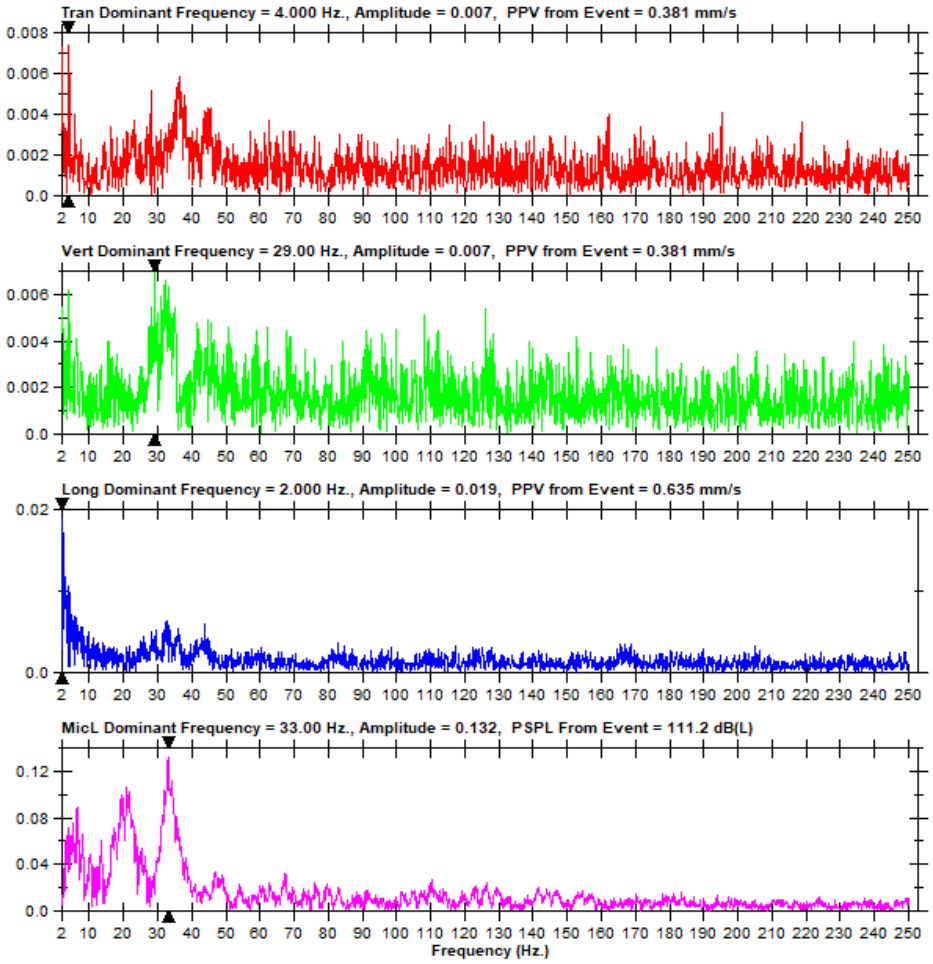
FFT Report

Date/Time	Long at 15:38:52 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1Q.4S0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 100 m



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Event Report

Date/Time Long at 15:38:49 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1Q.4P0
Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 111 m

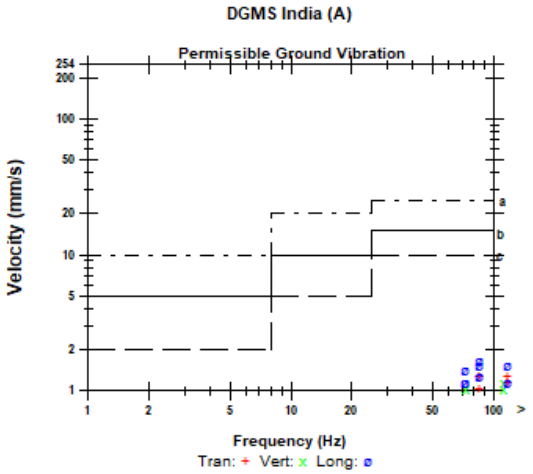
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

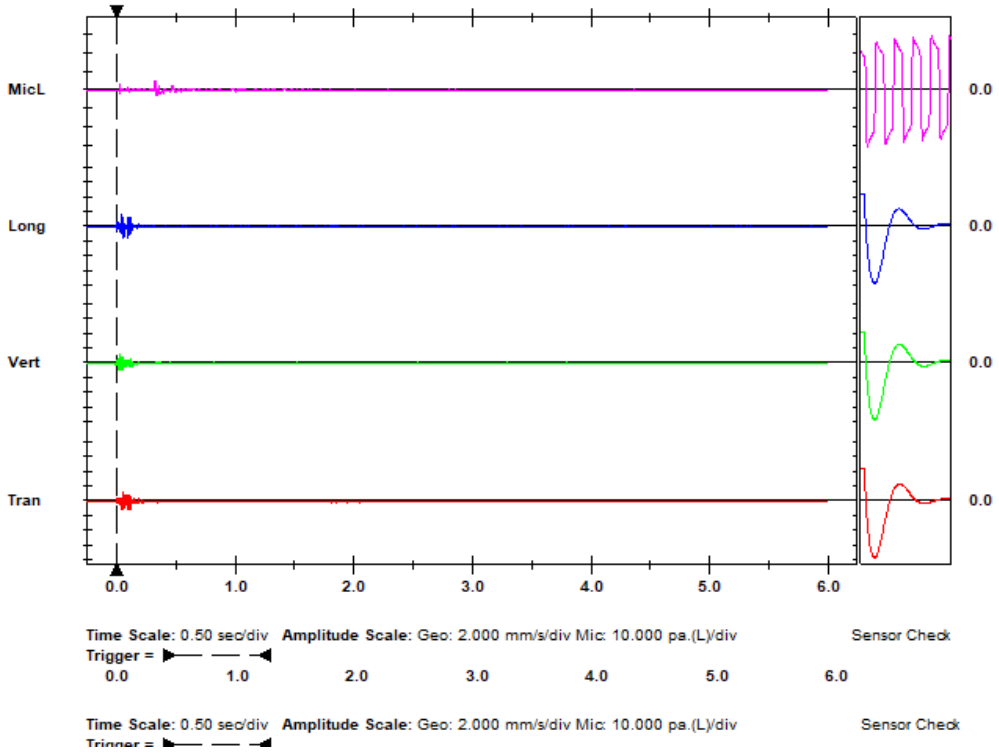
Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.325 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.270	1.143	1.651	mm/s
ZC Freq	85	>100	85	Hz
Time (Rel. to Trig)	0.051	0.032	0.045	sec
Peak Acceleration	0.080	0.066	0.093	g
Peak Displacement	0.002	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.174 mm/s at 0.051 sec





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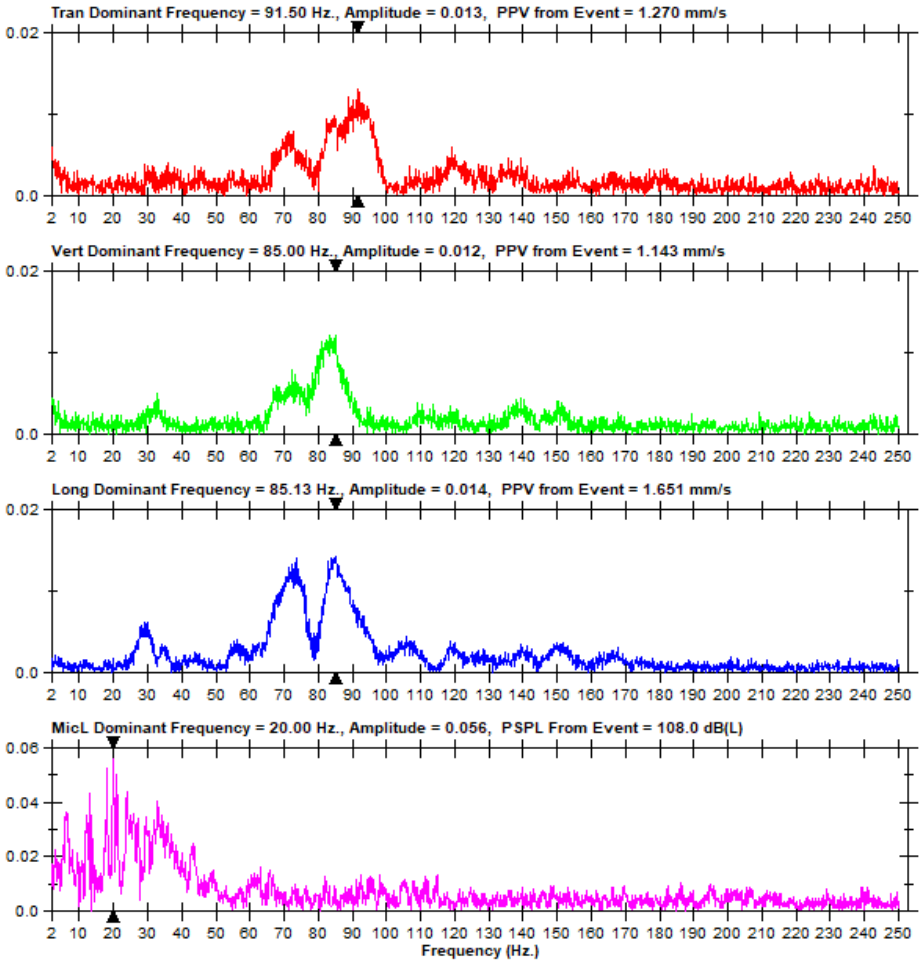
FFT Report

Date/Time	Long at 15:38:49 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1Q.4P0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg,
MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 111 m



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Event Report

Date/Time	Long at 15:39:01 December 14, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221214153901.IDFW

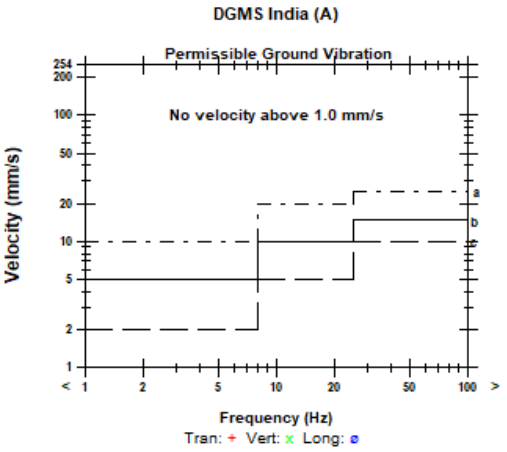
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 125 m

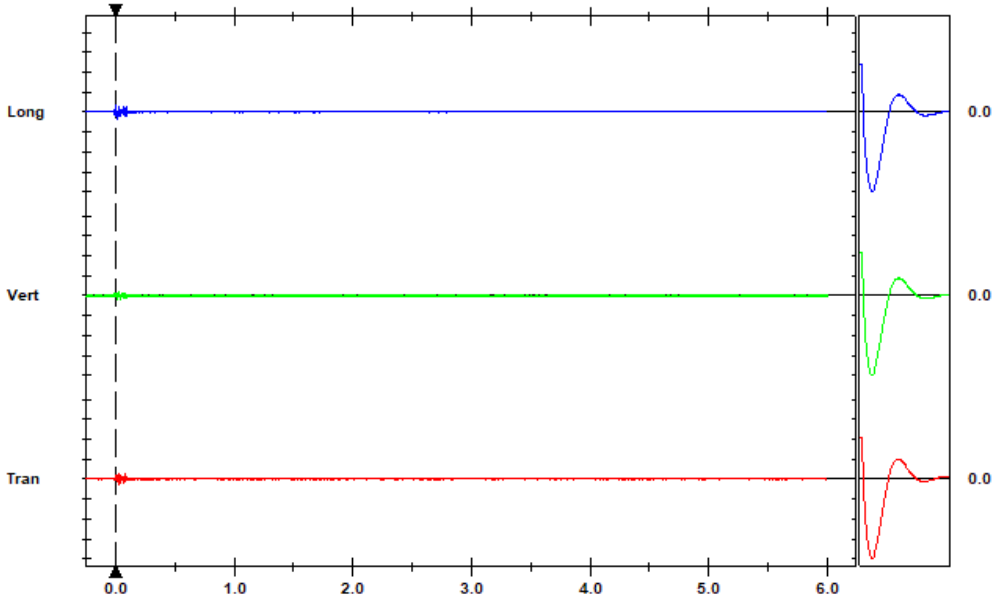
Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

	Tran	Vert	Long	
PPV	0.528	0.426	0.788	mm/s
ZC Freq	37	51	64	Hz
Time (Rel. to Trig)	0.022	0.026	0.002	sec
Peak Acceleration	0.044	0.026	0.039	g
Peak Displacement	0.001	0.001	0.012	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.872 mm/s at 0.002 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

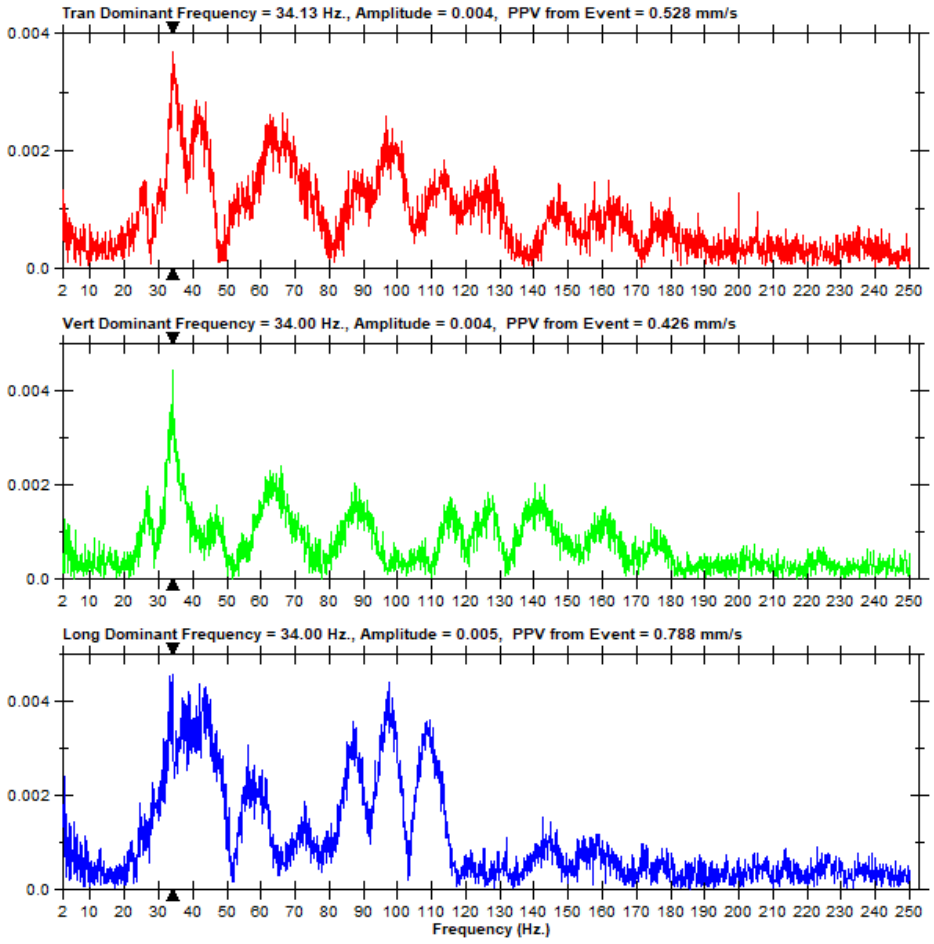
FFT Report

Date/Time	Long at 15:39:01 December 14, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	UM12915_20221214153901.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 125 m



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Event Report

Date/Time Vert at 15:38:54 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JT1Q.4U0
Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 140 m

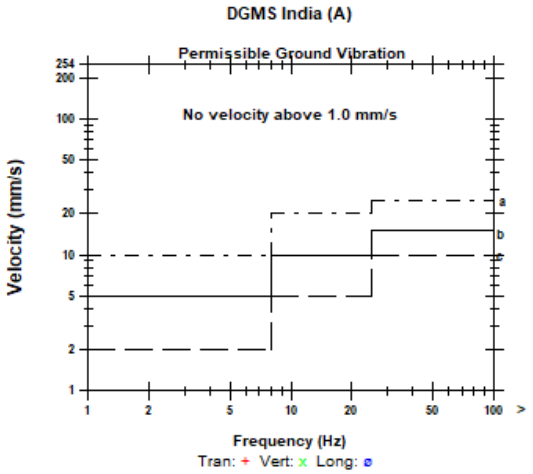
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

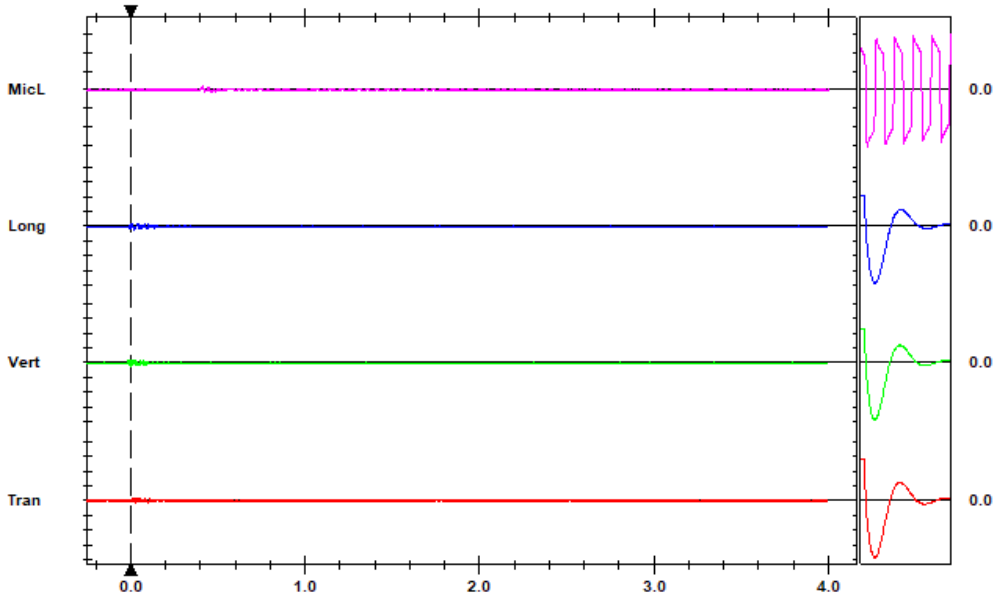
Microphone Linear Weighting
PSPL 101.0 dB(L) at 0.414 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 538 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.015	0.000	0.022	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.7	3.9	

Peak Vector Sum 0.622 mm/s at 0.022 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

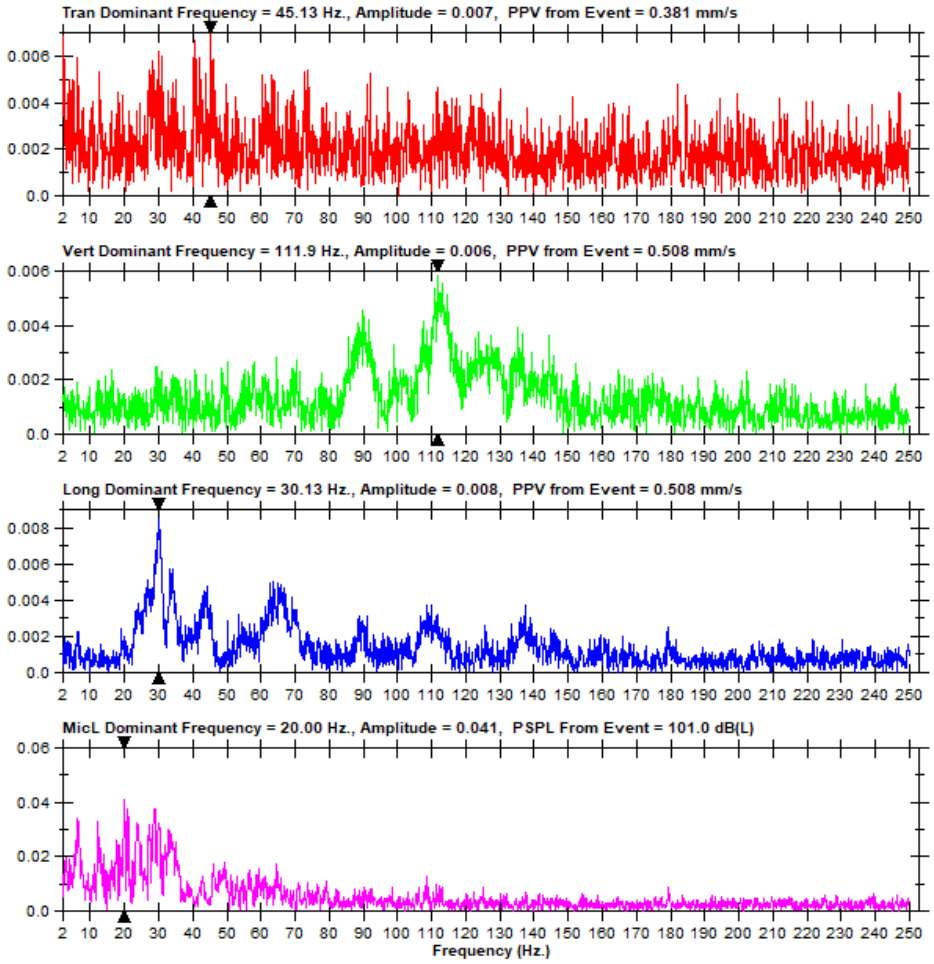
FFT Report

Date/Time	Vert at 15:38:54 December 14, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JT1Q.4U0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes - 7, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 2.625 Kg, Distance - 140 m



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Event Report

Date/Time Long at 15:40:46 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1Q.7Y0
Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 93 m

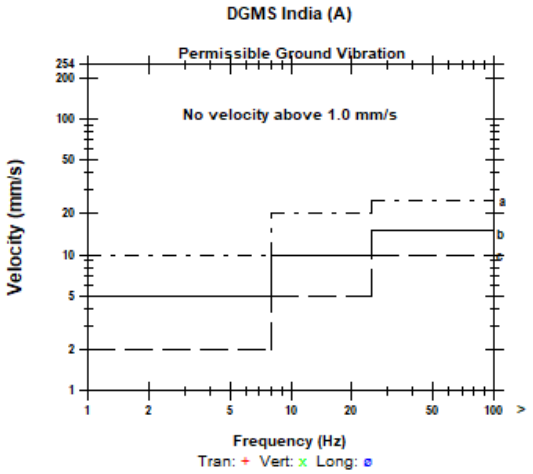
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

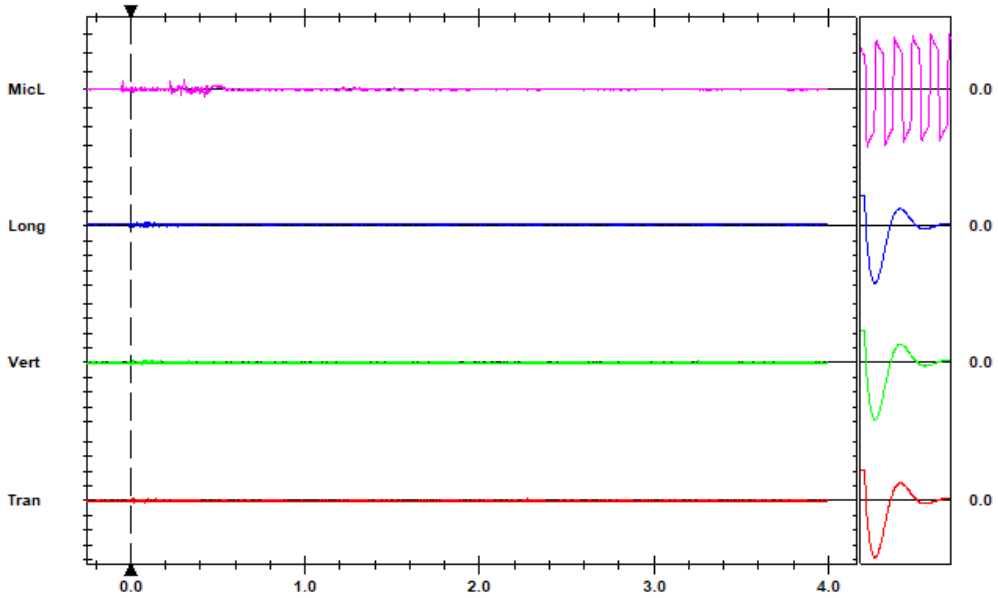
Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.306 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 472 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	0.635	mm/s
ZC Freq	85	>100	73	Hz
Time (Rel. to Trig)	0.015	0.008	0.086	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.000	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.635 mm/s at 0.086 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

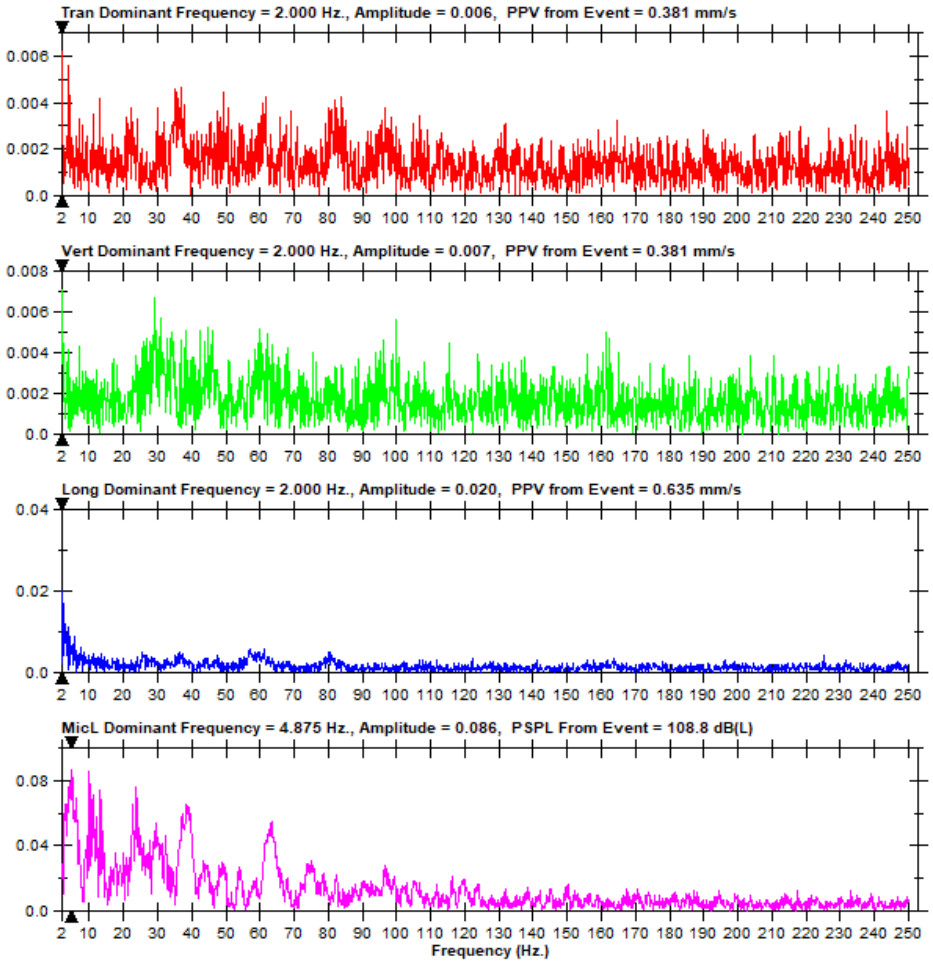
FFT Report

Date/Time	Long at 15:40:46 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1Q.7Y0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 93 m



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Event Report

Date/Time Long at 15:40:43 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1Q.7V0
Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 112 m

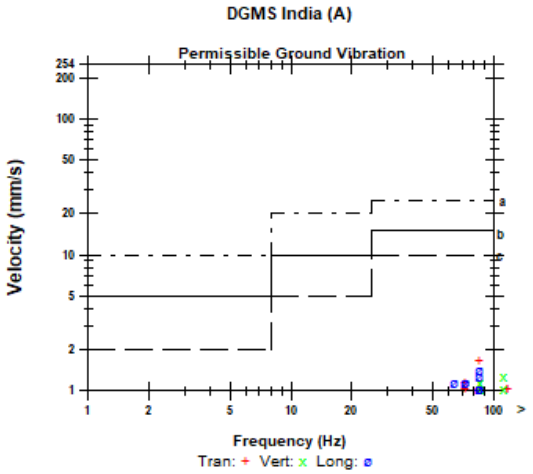
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

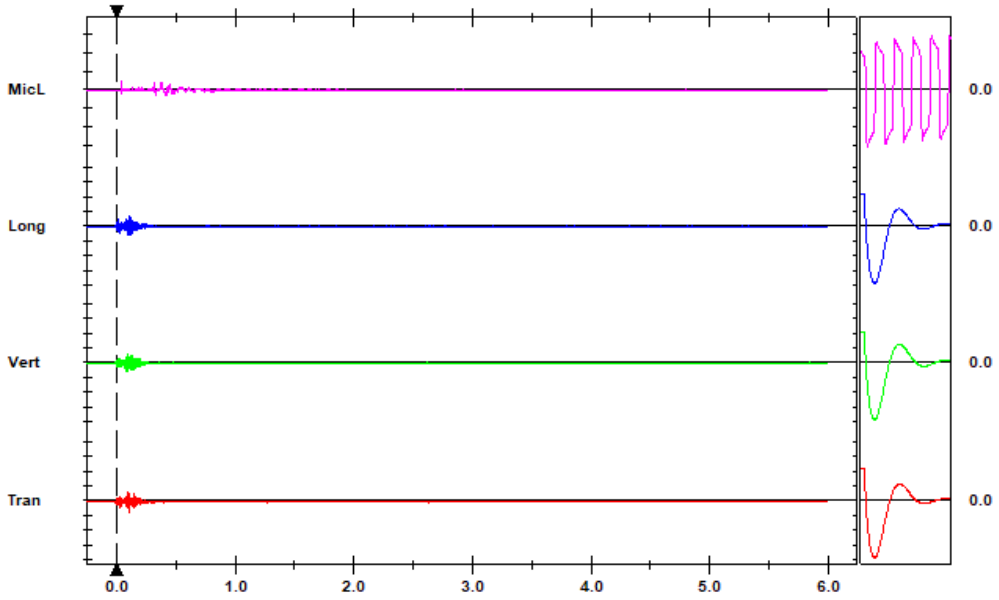
Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.035 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.651	1.270	1.397	mm/s
ZC Freq	85	>100	85	Hz
Time (Rel. to Trig)	0.103	0.098	0.103	sec
Peak Acceleration	0.093	0.066	0.080	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.254 mm/s at 0.103 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

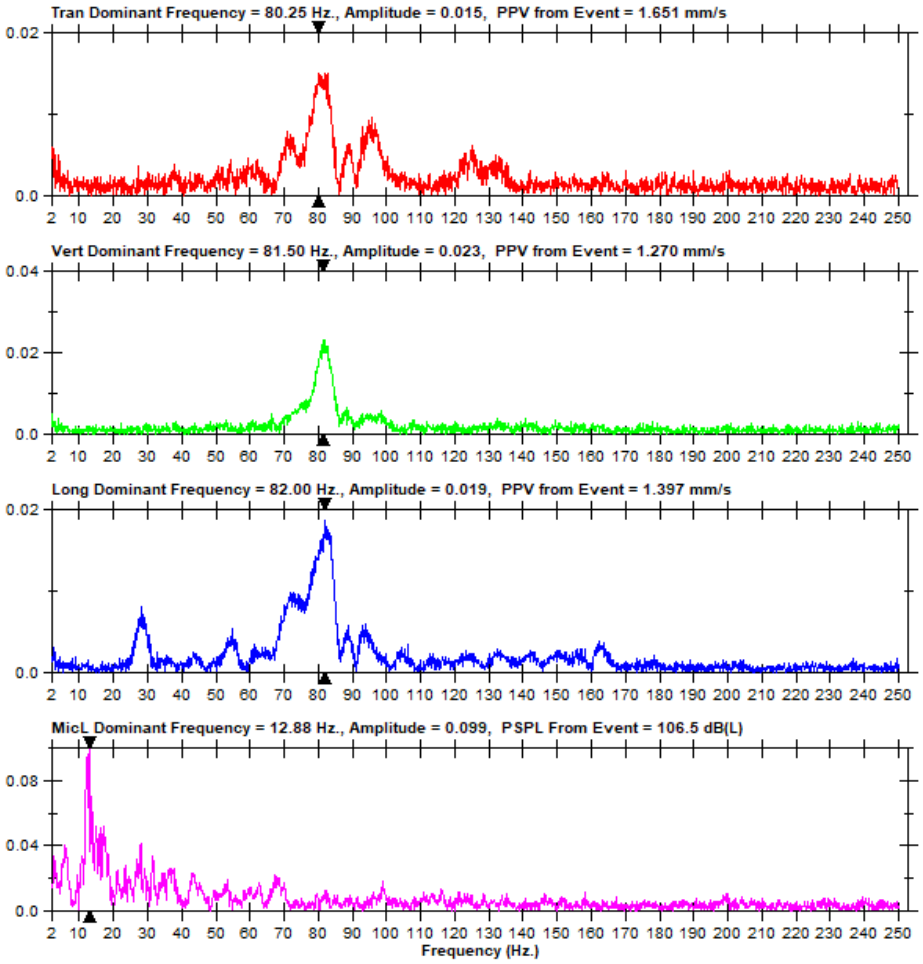
FFT Report

Date/Time	Long at 15:40:43 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1Q.7V0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 112 m



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Event Report

Date/Time	Long at 15:40:55 December 14, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221214154055.IDFW

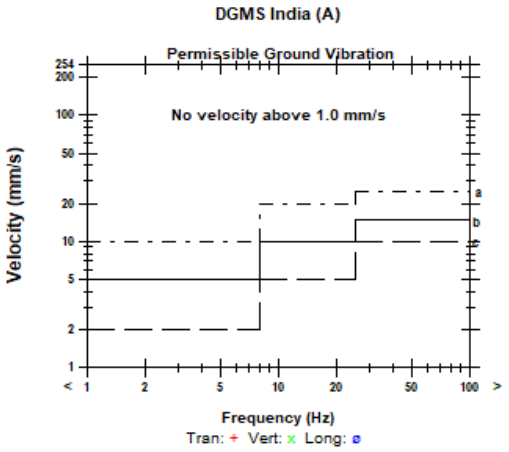
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 116 m

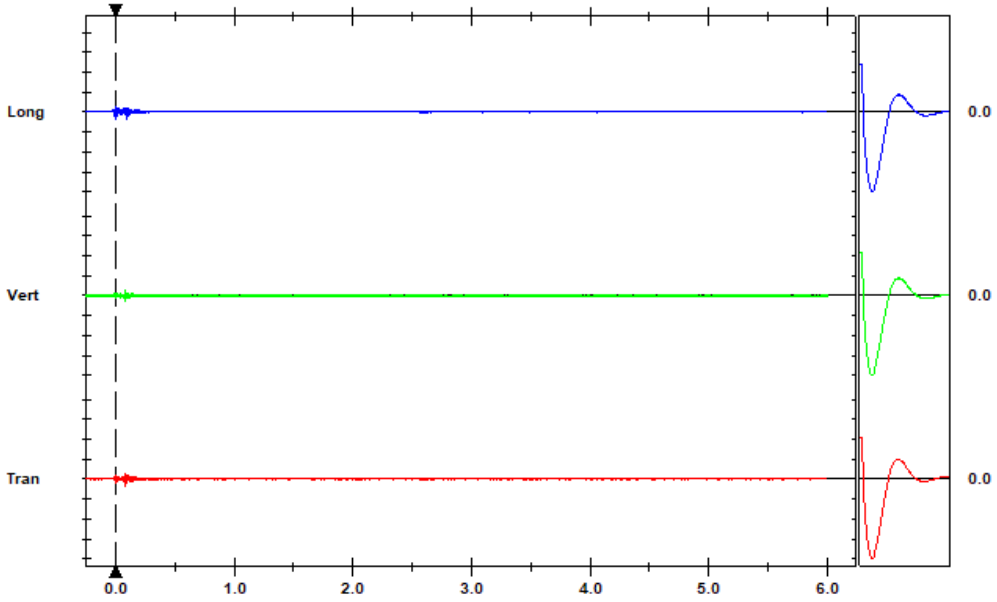
Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

	Tran	Vert	Long	
PPV	0.701	0.615	0.725	mm/s
ZC Freq	85	>100	64	Hz
Time (Rel. to Trig)	0.086	0.081	0.006	sec
Peak Acceleration	0.050	0.033	0.036	g
Peak Displacement	0.001	0.001	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.899 mm/s at 0.086 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

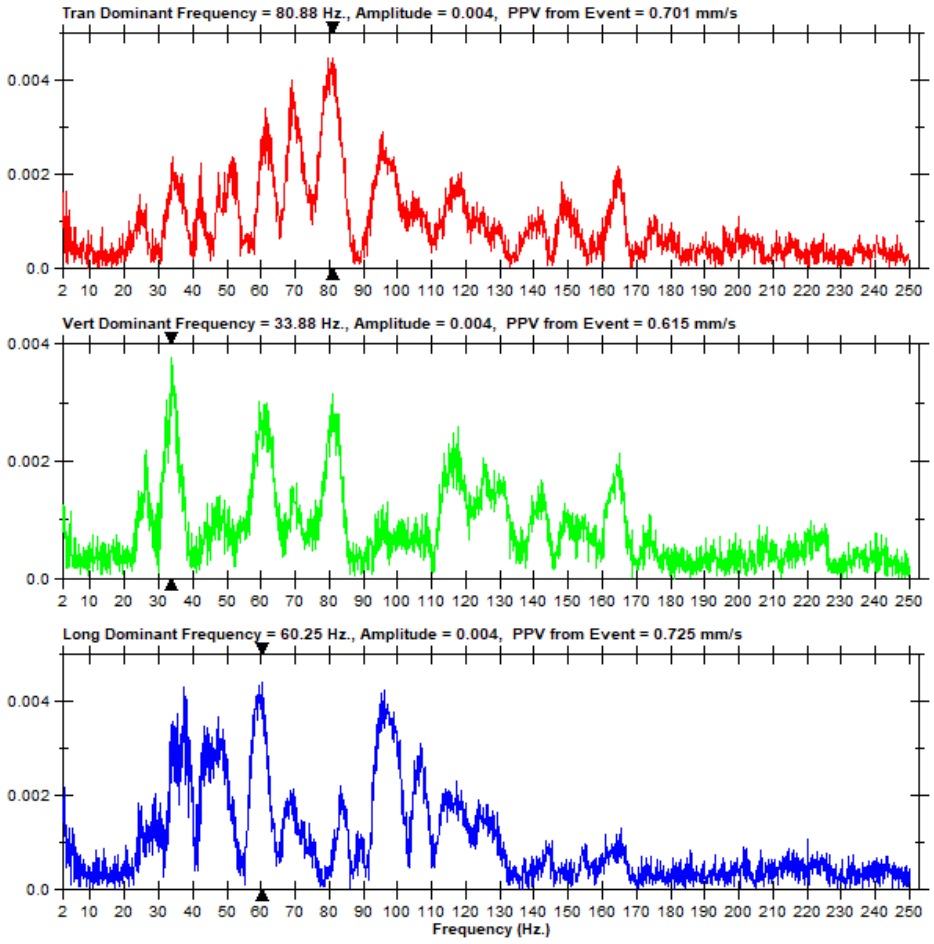
FFT Report

Date/Time	Long at 15:40:55 December 14, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	UM12915_20221214154055.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 116 m



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Event Report

Date/Time Vert at 15:40:48 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JT1Q.800
Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 143 m

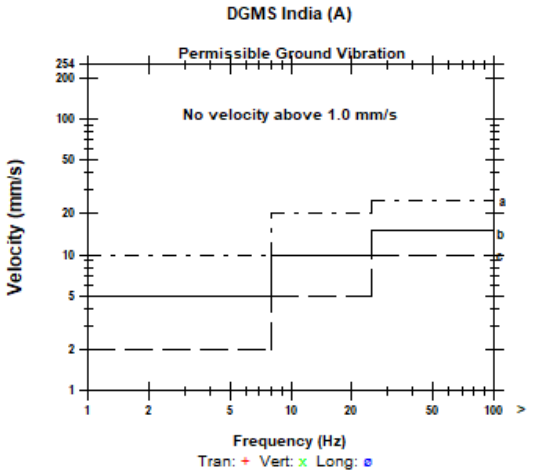
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

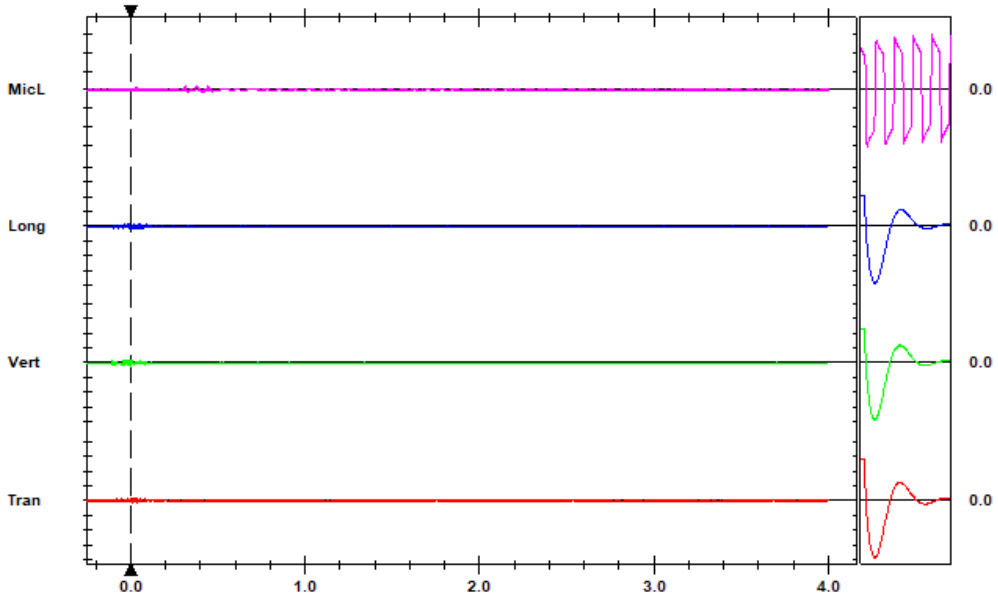
Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.445 sec
ZC Freq 47 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 532 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.015	0.000	-0.009	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	3.9	

Peak Vector Sum 0.582 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

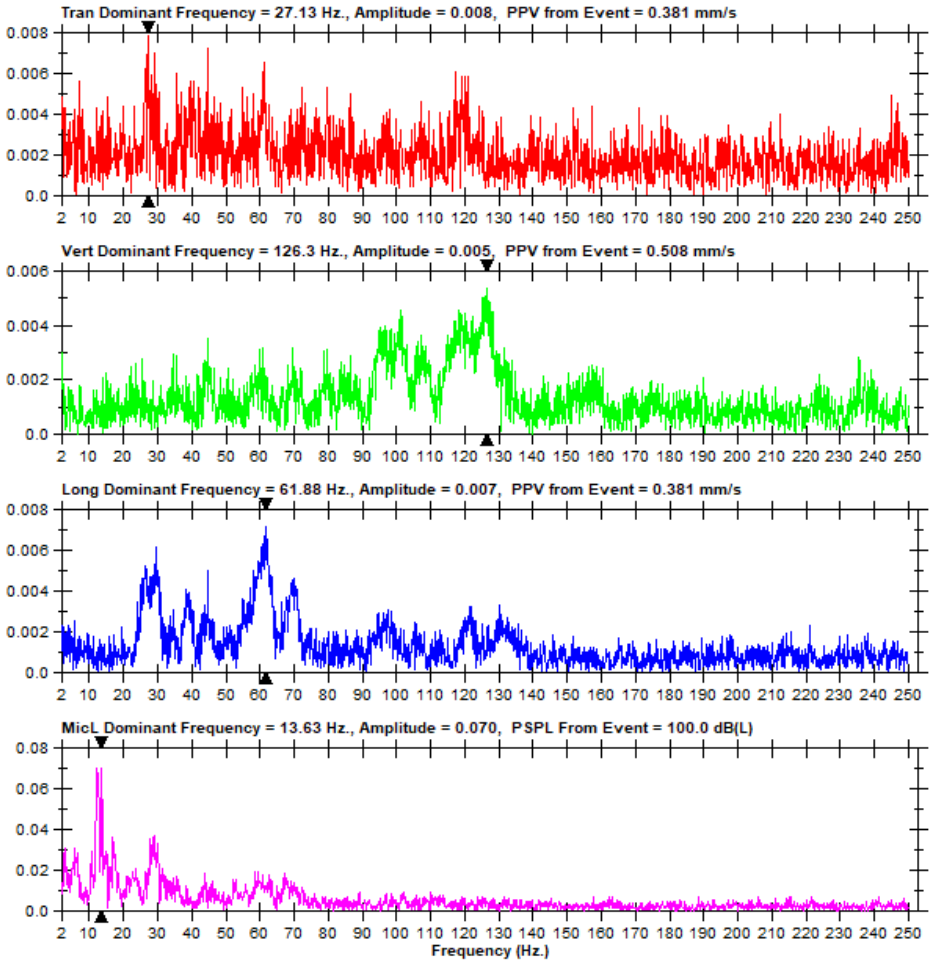
FFT Report

Date/Time	Vert at 15:40:48 December 14, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JT1Q.800

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 143 m



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Event Report

Date/Time Vert at 15:40:37 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JT1Q.7P0
Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 244 m

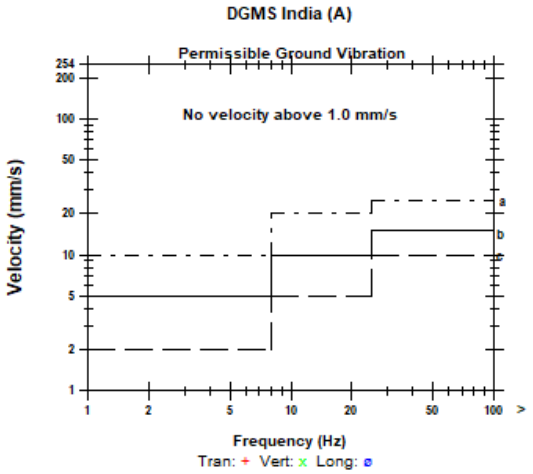
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

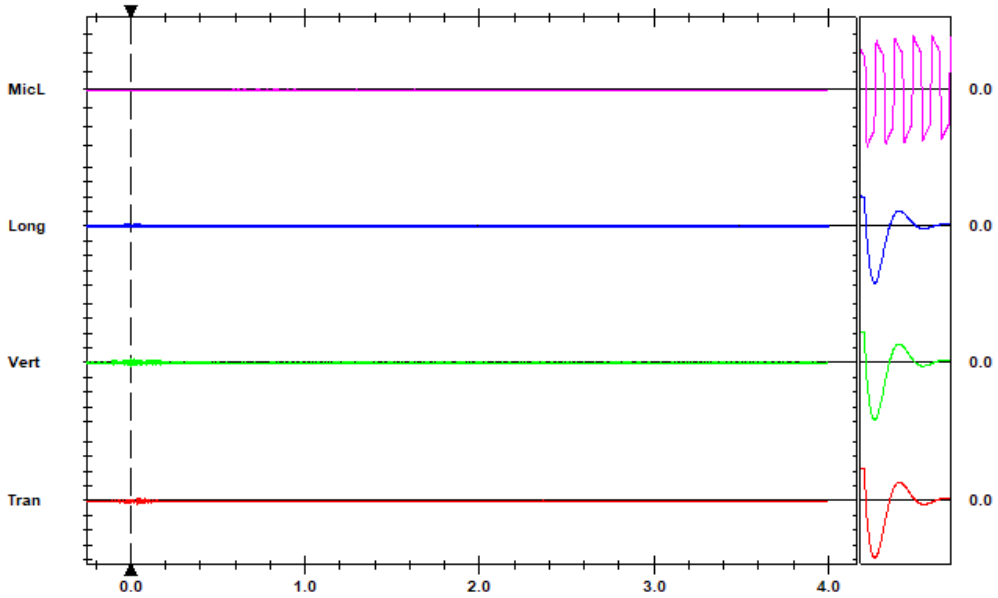
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.602 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 475 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.041	0.000	0.026	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.000	0.001	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.5	4.2	

Peak Vector Sum 0.582 mm/s at 0.017 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

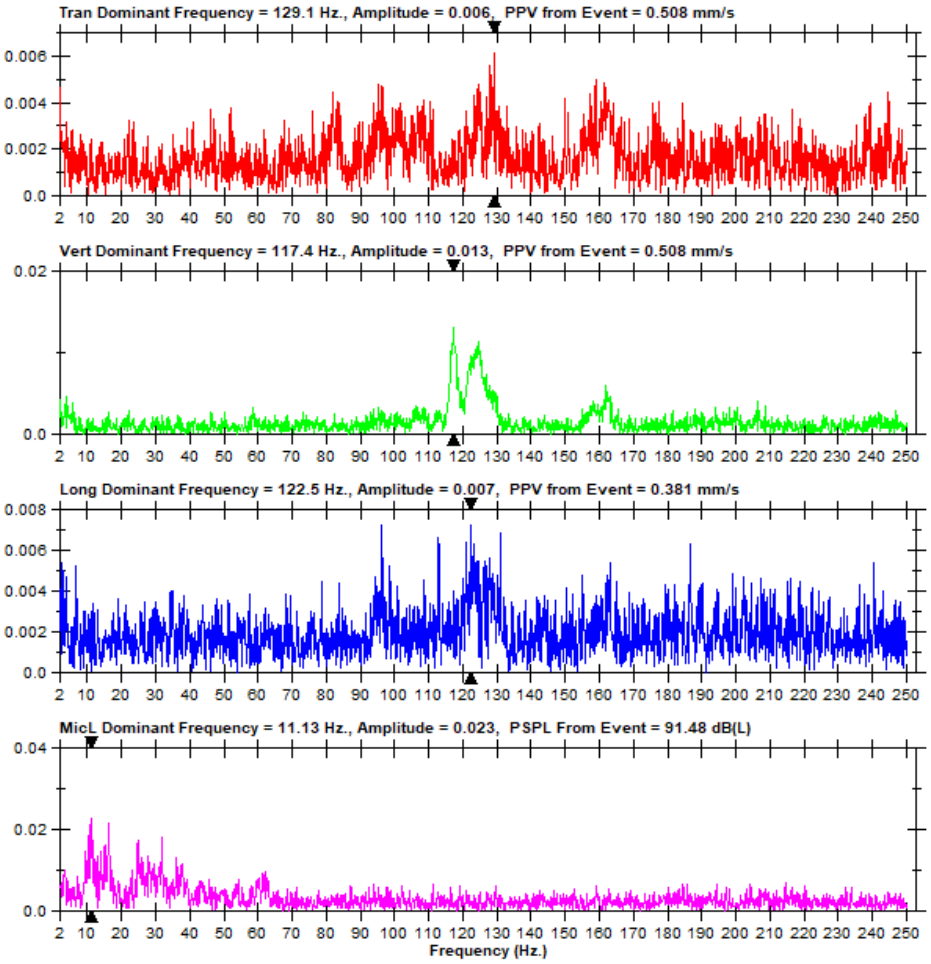
FFT Report

Date/Time	Vert at 15:40:37 December 14, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JT1Q.7P0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -12, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.500 Kg, Distance - 244 m



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Event Report

Date/Time Long at 15:42:38 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1Q.B20
Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 114 m

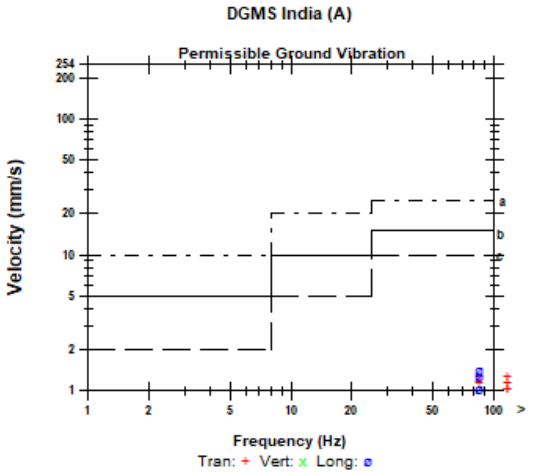
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

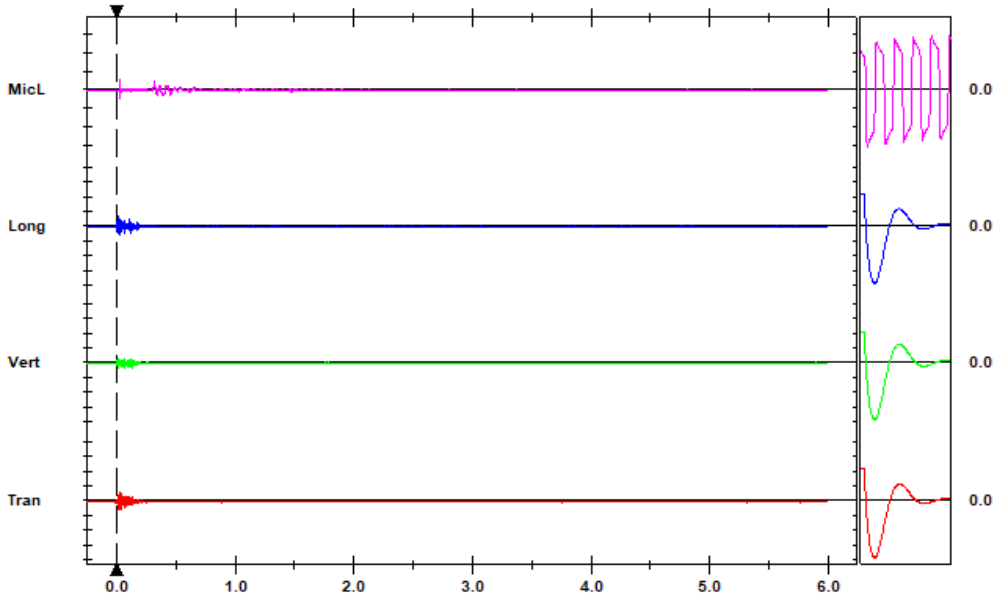
Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.025 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.270	0.762	1.397	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.018	0.013	0.018	sec
Peak Acceleration	0.080	0.053	0.080	g
Peak Displacement	0.002	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 1.905 mm/s at 0.018 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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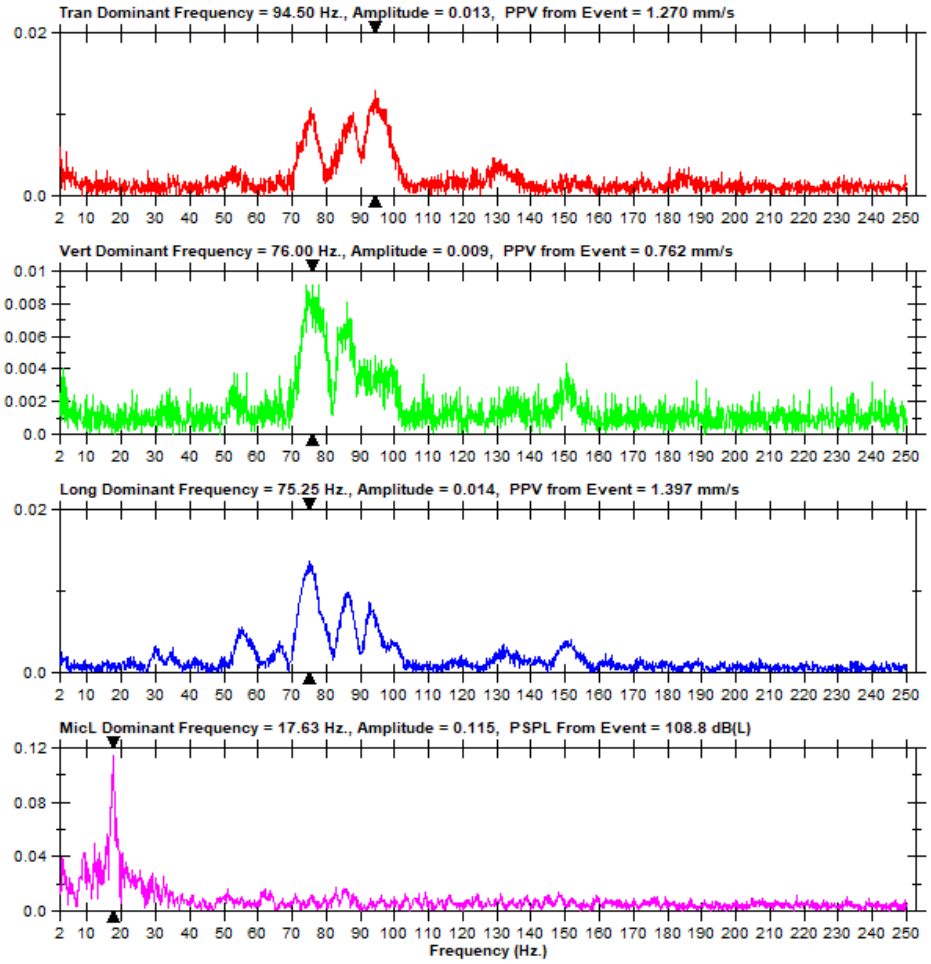
FFT Report

Date/Time	Long at 15:42:38 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1Q.B20

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 114 m



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Event Report

Date/Time	Tran at 15:42:49 December 14, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221214154249.IDFW

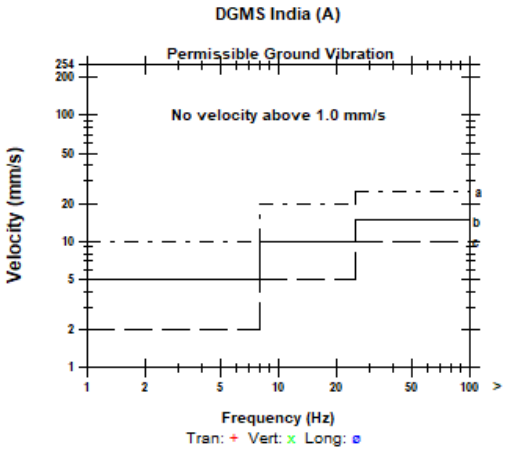
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 111 m

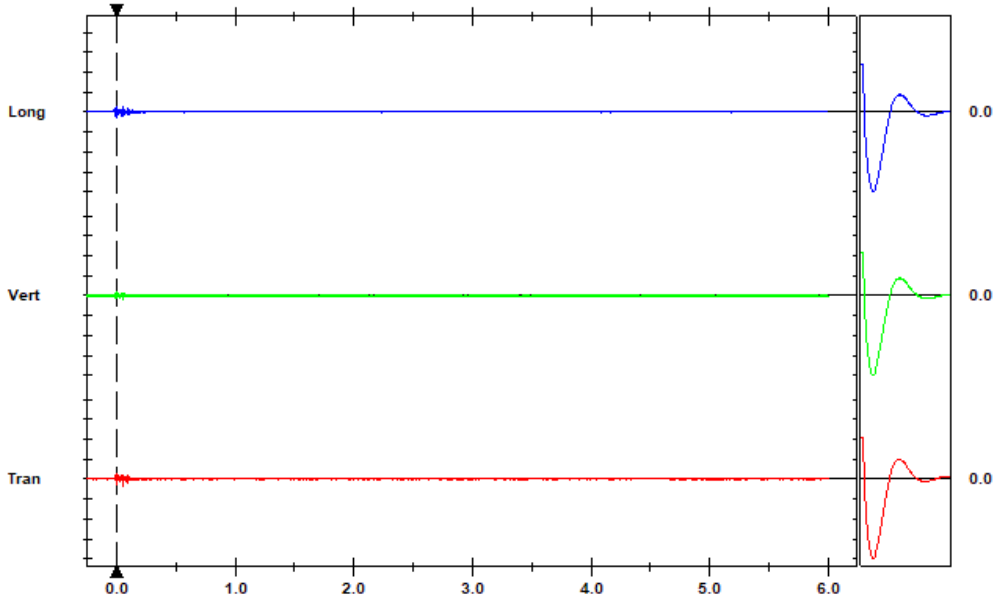
Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

	Tran	Vert	Long	
PPV	0.670	0.355	0.567	mm/s
ZC Freq	64	>100	>100	Hz
Time (Rel. to Trig)	0.052	0.051	0.054	sec
Peak Acceleration	0.062	0.030	0.049	g
Peak Displacement	0.001	0.001	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.818 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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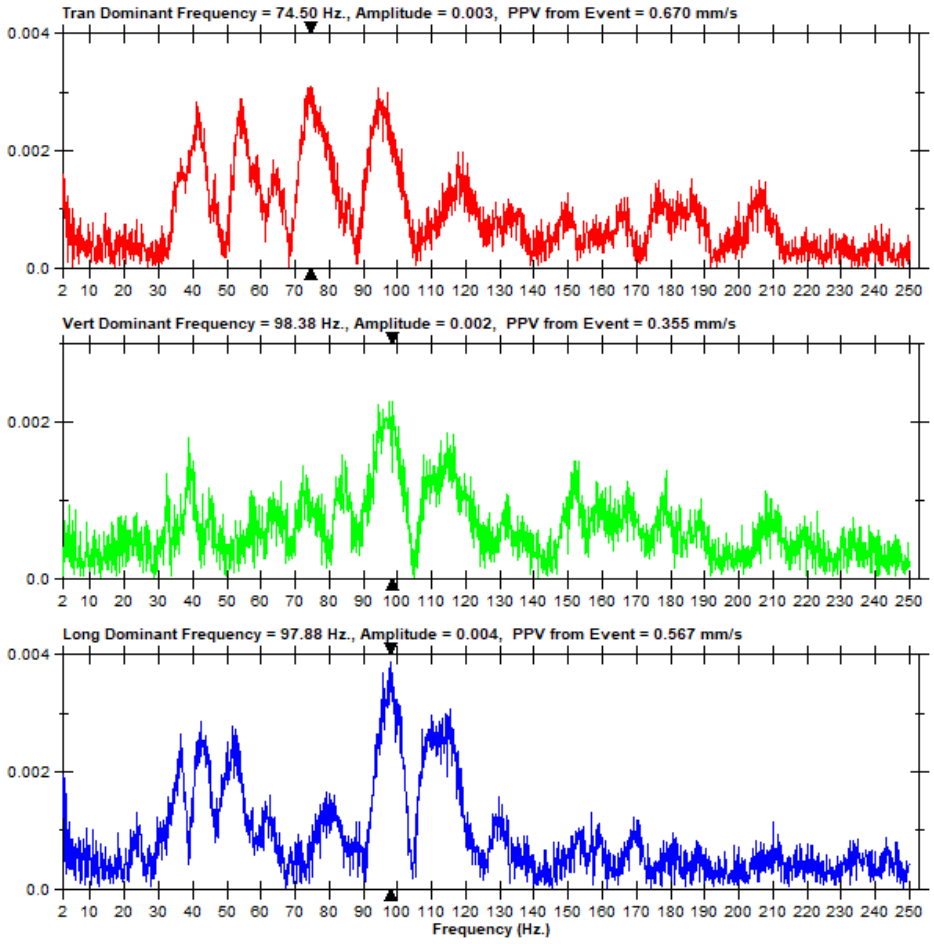
FFT Report

Date/Time	Tran at 15:42:49 December 14, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	UM12915_20221214154249.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 111 m



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Event Report

Date/Time Long at 15:44:31 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1Q.E70
Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 87 m

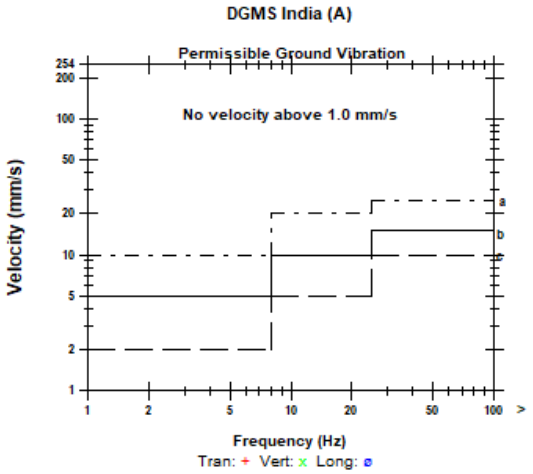
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

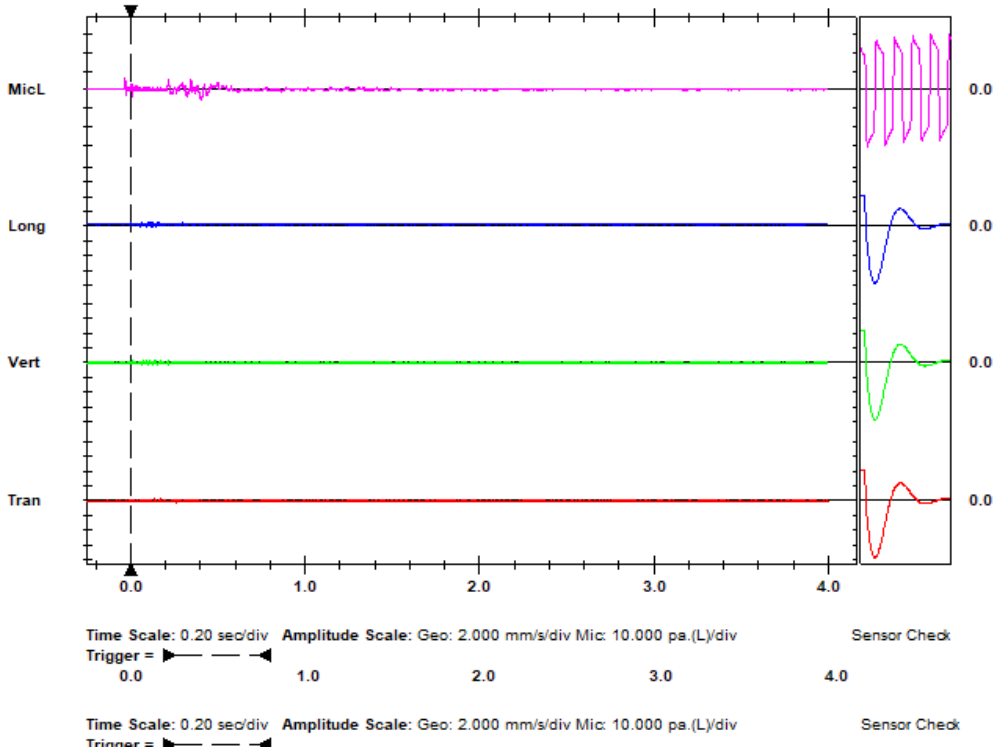
Microphone Linear Weighting
PSPL 109.5 dB(L) at -0.030 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 472 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	37	Hz
Time (Rel. to Trig)	0.137	0.011	0.000	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.000	0.001	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.582 mm/s at 0.062 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Instantel

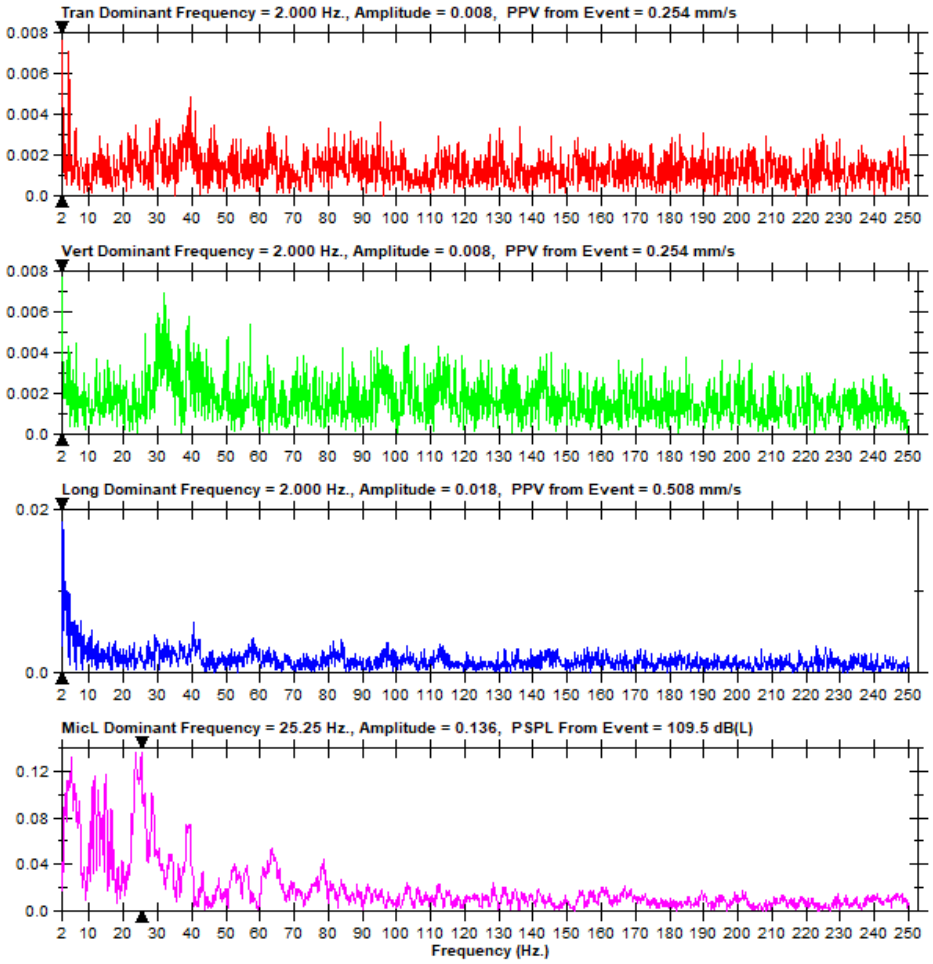
FFT Report

Date/Time	Long at 15:44:31 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1Q.E70

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 87 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:44:28 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1Q.E40
Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 118 m

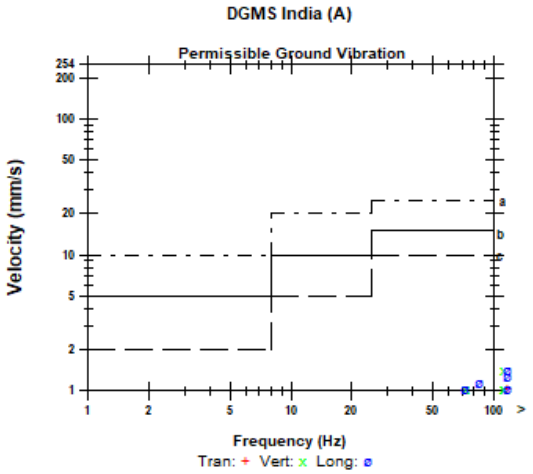
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

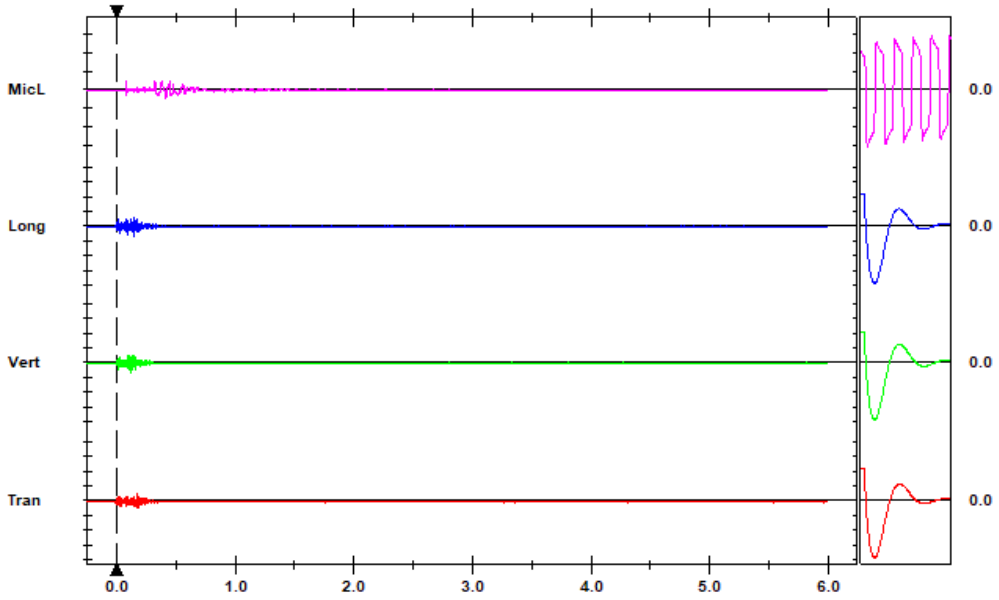
Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.080 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.016	1.397	1.397	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.170	0.126	0.146	sec
Peak Acceleration	0.066	0.080	0.093	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 1.616 mm/s at 0.126 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

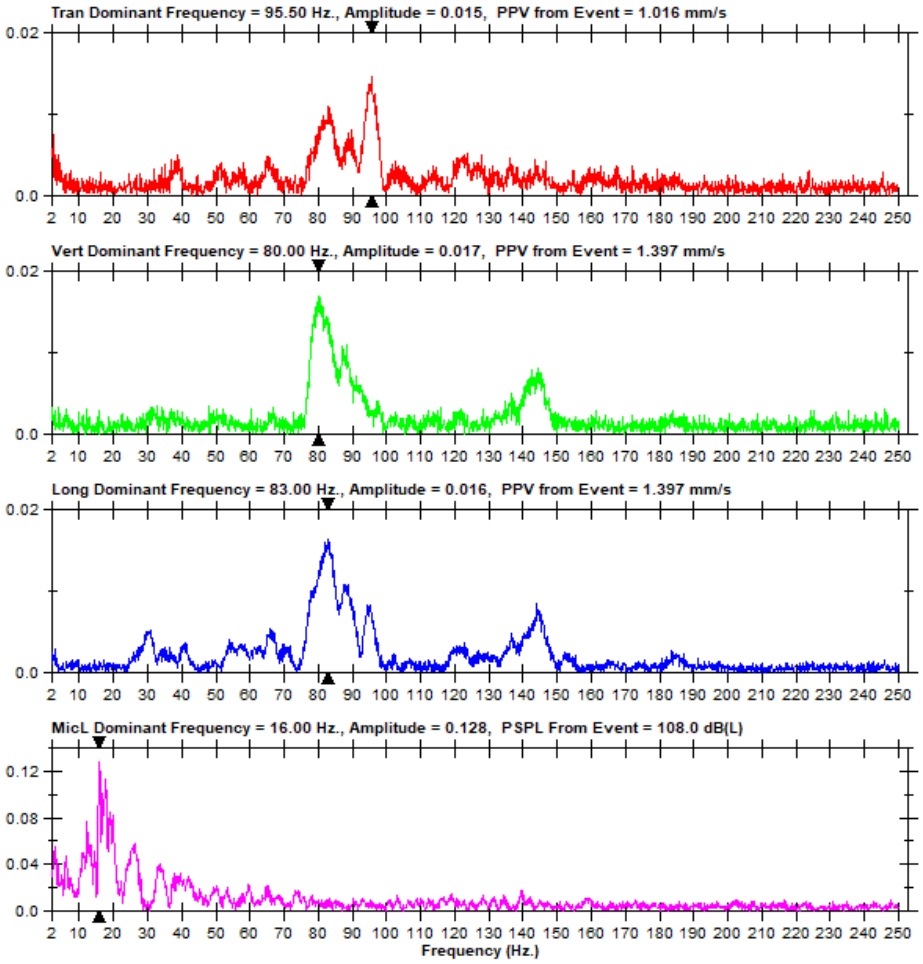
FFT Report

Date/Time	Long at 15:44:28 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1Q.E40

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 118 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 15:44:40 December 14, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221214154440.IDFW

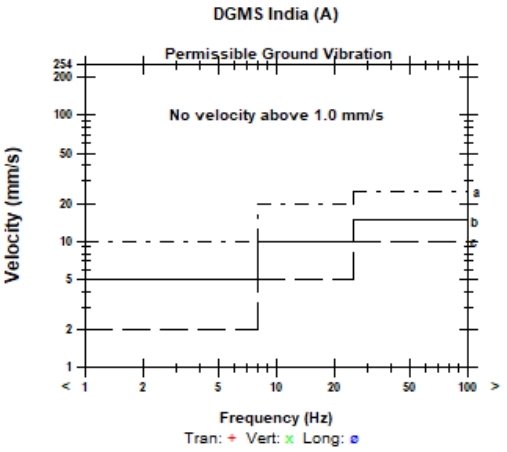
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 108 m

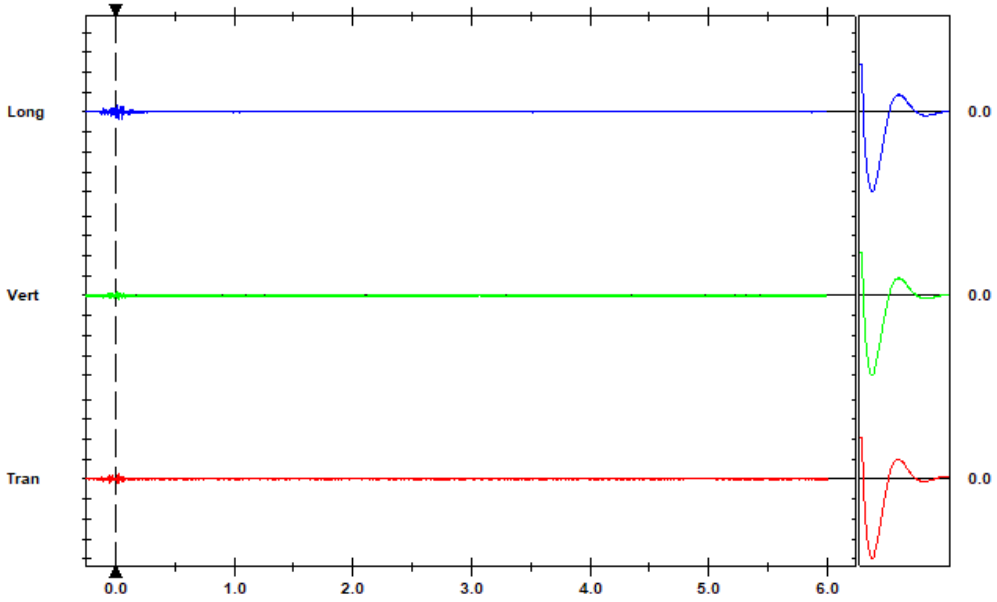
Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

	Tran	Vert	Long	
PPV	0.575	0.410	0.780	mm/s
ZC Freq	73	73	>100	Hz
Time (Rel. to Trig)	0.022	0.012	0.021	sec
Peak Acceleration	0.036	0.034	0.046	g
Peak Displacement	0.001	0.001	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.939 mm/s at 0.022 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

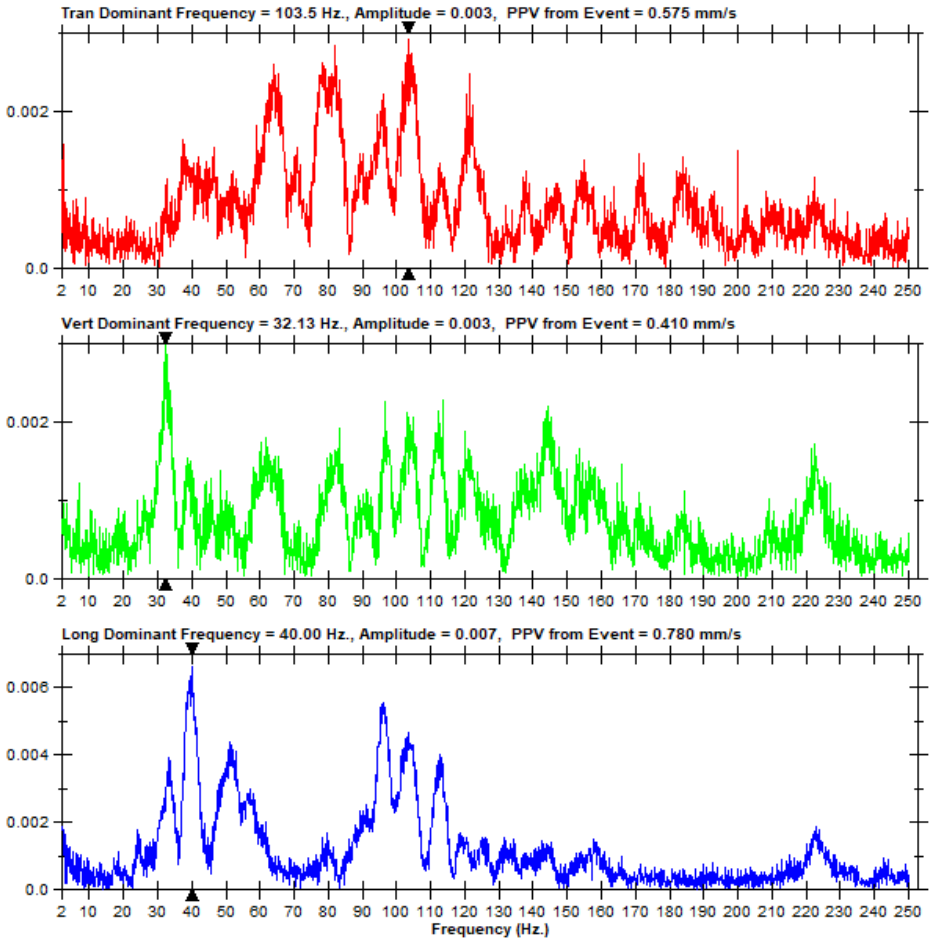
FFT Report

Date/Time	Long at 15:44:40 December 14, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	UM12915_20221214154440.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Study and advice for blast vibration, air-overpressure and fly-rock control at Kerala State Pollution Control Board

Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 108 m



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Event Report

Date/Time Tran at 15:44:22 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JT1Q.DY0
Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 250 m

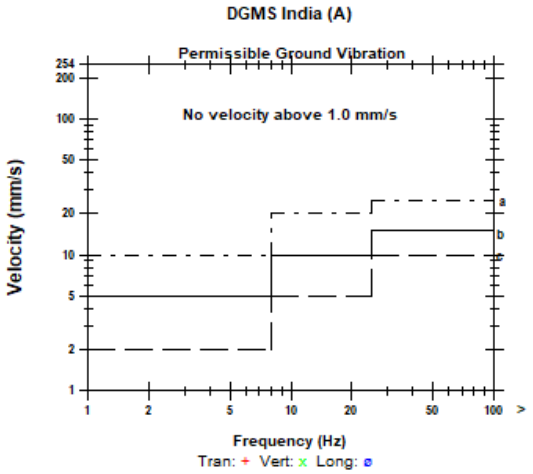
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

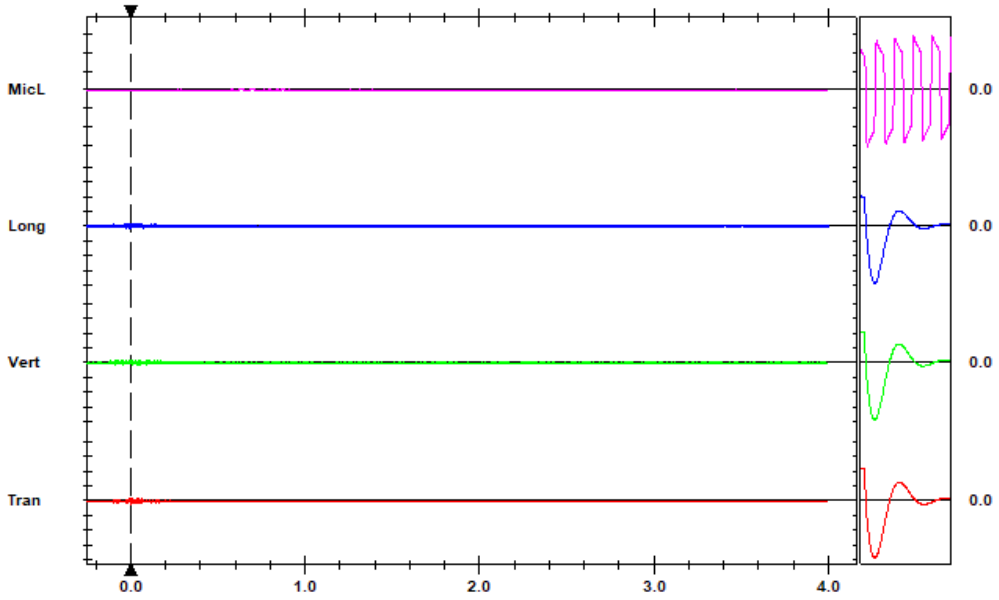
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.595 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 475 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	0.048	-0.009	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.000	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.5	4.2	

Peak Vector Sum 0.554 mm/s at 0.048 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

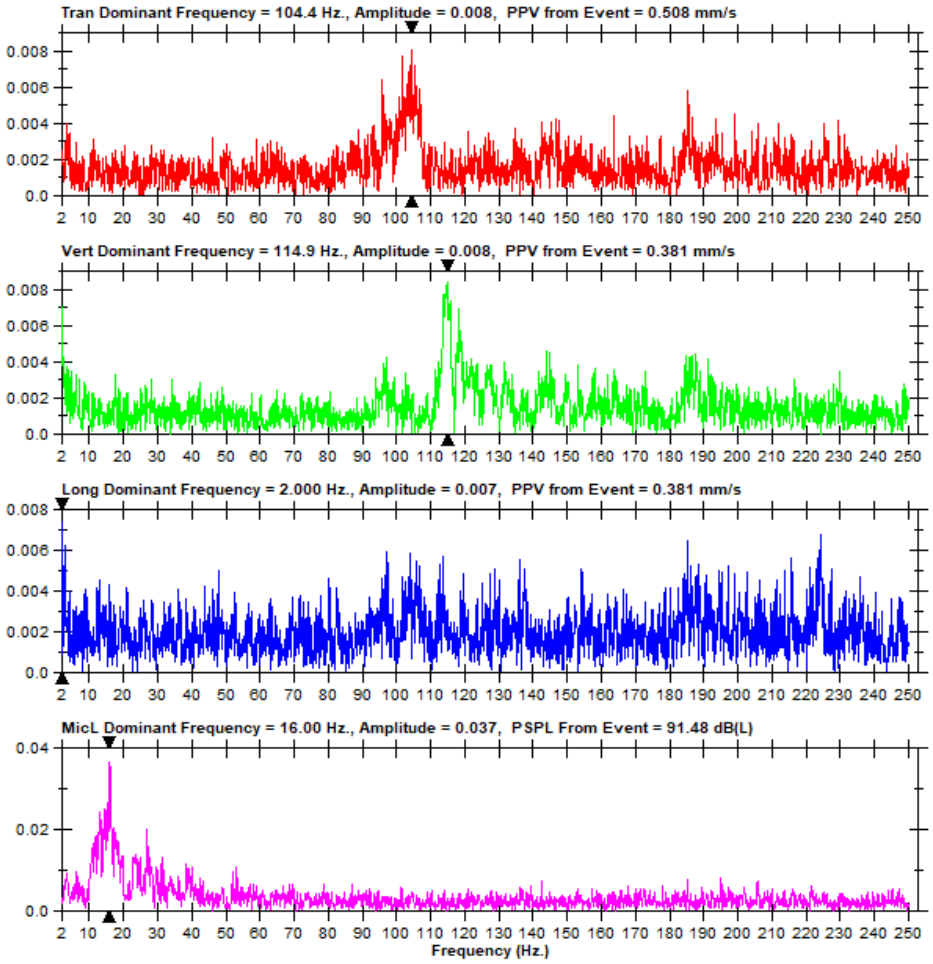
FFT Report

Date/Time	Tran at 15:44:22 December 14, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JT1Q.DY0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -15, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 5.625 Kg, Distance - 250 m



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Event Report

Date/Time Long at 15:48:40 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JT1Q.L40
Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 50 m

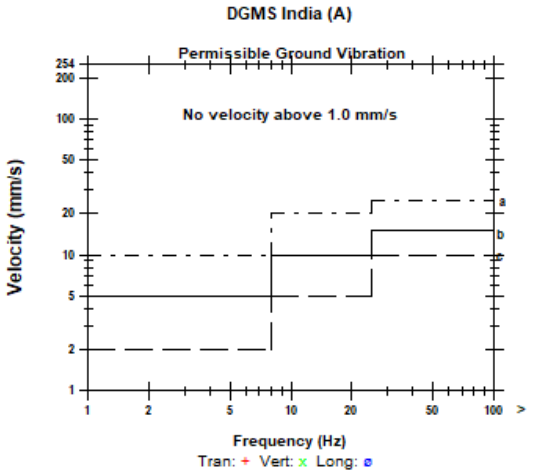
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

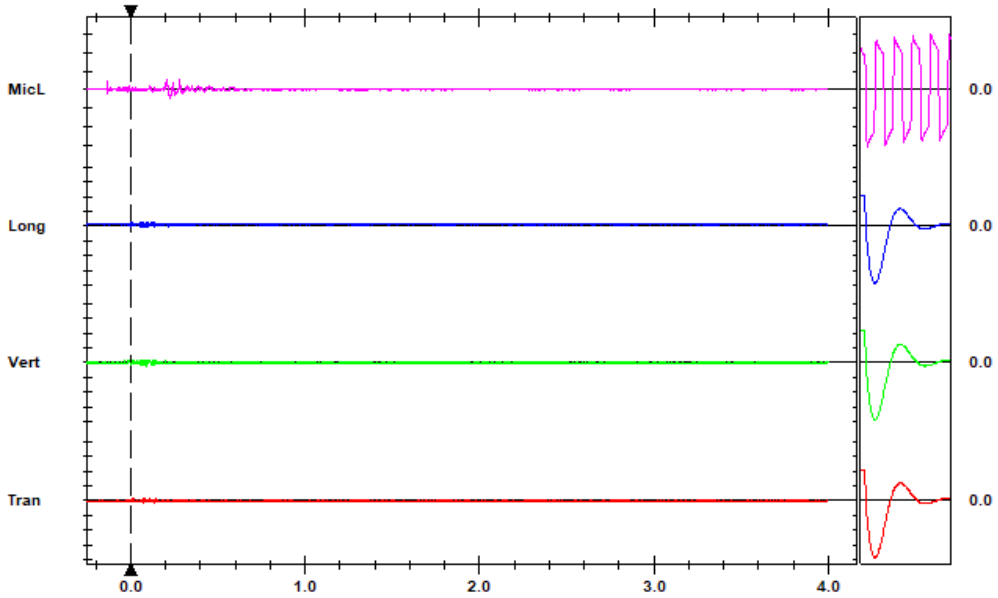
Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.205 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 472 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.635	mm/s
ZC Freq	>100	>100	64	Hz
Time (Rel. to Trig)	0.013	0.094	0.088	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.000	0.001	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.5	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.751 mm/s at 0.096 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

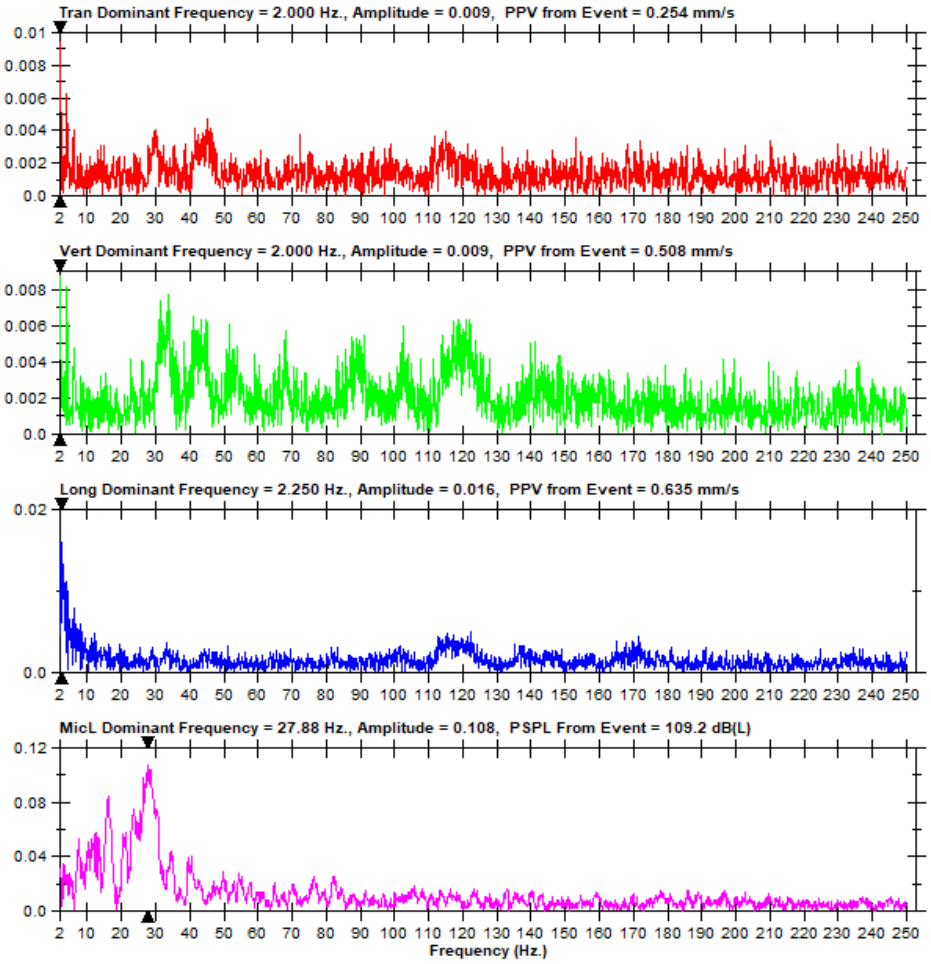
FFT Report

Date/Time	Long at 15:48:40 December 14, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JT1Q.L40

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 50 m



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Event Report

Date/Time Long at 15:48:37 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 6.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JT1Q.L10
Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 65 m

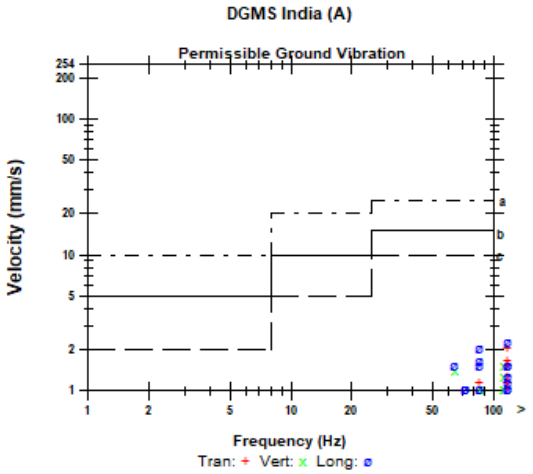
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

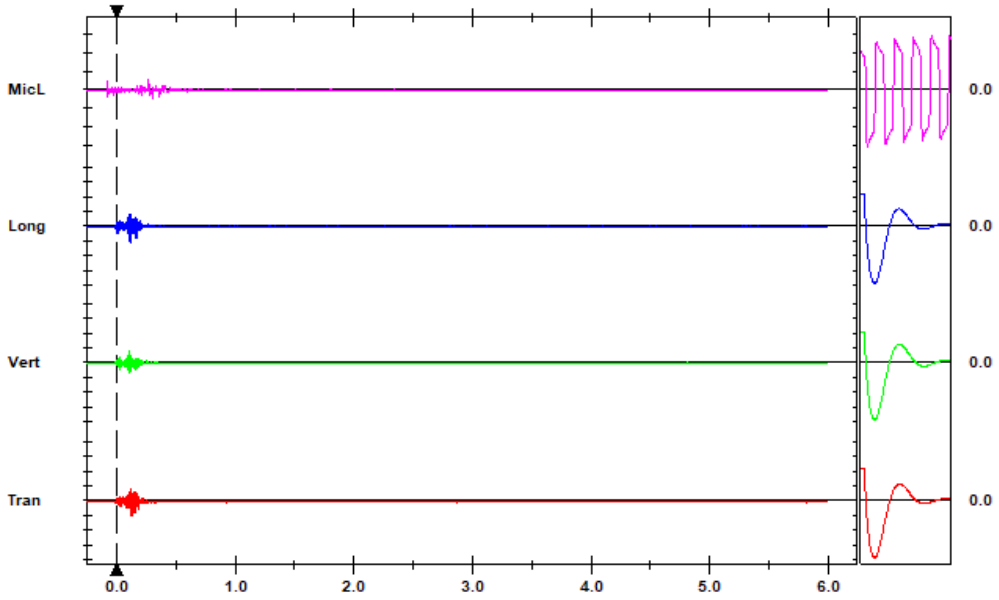
Microphone Linear Weighting
PSPL 108.4 dB(L) at 0.266 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	2.032	1.524	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.125	0.102	0.120	sec
Peak Acceleration	0.133	0.093	0.146	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.965 mm/s at 0.120 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

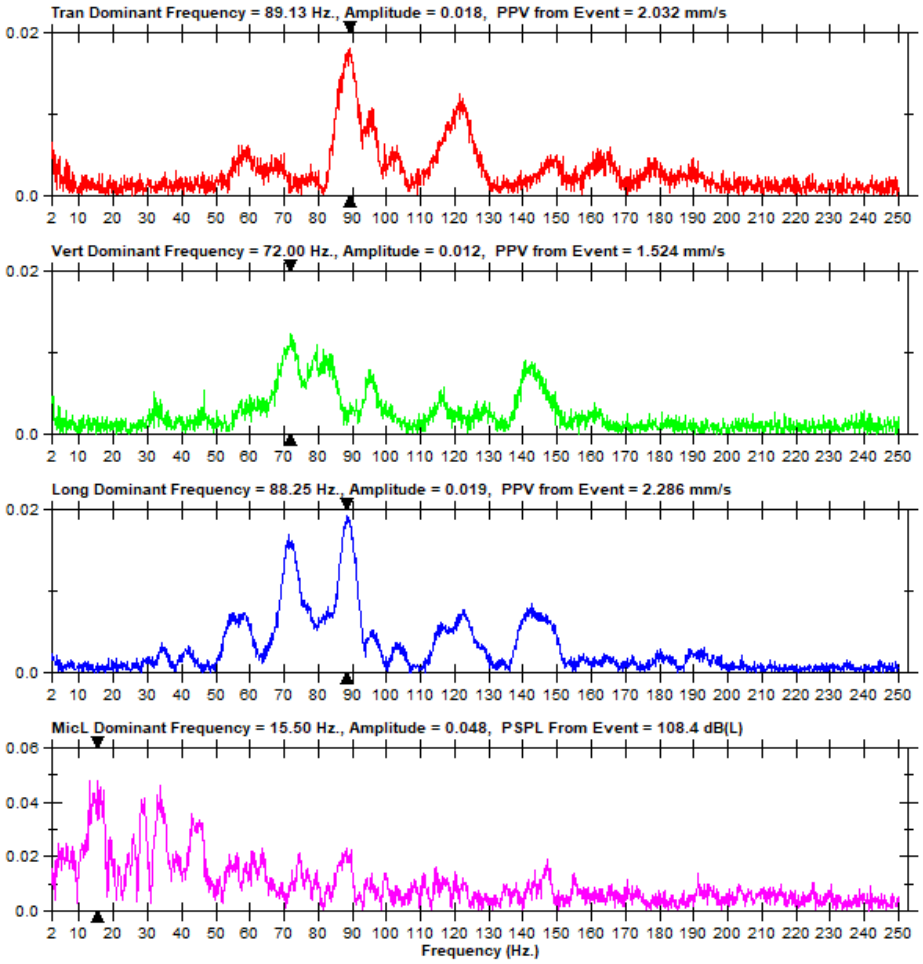
FFT Report

Date/Time	Long at 15:48:37 December 14, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	S247JT1Q.L10

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 65 m



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Event Report

Date/Time Vert at 15:48:42 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JT1Q.L60
Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 100 m

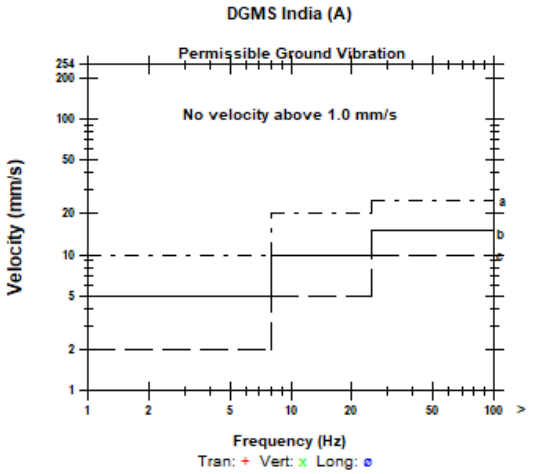
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

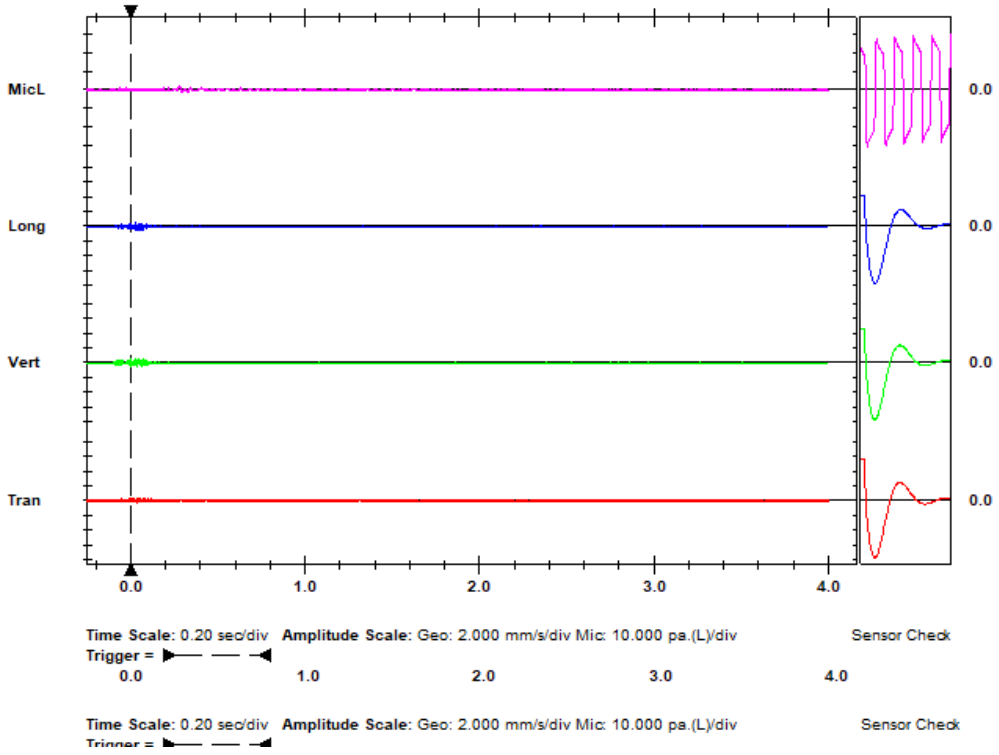
Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.279 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 488 mv)

	Tran	Vert	Long	
PPV	0.381	0.635	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.016	0.033	0.024	sec
Peak Acceleration	0.027	0.053	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	3.9	

Peak Vector Sum 0.783 mm/s at 0.041 sec





Instantel

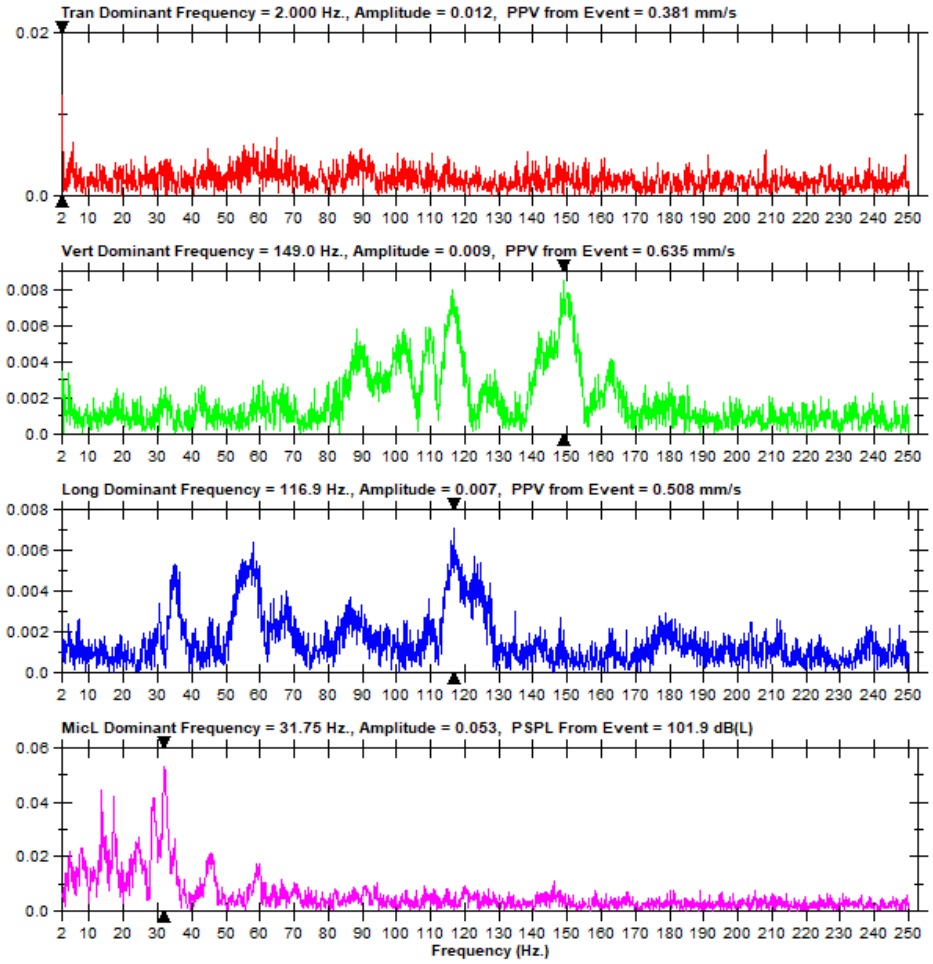
FFT Report

Date/Time	Vert at 15:48:42 December 14, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JT1Q.L60

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Scientific study for the development of controlled blasting at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 100 m



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Event Report

Date/Time Long at 15:48:31 December 14, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JT1Q.KV0
Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 200 m

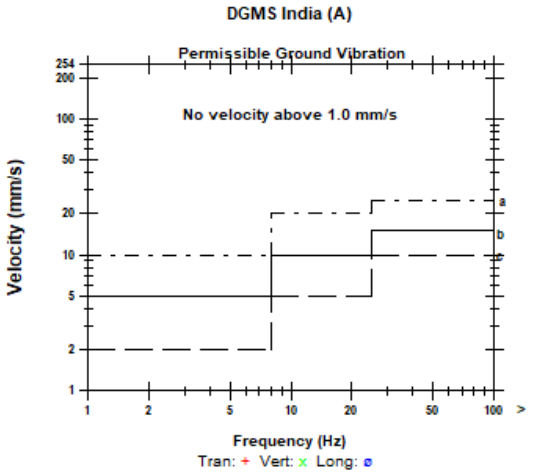
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

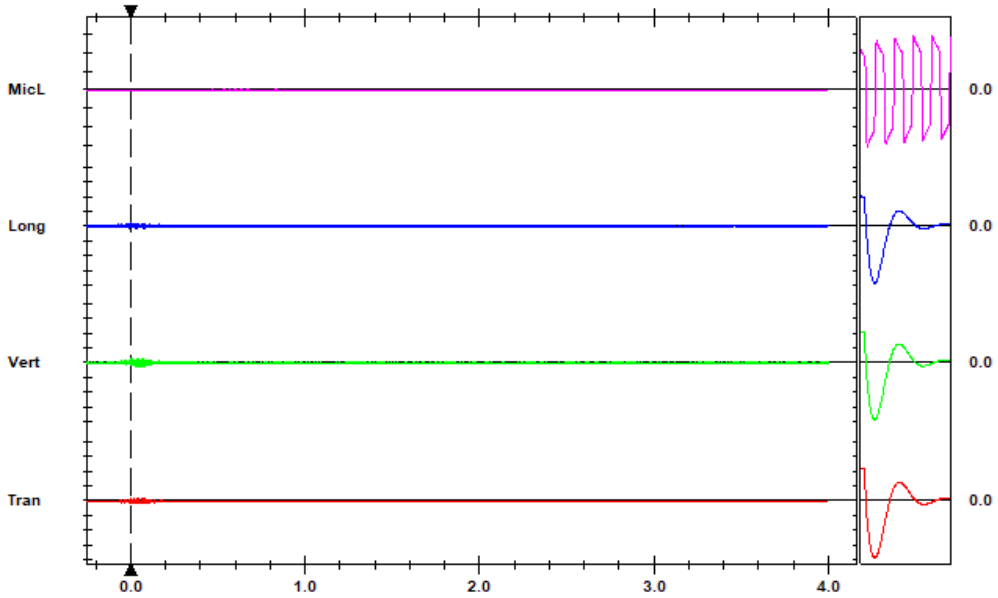
Microphone Linear Weighting
PSPL <88 dB(L)
ZC Freq 47 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 475 mv)

	Tran	Vert	Long	
PPV	0.381	0.635	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.024	0.005	0.000	sec
Peak Acceleration	0.040	0.053	0.040	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.5	4.2	

Peak Vector Sum 0.741 mm/s at 0.043 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

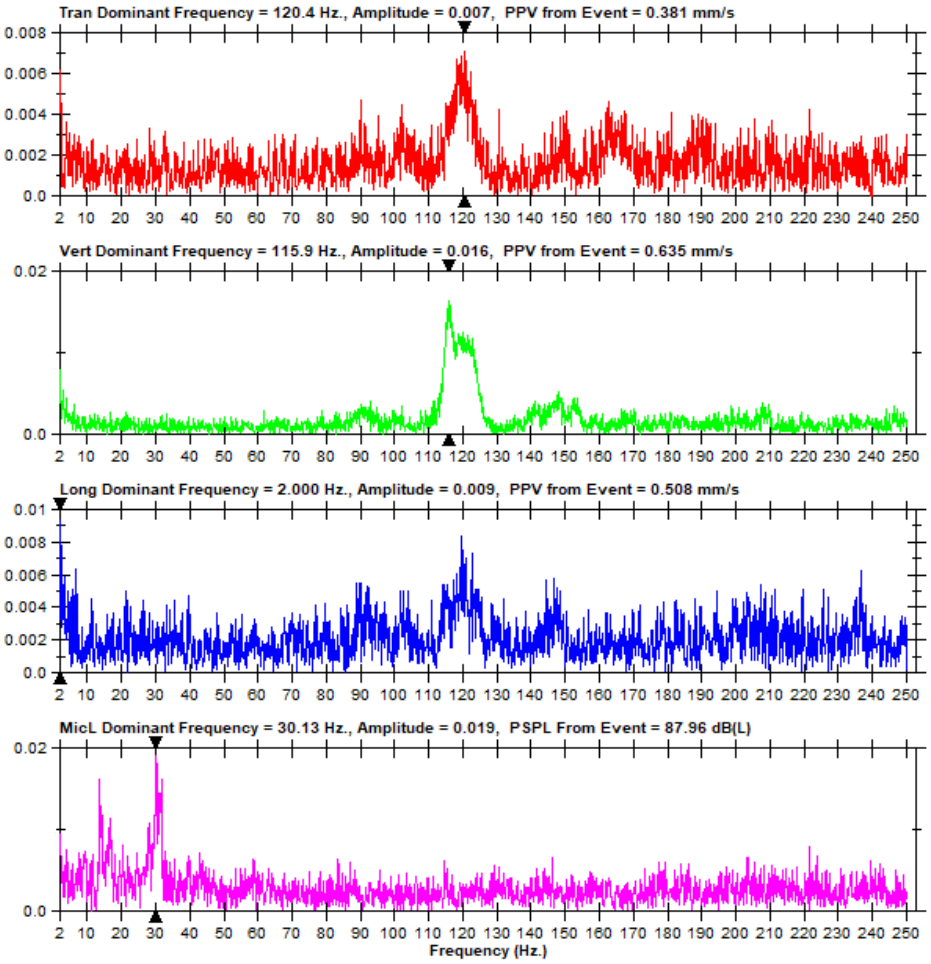
FFT Report

Date/Time	Long at 15:48:31 December 14, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JT1Q.KV0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration and Air Over Pressure monitoring at Kerela State Pollution Control Board

Post Event Notes
Total No. of holes -10, Hole Depth - 1.8 m, Charge/holes - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 3.750 Kg, Distance - 200 m



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ANNEXURE-2

Event and FFT Reports of Ground Vibration Recorded at Granite Building Stone Quarry of Muhammad Roshen, Kollam District

Instantel

Event Report

Date/Time	Long at 10:47:18 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAL.YU0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

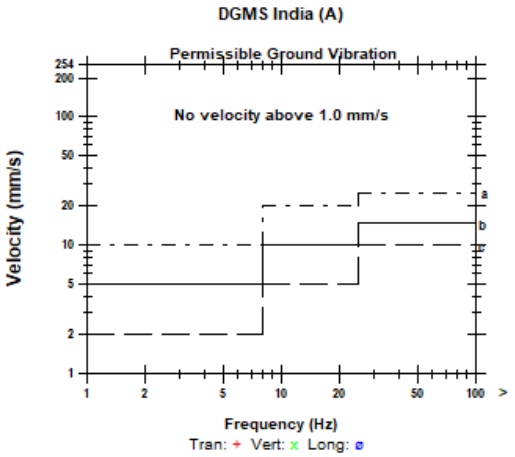
Post Event Notes
Total No. of holes -15, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 3.750 Kg, Distance - 100 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

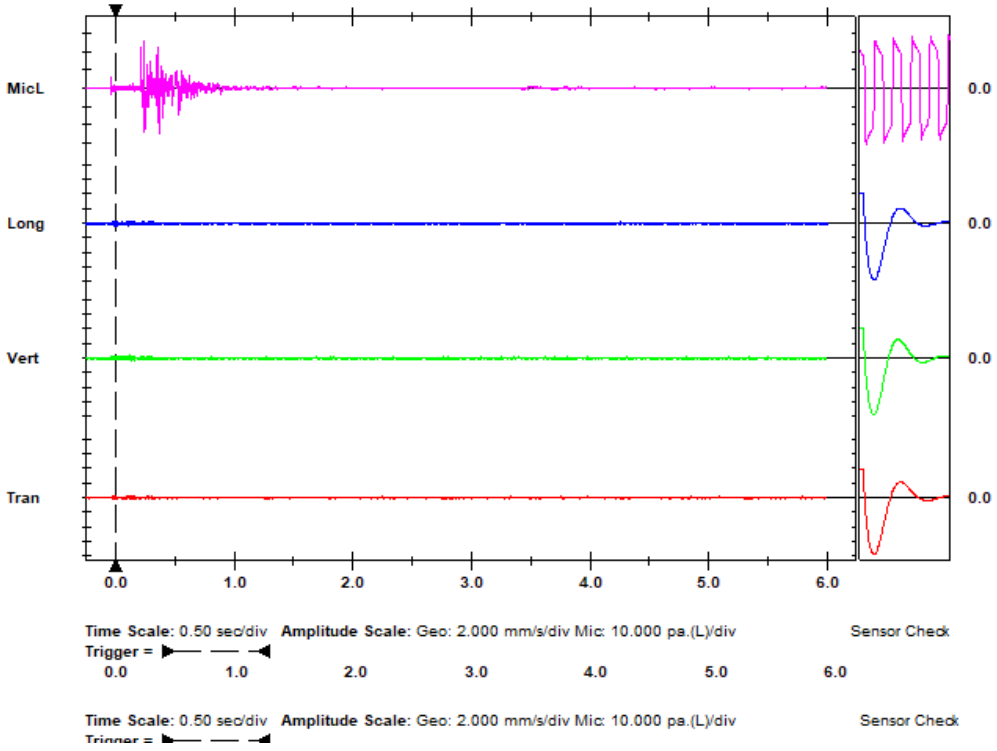
Microphone	Linear Weighting
PSPL	122.2 dB(L) at 0.234 sec
ZC Freq	73 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 544 mv)

	Tran	Vert	Long	
PPV	0.127	0.381	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	-0.222	0.126	0.000	sec
Peak Acceleration	0.013	0.040	0.027	g
Peak Displacement	0.000	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 0.568 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Instantel

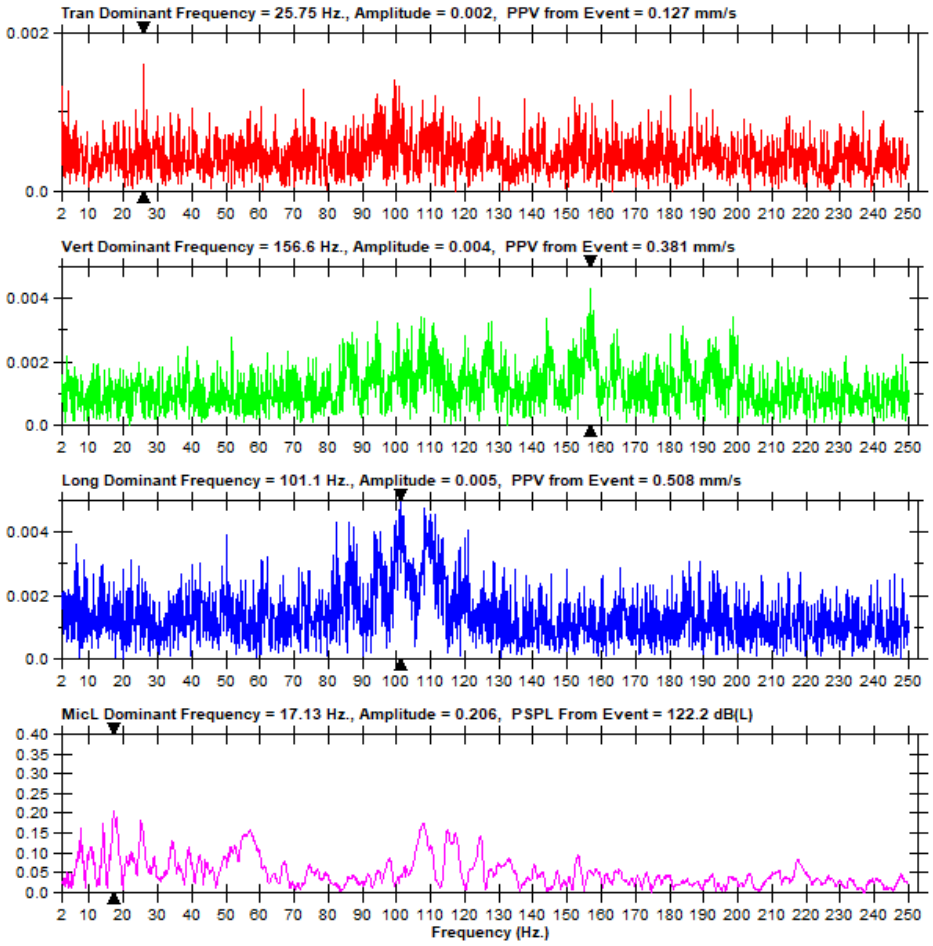
FFT Report

Date/Time	Long at 10:47:18 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAL.YU0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes -15, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 3.750 Kg, Distance - 100 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Vert at 10:53:44 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAM.9K0

Notes

Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Post Event Notes

Total No. of holes - 8, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.00 Kg, Distance - 72 m

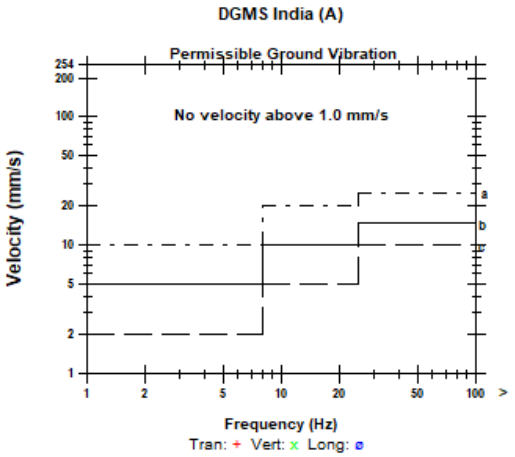
Extended Notes

Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

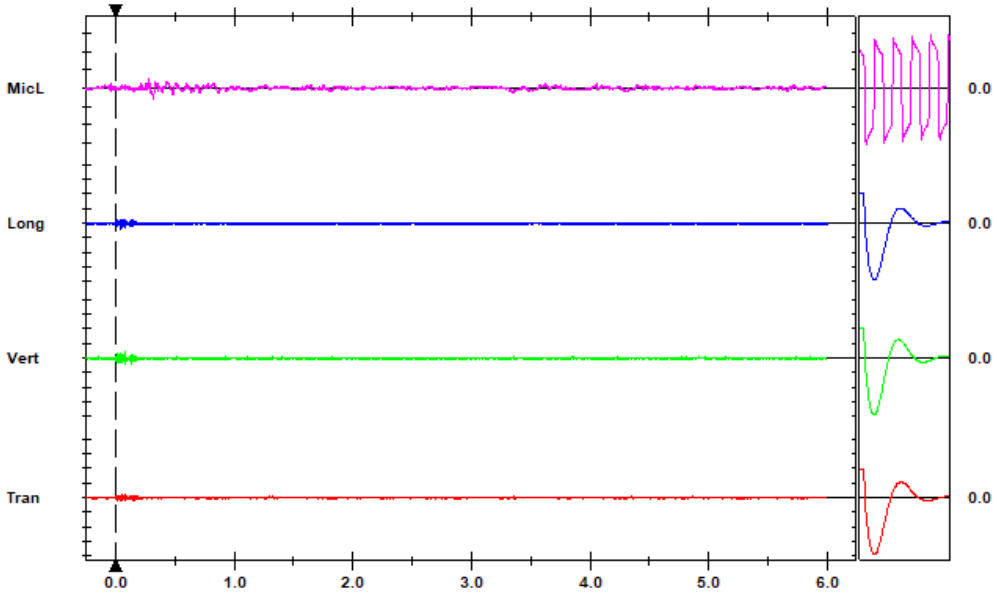
Microphone	Linear Weighting
PSPL	109.2 dB(L) at 0.318 sec
ZC Freq	13 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 537 mv)

	Tran	Vert	Long	
PPV	0.508	0.889	0.762	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.146	0.077	0.039	sec
Peak Acceleration	0.040	0.093	0.080	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.0	7.6	7.1	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 1.122 mm/s at 0.080 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

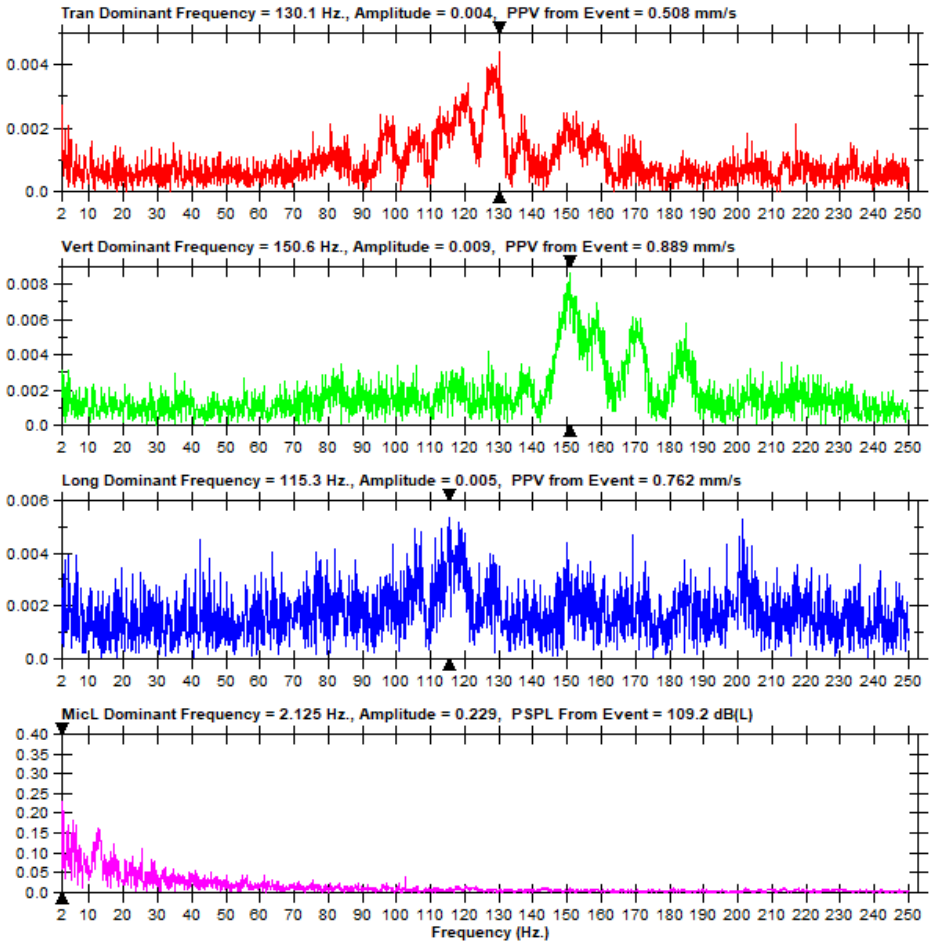
FFT Report

Date/Time	Vert at 10:53:44 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAM.9K0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 8, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.00 Kg, Distance - 72 m



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Event Report

Date/Time	Vert at 11:03:19 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAM.PJ0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

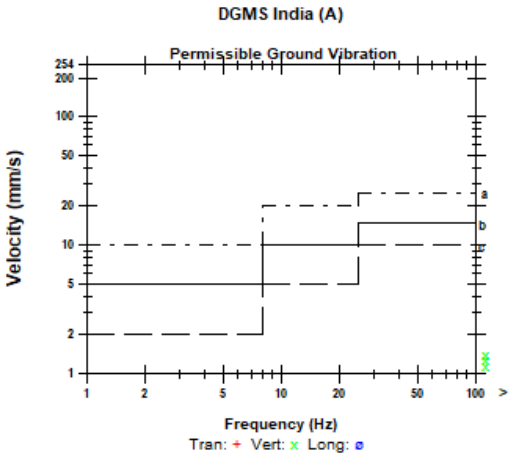
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 3.00 Kg, Distance - 75 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

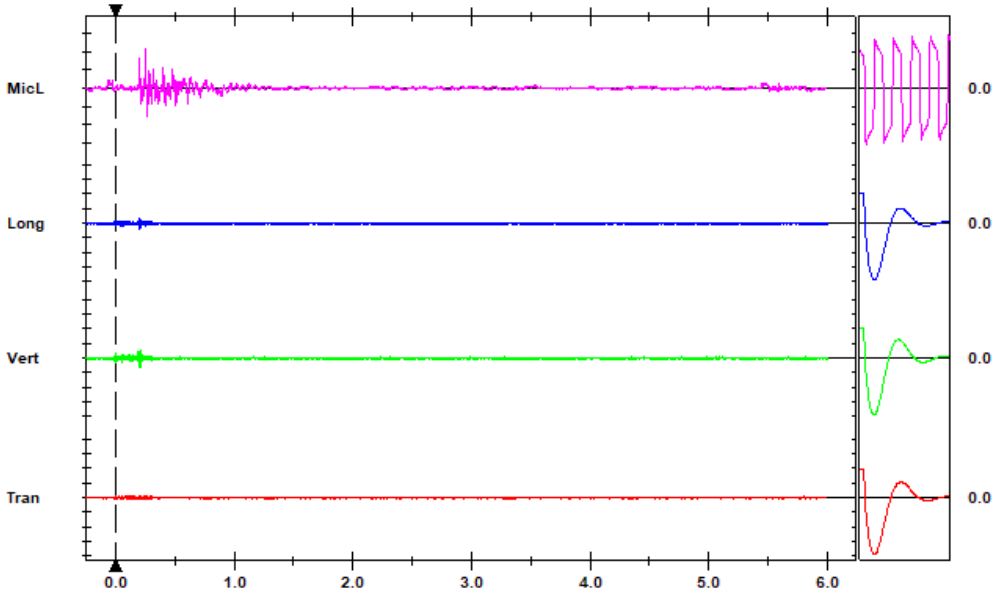
Microphone	Linear Weighting
PSPL	120.7 dB(L) at 0.251 sec
ZC Freq	34 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 540 mv)

	Tran	Vert	Long	
PPV	0.254	1.397	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.008	0.208	0.195	sec
Peak Acceleration	0.027	0.119	0.066	g
Peak Displacement	0.000	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.0	7.6	7.1	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 1.481 mm/s at 0.196 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

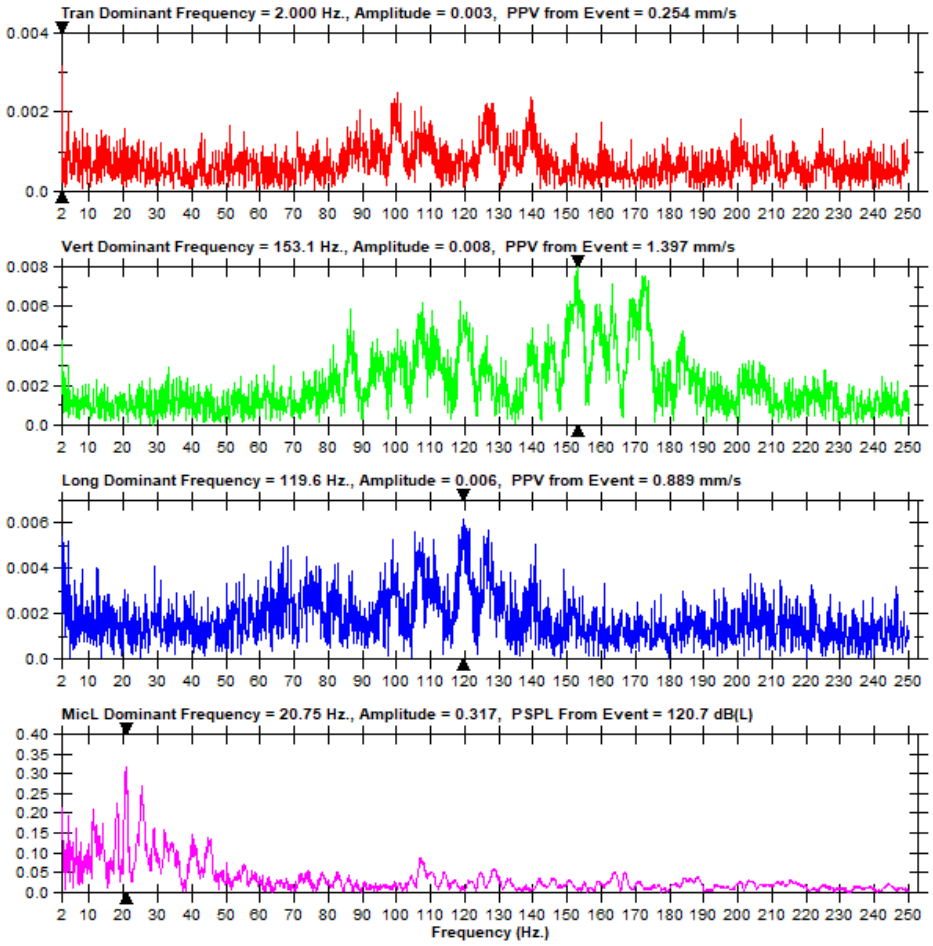
FFT Report

Date/Time	Vert at 11:03:19 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAM.PJ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 3.00 Kg, Distance - 75 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 11:21:08 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAN.J80

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

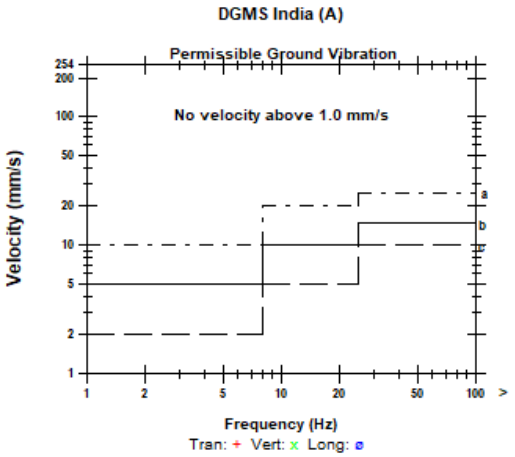
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 5.00 Kg, Distance - 78 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

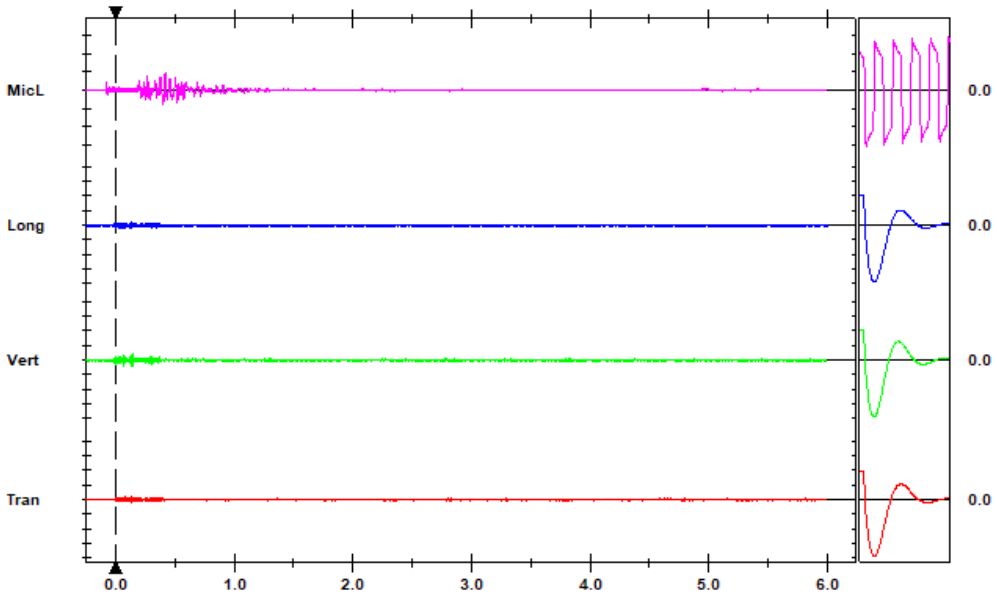
Microphone	Linear Weighting
PSPL	113.5 dB(L) at 0.418 sec
ZC Freq	32 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 539 mv)

	Tran	Vert	Long	
PPV	0.508	0.889	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.132	0.141	0.054	sec
Peak Acceleration	0.053	0.080	0.053	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.0	7.6	7.1	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 0.925 mm/s at 0.141 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

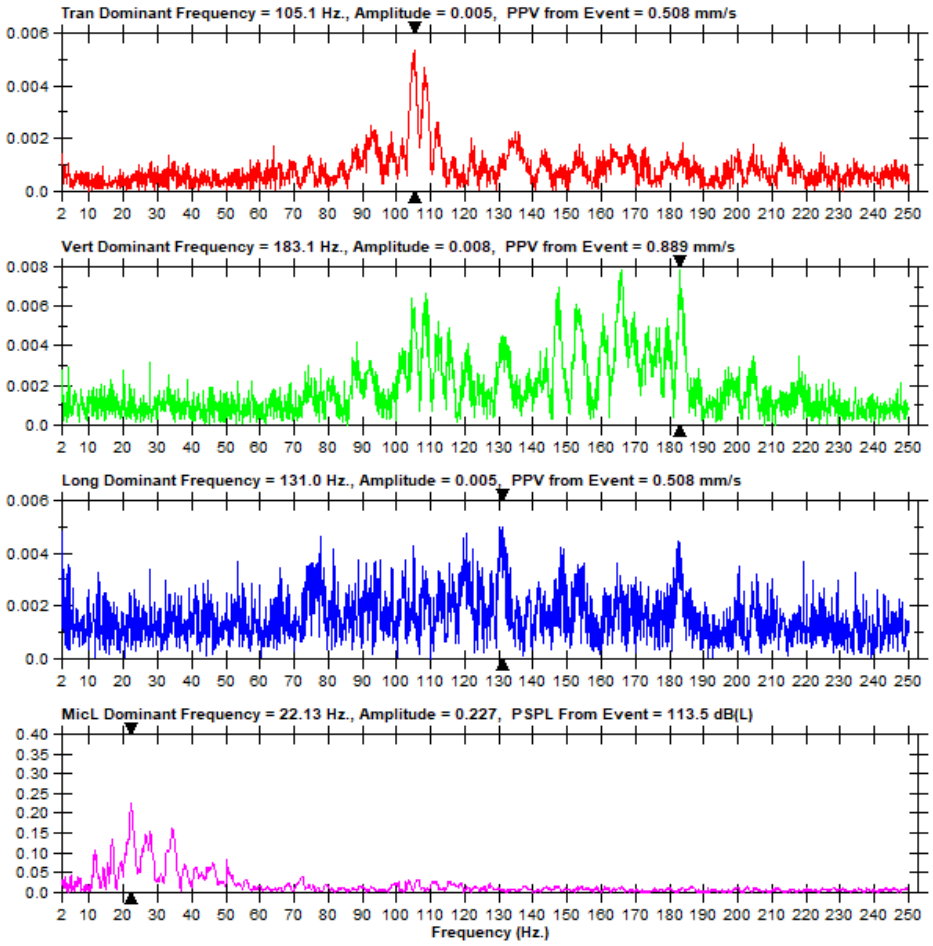
FFT Report

Date/Time	Vert at 11:21:08 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAN.J80
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 5.00 Kg, Distance - 78 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 11:28:36 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAN.VO0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

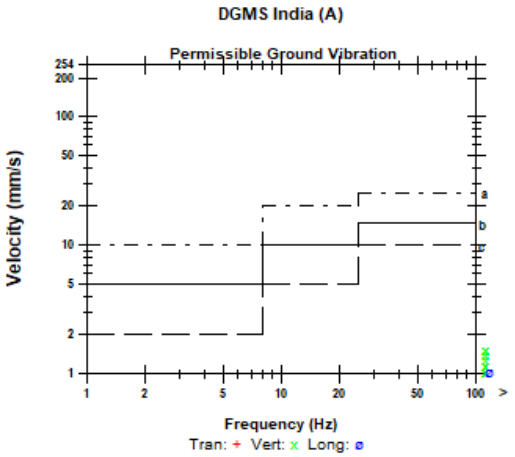
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.75 Kg, Distance - 60 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

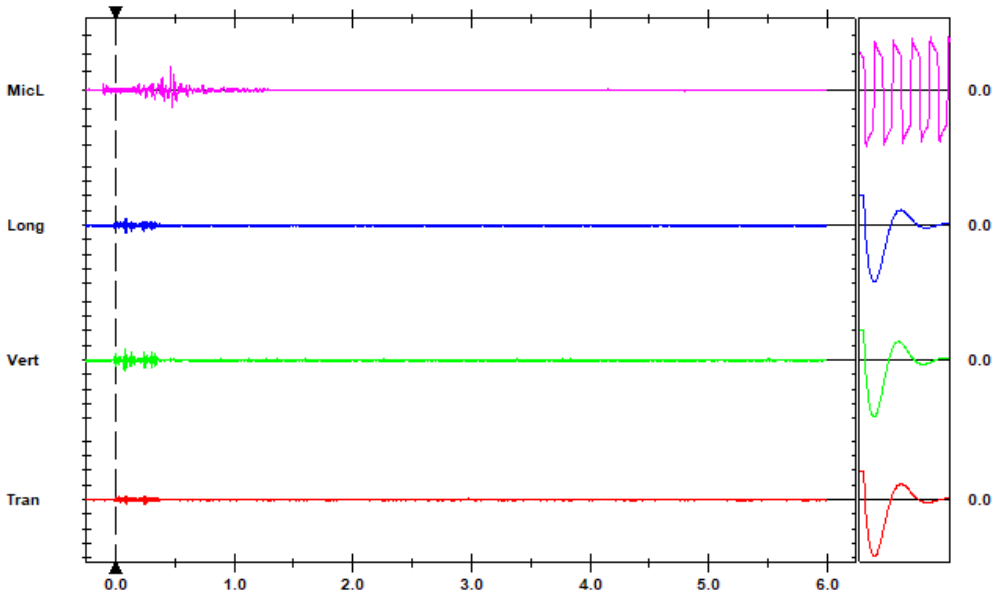
Microphone	Linear Weighting
PSPL	116.4 dB(L) at 0.462 sec
ZC Freq	37 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 525 mv)

	Tran	Vert	Long	
PPV	0.635	1.524	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.088	0.077	0.086	sec
Peak Acceleration	0.053	0.133	0.080	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.0	7.6	7.1	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 1.778 mm/s at 0.082 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

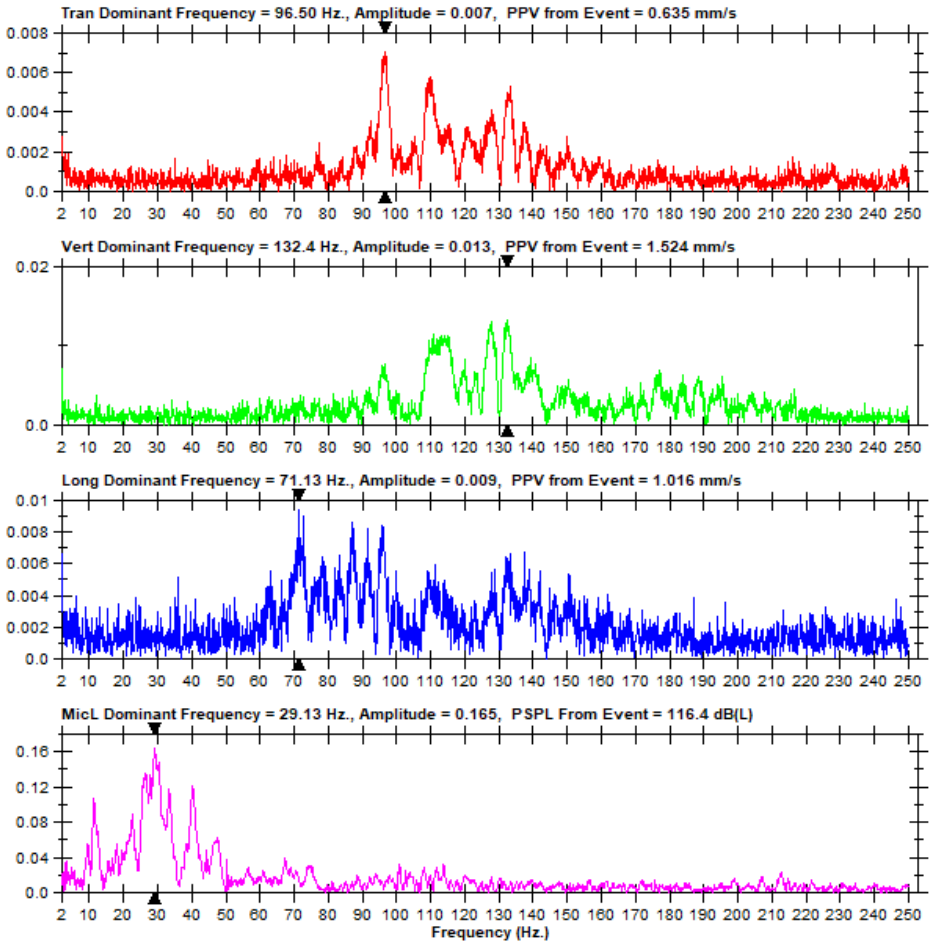
FFT Report

Date/Time	Vert at 11:28:36 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAN.VO0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.75 Kg, Distance - 60 m



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Event Report

Date/Time	Vert at 14:29:51 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAW.9R0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

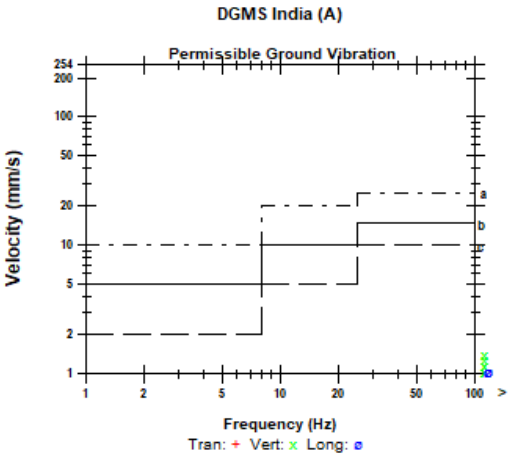
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.75 Kg, Distance - 36 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

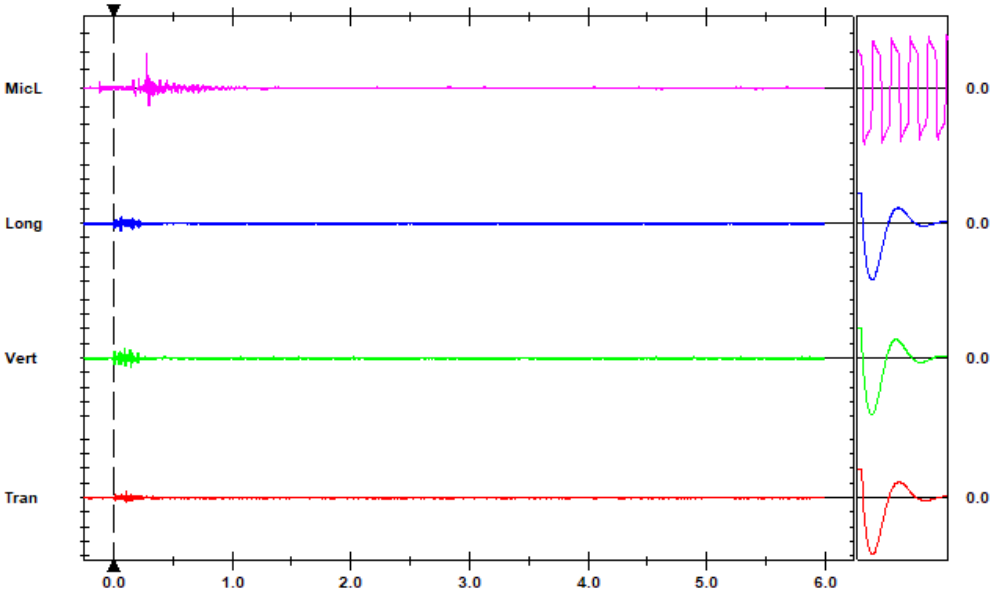
Microphone	Linear Weighting
PSPL	119.6 dB(L) at 0.282 sec
ZC Freq	64 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 542 mv)

	Tran	Vert	Long	
PPV	0.762	1.397	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.104	0.093	0.058	sec
Peak Acceleration	0.093	0.133	0.093	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 1.420 mm/s at 0.093 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

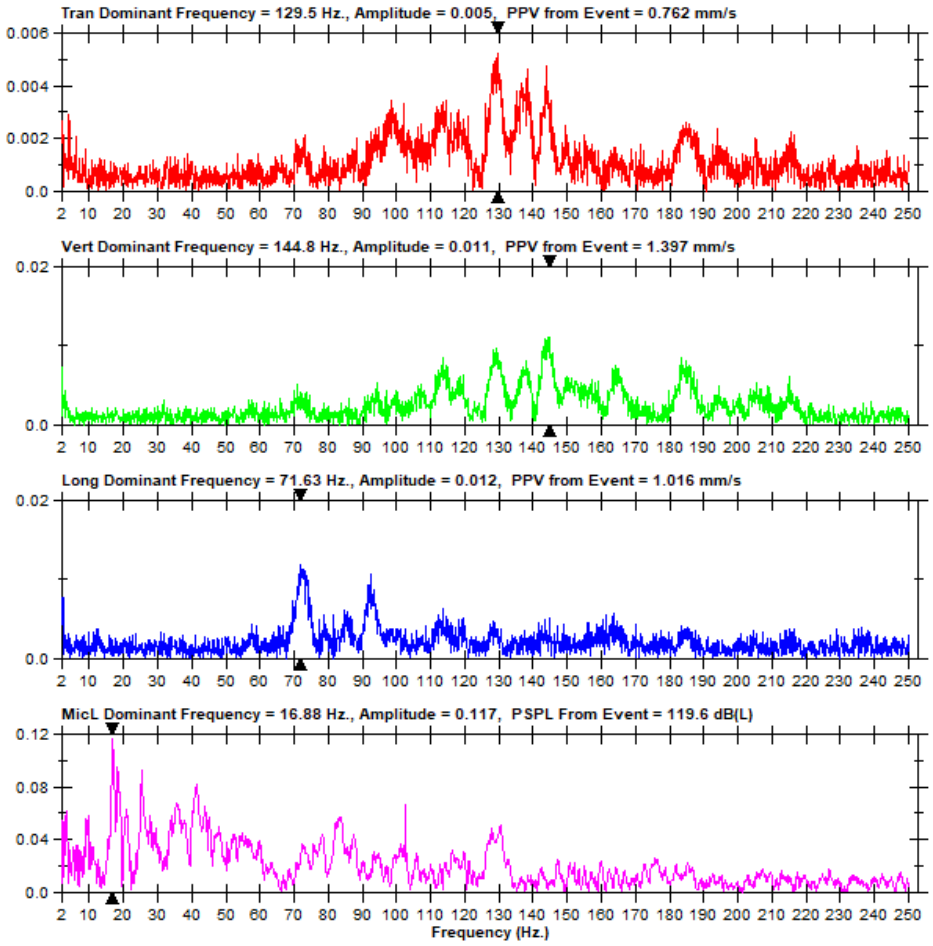
FFT Report

Date/Time	Vert at 14:29:51 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAW.9R0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.75 Kg, Distance - 36 m



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Event Report

Date/Time	Vert at 14:34:58 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAW.IA0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

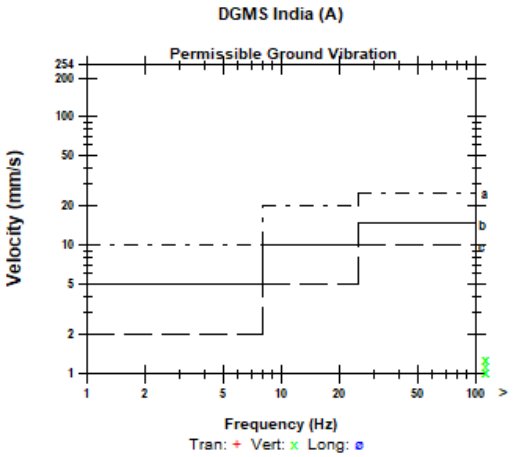
Post Event Notes
Total No. of holes - 8, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.00 Kg, Distance - 50 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

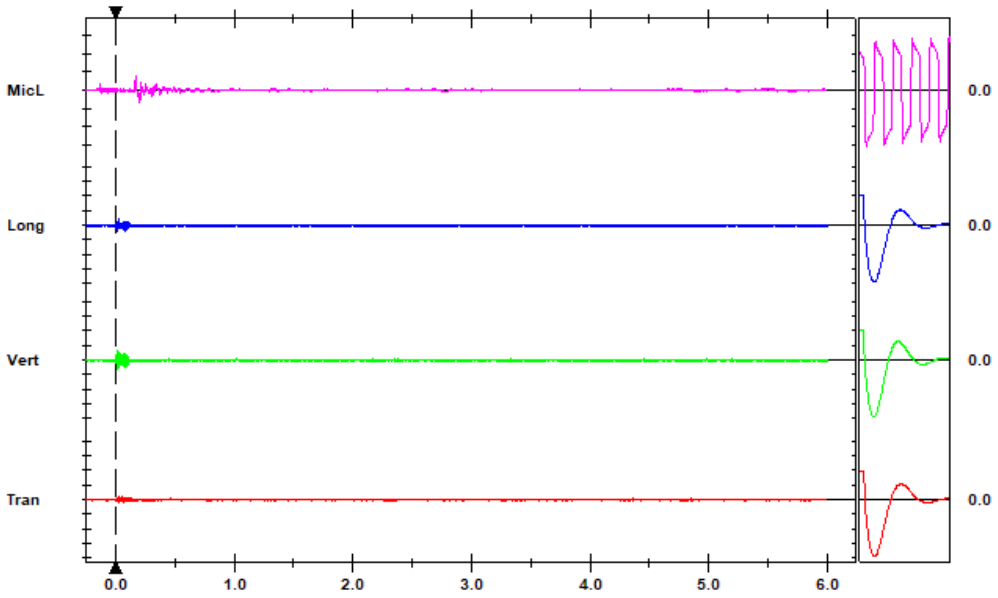
Microphone	Linear Weighting
PSPL	111.5 dB(L) at 0.172 sec
ZC Freq	24 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 560 mv)

	Tran	Vert	Long	
PPV	0.508	1.270	0.889	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.028	0.018	0.018	sec
Peak Acceleration	0.040	0.146	0.066	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 1.571 mm/s at 0.018 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

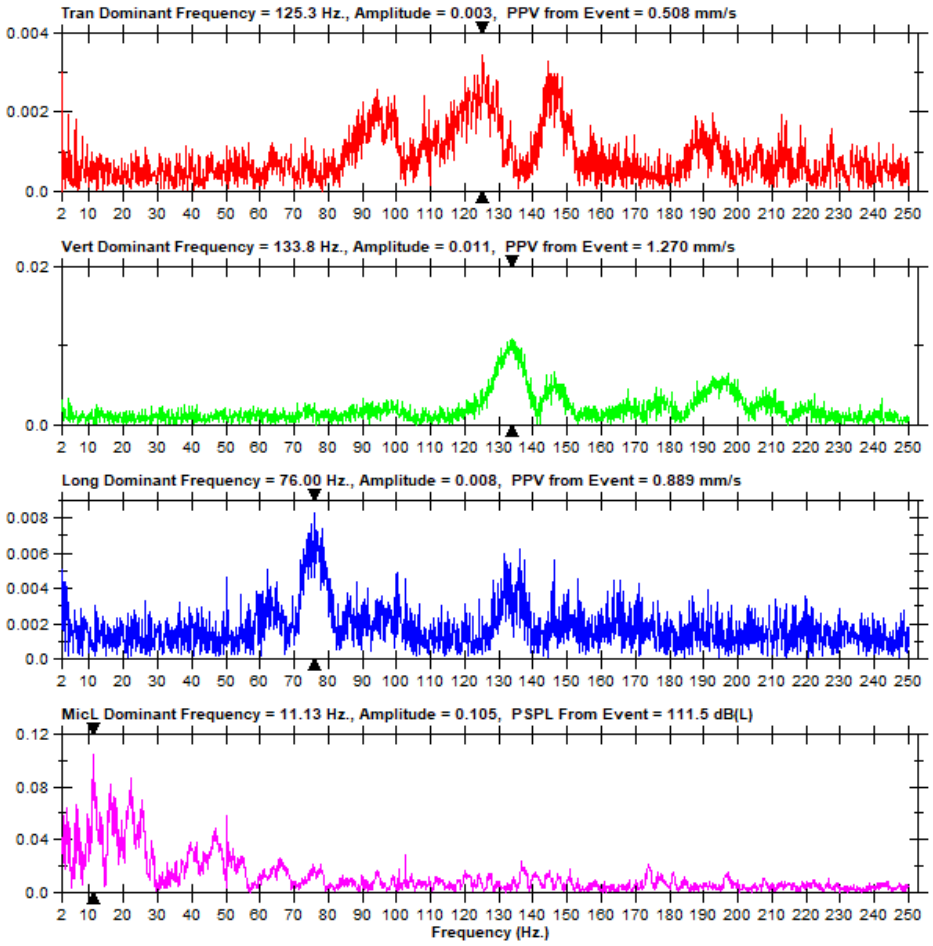
FFT Report

Date/Time	Vert at 14:34:58 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAW.IA0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 8, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.00 Kg, Distance - 50 m



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Event Report

Date/Time	Vert at 14:40:11 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAW.QZ0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

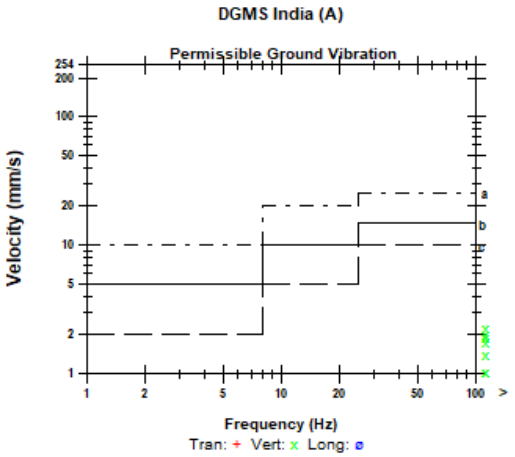
Post Event Notes
Total No. of holes - 5, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 1.25 Kg, Distance - 50 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

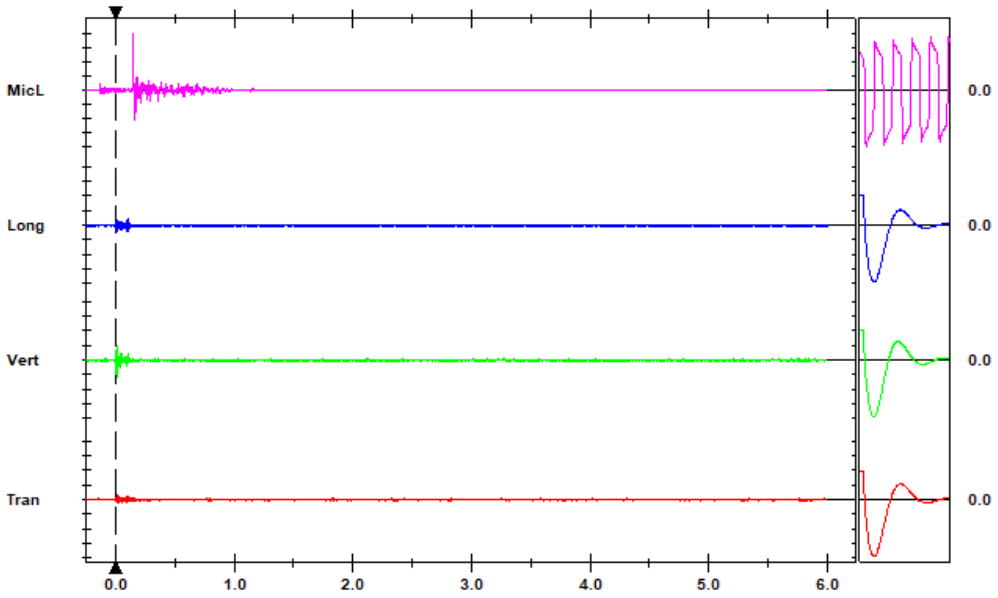
Microphone	Linear Weighting
PSPL	126.2 dB(L) at 0.148 sec
ZC Freq	30 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 538 mv)

	Tran	Vert	Long	
PPV	0.635	2.286	0.889	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.013	0.014	0.104	sec
Peak Acceleration	0.053	0.199	0.066	g
Peak Displacement	0.001	0.003	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 2.349 mm/s at 0.014 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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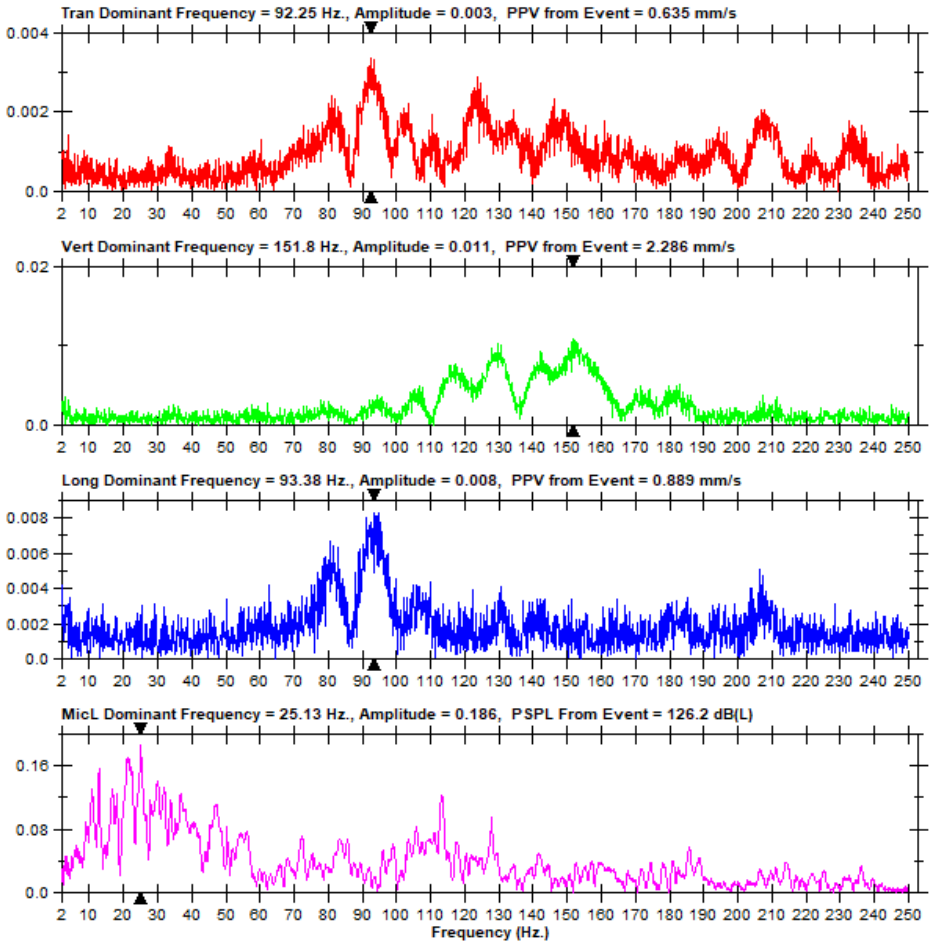
FFT Report

Date/Time	Vert at 14:40:11 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAW.QZ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 5, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 1.25 Kg, Distance - 50 m



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Event Report

Date/Time	Vert at 14:45:22 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAW.ZM0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

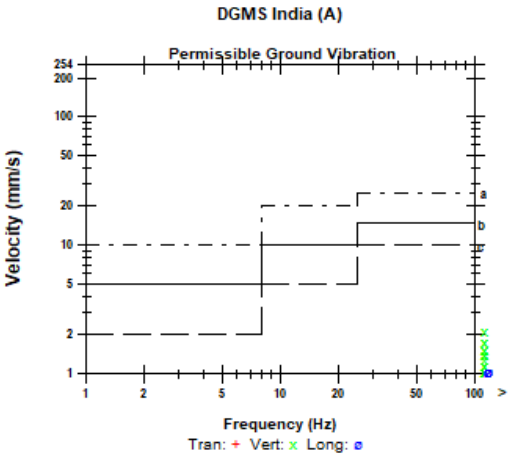
Post Event Notes
Total No. of holes -11, Hole Depth - 1.5 m, Charge/holes - 0.18 - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.12 Kg, Distance - 48 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

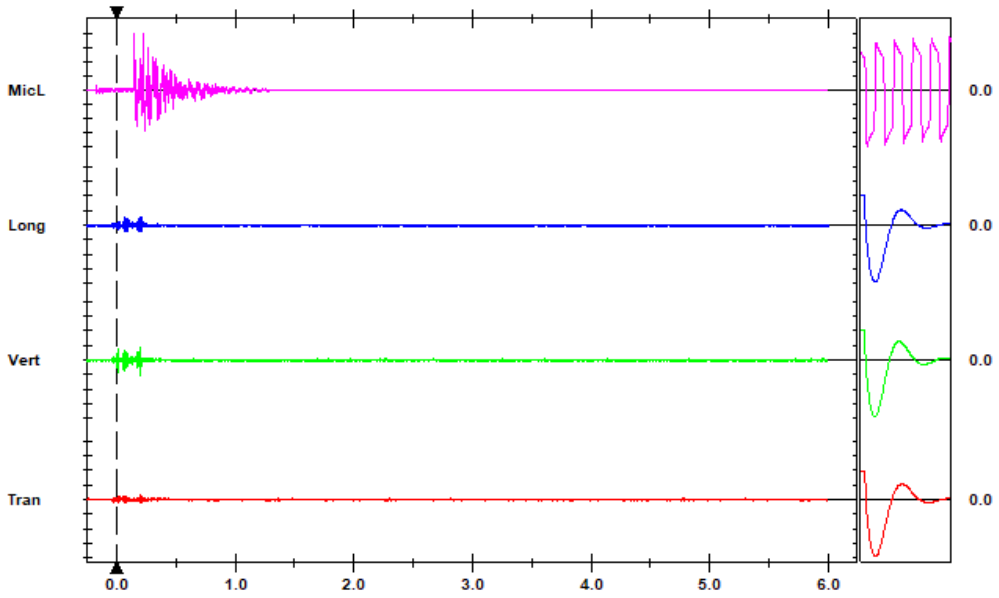
Microphone	Linear Weighting
PSPL	126.1 dB(L) at 0.146 sec
ZC Freq	30 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 545 mv)

	Tran	Vert	Long	
PPV	0.635	2.159	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.200	0.200	0.070	sec
Peak Acceleration	0.053	0.172	0.080	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 2.282 mm/s at 0.200 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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Instantel

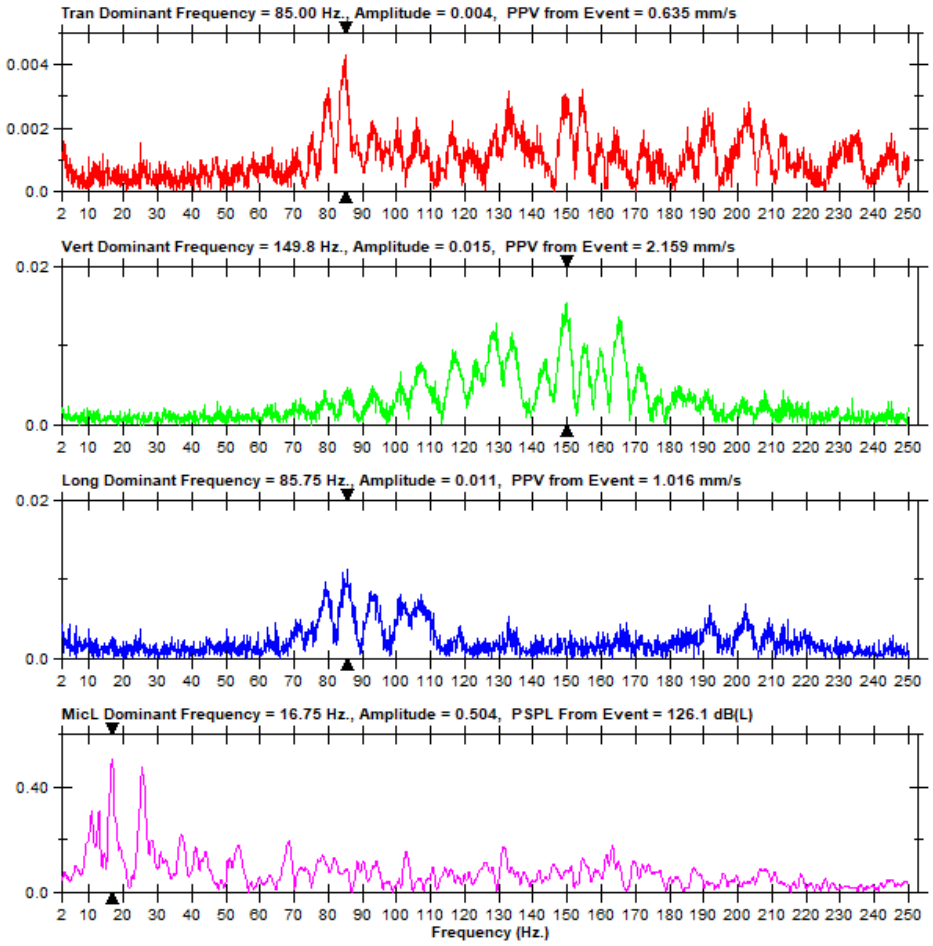
FFT Report

Date/Time	Vert at 14:45:22 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAW.ZM0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes -11, Hole Depth - 1.5 m, Charge/holes - 0.18 - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 2.12 Kg, Distance - 48 m



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Event Report

Date/Time	Vert at 14:49:34 December 19, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	6.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTAX.6M0

Notes

Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Post Event Notes

Total No. of holes - 5, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 1.25 Kg, Distance - 50 m

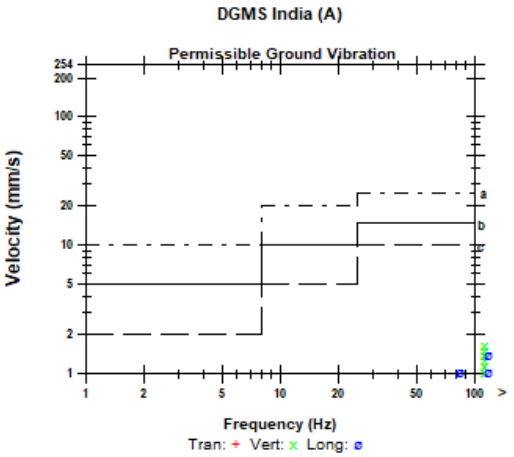
Extended Notes

Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

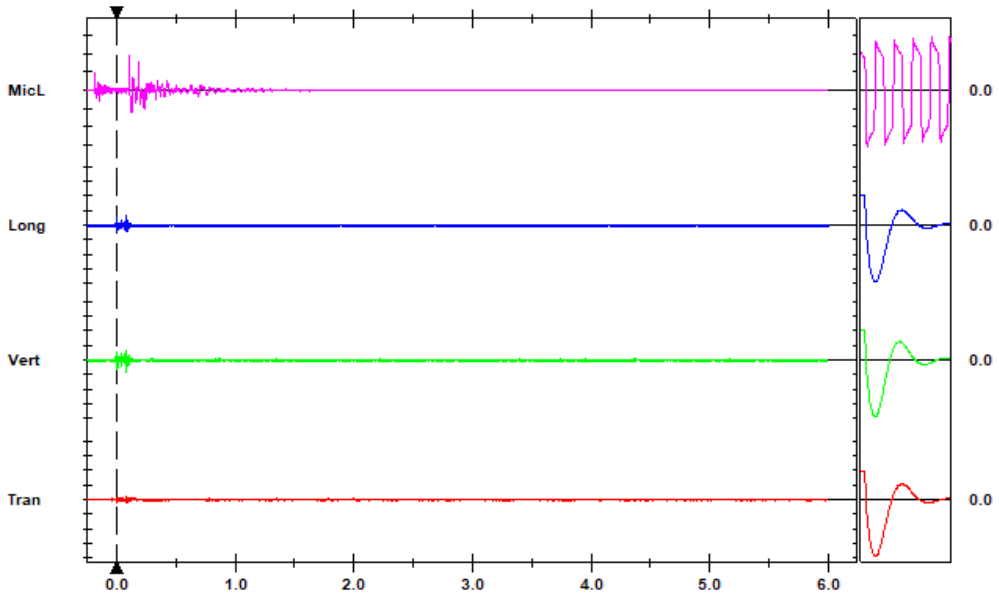
Microphone	Linear Weighting
PSPL	119.6 dB(L) at 0.107 sec
ZC Freq	39 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 535 mv)

	Tran	Vert	Long	
PPV	0.508	1.651	1.397	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.082	0.080	0.080	sec
Peak Acceleration	0.053	0.172	0.133	g
Peak Displacement	0.000	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	4.0	3.3	4.1	

Peak Vector Sum 2.196 mm/s at 0.080 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0 5.0 6.0

Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

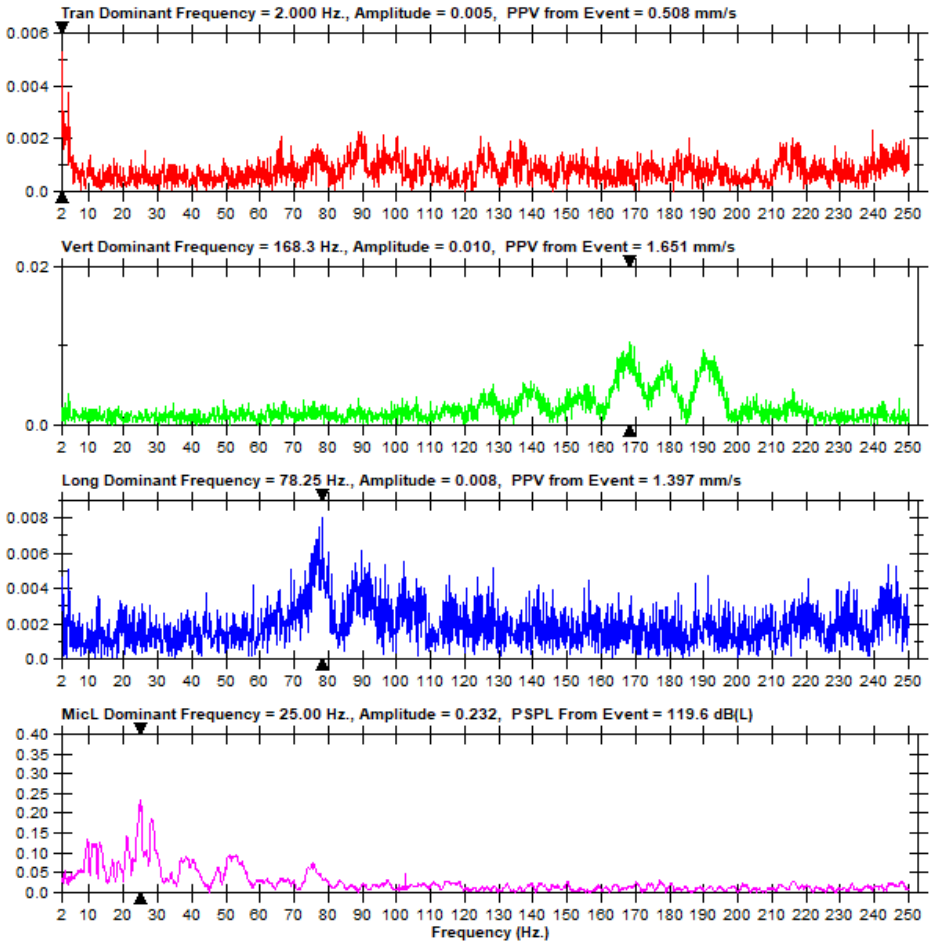
FFT Report

Date/Time	Vert at 14:49:34 December 19, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	6.0 sec at 1024 sps	**File Name**	V376JTAX.6M0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Kollam)

Post Event Notes
Total No. of holes - 5, Hole Depth - 1.5 m, Charge/holes - 0.250 Kg, MCPD - 0.250 Kg, Total Charge - 1.25 Kg, Distance - 50 m



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ANNEXURE-3

Event and FFT Reports of Ground Vibration Recorded at Granite Building Stone Quarry of M/s POABS Granites Pvt. Ltd., Trivandrum District

Instantel

Event Report

Date/Time Tran at 10:03:29 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG3.XT0
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 107 m

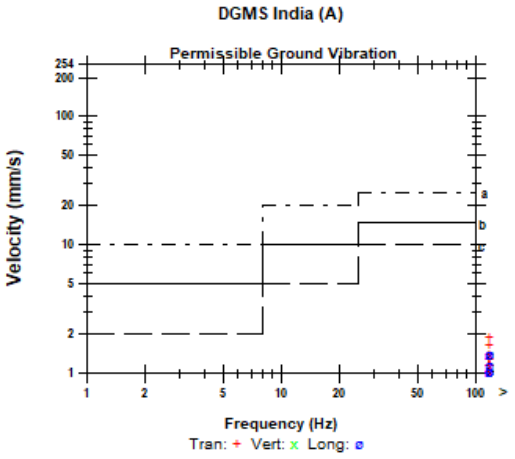
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

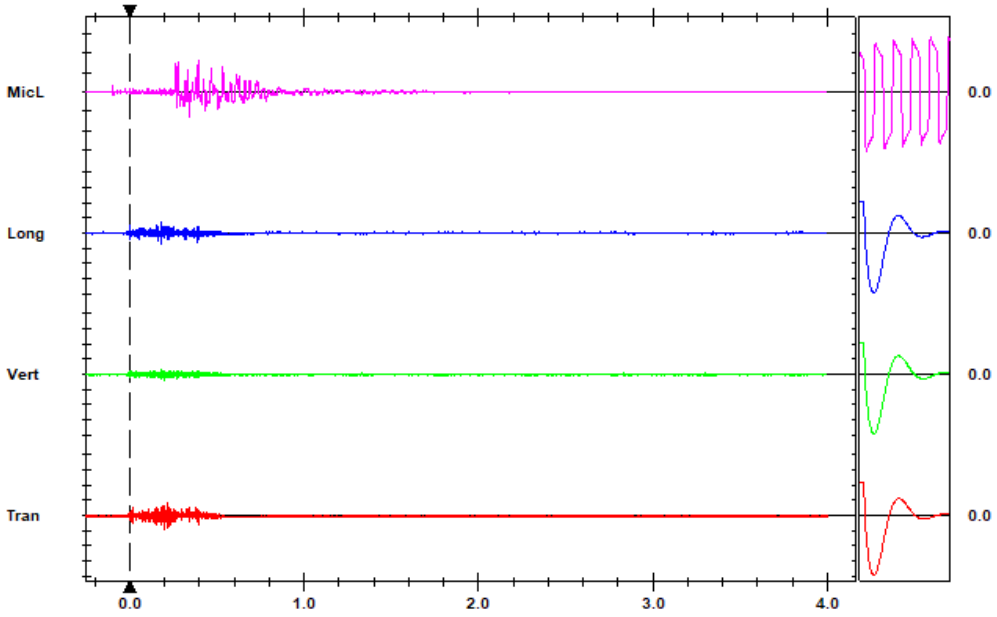
Microphone Linear Weighting
PSPL 118.2 dB(L) at 0.394 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	1.905	0.762	1.397	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.197	0.200	0.182	sec
Peak Acceleration	0.239	0.093	0.172	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.044 mm/s at 0.197 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

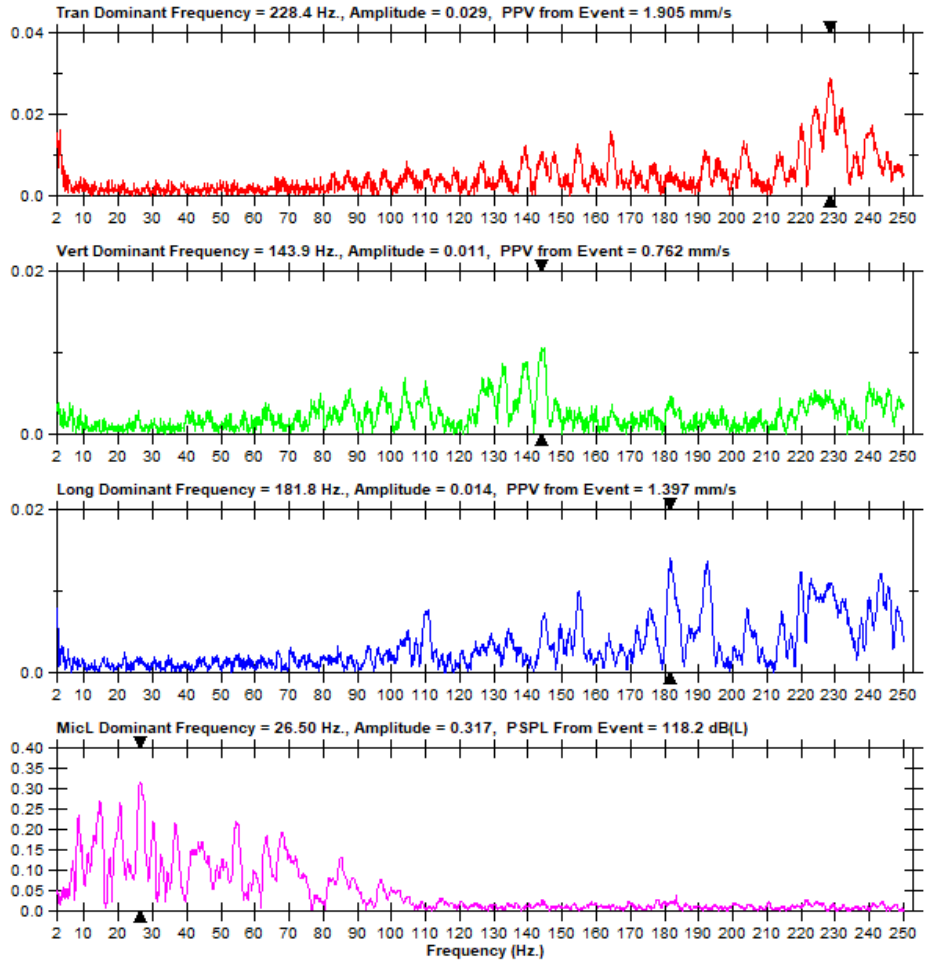
FFT Report

Date/Time	Tran at 10:03:29 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG3.XT0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 107 m



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Event Report

Date/Time Tran at 10:03:25 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG3.XP0
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 195 m

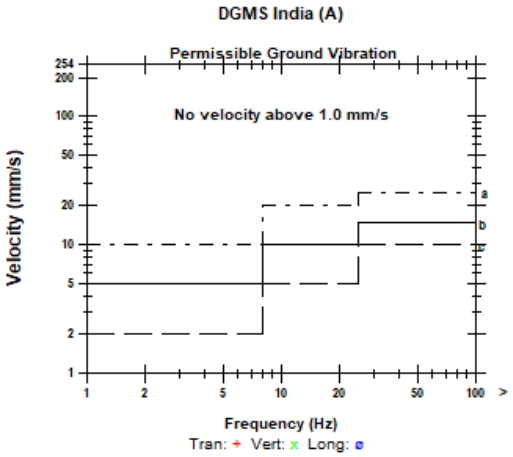
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

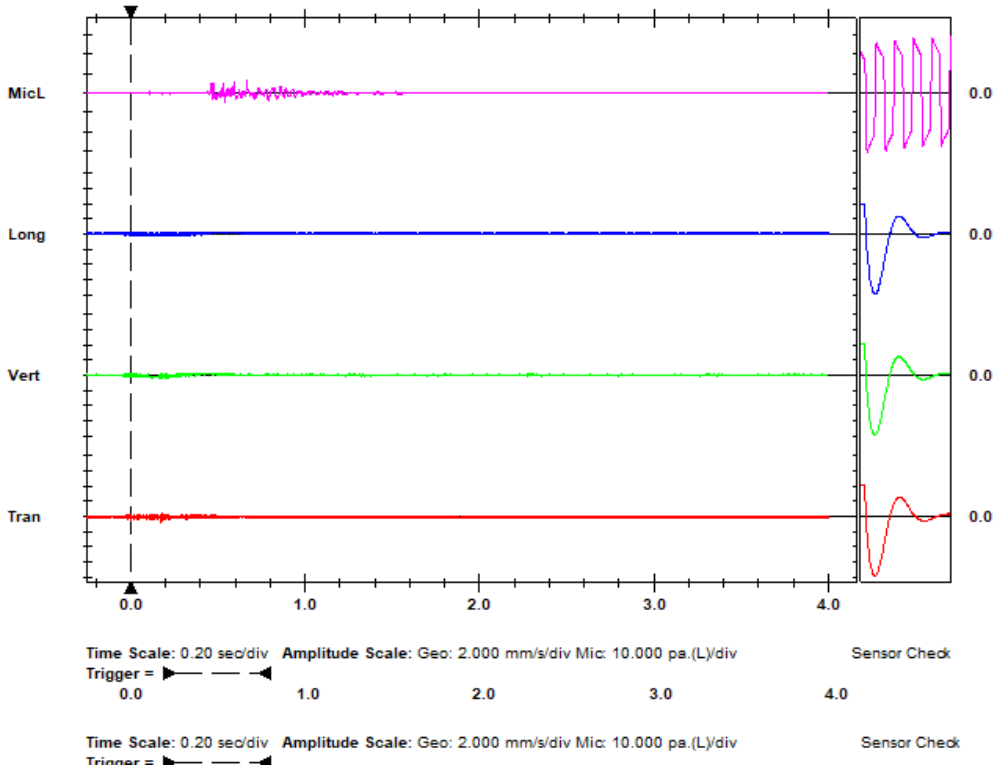
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.667 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	0.254	mm/s
ZC Freq	>100	64	>100	Hz
Time (Rel. to Trig)	0.175	0.178	-0.030	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.001	0.001	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 0.898 mm/s at 0.175 sec





Instantel

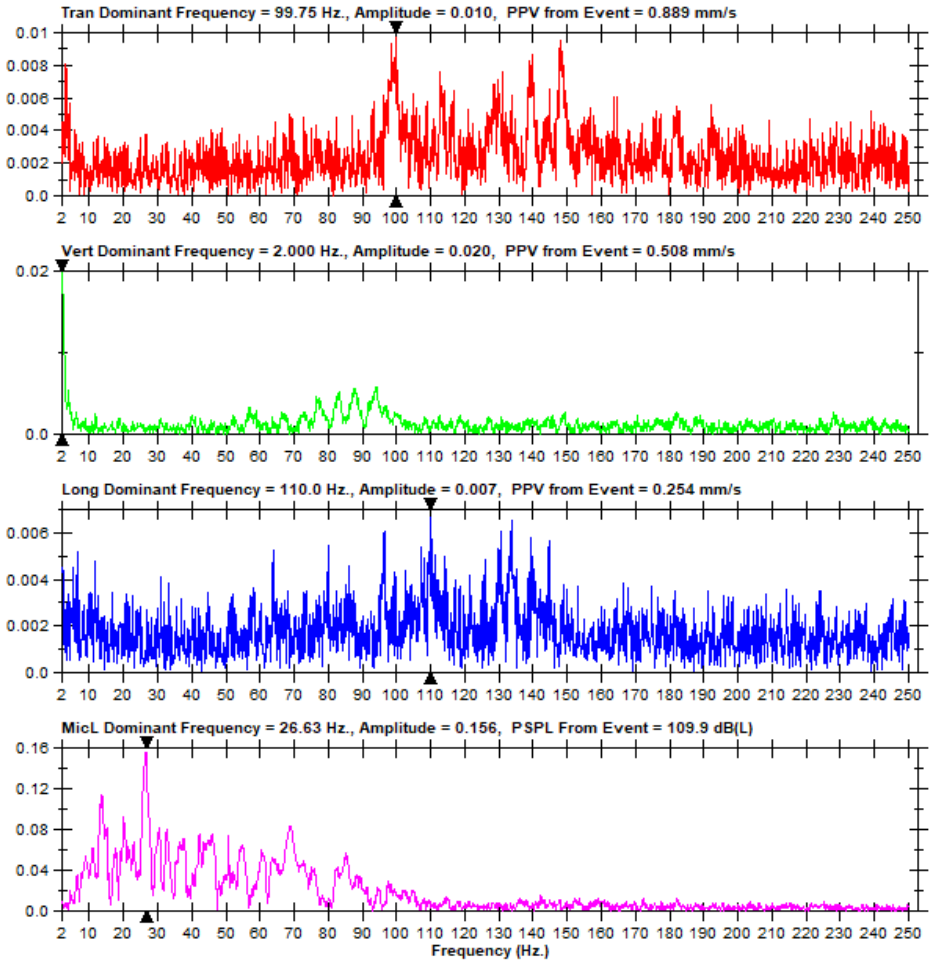
FFT Report

Date/Time	Tran at 10:03:25 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG3.XP0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 195 m



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Event Report

Date/Time Long at 10:03:30 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

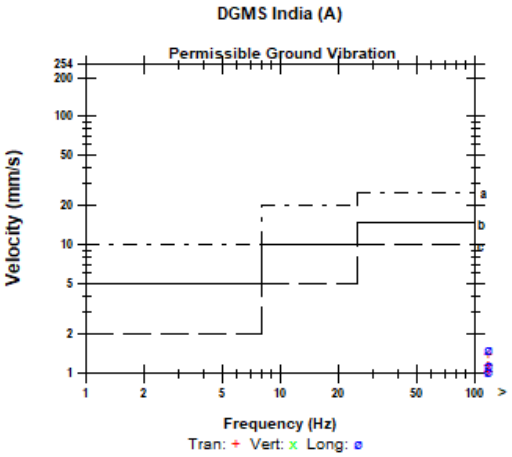
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

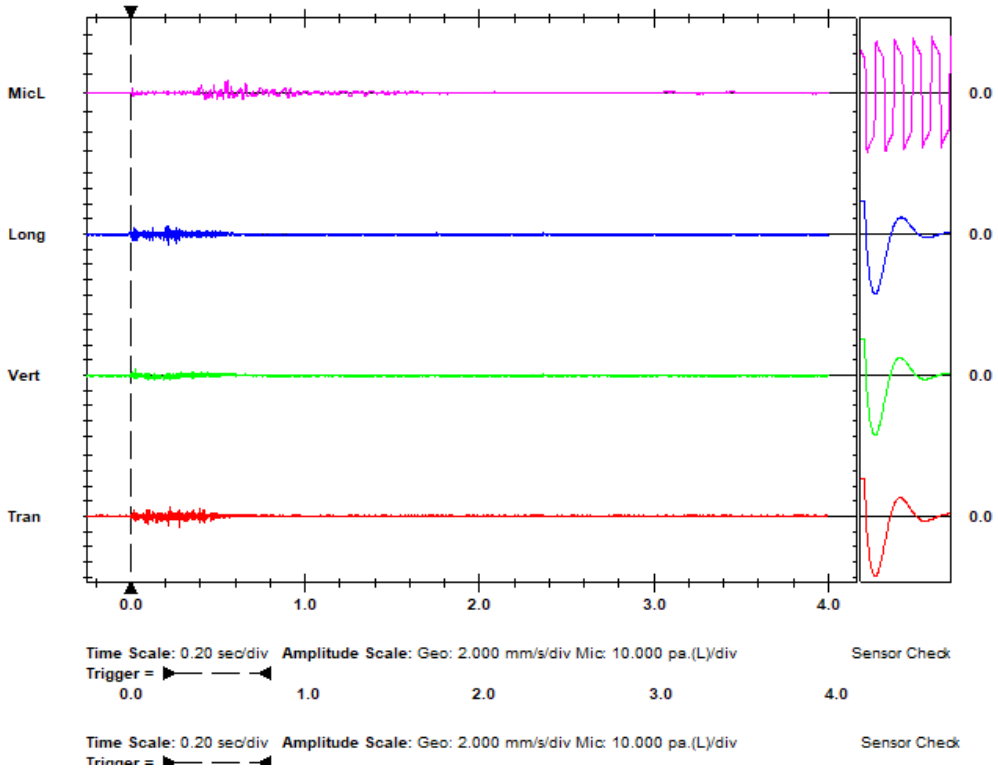
Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.555 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 500 mv)

	Tran	Vert	Long	
PPV	1.397	0.762	1.524	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.277	0.028	0.217	sec
Peak Acceleration	0.119	0.080	0.093	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.581 mm/s at 0.277 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG3.XU0
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 110 m





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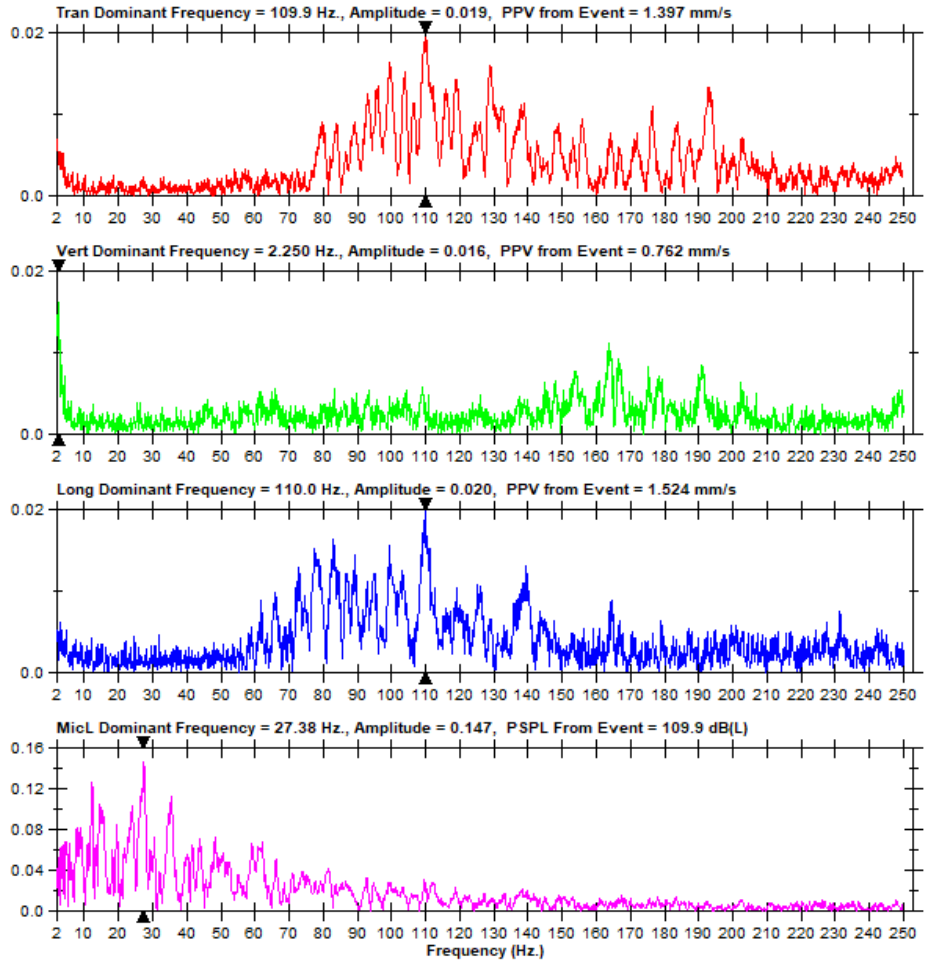
FFT Report

Date/Time	Long at 10:03:30 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG3.XU0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 110 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 10:03:29 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

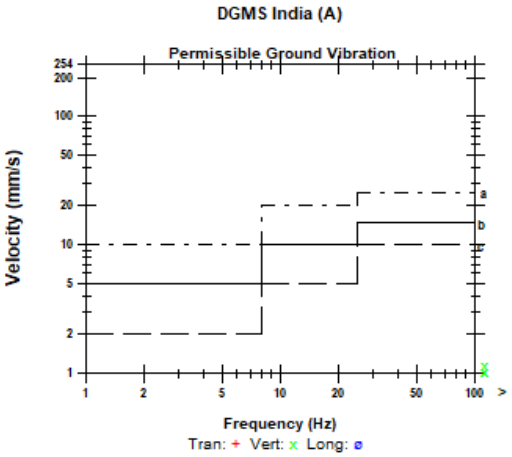
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

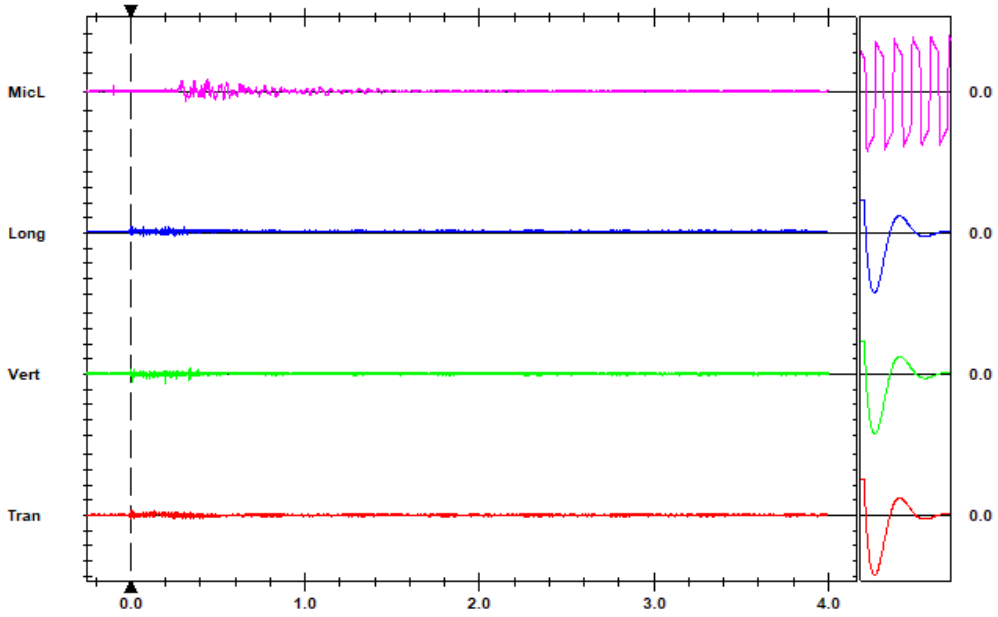
Microphone Linear Weighting
PSPL 110.6 dB(L) at 0.444 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.635	1.143	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.005	0.200	0.006	sec
Peak Acceleration	0.093	0.133	0.093	g
Peak Displacement	0.001	0.001	0.016	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 1.257 mm/s at 0.199 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG3.XT0
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 150 m





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

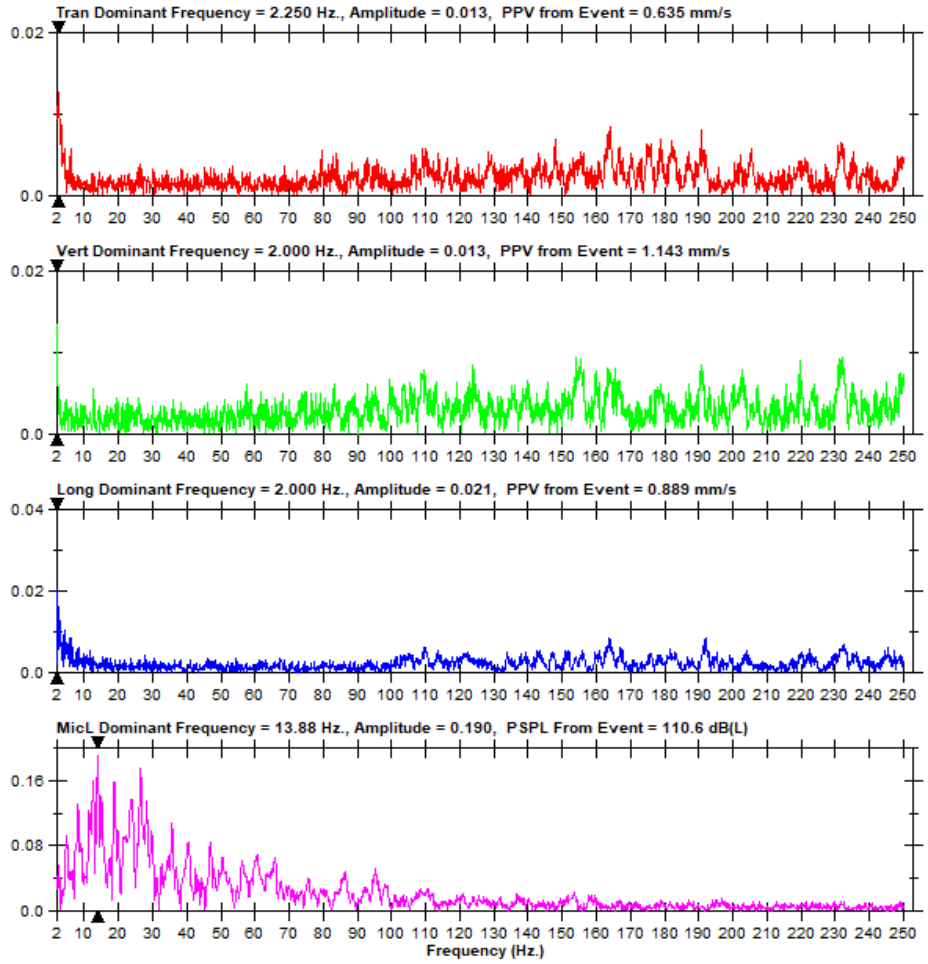
FFT Report

Date/Time	Long at 10:03:29 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG3.XT0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.2 - 2.4 m, Charge/holes - 0.590 Kg, MCPD - 0.590 Kg, Total Charge - 23.57 Kg, Distance - 150 m



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Event Report

Date/Time Long at 10:04:24 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG3.ZC0
Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 66 m

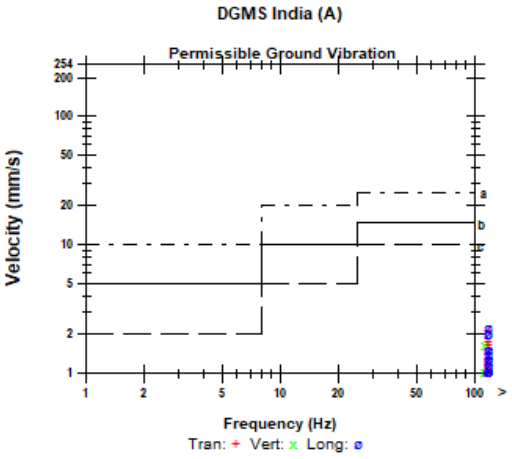
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

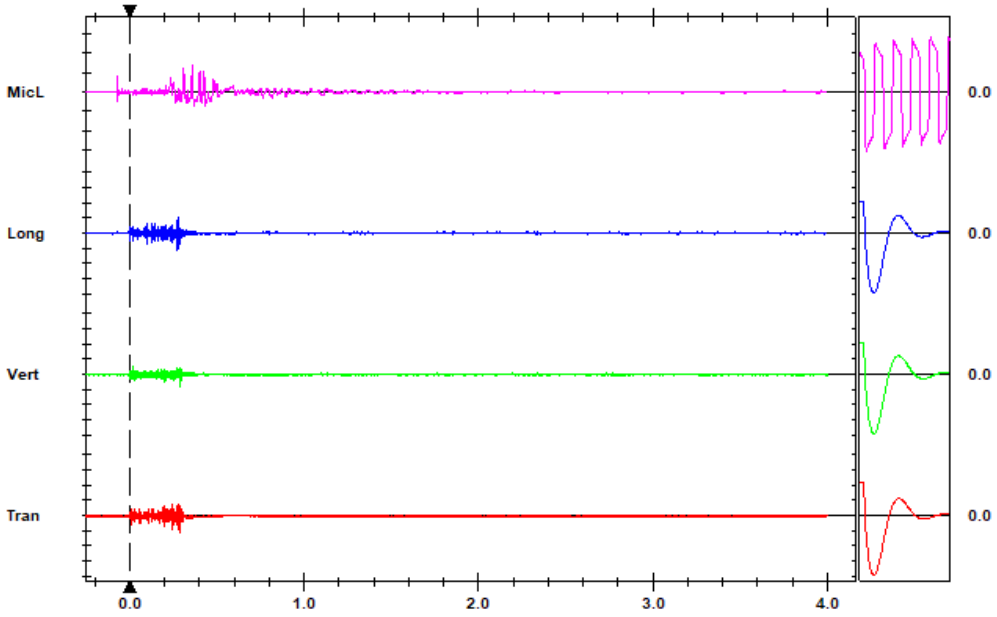
Microphone Linear Weighting
PSPL 116.6 dB(L) at 0.359 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	2.159	1.651	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.285	0.286	0.273	sec
Peak Acceleration	0.265	0.133	0.278	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.664 mm/s at 0.273 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

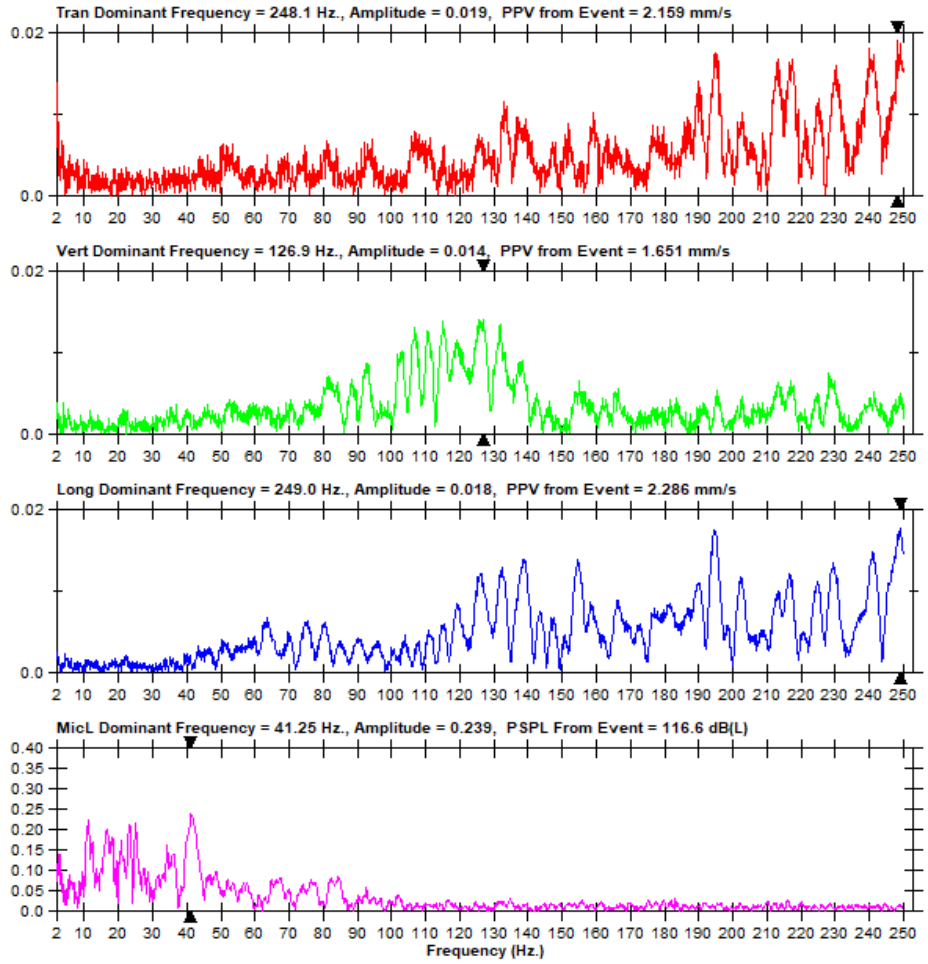
FFT Report

Date/Time	Long at 10:04:24 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG3.ZC0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 66 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 10:04:19 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG3.Z70
Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 154 m

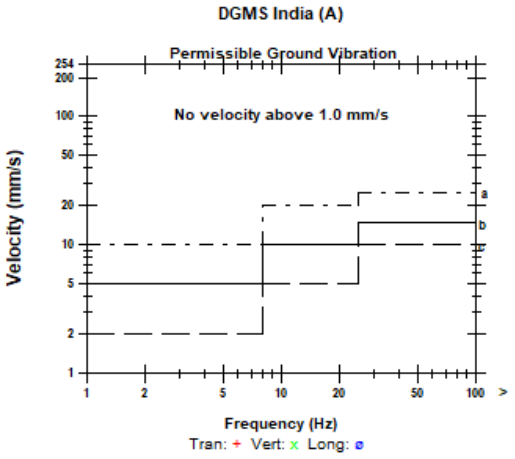
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

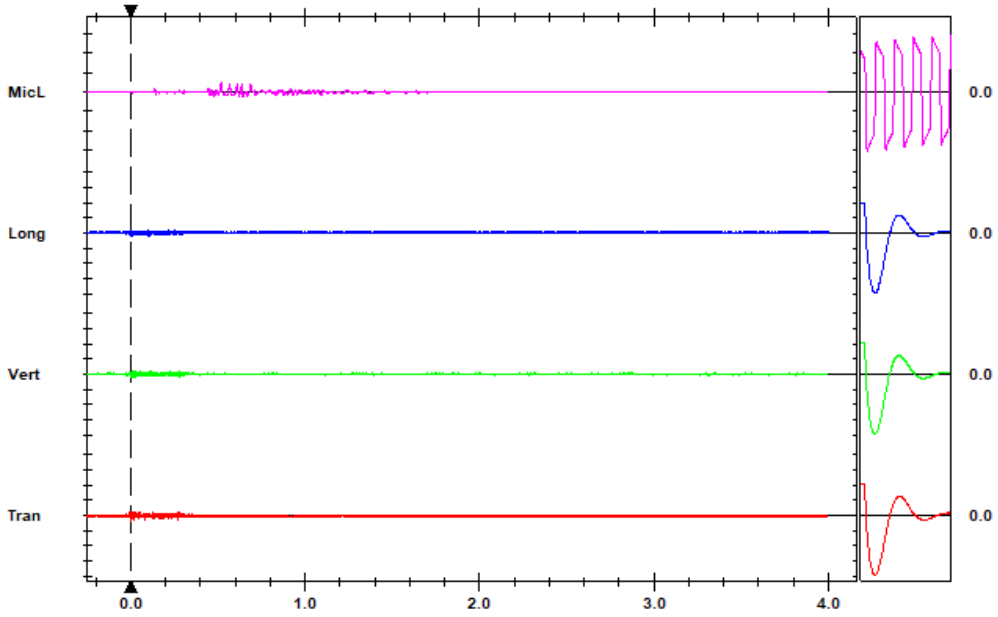
Microphone Linear Weighting
PSPL 107.0 dB(L) at 0.519 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.762	0.508	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	0.004	0.000	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 0.861 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

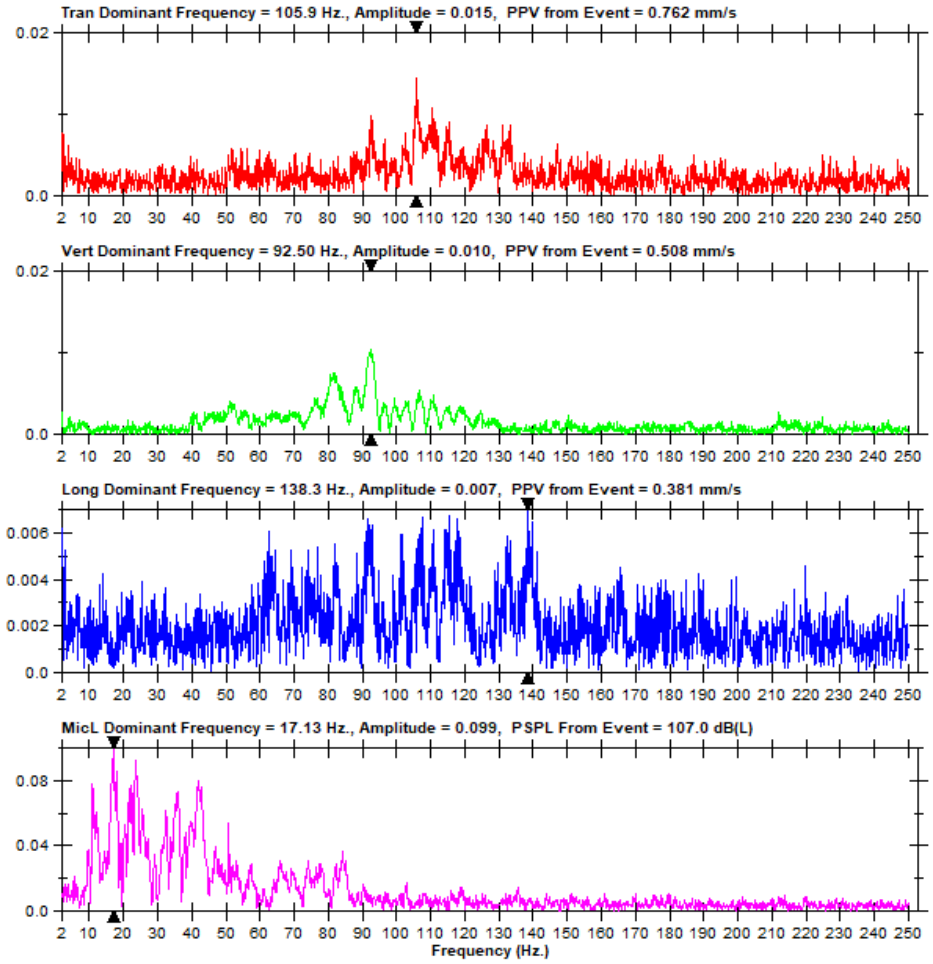
FFT Report

Date/Time	Tran at 10:04:19 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG3.Z70

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 154 m



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Event Report

Date/Time Vert at 10:04:24 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG3.ZC0
Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 105 m

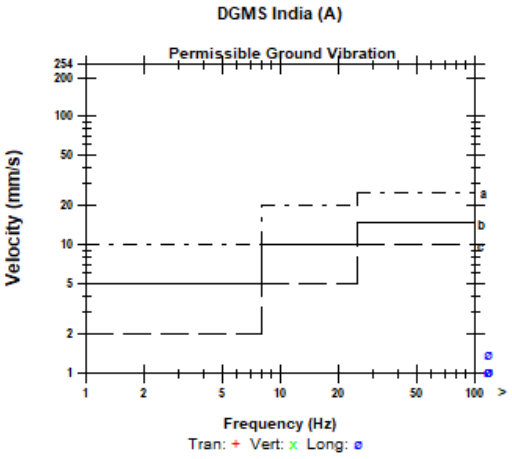
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

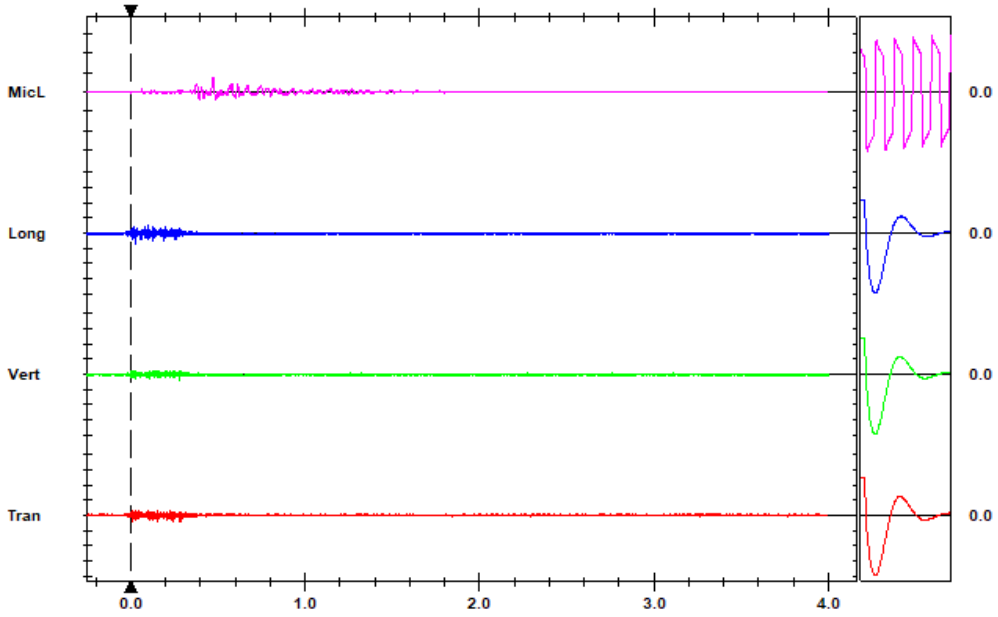
Microphone Linear Weighting
PSPL 111.8 dB(L) at 0.474 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 500 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	1.397	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.011	0.282	0.028	sec
Peak Acceleration	0.093	0.066	0.093	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.508 mm/s at 0.027 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

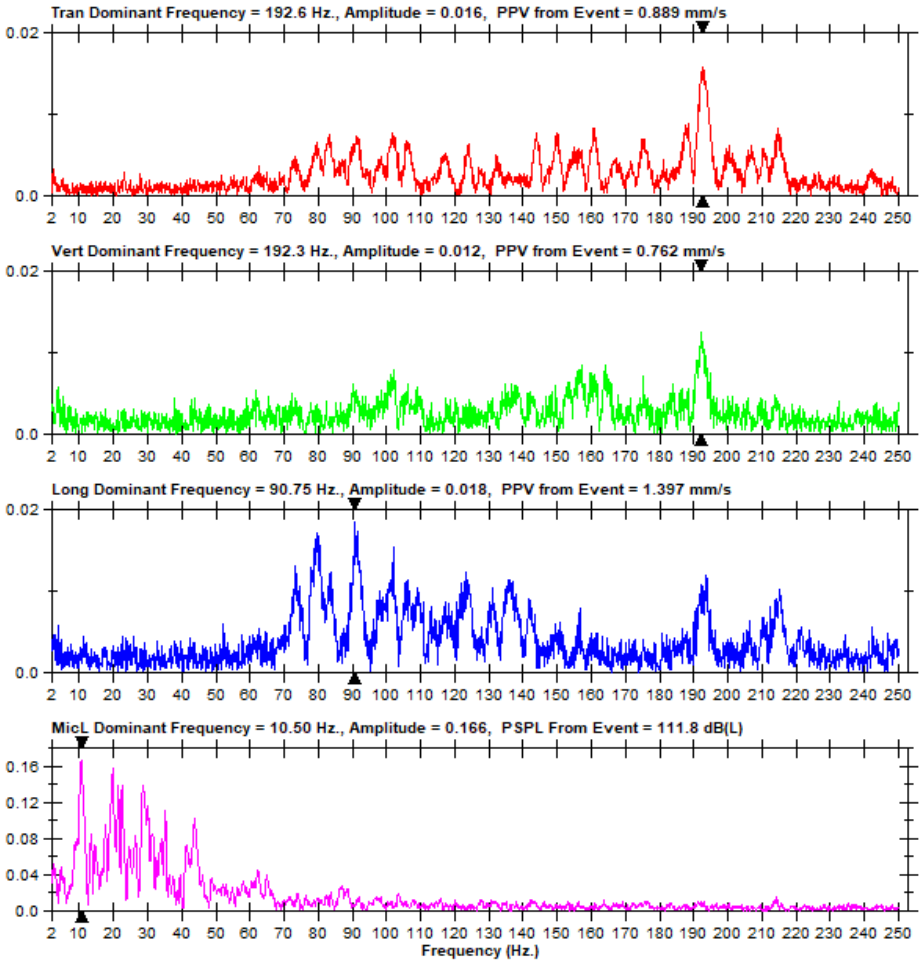
FFT Report

Date/Time	Vert at 10:04:24 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG3.ZC0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 105 m



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Event Report

Date/Time Long at 10:04:23 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG3.ZB0
Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 150 m

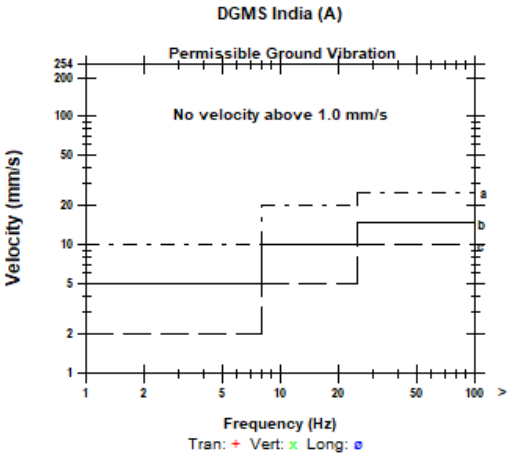
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

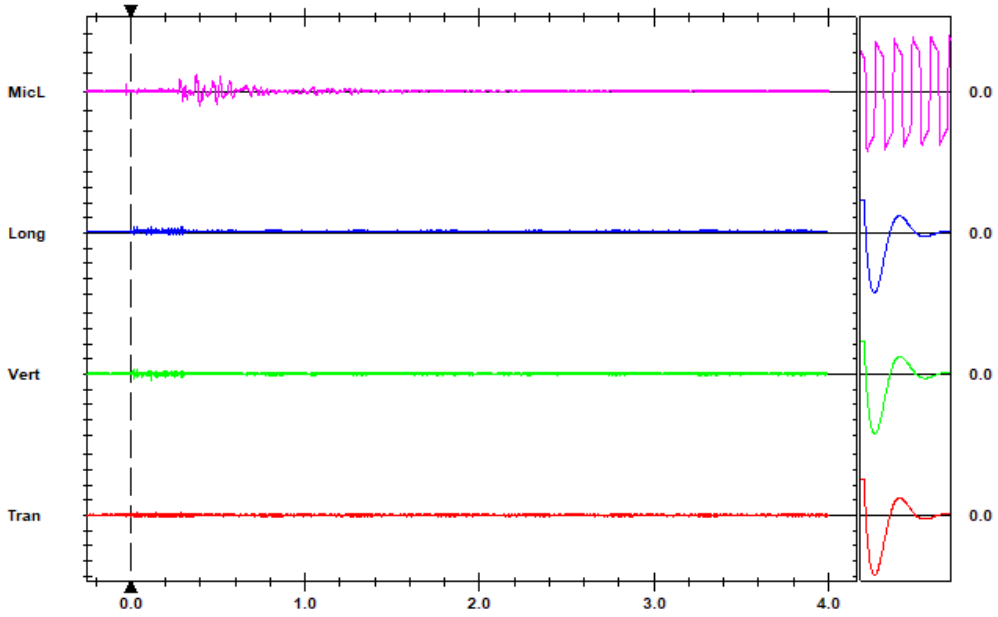
Microphone Linear Weighting
PSPL 113.3 dB(L) at 0.376 sec
ZC Freq 23 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.381	0.762	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.035	0.116	0.036	sec
Peak Acceleration	0.053	0.080	0.066	g
Peak Displacement	0.000	0.001	0.024	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 1.000 mm/s at 0.018 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

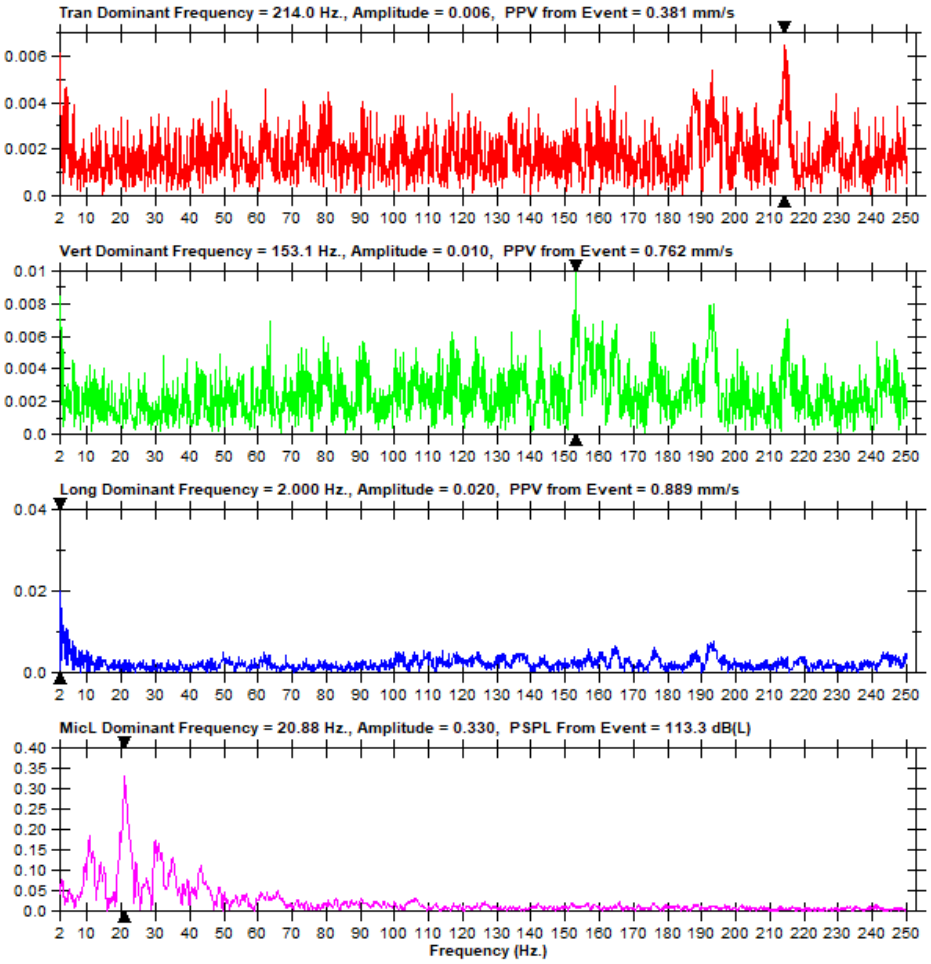
FFT Report

Date/Time	Long at 10:04:23 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG3.ZB0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 2.4 m, Charge/holes - 0.575 Kg, MCPD - 0.570 Kg, Total Charge - 11.50 Kg, Distance - 150 m



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Event Report

Date/Time Tran at 10:08:37 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.6D0
Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 94 m

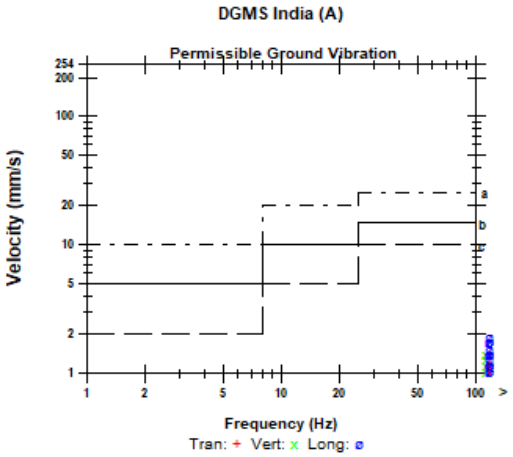
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

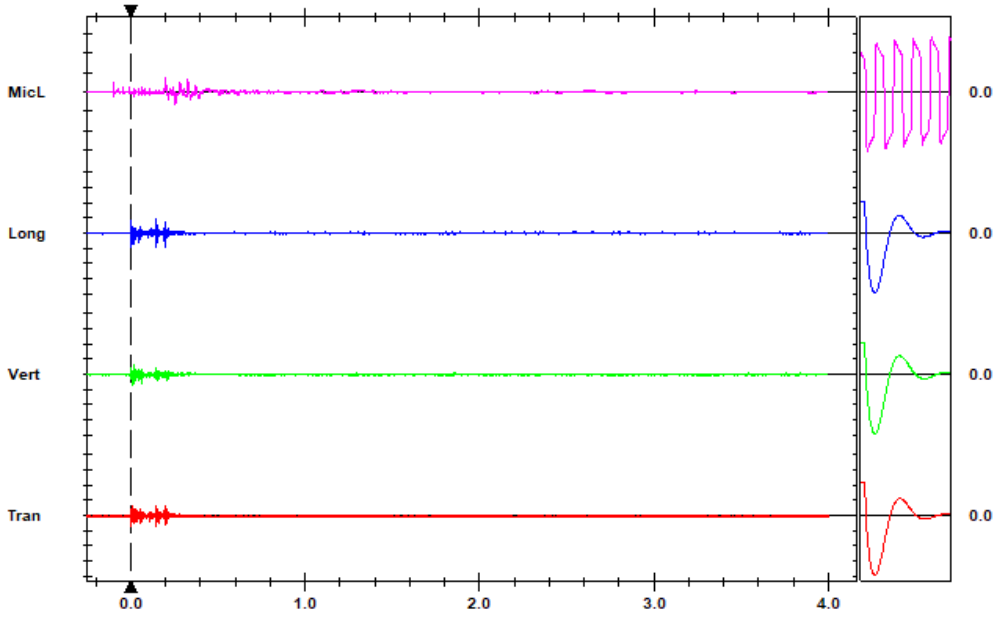
Microphone Linear Weighting
PSPL 110.9 dB(L) at 0.200 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	1.397	1.397	1.905	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.005	0.015	0.145	sec
Peak Acceleration	0.186	0.119	0.225	g
Peak Displacement	0.001	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 2.293 mm/s at 0.146 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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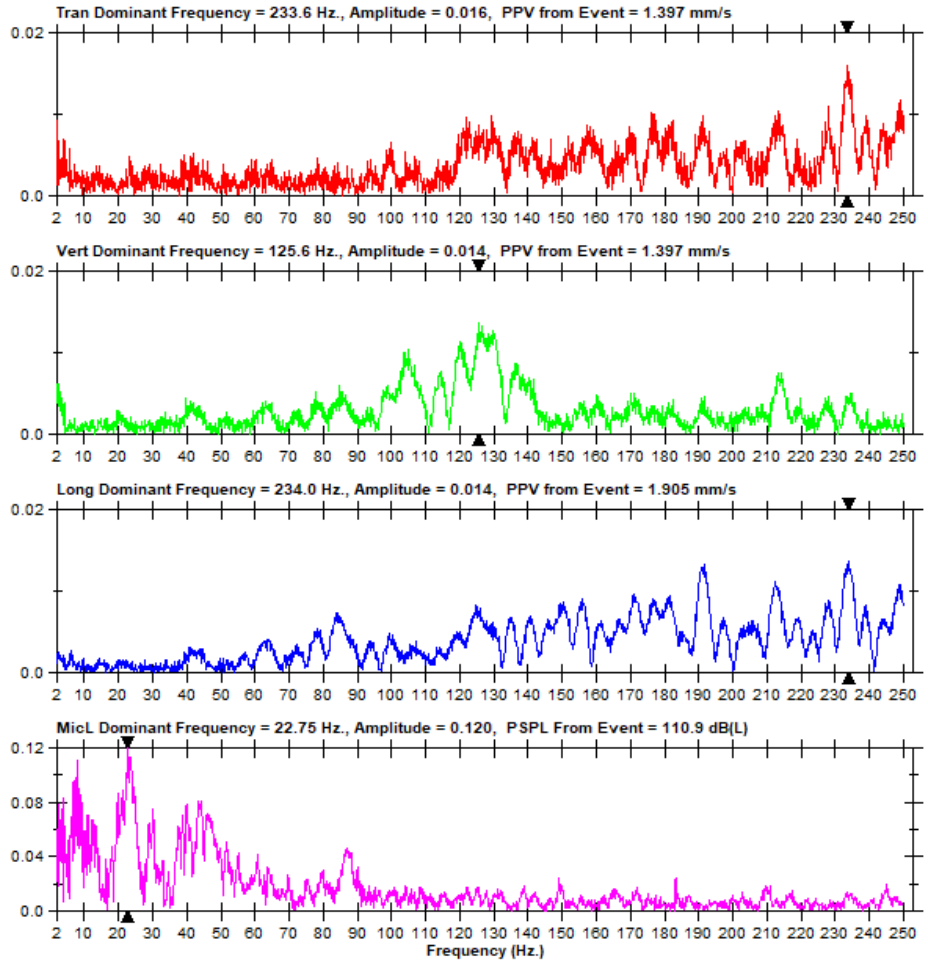
FFT Report

Date/Time	Tran at 10:08:37 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.6D0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 94 m



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Event Report

Date/Time Tran at 10:08:33 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.690
Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 182 m

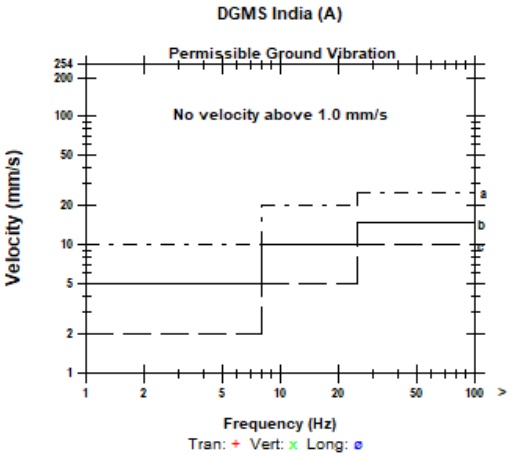
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

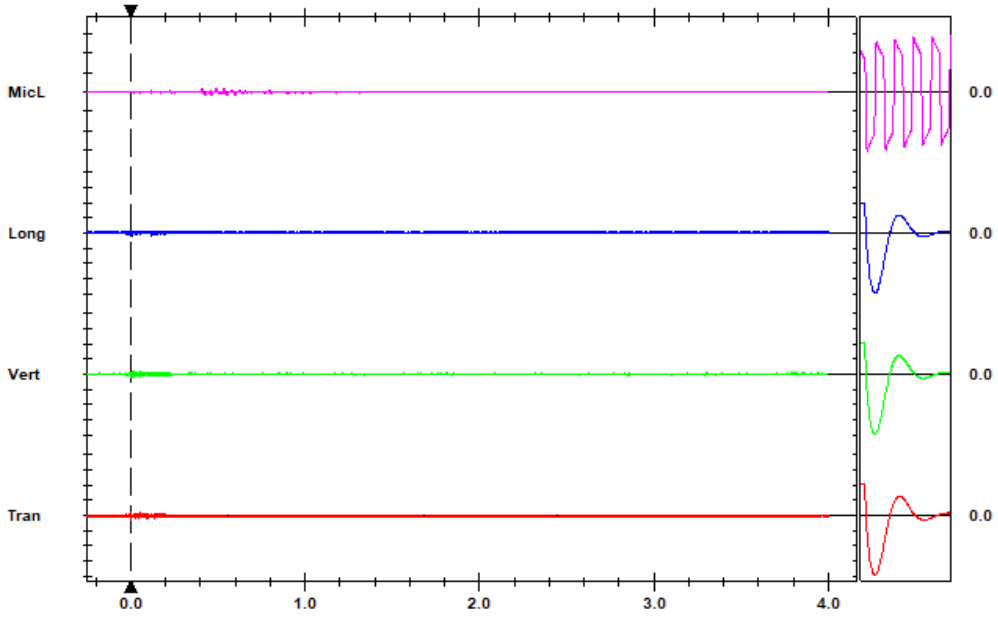
Microphone Linear Weighting
PSPL 98.84 dB(L) at 0.409 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.001	0.003	0.005	sec
Peak Acceleration	0.053	0.053	0.027	g
Peak Displacement	0.001	0.001	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 0.741 mm/s at 0.005 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

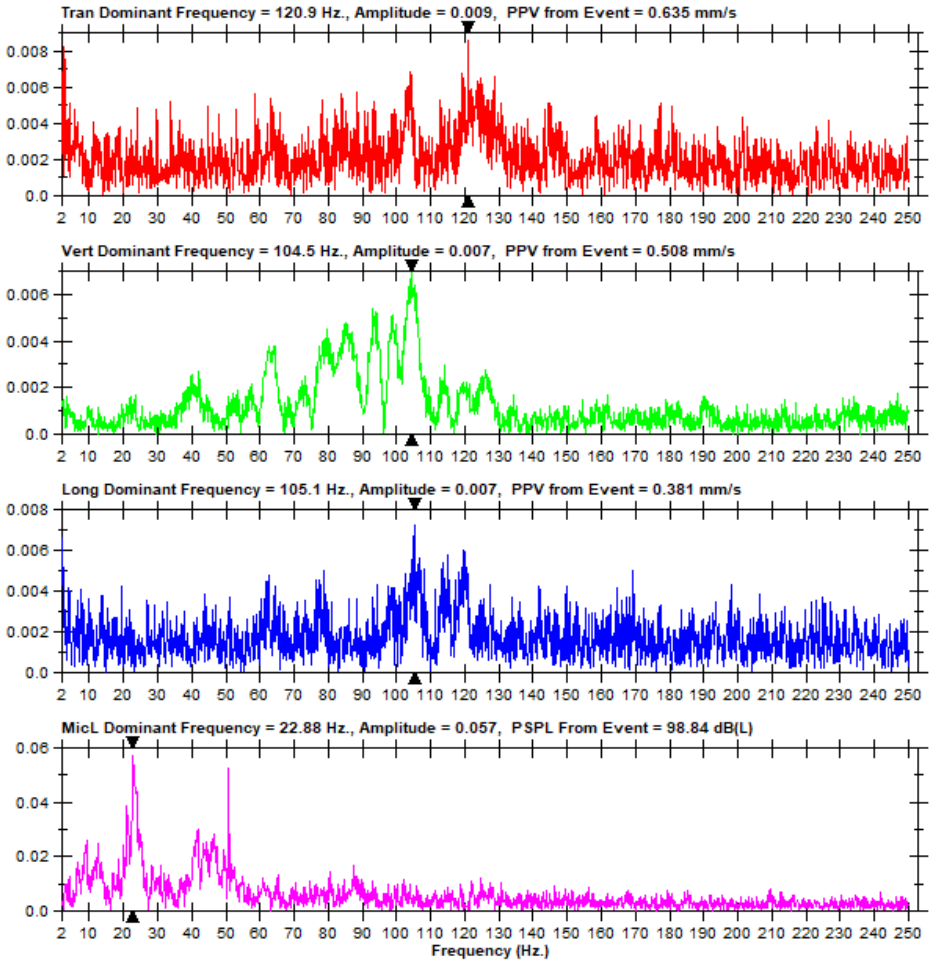
FFT Report

Date/Time	Tran at 10:08:33 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.690

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 182 m



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Event Report

Date/Time Long at 10:08:38 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.6E0
Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 100 m

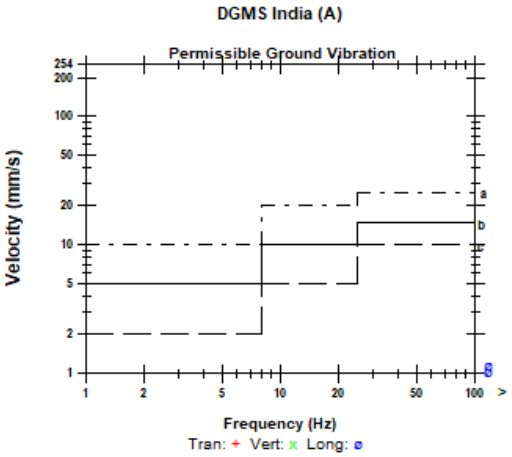
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

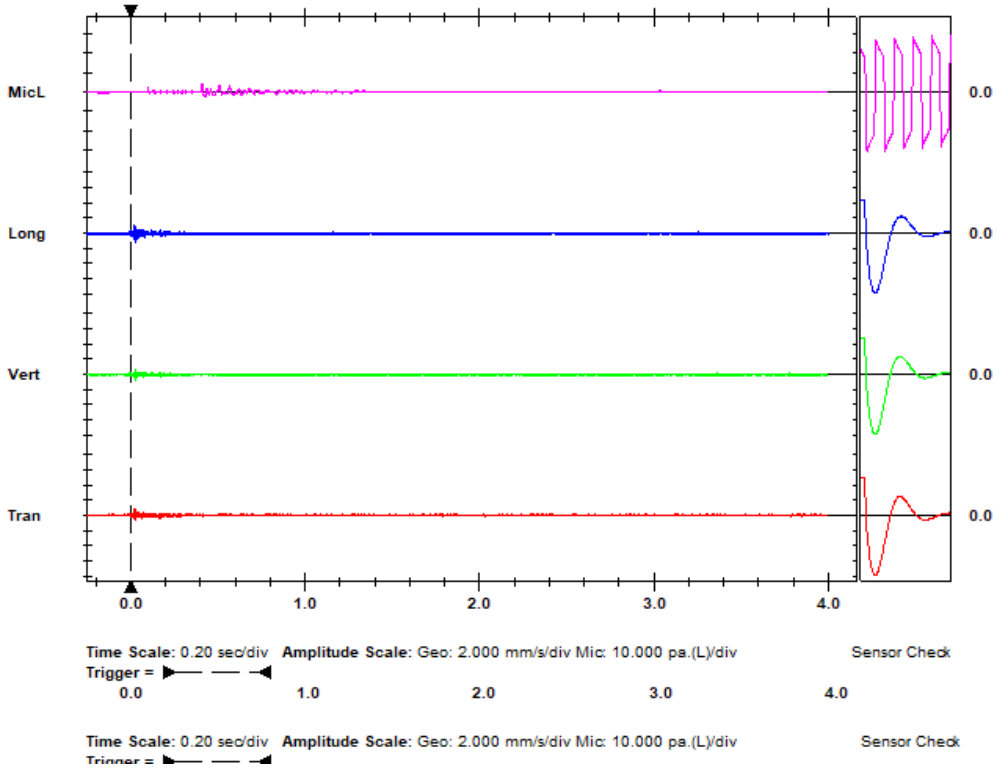
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 106.0 dB(L) at 0.409 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 462 mv)

	Tran	Vert	Long	
PPV	0.762	0.762	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.023	0.025	0.025	sec
Peak Acceleration	0.066	0.053	0.080	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.465 mm/s at 0.025 sec





Instantel

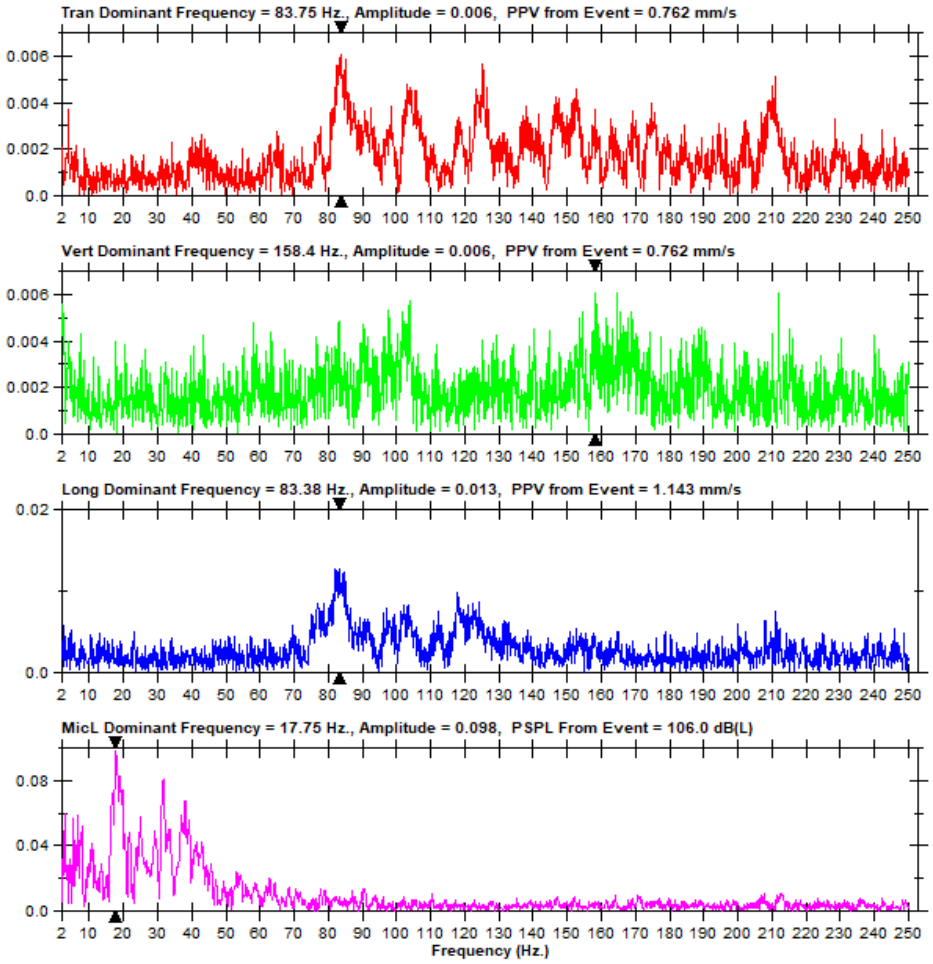
FFT Report

Date/Time	Long at 10:08:38 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.6E0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 100 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 10:08:37 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

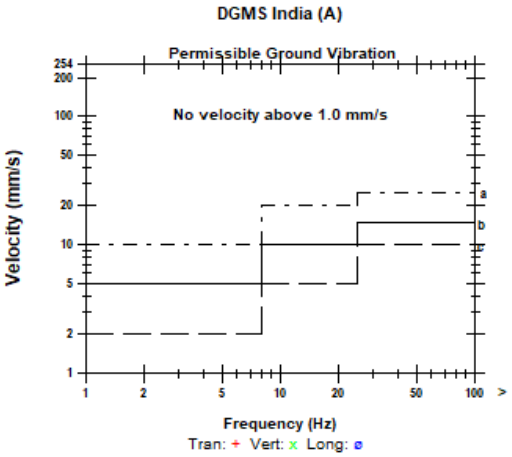
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 112.0 dB(L) at 0.391 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

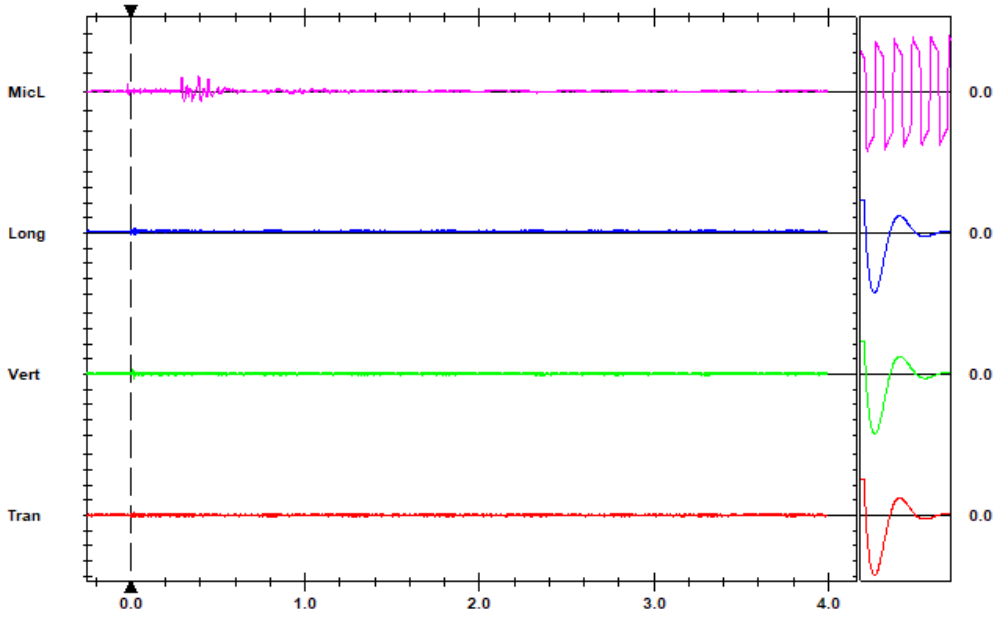
	Tran	Vert	Long	
PPV	0.508	0.635	0.635	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.017	0.015	0.017	sec
Peak Acceleration	0.040	0.066	0.053	g
Peak Displacement	0.000	0.001	0.034	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.823 mm/s at 0.017 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.6D0
Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 145 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

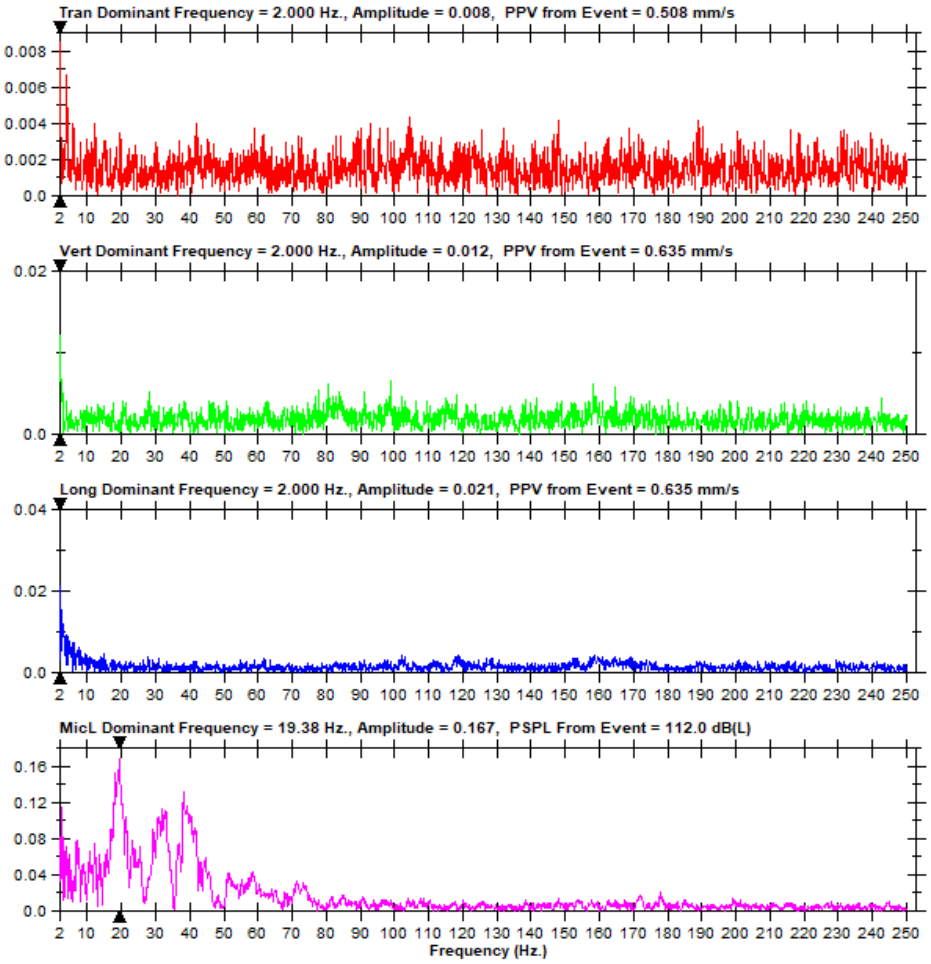
FFT Report

Date/Time	Long at 10:08:37 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.6D0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 8, Hole Depth - 2.2 m, Charge/holes - 0.575 Kg, MCPD - 0.575 Kg, Total Charge - 4.60 Kg, Distance - 145 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:10:54 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.A60
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 75 m

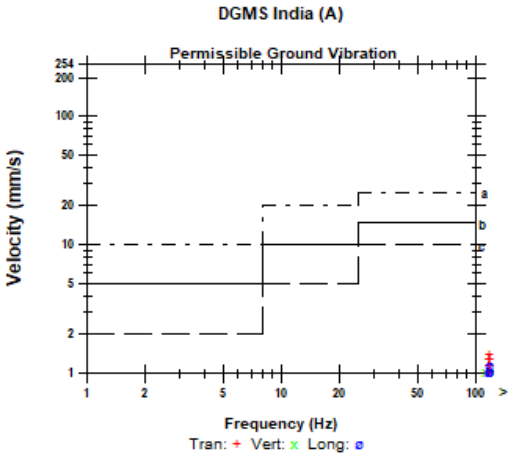
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

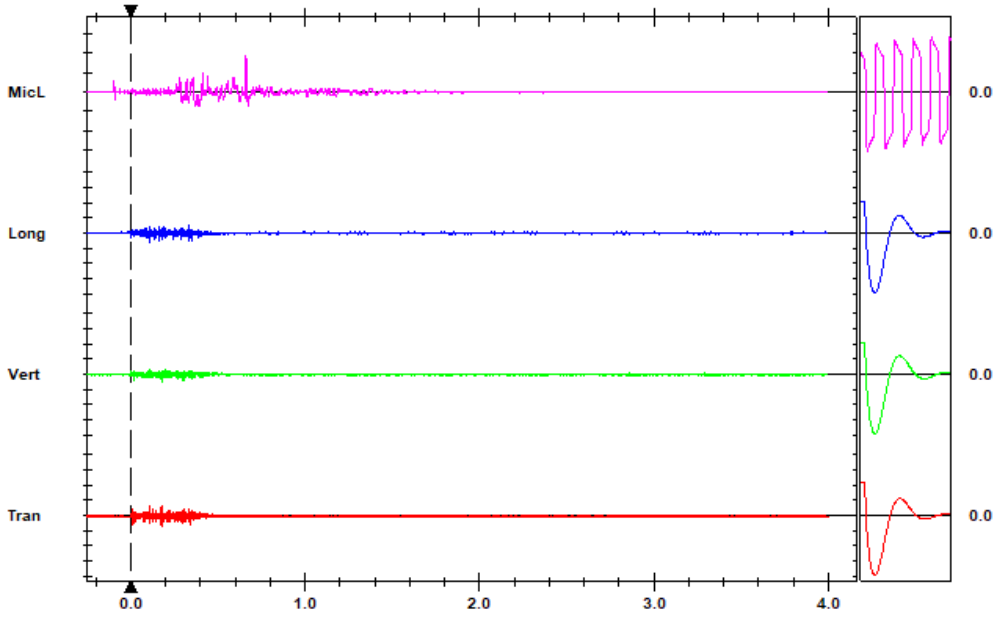
Microphone Linear Weighting
PSPL 119.6 dB(L) at 0.661 sec
ZC Freq 85 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	1.397	1.016	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.181	0.183	0.108	sec
Peak Acceleration	0.133	0.093	0.133	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 1.737 mm/s at 0.108 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

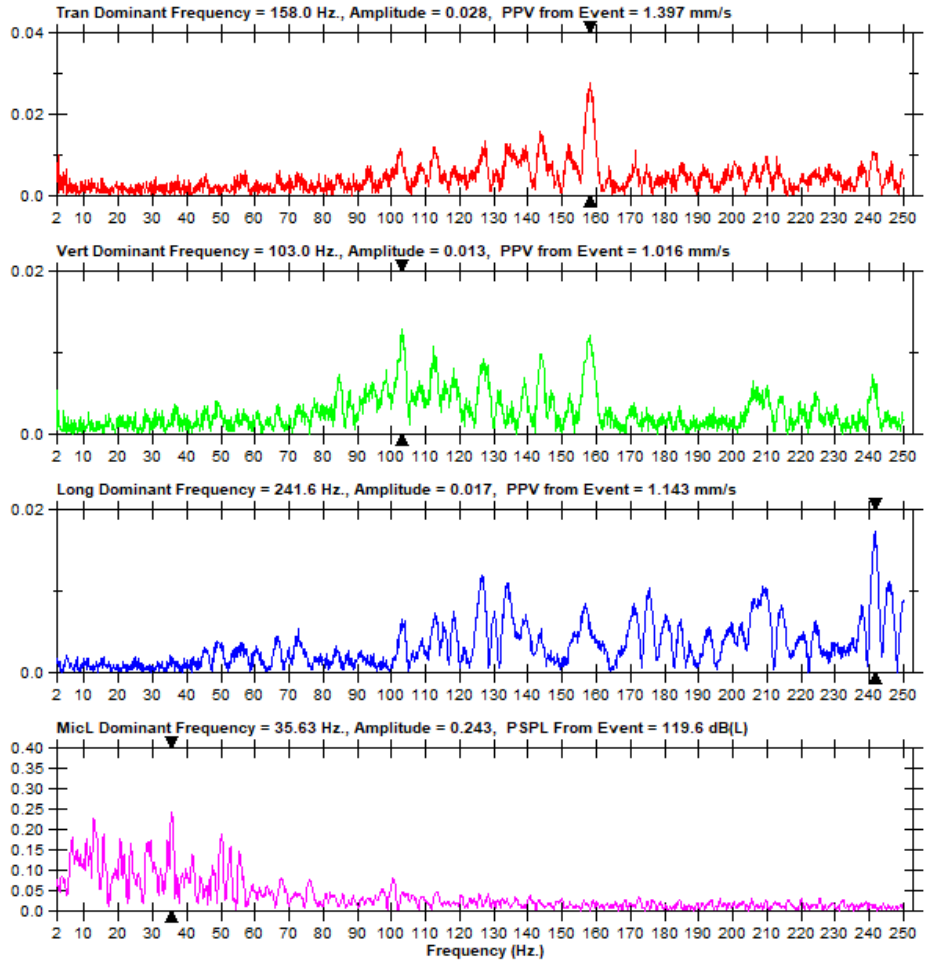
FFT Report

Date/Time	Long at 10:10:54 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.A60

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 75 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 10:10:50 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.A20
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 166 m

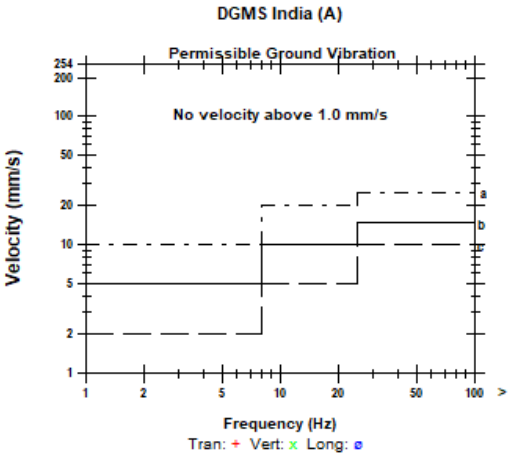
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

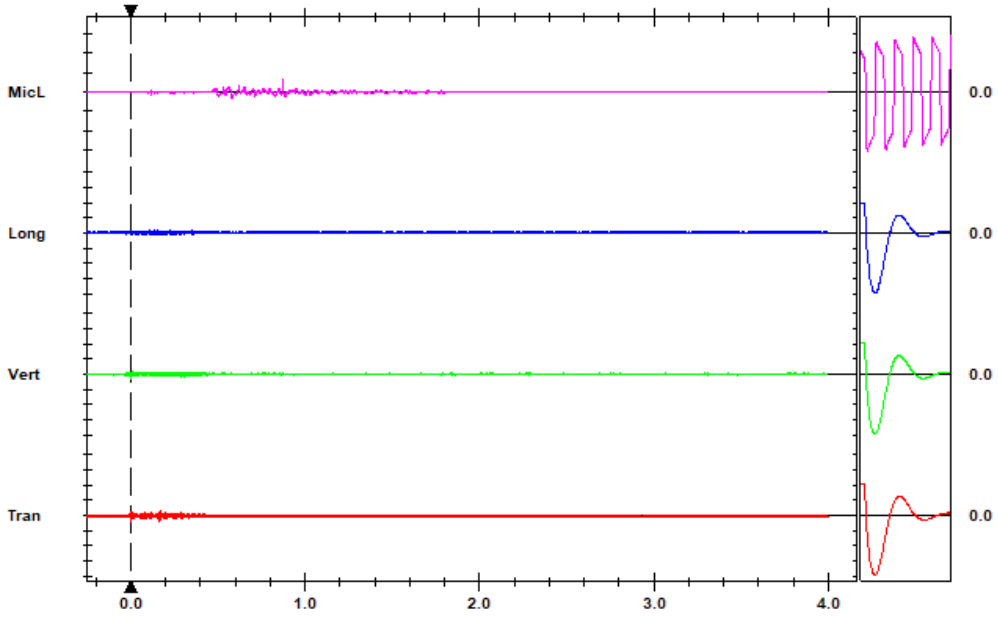
Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.872 sec
ZC Freq 64 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.001	0.005	0.109	sec
Peak Acceleration	0.053	0.027	0.040	g
Peak Displacement	0.001	0.001	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 0.813 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

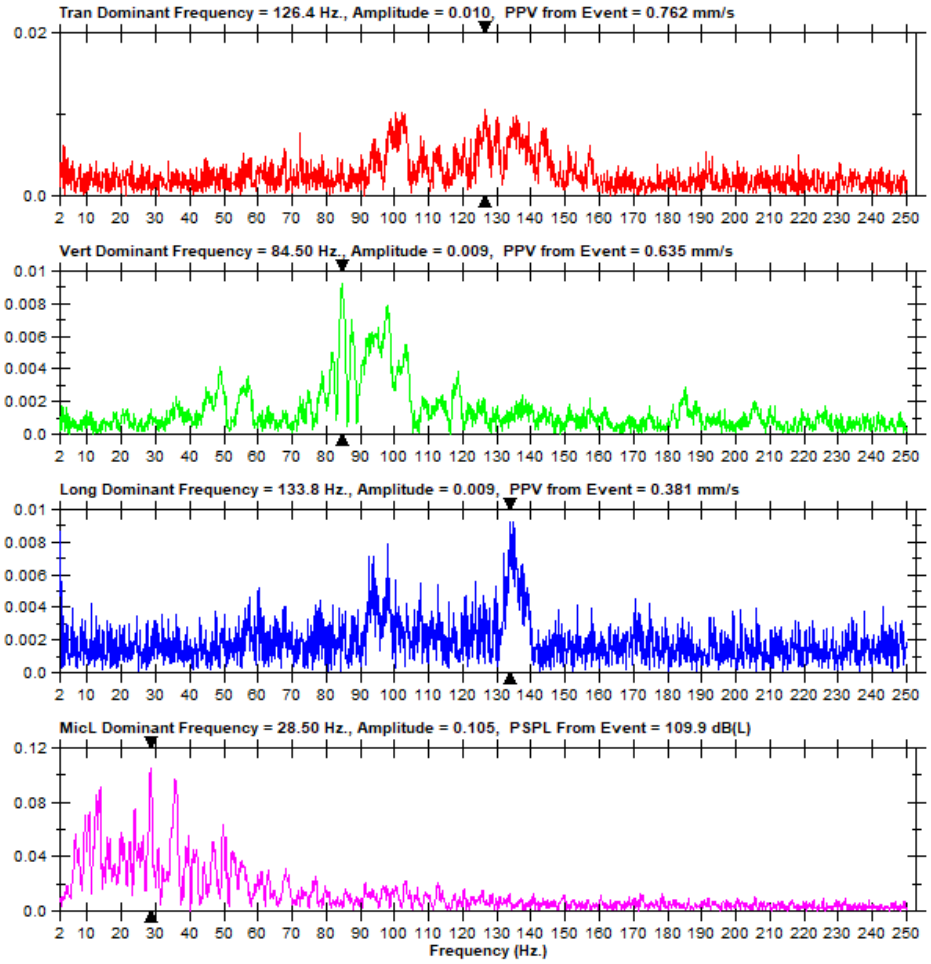
FFT Report

Date/Time	Tran at 10:10:50 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.A20

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 166 m



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Event Report

Date/Time Long at 10:10:55 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.A70
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 105 m

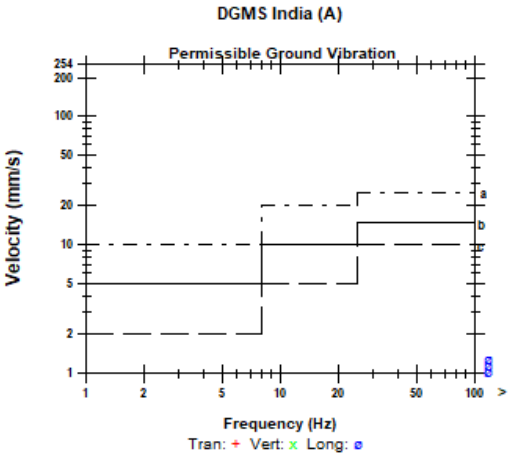
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

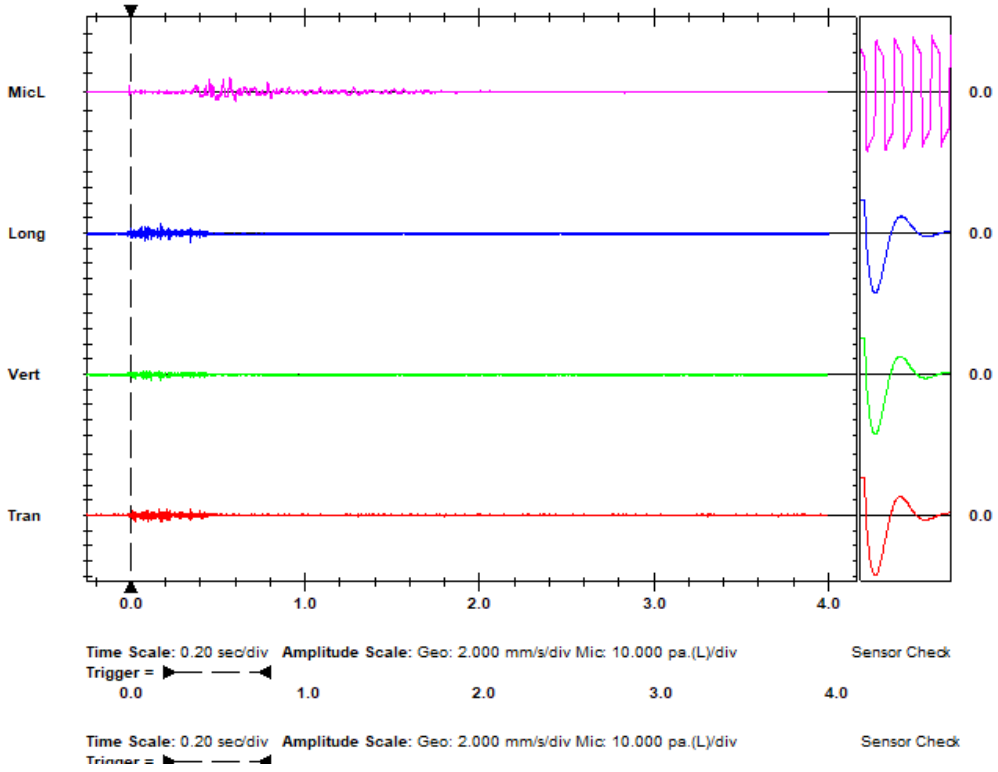
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 110.9 dB(L) at 0.571 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	1.270	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.099	0.118	0.169	sec
Peak Acceleration	0.106	0.053	0.119	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.571 mm/s at 0.169 sec





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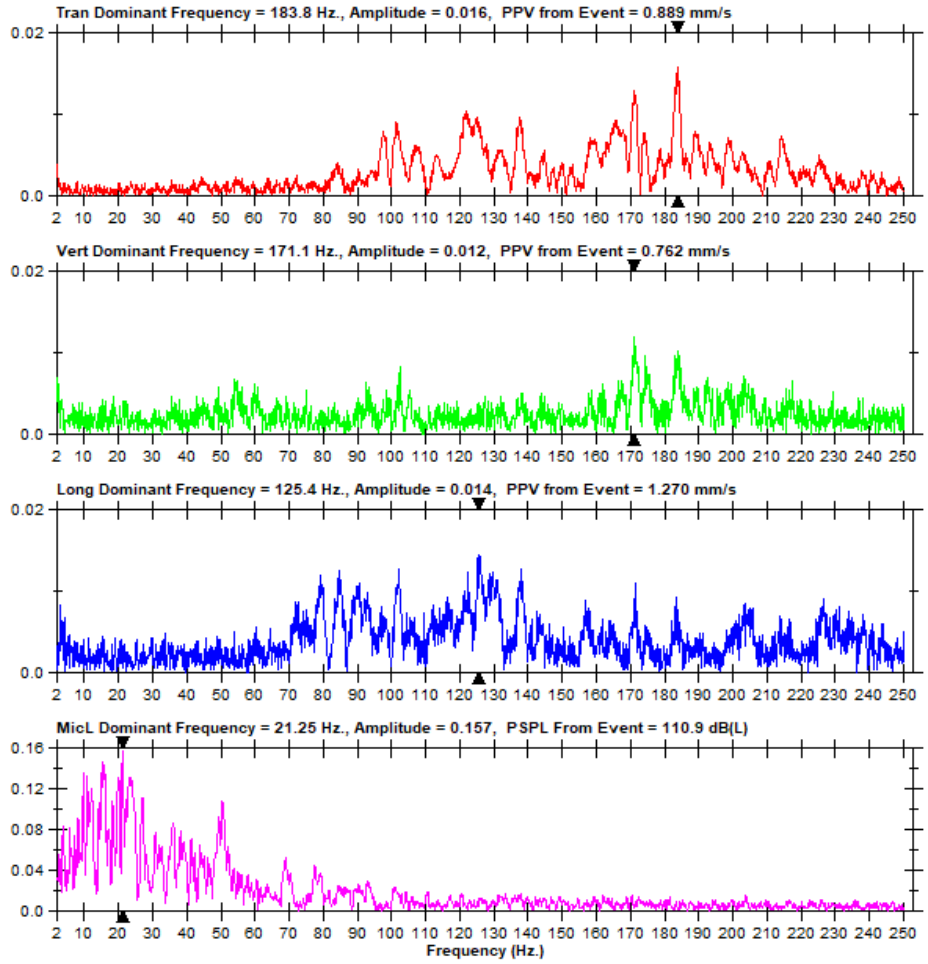
FFT Report

Date/Time	Long at 10:10:55 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.A70

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 105 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:10:54 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.A60
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 148 m

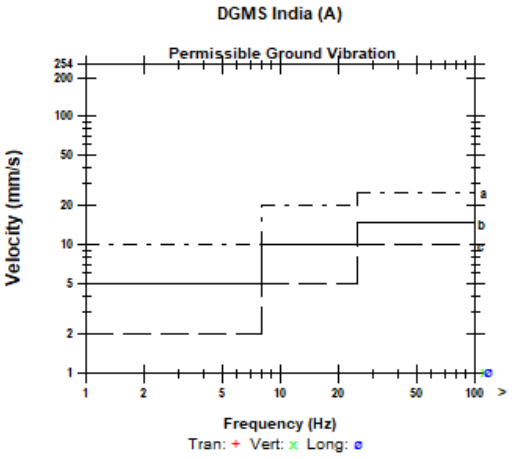
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

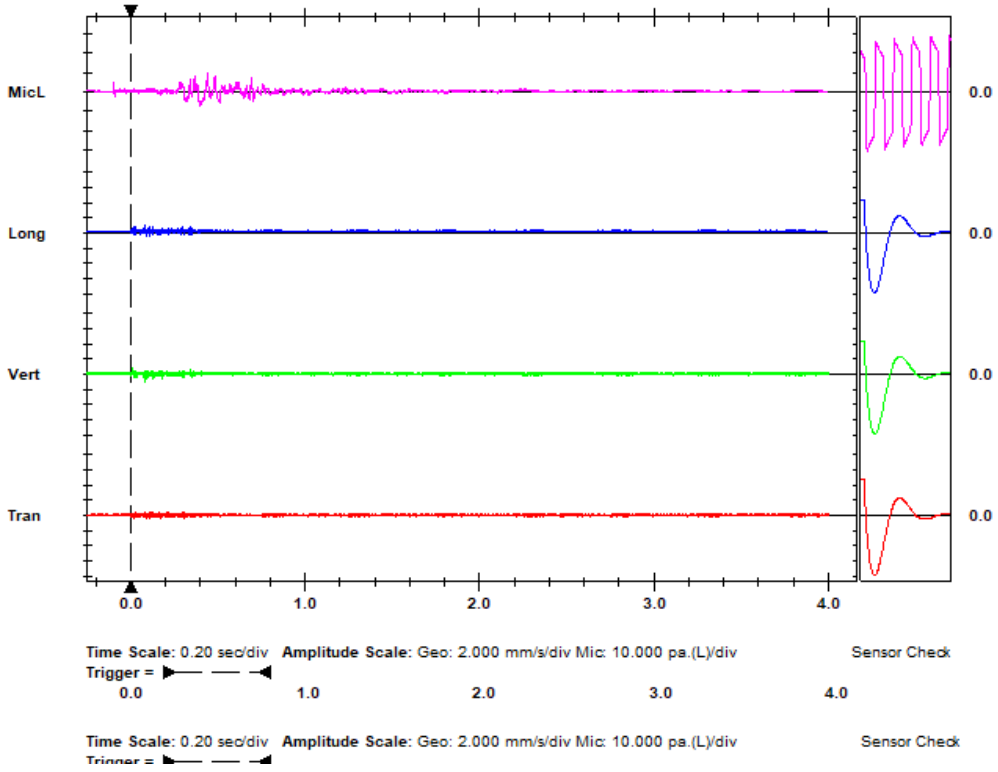
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 113.5 dB(L) at 0.442 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.381	1.016	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.018	0.087	0.086	sec
Peak Acceleration	0.053	0.093	0.106	g
Peak Displacement	0.000	0.001	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 1.136 mm/s at 0.087 sec





Instantel

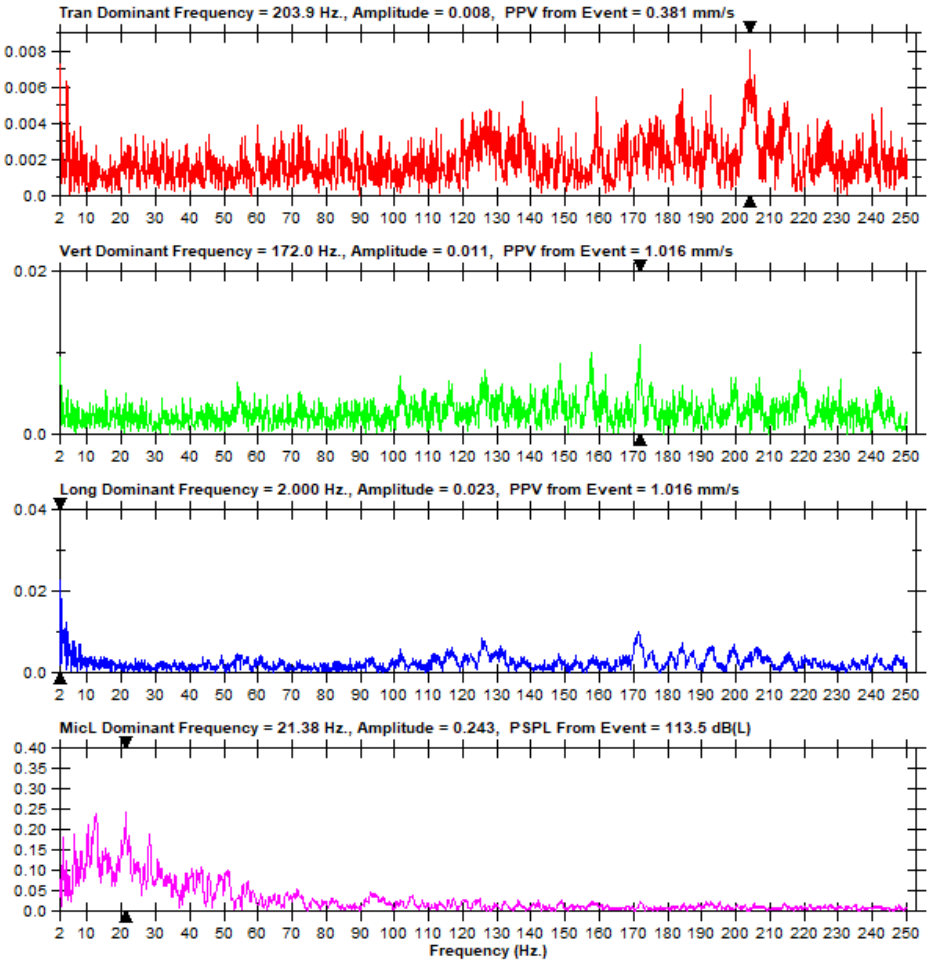
FFT Report

Date/Time	Long at 10:10:54 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.A60

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.2 m, Charge/holes - 0.570 Kg, MCPD - 0.570 Kg, Total Charge - 17.25 Kg, Distance - 148 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:15:05 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.H50
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 50 m

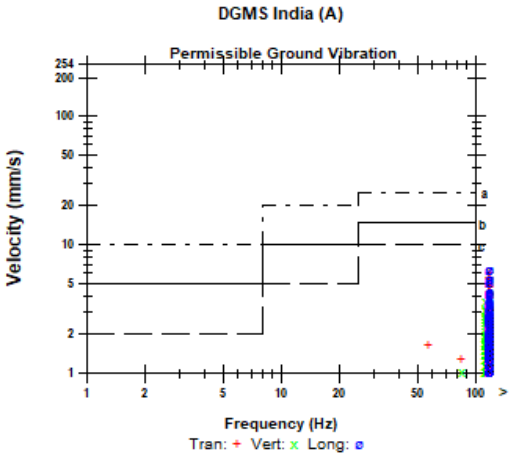
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

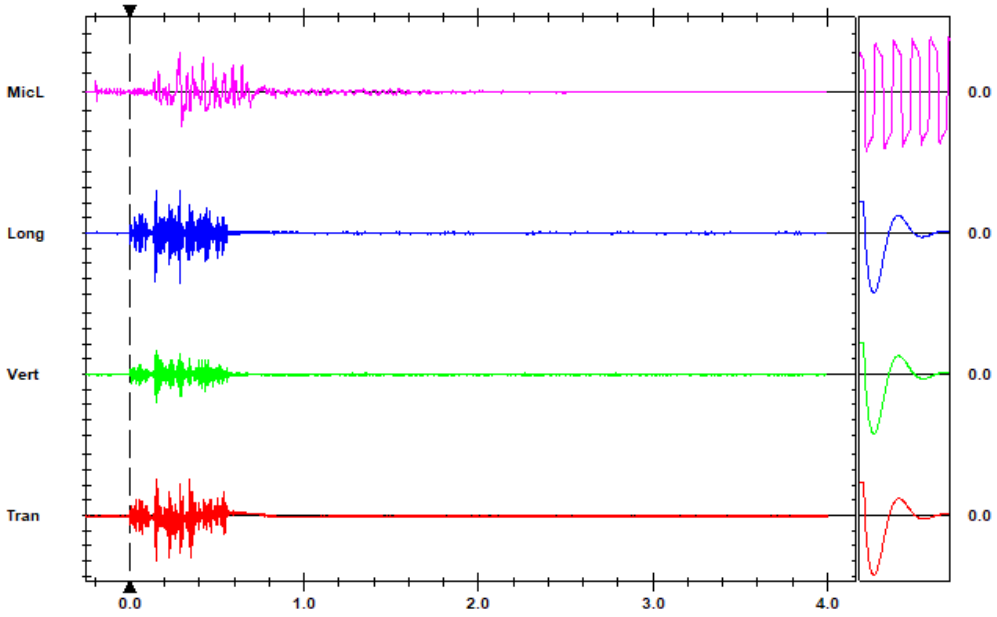
Microphone Linear Weighting
PSPL 120.3 dB(L) at 0.287 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	5.969	3.683	6.477	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.156	0.157	0.288	sec
Peak Acceleration	0.676	0.477	0.848	g
Peak Displacement	0.006	0.003	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 8.210 mm/s at 0.156 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

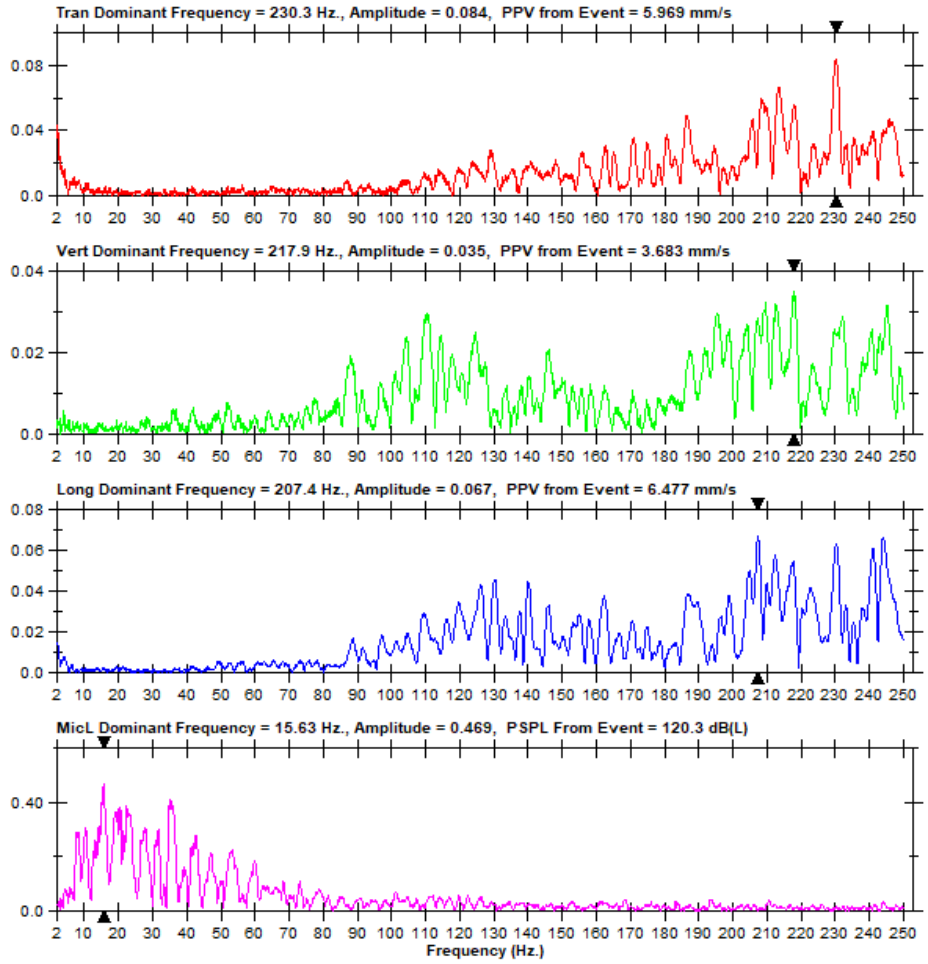
FFT Report

Date/Time	Long at 10:15:05 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.H50

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 50 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:15:01 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.H10
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 035 m

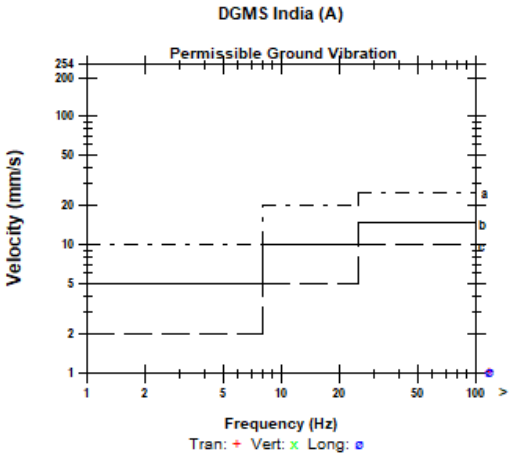
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

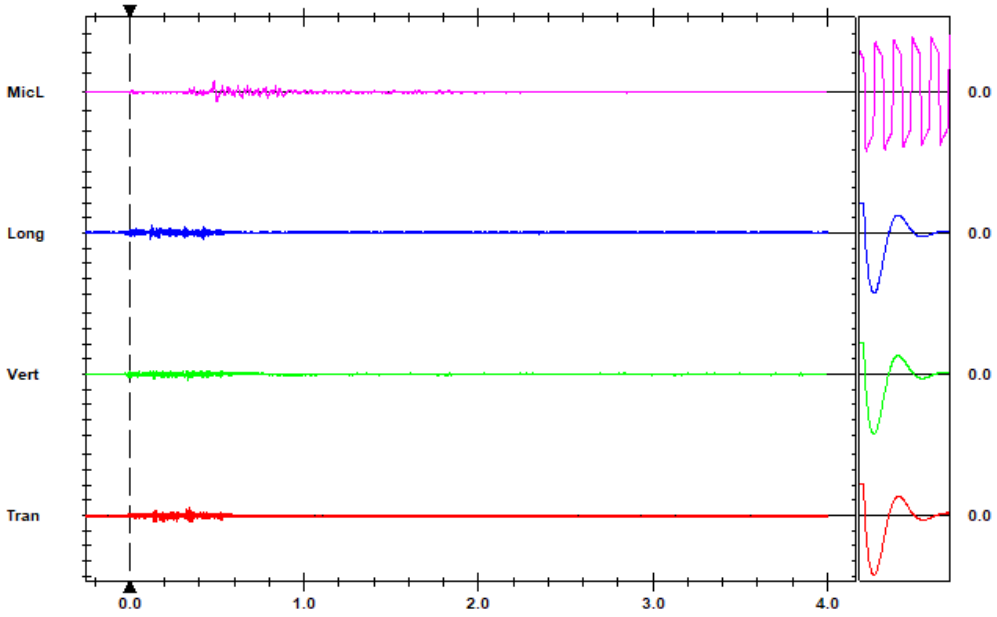
Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.482 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	1.016	0.889	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.346	0.331	0.125	sec
Peak Acceleration	0.106	0.053	0.093	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.092 mm/s at 0.425 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

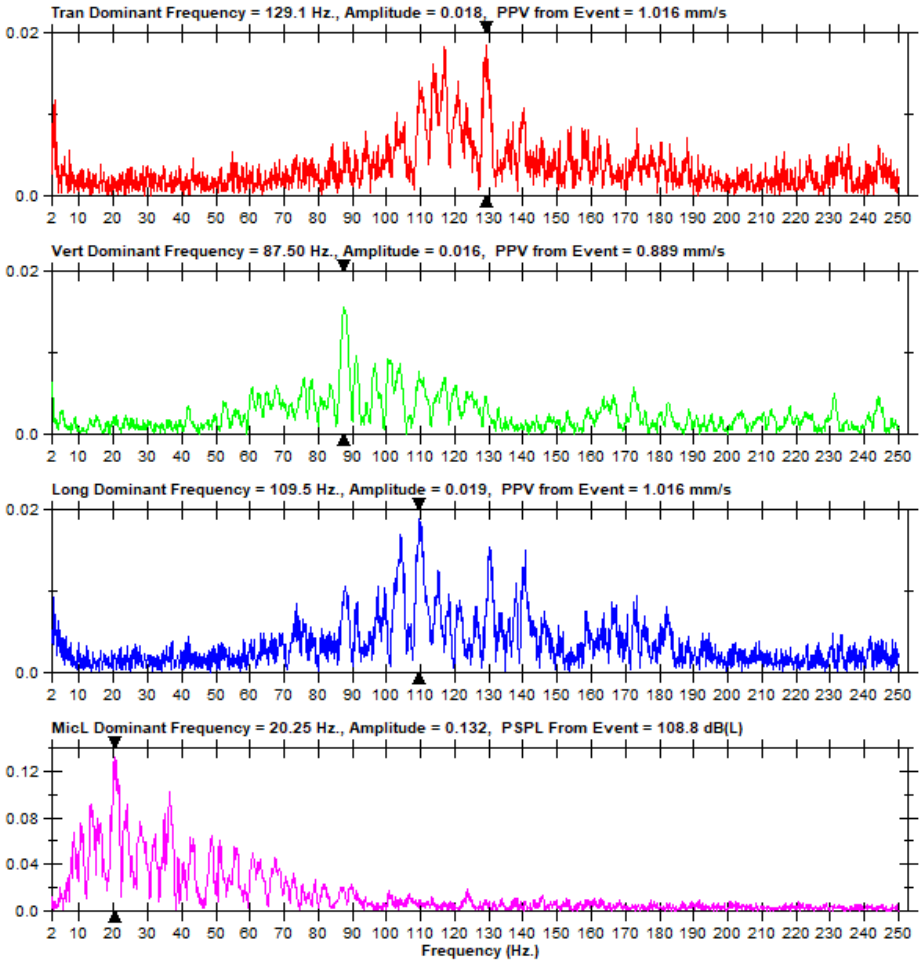
FFT Report

Date/Time	Long at 10:15:01 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.H10

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 035 m



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Event Report

Date/Time Long at 10:15:06 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.H60
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 125 m

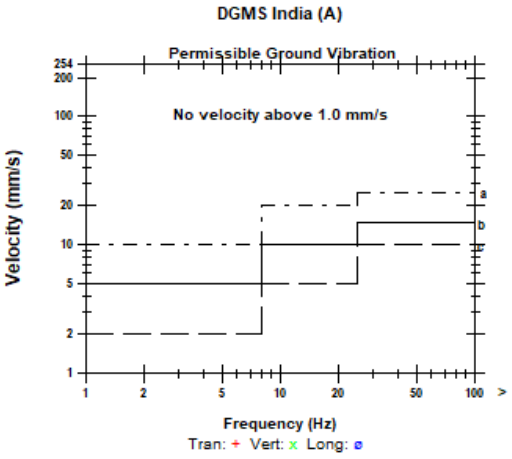
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

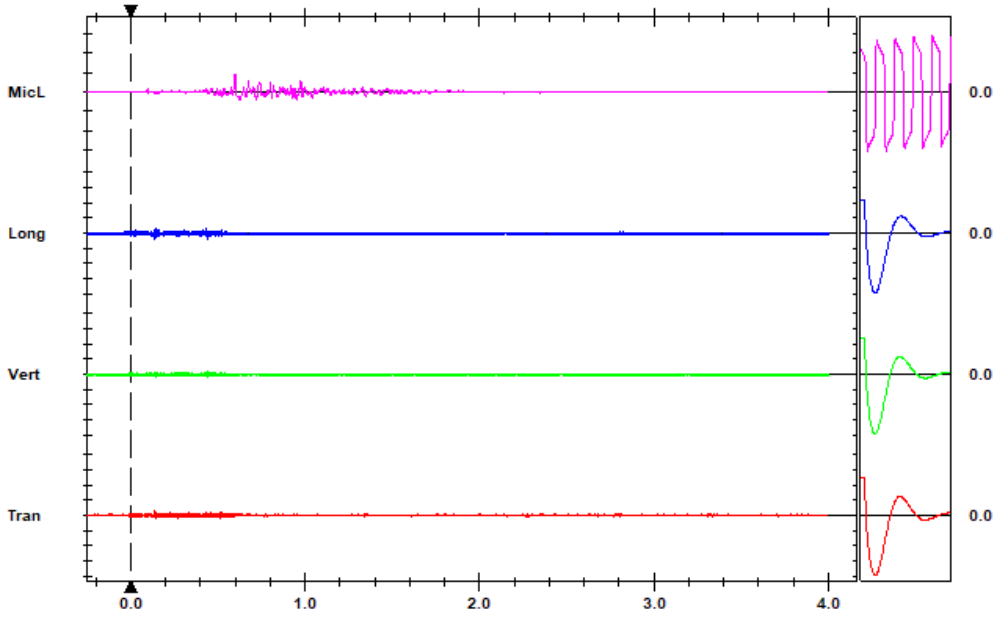
Microphone Linear Weighting
PSPL 113.1 dB(L) at 0.598 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.762	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.141	0.146	0.139	sec
Peak Acceleration	0.053	0.040	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 0.783 mm/s at 0.139 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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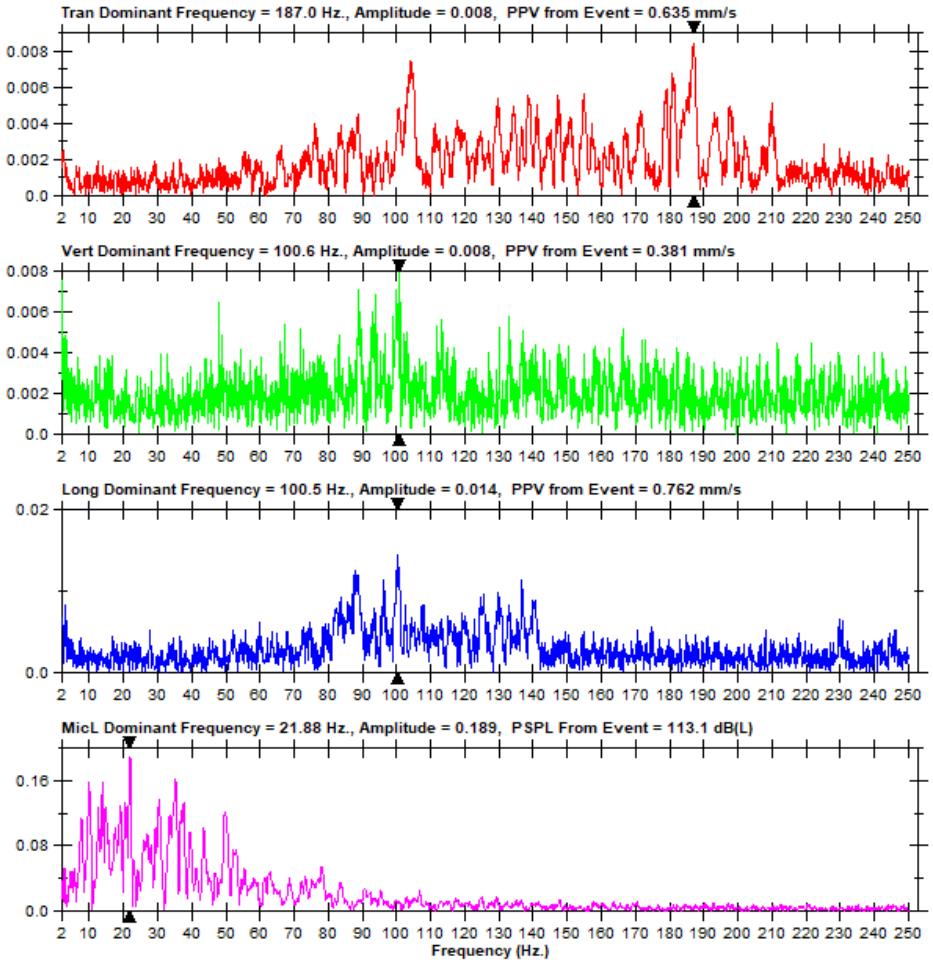
FFT Report

Date/Time	Long at 10:15:06 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.H60

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 125 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:15:05 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.H50
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 175 m

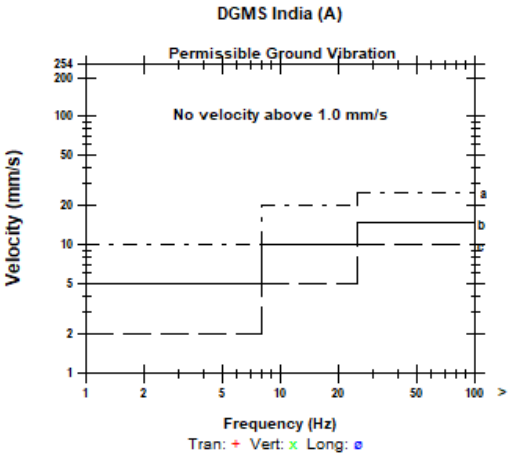
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

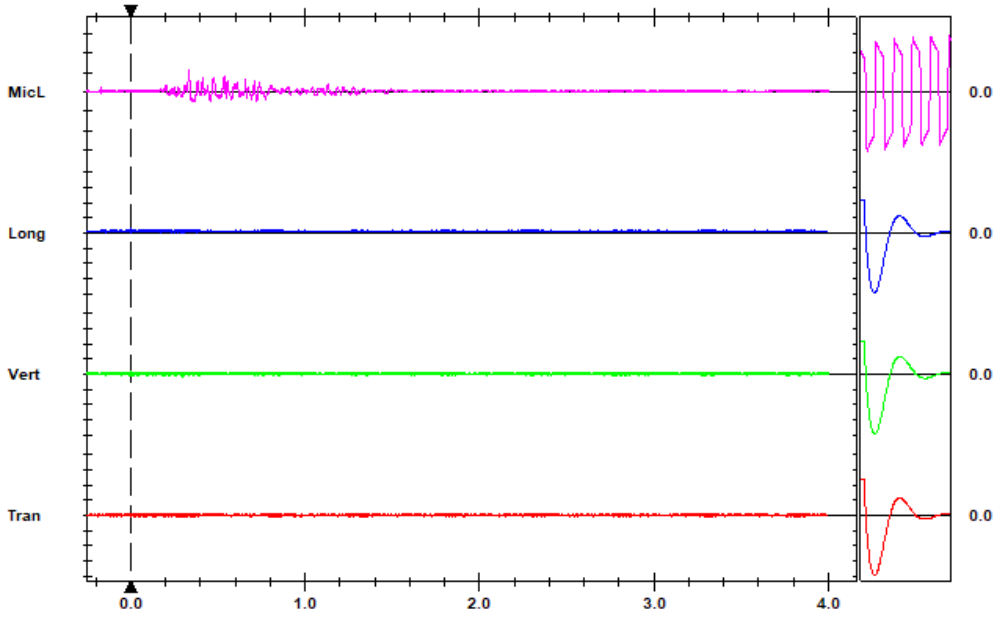
Microphone Linear Weighting
PSPL 115.2 dB(L) at 0.334 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.254	0.381	0.635	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	-0.097	-0.002	0.001	sec
Peak Acceleration	0.027	0.040	0.040	g
Peak Displacement	0.000	0.000	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.648 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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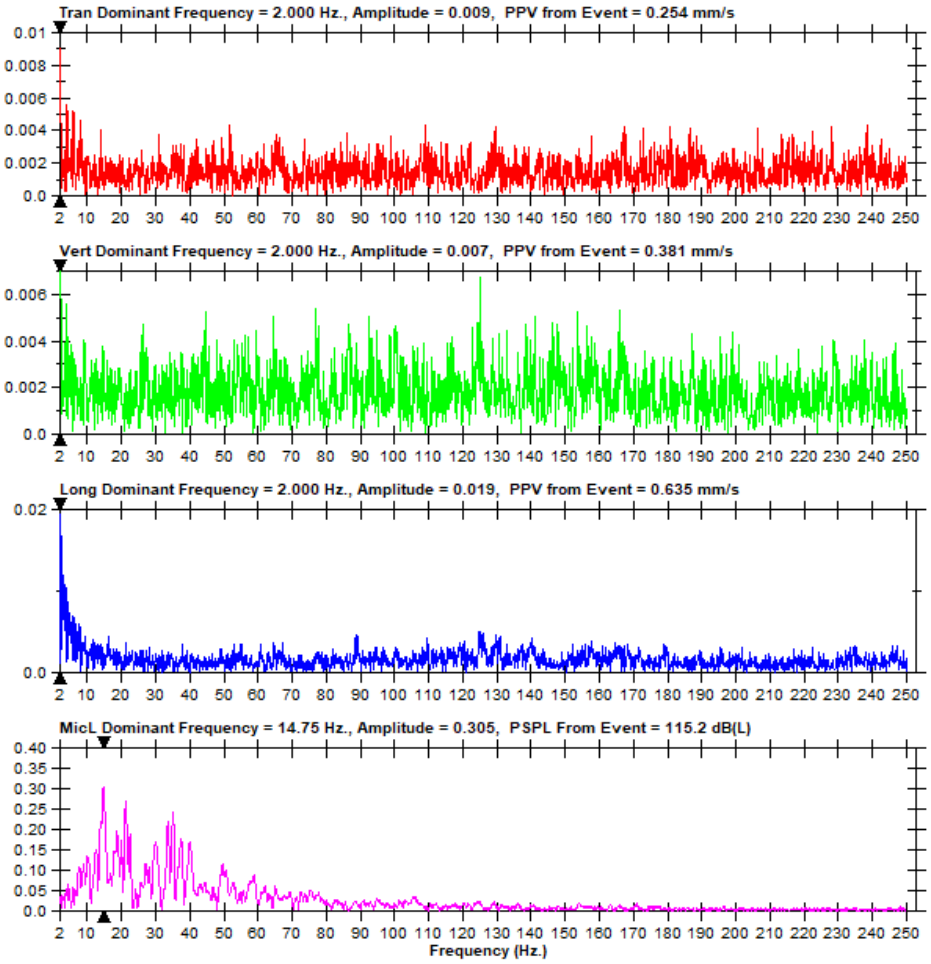
FFT Report

Date/Time	Long at 10:15:05 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.H50

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 16.00 Kg, Distance - 175 m



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Event Report

Date/Time Long at 10:17:39 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.LF0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 63 m

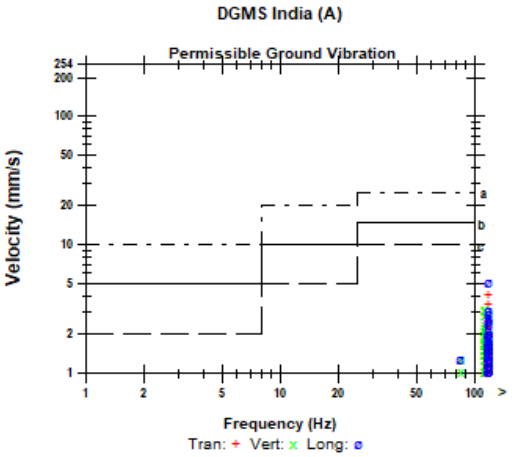
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

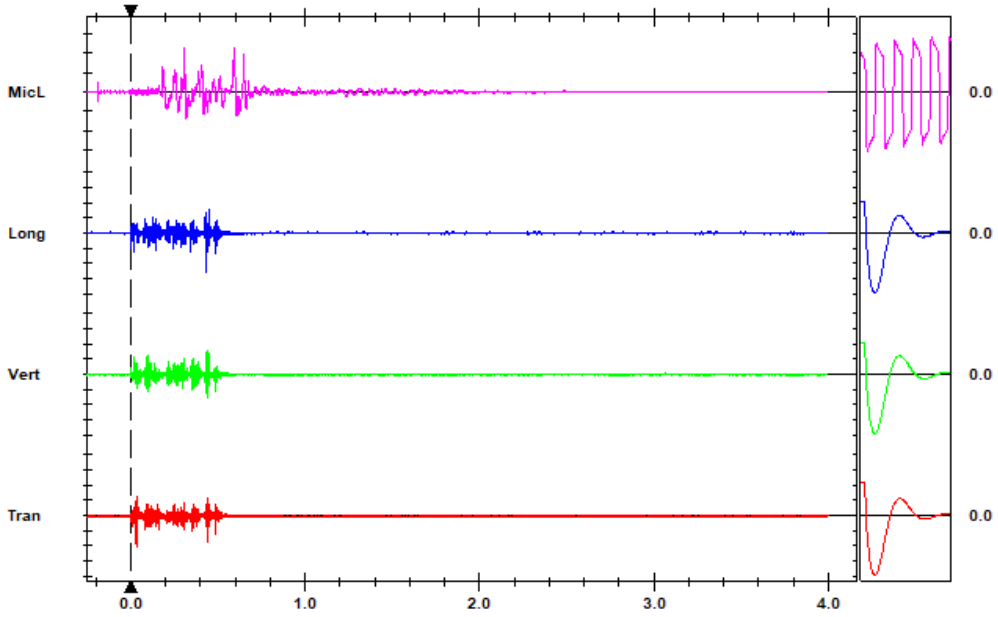
Microphone Linear Weighting
PSPL 121.1 dB(L) at 0.307 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	4.064	3.175	5.080	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.033	0.446	0.430	sec
Peak Acceleration	0.358	0.305	0.451	g
Peak Displacement	0.004	0.004	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 5.680 mm/s at 0.430 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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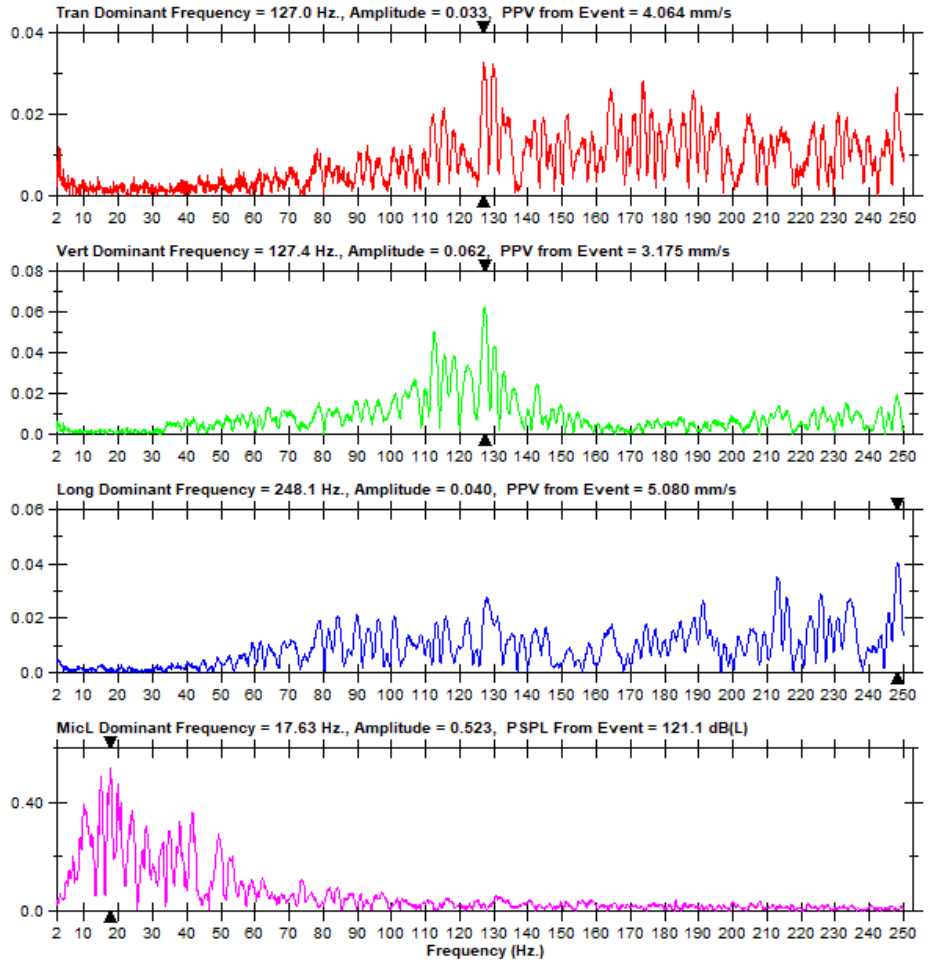
FFT Report

Date/Time	Long at 10:17:39 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.LF0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 63 m



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Event Report

Date/Time Long at 10:17:35 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.LB0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 137 m

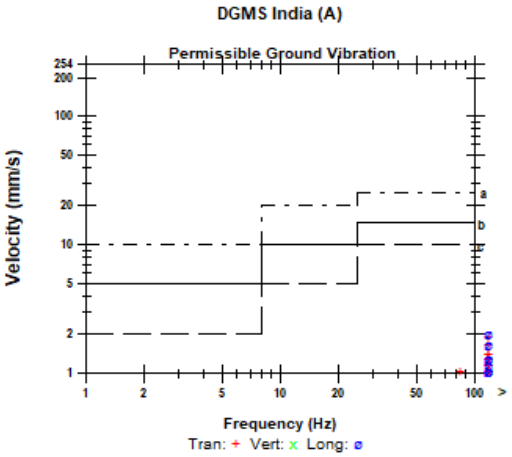
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

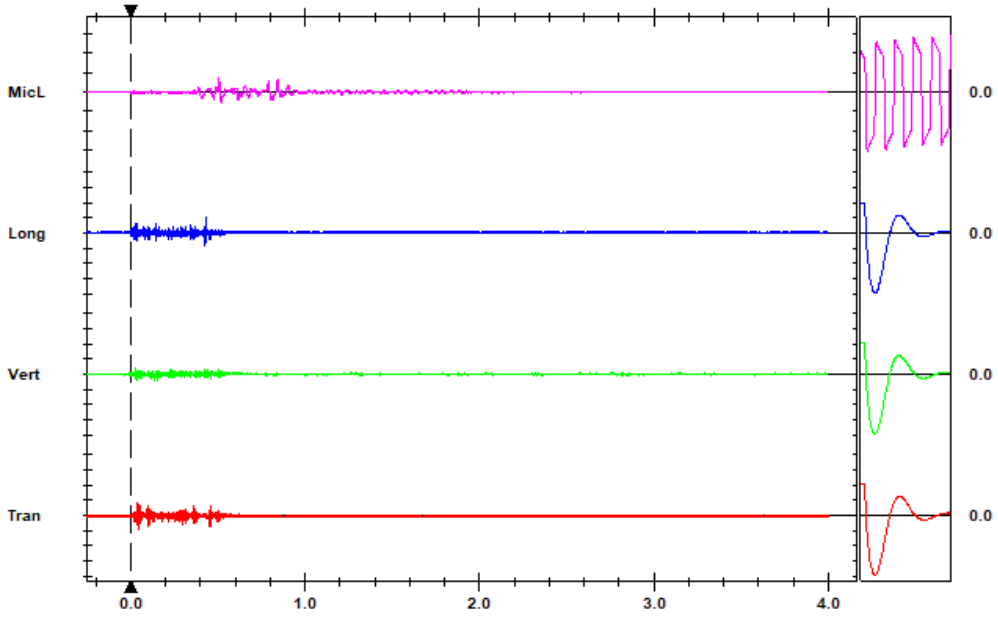
Microphone Linear Weighting
PSPL 111.8 dB(L) at 0.508 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	1.905	0.889	2.032	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.047	0.031	0.430	sec
Peak Acceleration	0.106	0.053	0.146	g
Peak Displacement	0.003	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 2.071 mm/s at 0.430 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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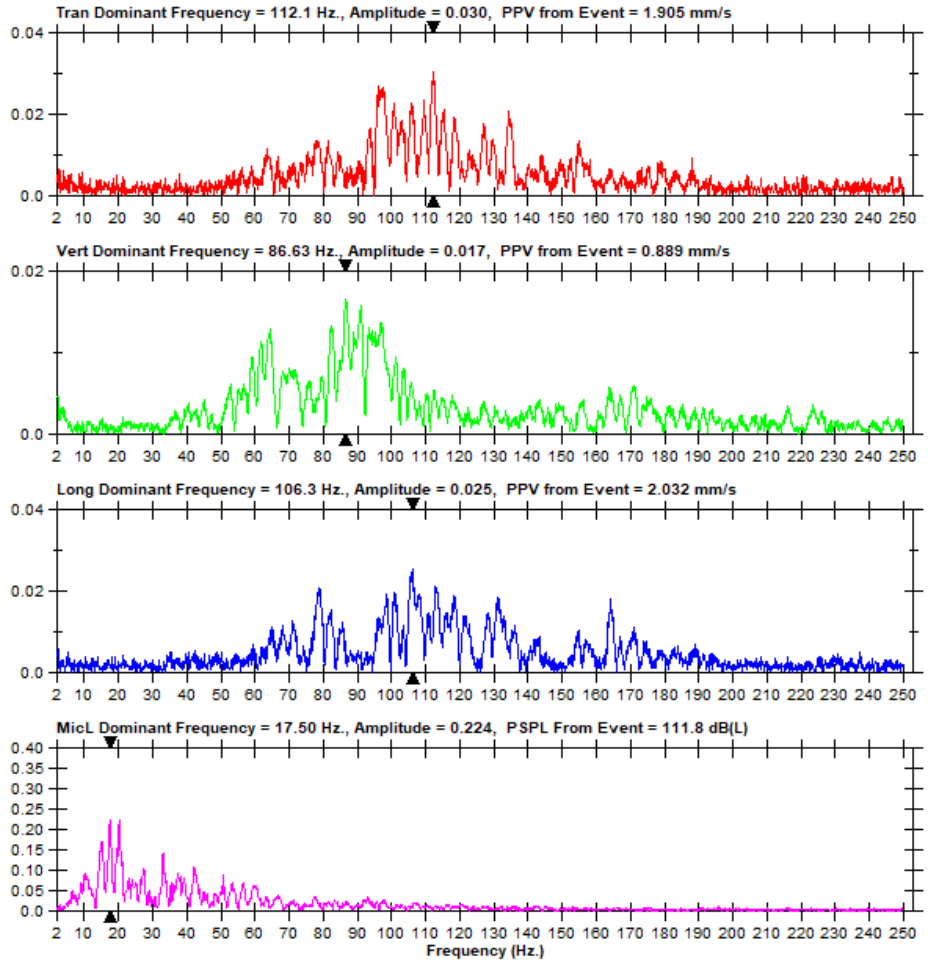
FFT Report

Date/Time	Long at 10:17:35 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.LB0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 137 m



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Event Report

Date/Time Long at 10:17:40 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.LG0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 150 m

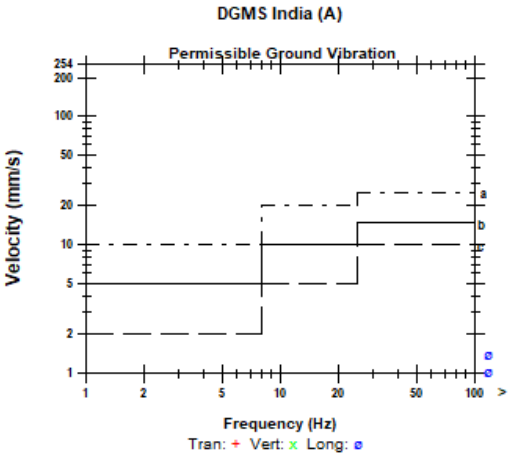
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

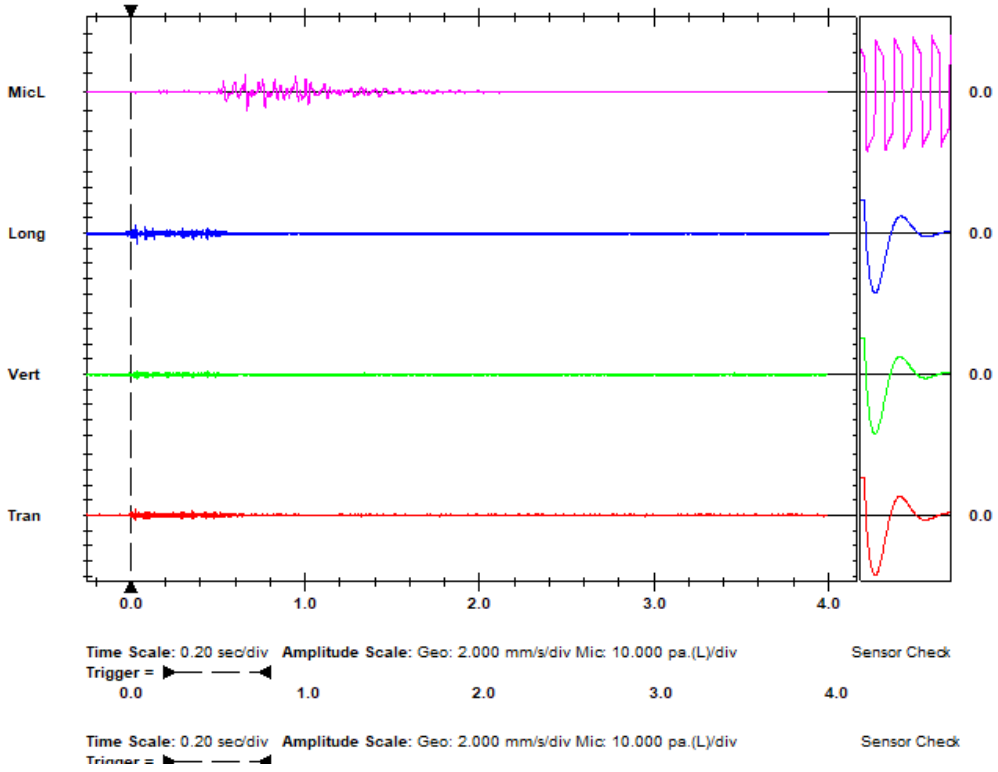
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 113.8 dB(L) at 0.669 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 472 mv)

	Tran	Vert	Long	
PPV	0.889	0.635	1.397	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.026	0.033	0.035	sec
Peak Acceleration	0.066	0.053	0.093	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.3	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.403 mm/s at 0.035 sec





Instantel

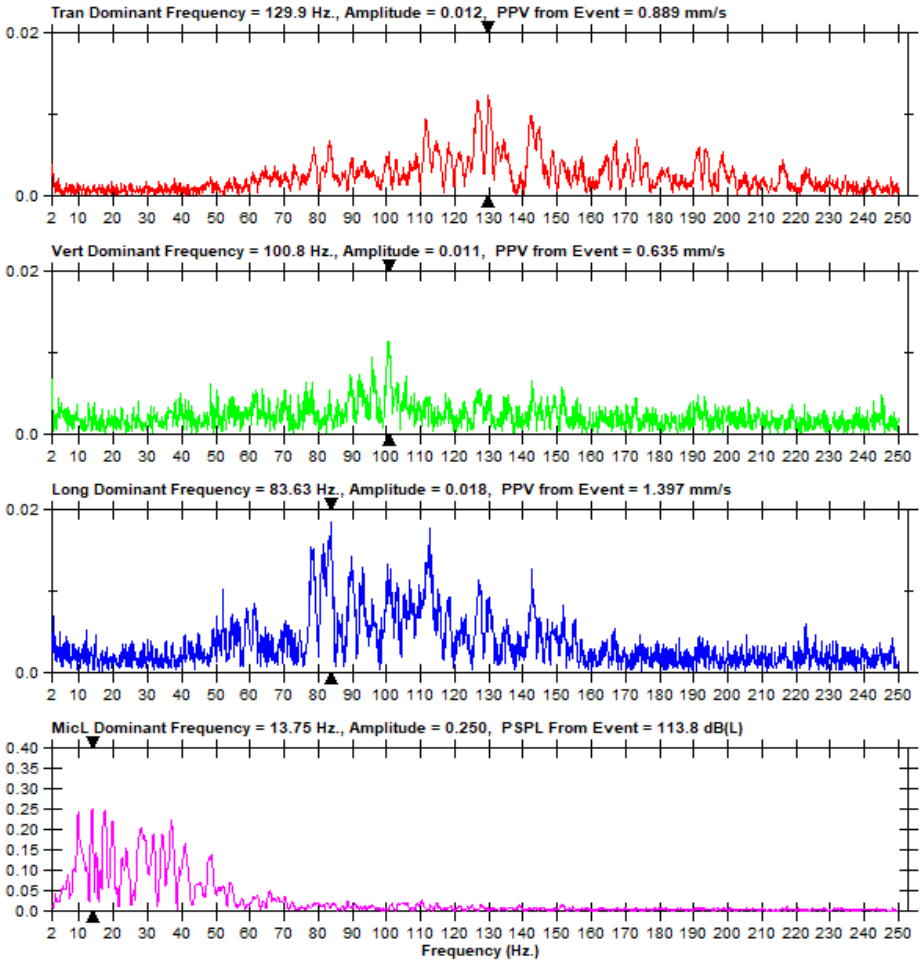
FFT Report

Date/Time	Long at 10:17:40 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.LG0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 150 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:17:39 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.LF0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 200 m

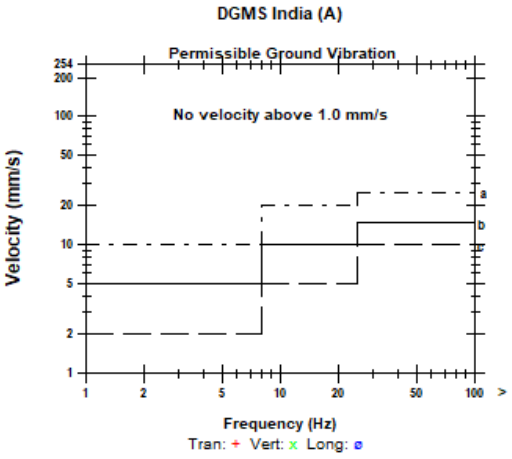
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

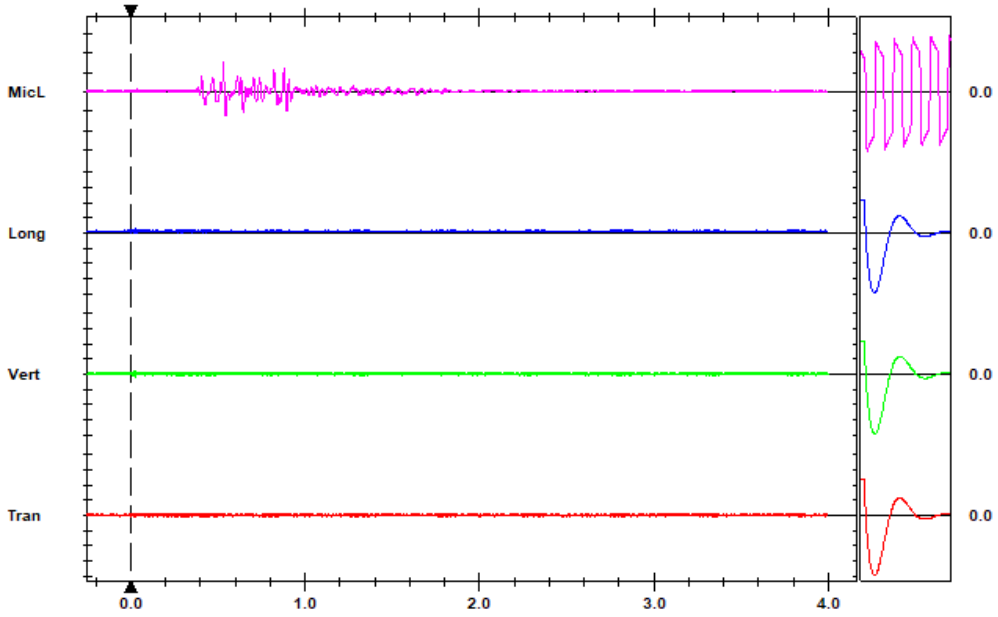
Microphone Linear Weighting
PSPL 117.9 dB(L) at 0.531 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.635	mm/s
ZC Freq	>100	>100	73	Hz
Time (Rel. to Trig)	0.011	0.028	0.025	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.000	0.000	0.036	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.696 mm/s at 0.025 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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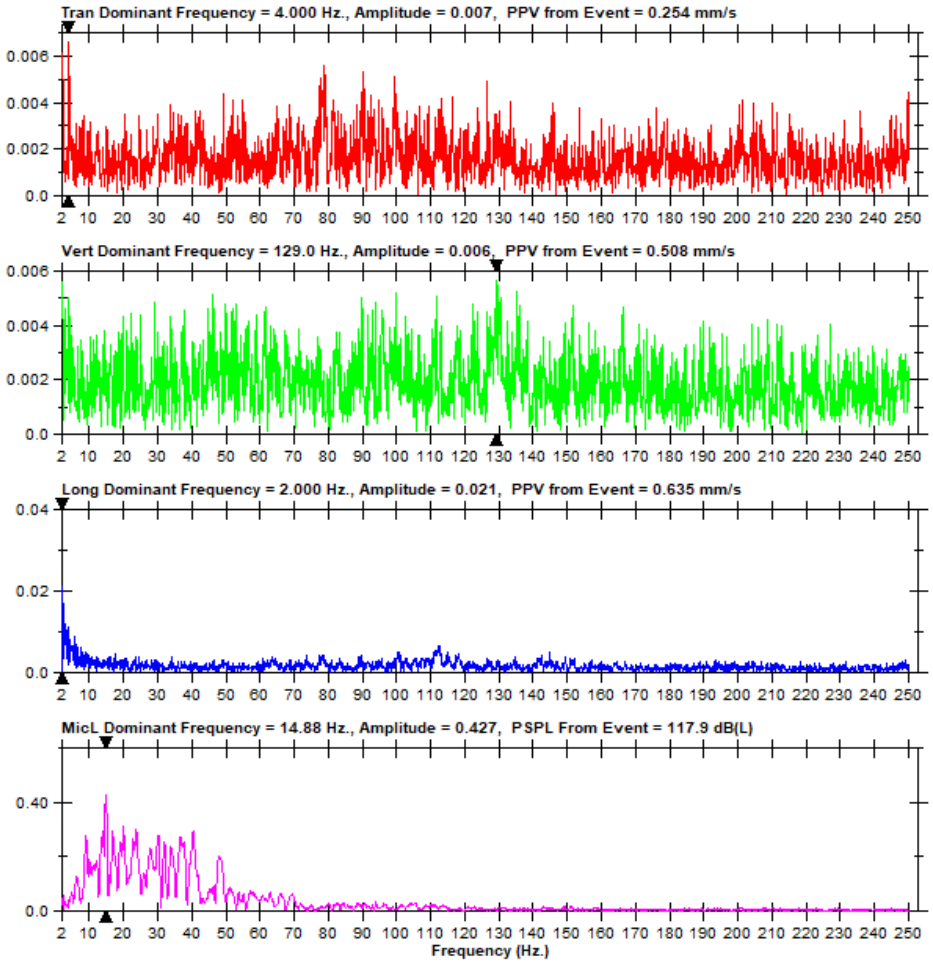
FFT Report

Date/Time	Long at 10:17:39 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.LF0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.5 m, Charge/holes - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 15.00 Kg, Distance - 200 m



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Event Report

Date/Time Long at 10:22:43 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.TV0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 63 m

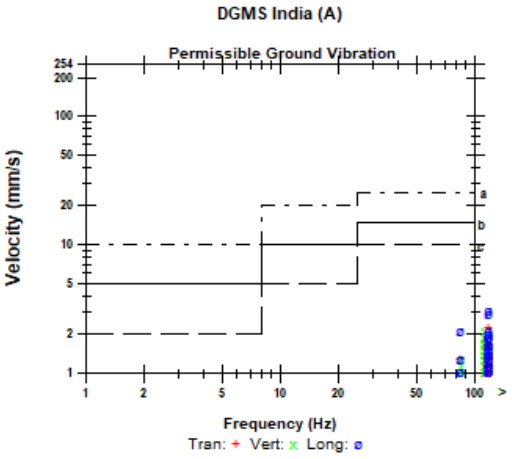
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

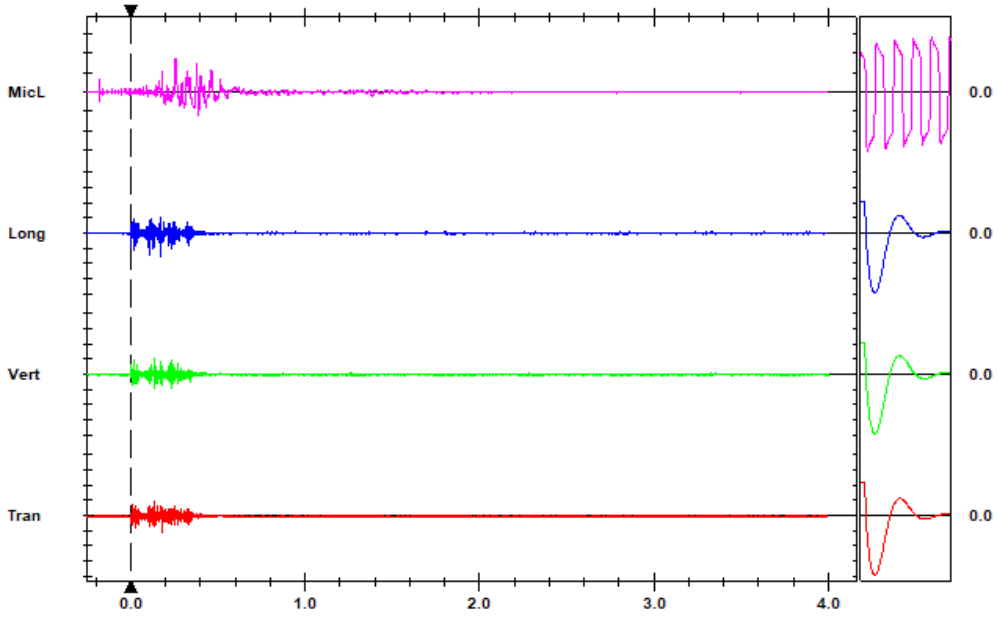
Microphone Linear Weighting
PSPL 118.8 dB(L) at 0.257 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	2.286	2.159	3.048	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.179	0.140	0.169	sec
Peak Acceleration	0.212	0.186	0.252	g
Peak Displacement	0.002	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 3.362 mm/s at 0.169 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

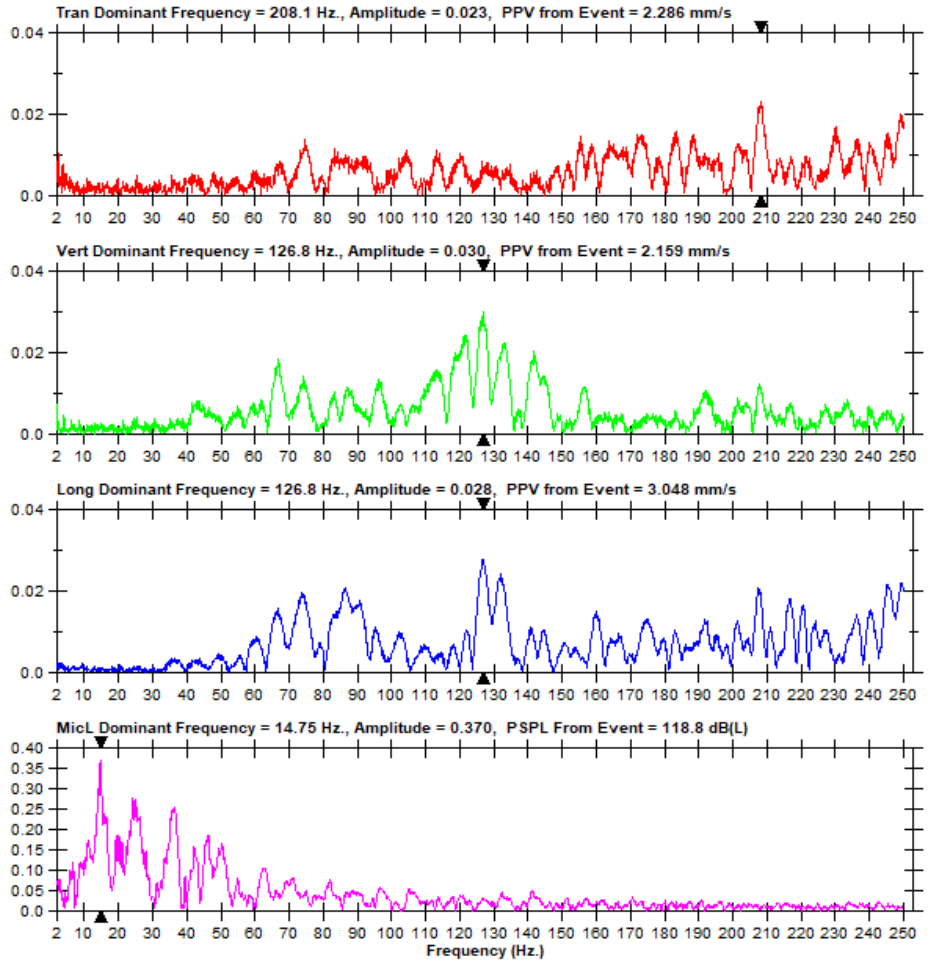
FFT Report

Date/Time	Long at 10:22:43 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.TV0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/holes - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 63 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:22:38 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.TQ0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 134 m

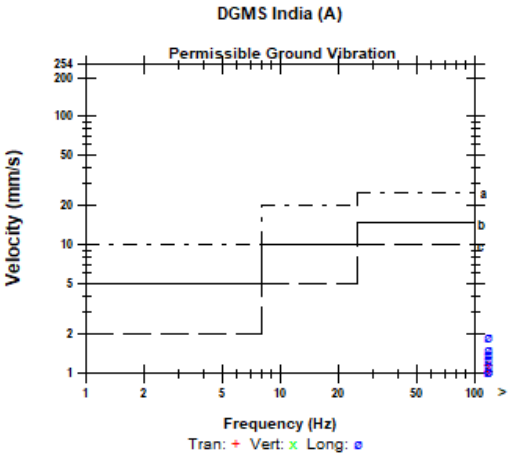
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

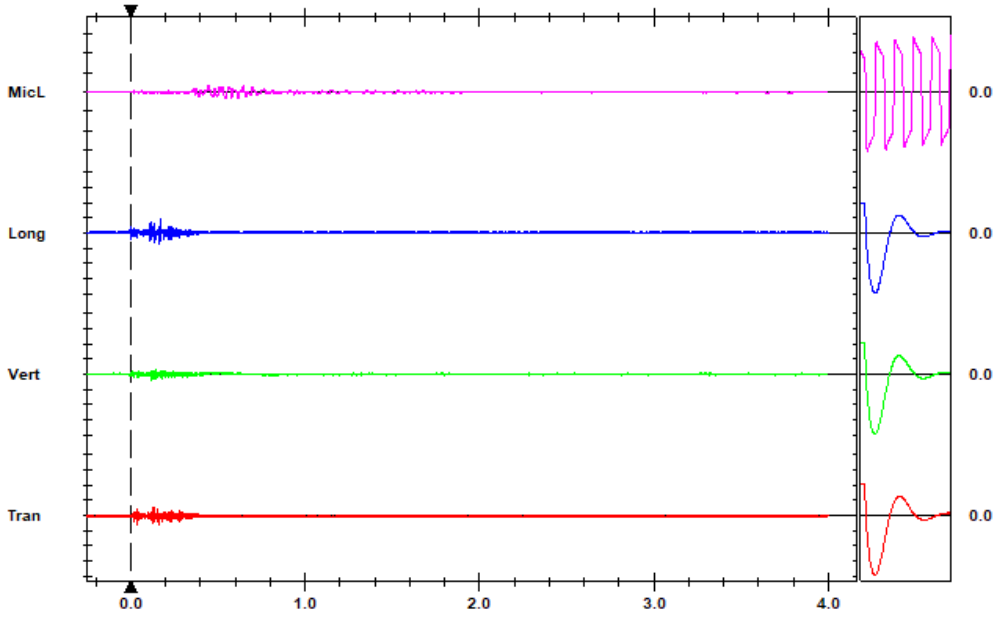
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.446 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	1.143	0.762	1.905	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.037	0.117	0.170	sec
Peak Acceleration	0.106	0.053	0.133	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.913 mm/s at 0.170 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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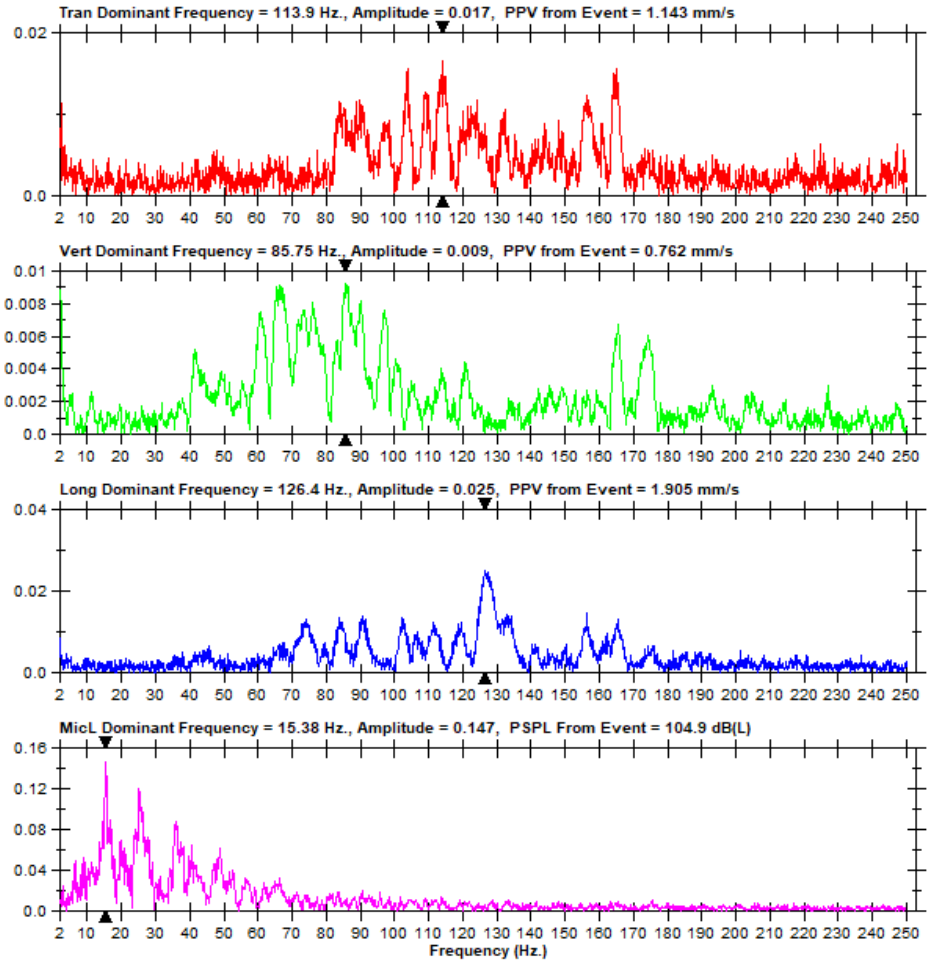
FFT Report

Date/Time	Long at 10:22:38 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.TQ0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 134 m



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Event Report

Date/Time Long at 10:22:43 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.TV0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 158 m

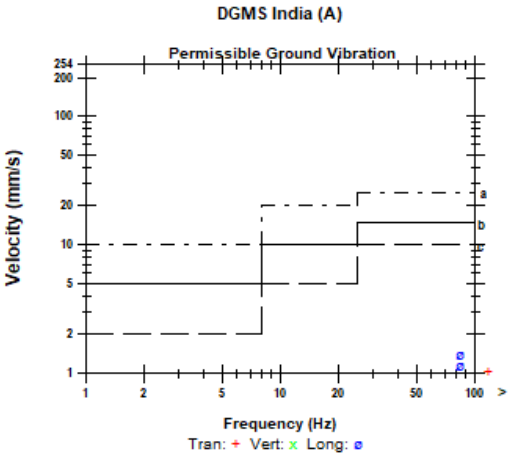
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

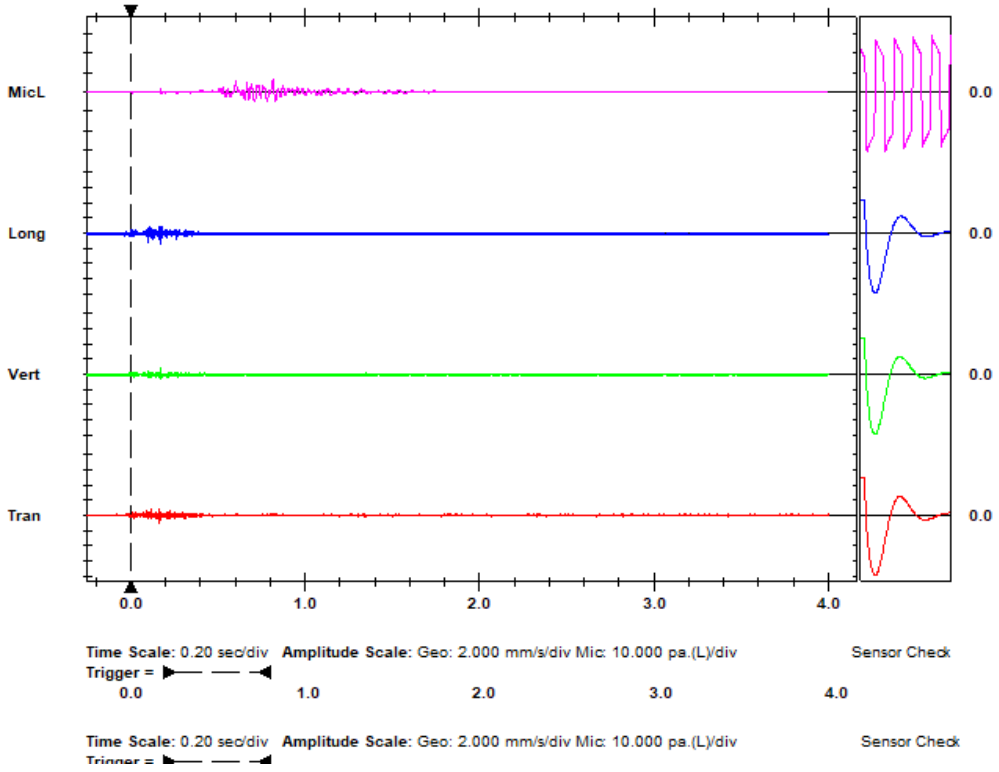
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.815 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 467 mv)

	Tran	Vert	Long	
PPV	1.016	0.762	1.397	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.167	0.174	0.171	sec
Peak Acceleration	0.066	0.053	0.080	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.535 mm/s at 0.171 sec





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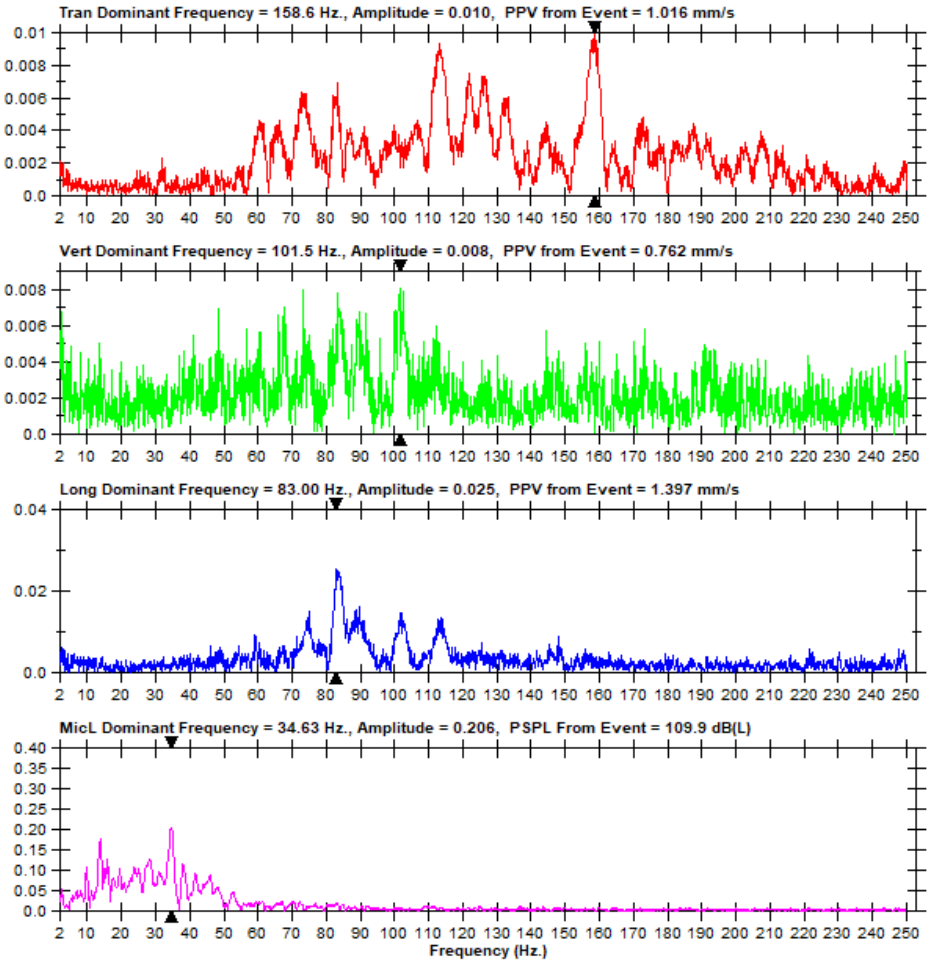
FFT Report

Date/Time	Long at 10:22:43 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.TV0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 158 m



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Event Report

Date/Time Long at 10:22:42 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.TU0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 205 m

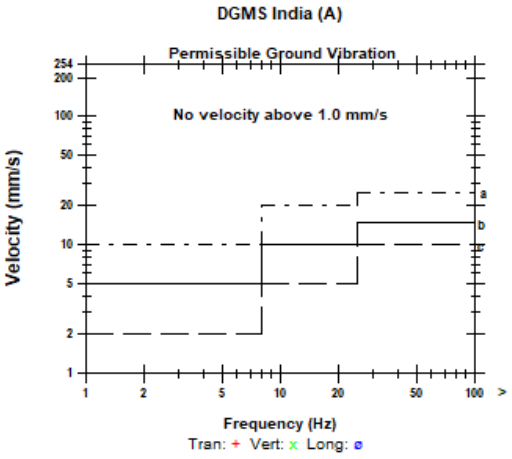
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

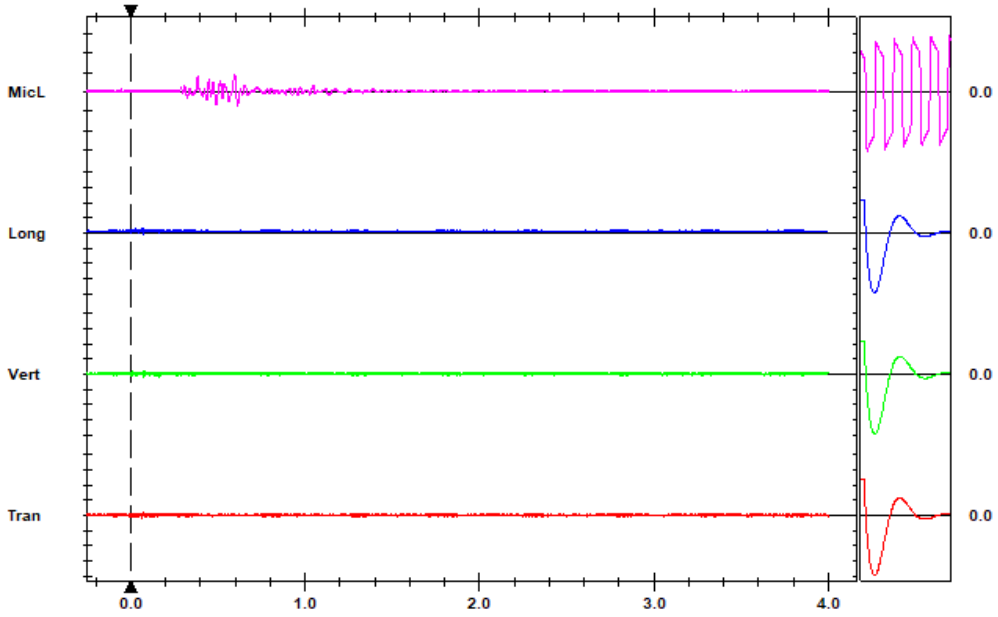
Microphone Linear Weighting
PSPL 113.1 dB(L) at 0.596 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	0.635	mm/s
ZC Freq	>100	>100	47	Hz
Time (Rel. to Trig)	0.066	0.010	0.024	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.000	0.001	0.030	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.696 mm/s at 0.024 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

Instantel

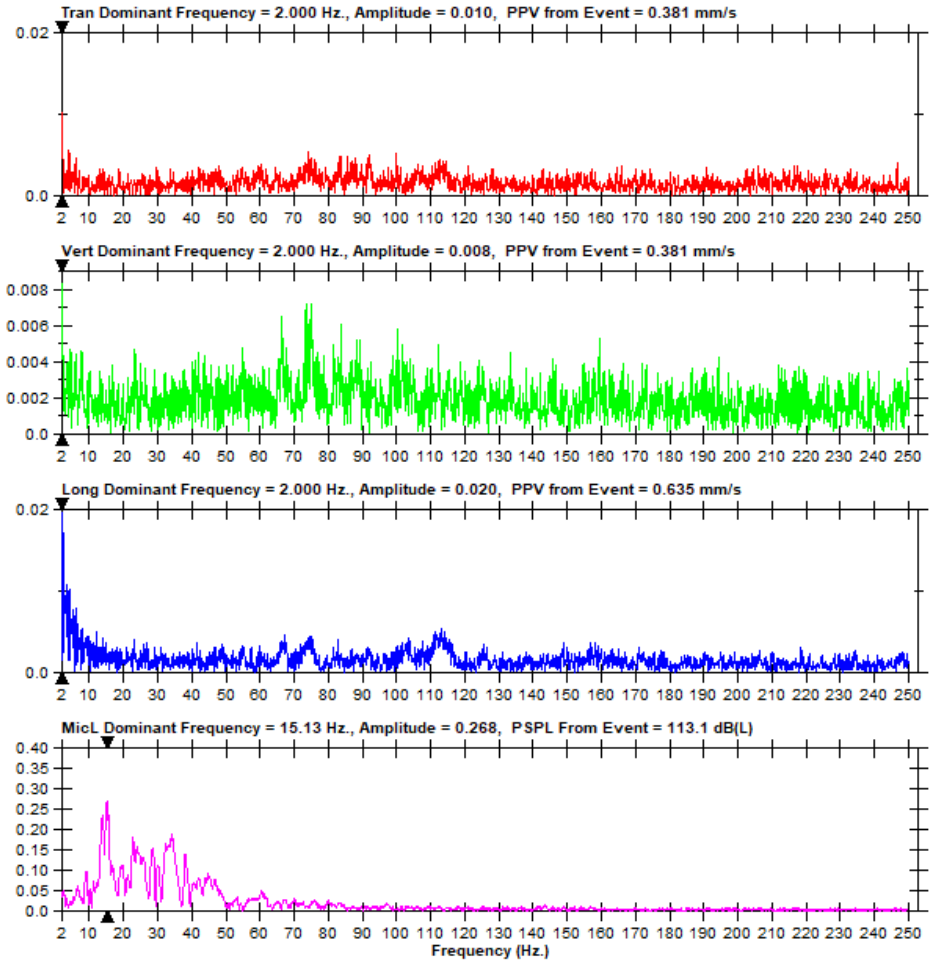
FFT Report

Date/Time	Long at 10:22:42 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.TU0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 12.00 Kg, Distance - 205 m



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Event Report

Date/Time Long at 10:24:22 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG4.WM0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 82 m

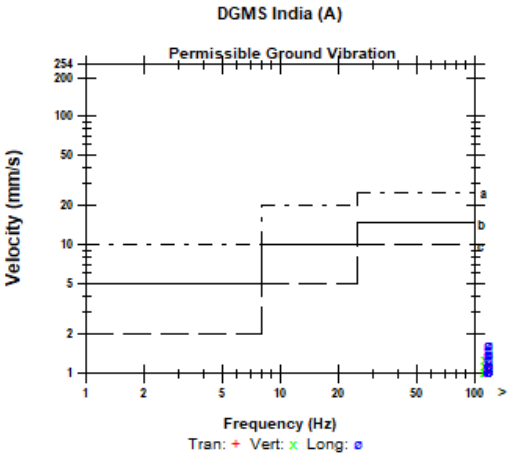
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

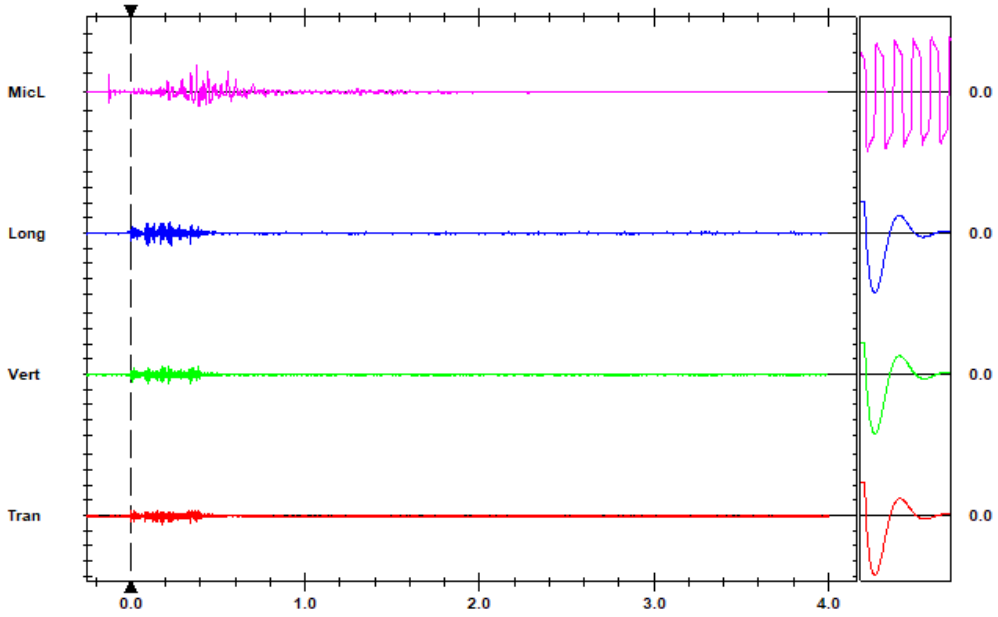
Microphone Linear Weighting
PSPL 116.9 dB(L) at 0.378 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	1.143	1.270	1.651	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.183	0.340	0.099	sec
Peak Acceleration	0.093	0.133	0.212	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 1.909 mm/s at 0.183 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

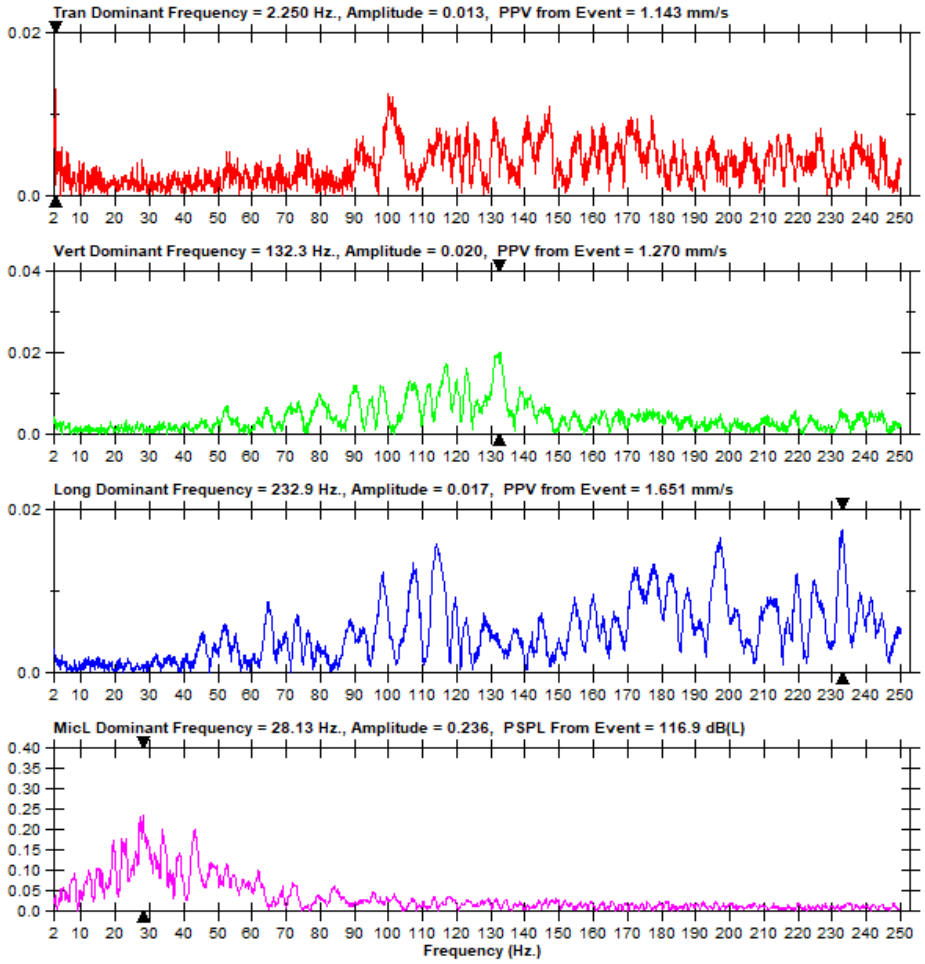
FFT Report

Date/Time	Long at 10:24:22 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG4.WM0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 82 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:24:18 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG4.WI0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 147 m

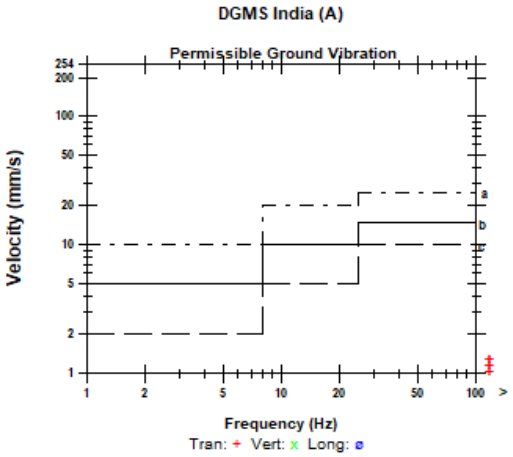
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

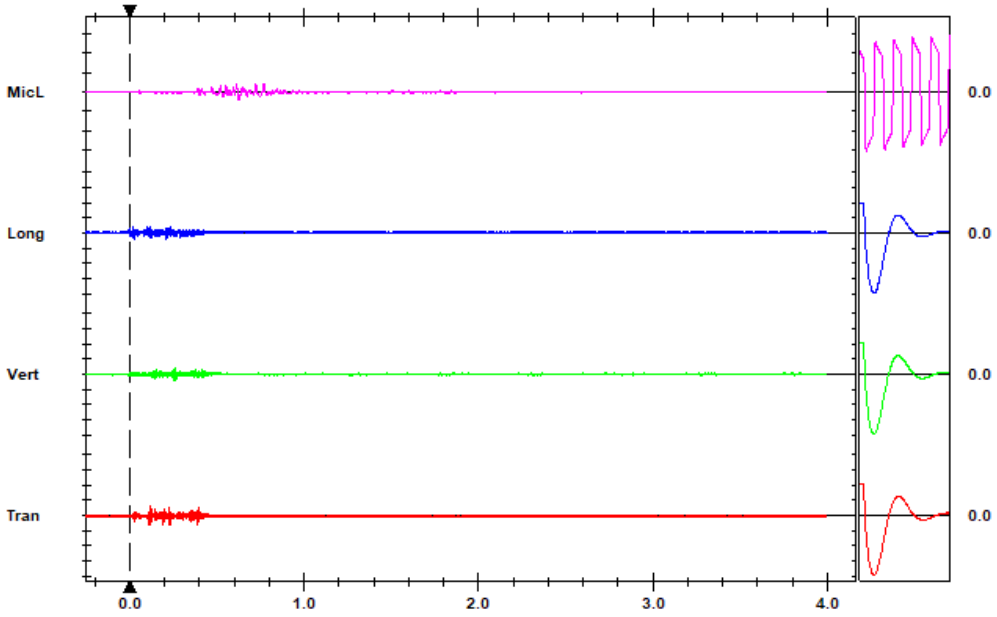
Microphone Linear Weighting
PSPL 106.0 dB(L) at 0.626 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	1.270	0.889	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.112	0.257	0.120	sec
Peak Acceleration	0.106	0.053	0.080	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.442 mm/s at 0.116 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

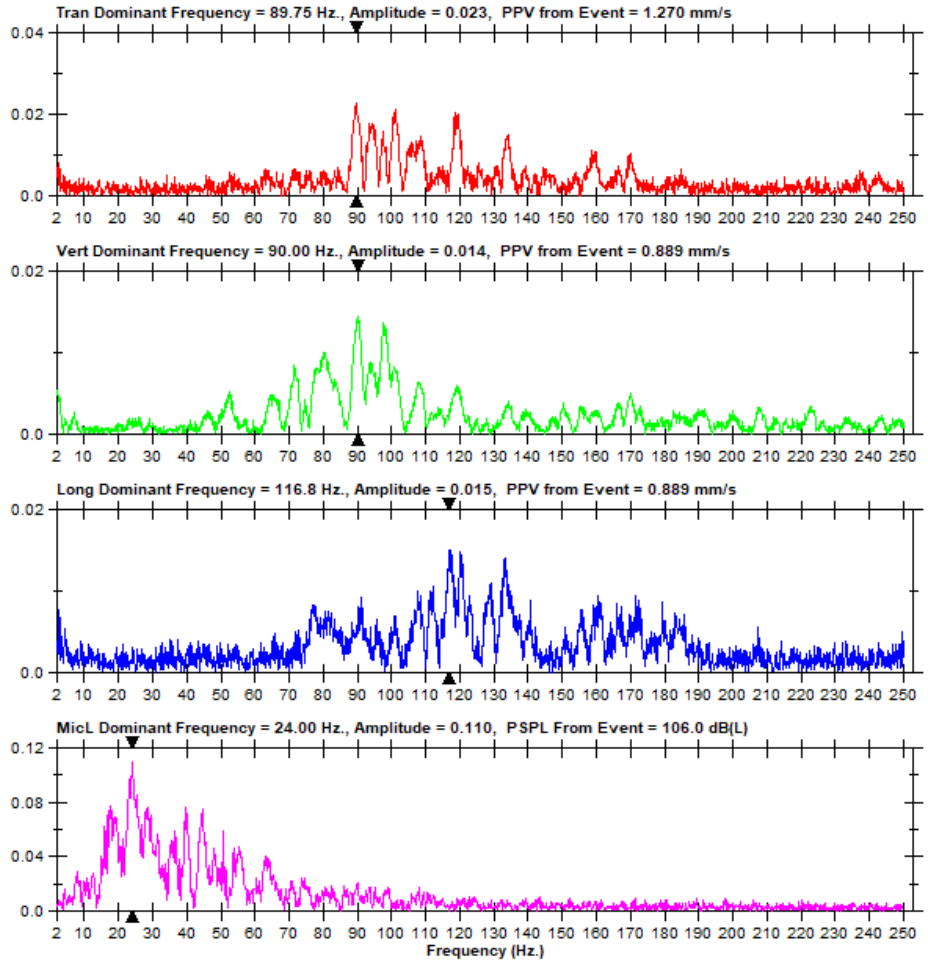
FFT Report

Date/Time	Long at 10:24:18 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG4.WI0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 147 m



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Event Report

Date/Time Long at 10:24:23 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG4.WN0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 175 m

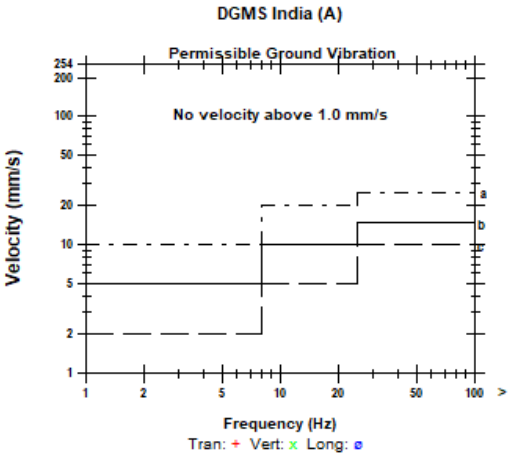
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

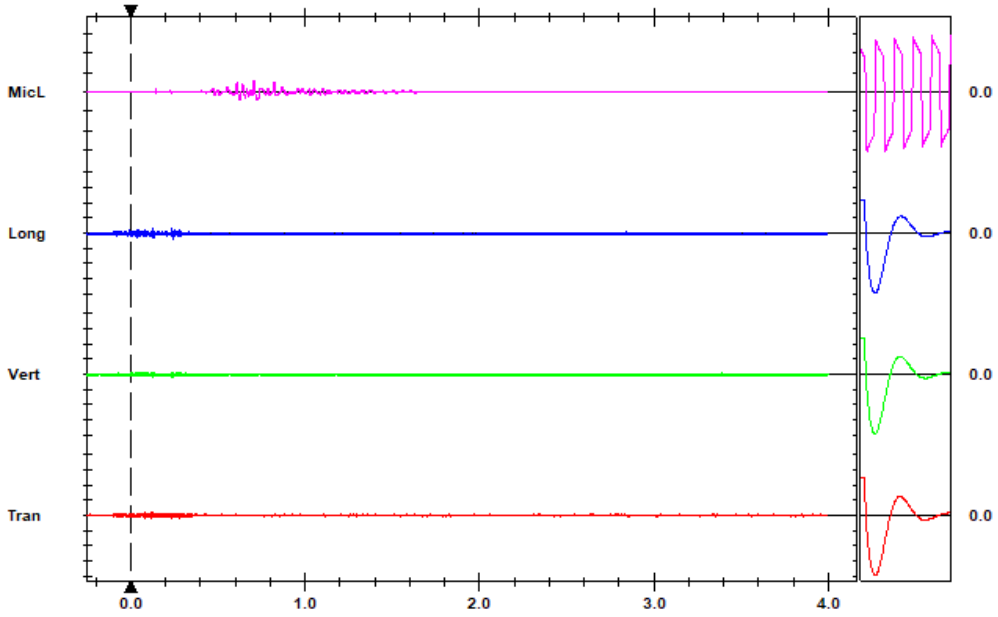
Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.706 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 467 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.889	mm/s
ZC Freq	>100	85	85	Hz
Time (Rel. to Trig)	0.280	0.241	0.243	sec
Peak Acceleration	0.040	0.027	0.053	g
Peak Displacement	0.000	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.3	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 0.907 mm/s at 0.243 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

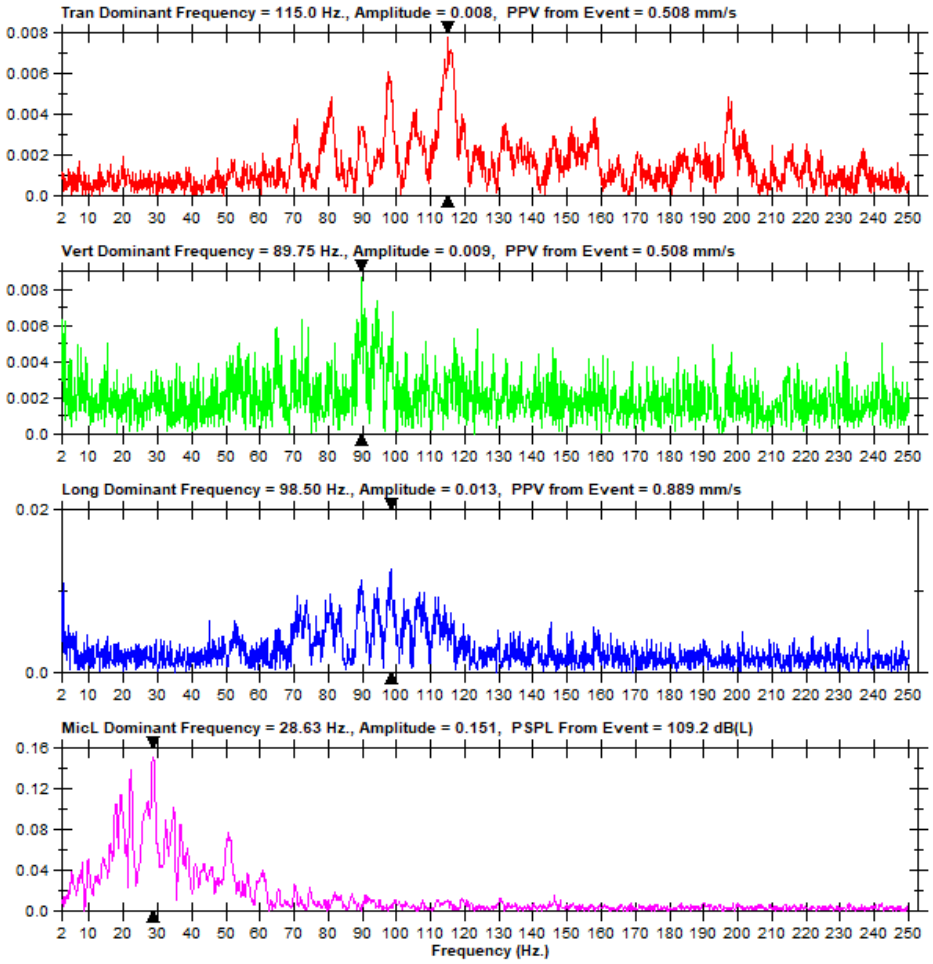
FFT Report

Date/Time	Long at 10:24:23 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG4.WN0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 175 m



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Event Report

Date/Time Long at 10:24:22 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG4.WM0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 225 m

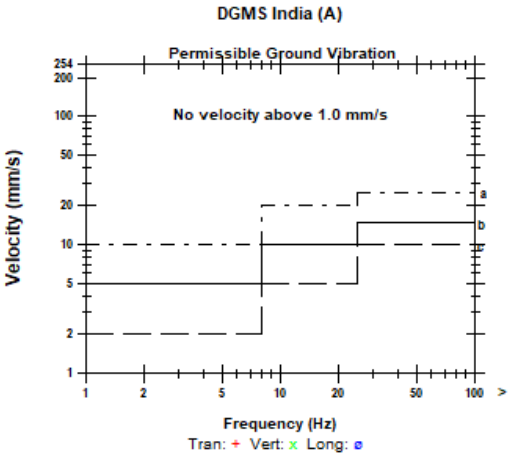
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

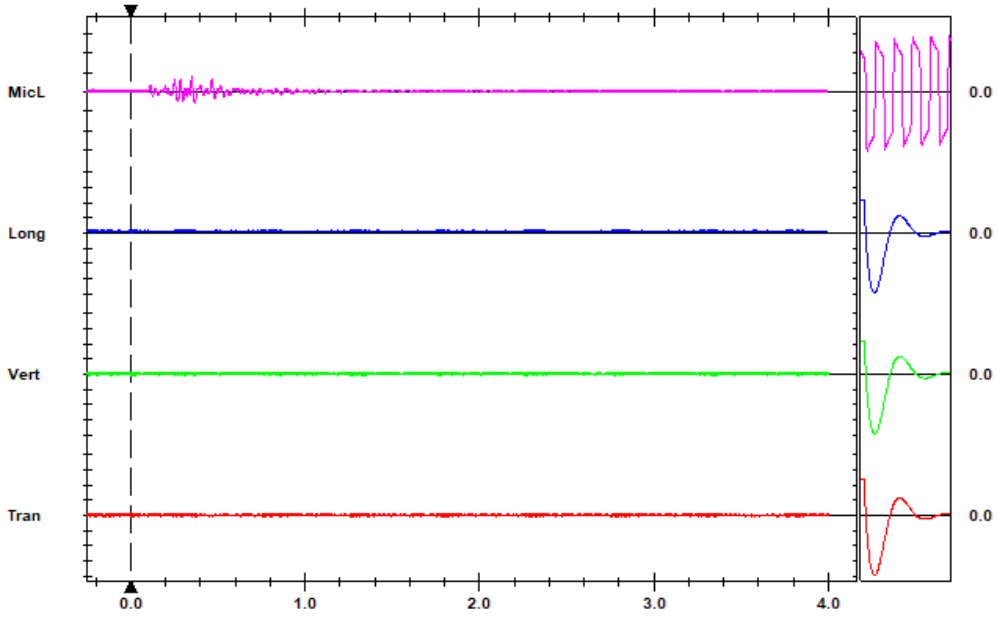
Microphone Linear Weighting
PSPL 112.3 dB(L) at 0.351 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	-0.117	-0.203	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.582 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

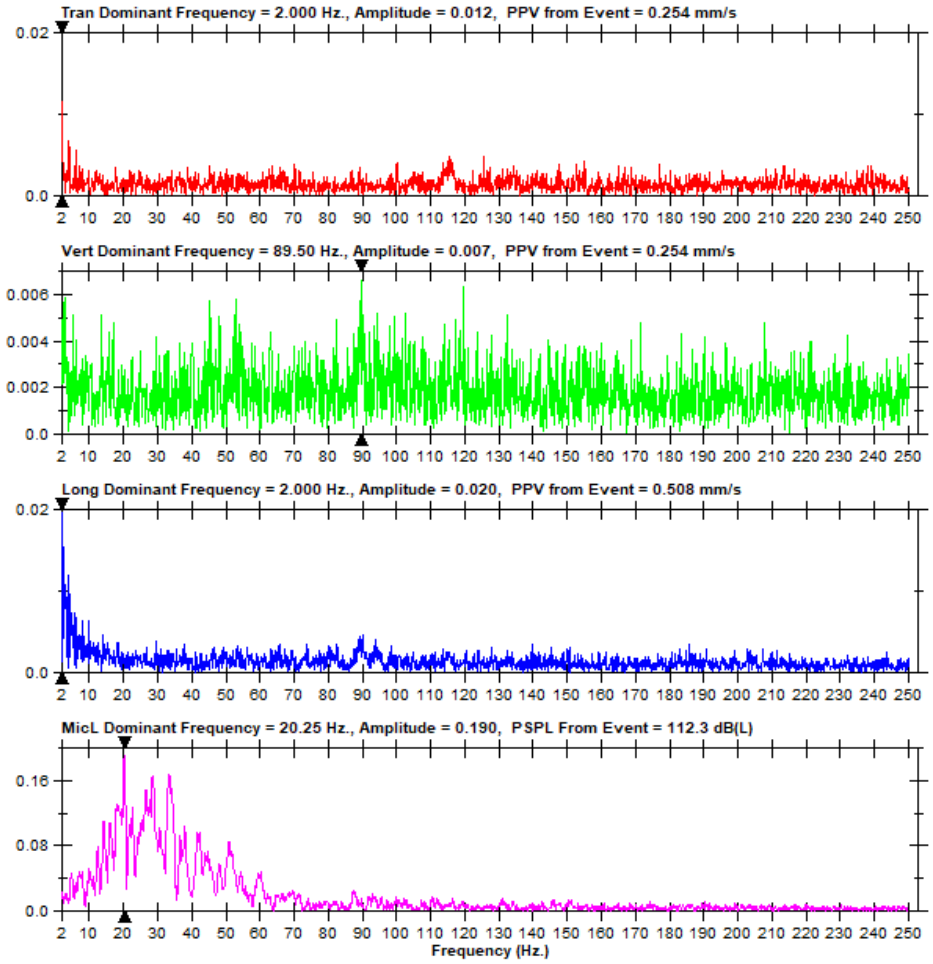
FFT Report

Date/Time	Long at 10:24:22 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG4.WM0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 8.00 Kg, Distance - 225 m



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Event Report

Date/Time Long at 10:30:12 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG5.6C0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 45 m

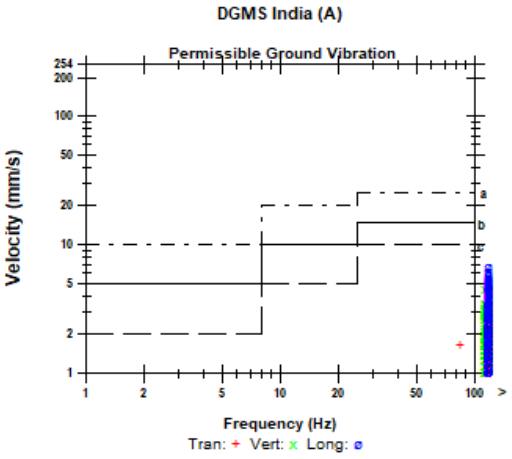
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

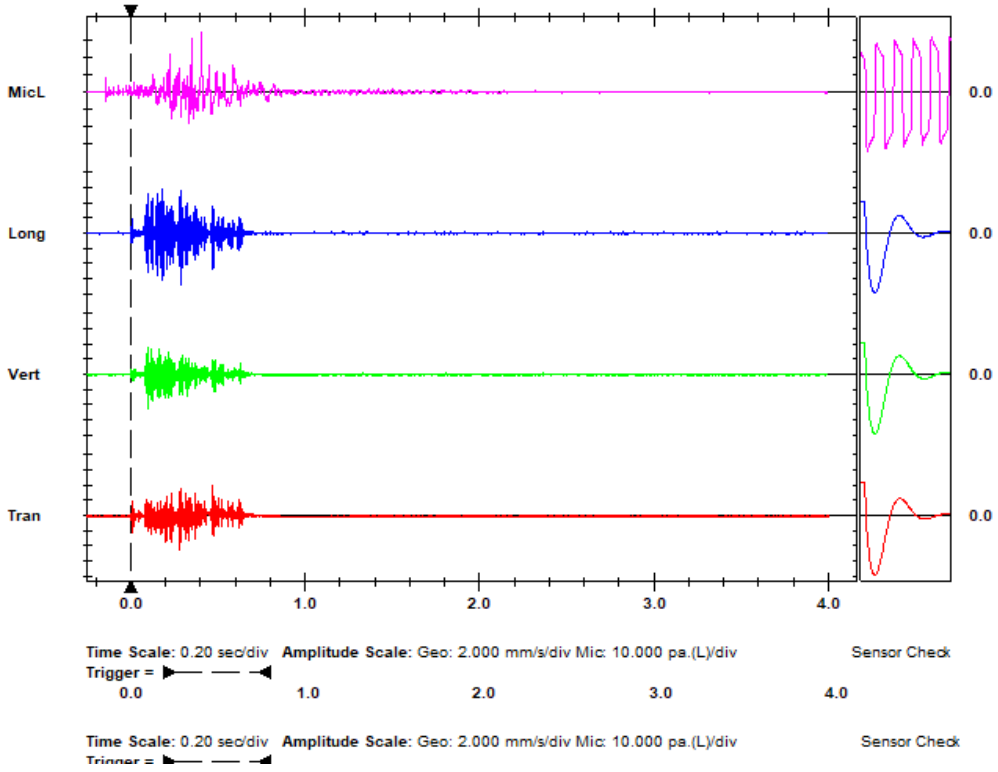
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 124.8 dB(L) at 0.404 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	4.572	4.572	6.731	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.284	0.098	0.290	sec
Peak Acceleration	0.517	0.477	0.769	g
Peak Displacement	0.003	0.003	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 6.850 mm/s at 0.290 sec





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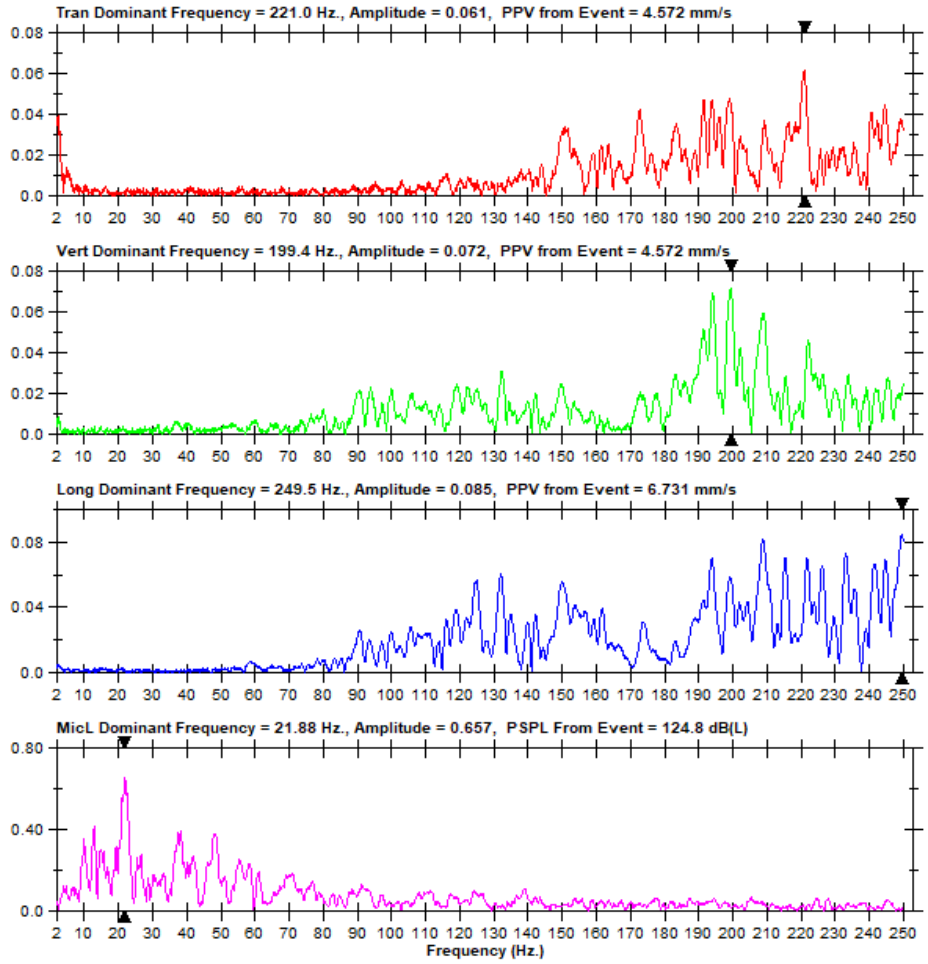
FFT Report

Date/Time	Long at 10:30:12 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG5.6C0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 45 m



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Event Report

Date/Time Tran at 10:30:08 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG5.680
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 130 m

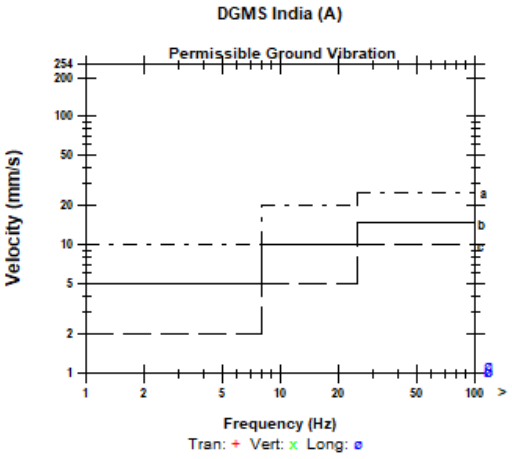
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

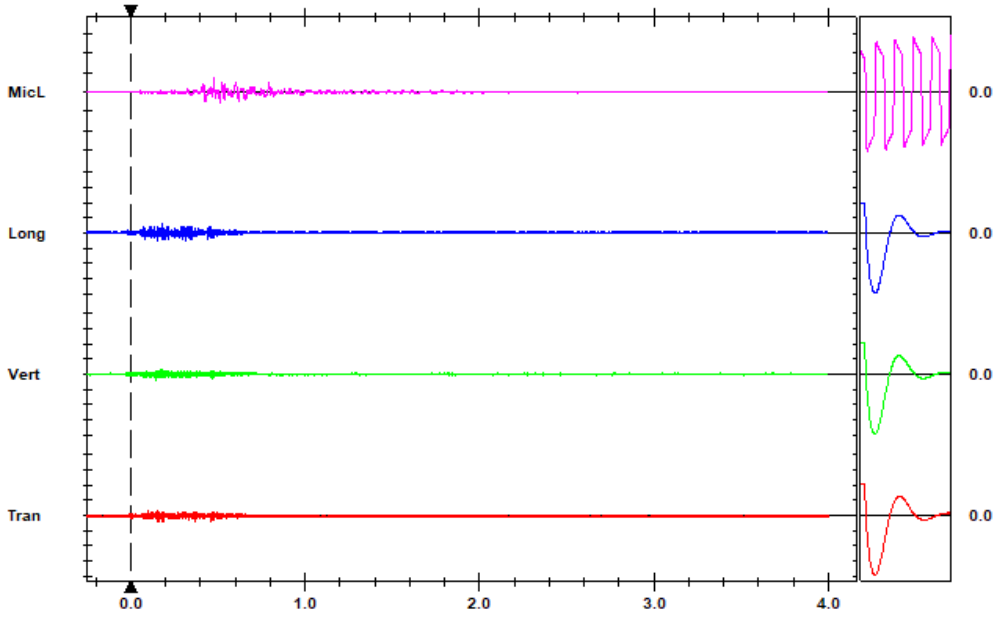
Microphone Linear Weighting
PSPL 111.5 dB(L) at 0.477 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.889	0.889	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.186	0.145	0.183	sec
Peak Acceleration	0.080	0.066	0.106	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.308 mm/s at 0.183 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

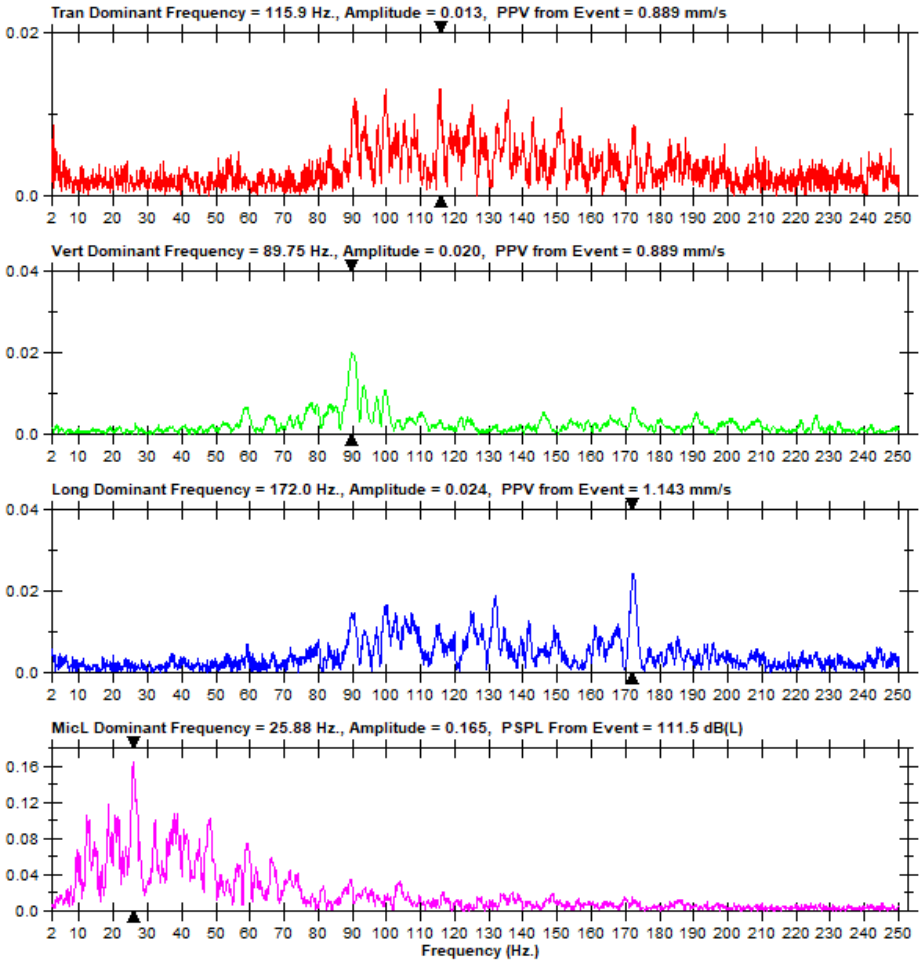
FFT Report

Date/Time	Tran at 10:30:08 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG5.680

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 130 m



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Event Report

Date/Time Long at 10:30:13 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG5.6D0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 120 m

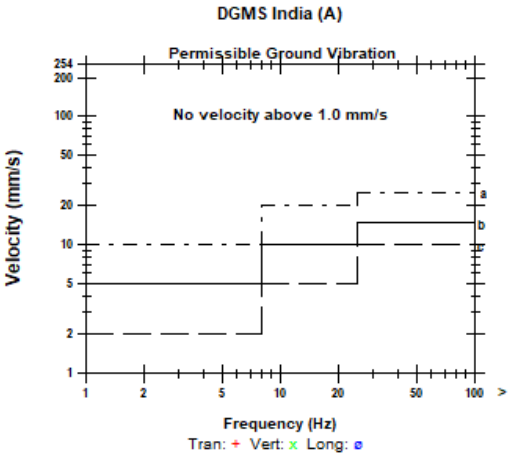
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

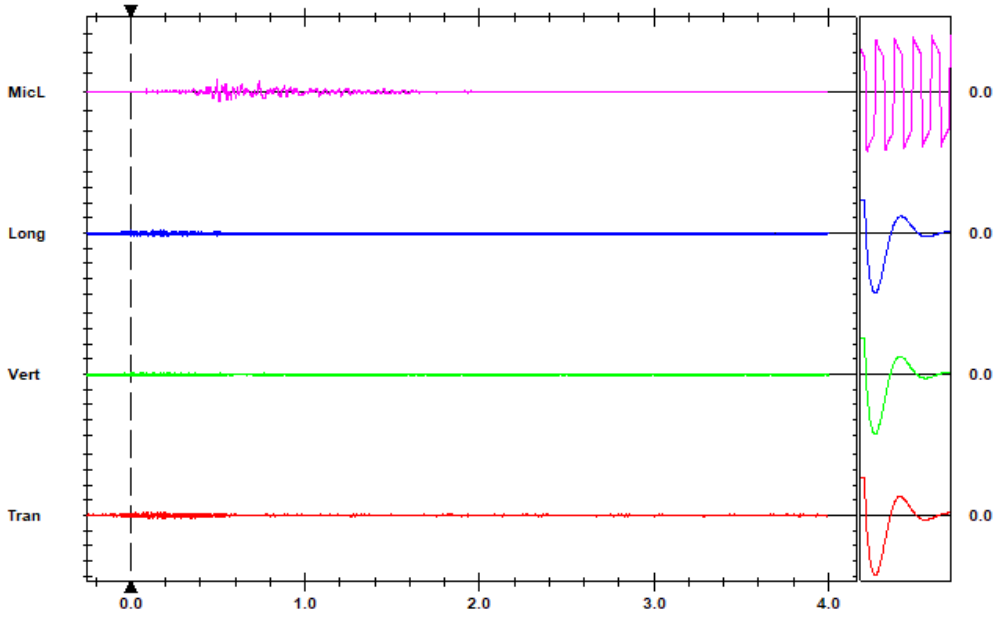
Microphone Linear Weighting
PSPL 109.9 dB(L) at 0.494 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.177	-0.017	0.000	sec
Peak Acceleration	0.053	0.027	0.053	g
Peak Displacement	0.000	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 0.582 mm/s at 0.177 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

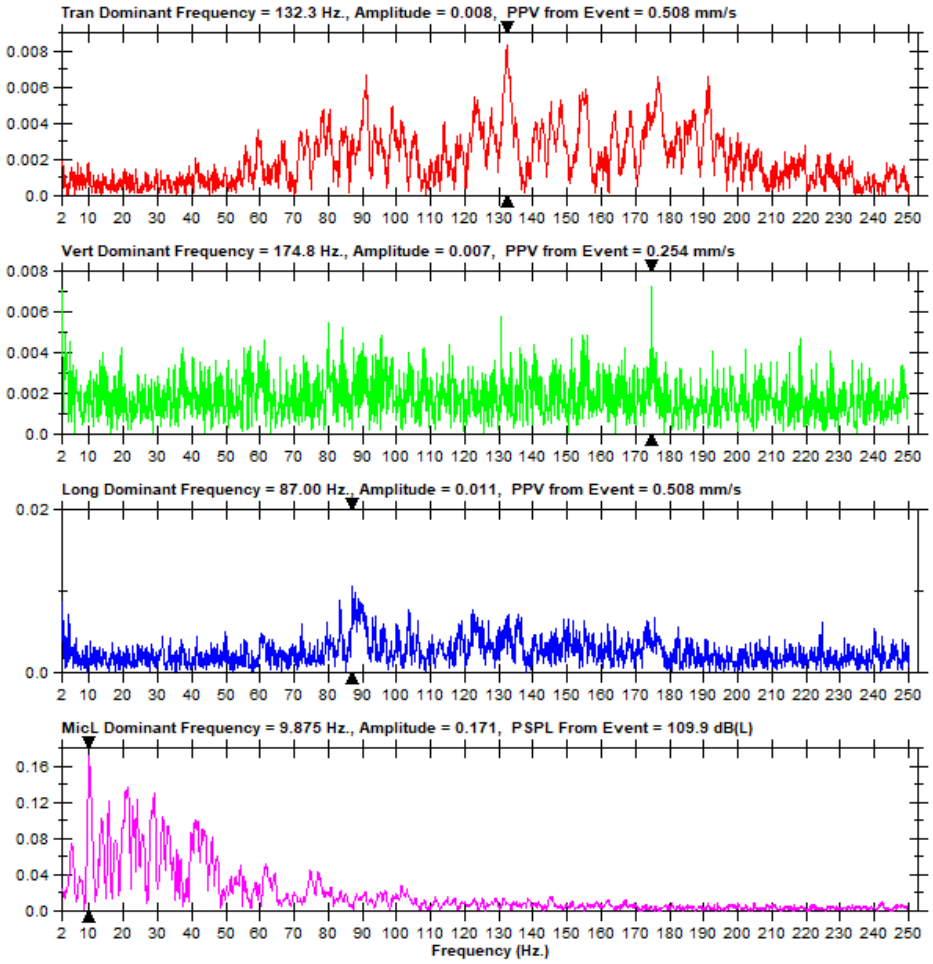
FFT Report

Date/Time	Long at 10:30:13 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG5.6D0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 24.00 Kg, Distance - 120 m



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Event Report

Date/Time Long at 10:31:00 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG5.7O0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 92 m

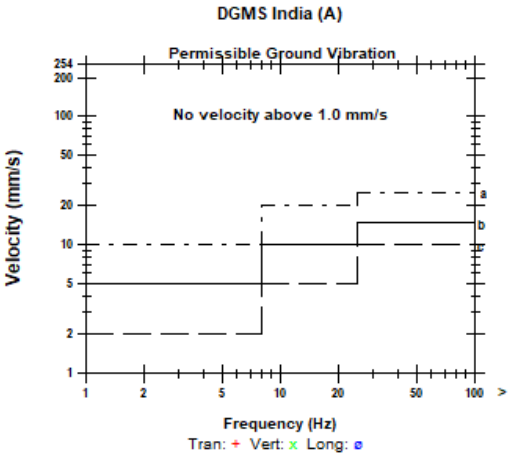
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

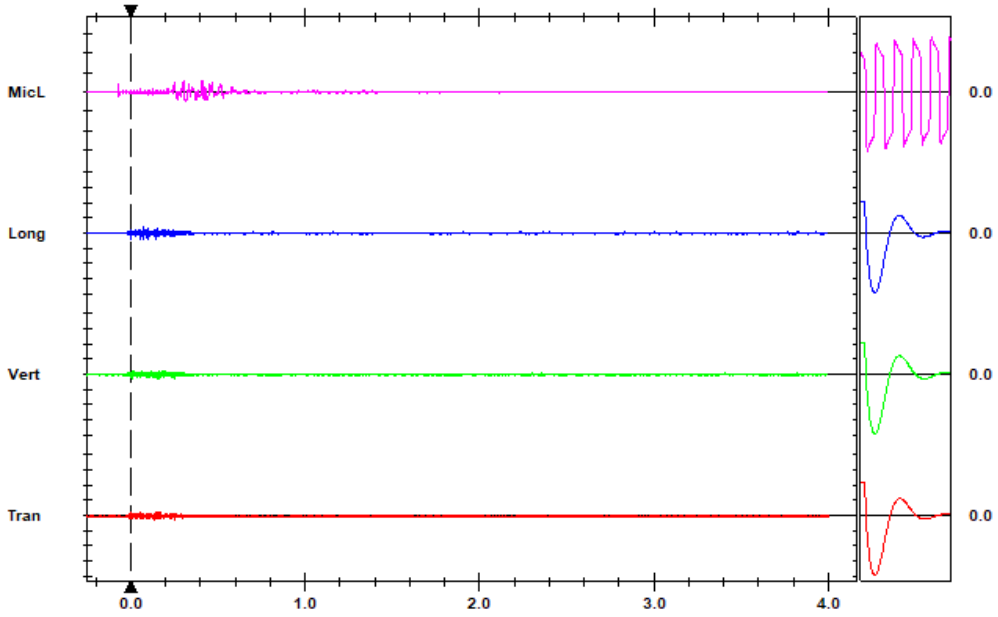
Microphone Linear Weighting
PSPL 109.5 dB(L) at 0.409 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	0.635	0.635	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.138	0.007	0.054	sec
Peak Acceleration	0.053	0.053	0.093	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 0.976 mm/s at 0.054 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

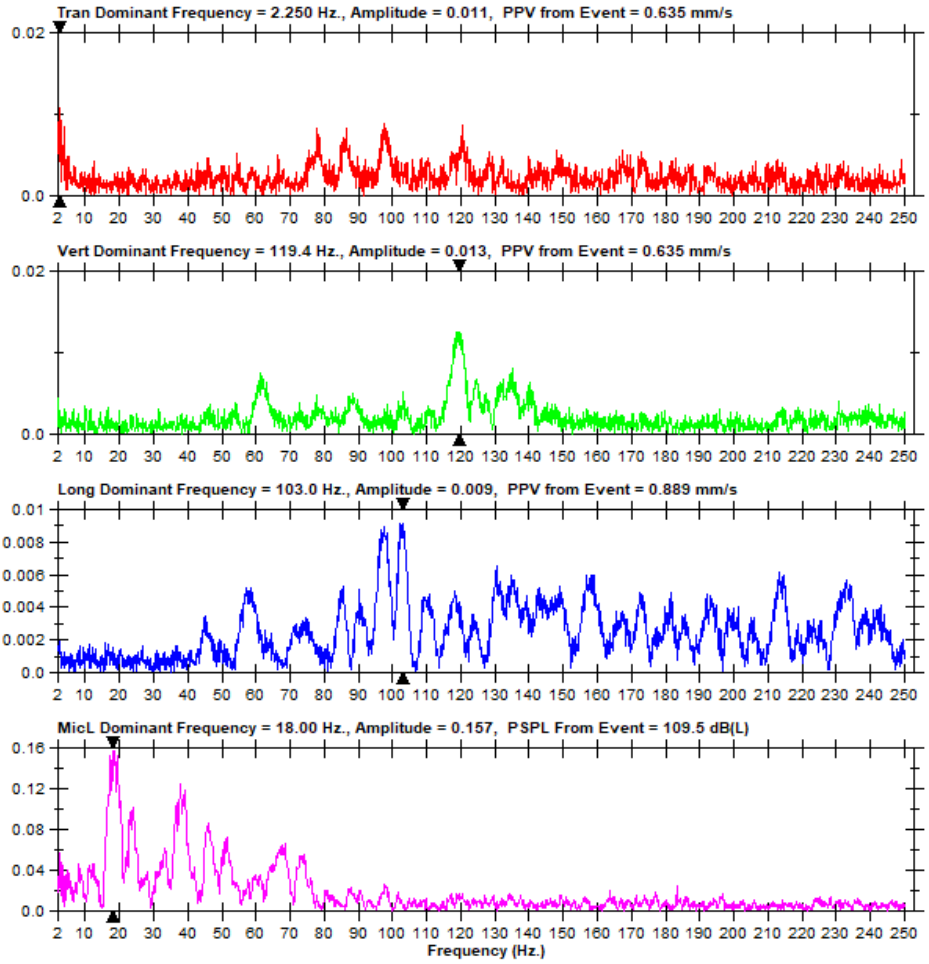
FFT Report

Date/Time	Long at 10:31:00 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG5.7O0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 92 m



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Event Report

Date/Time Long at 10:30:56 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG5.7K0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 180 m

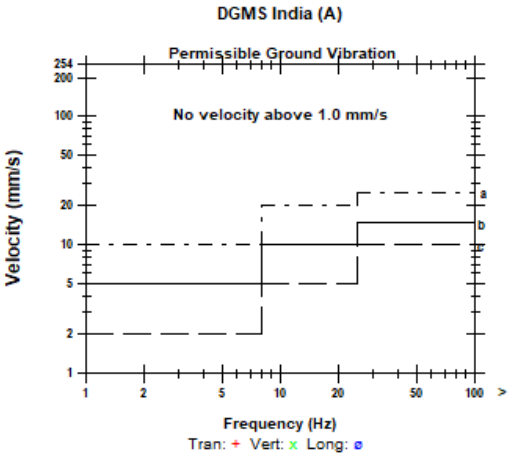
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

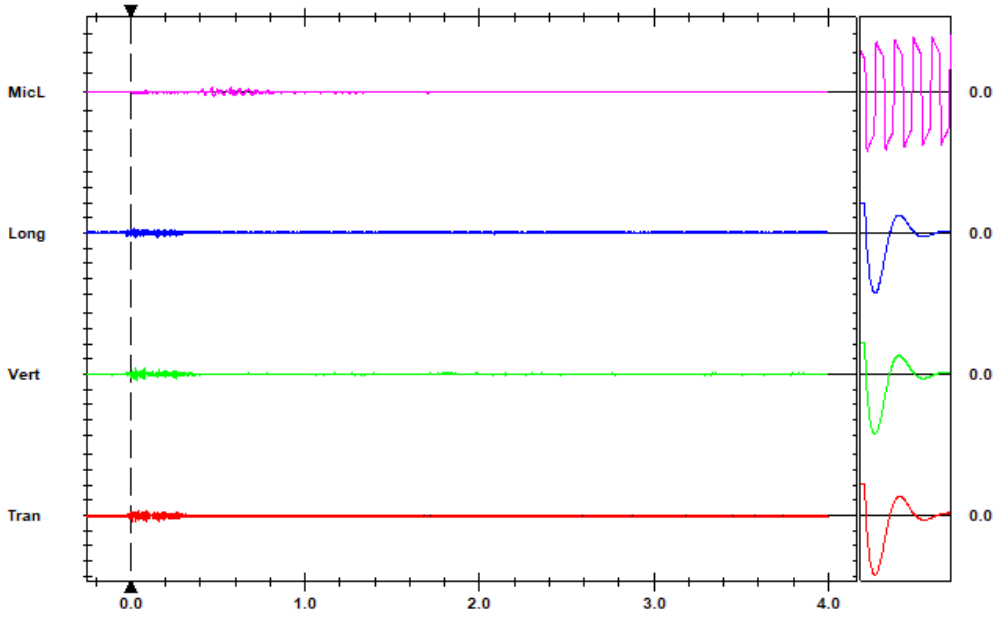
Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.466 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	0.635	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.027	0.028	0.020	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.032 mm/s at 0.027 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

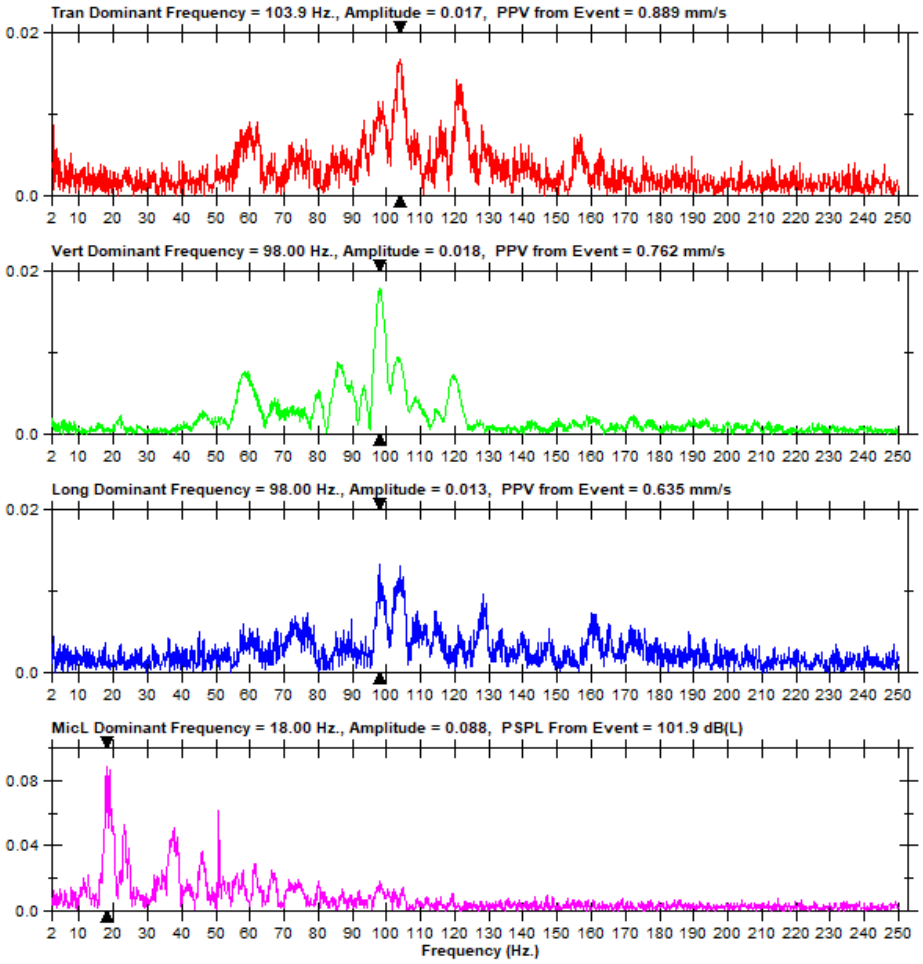
FFT Report

Date/Time	Long at 10:30:56 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG5.7K0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 180 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 10:31:01 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG5.7P0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 96 m

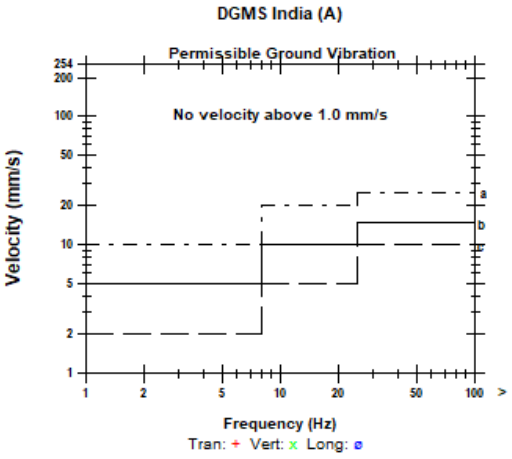
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

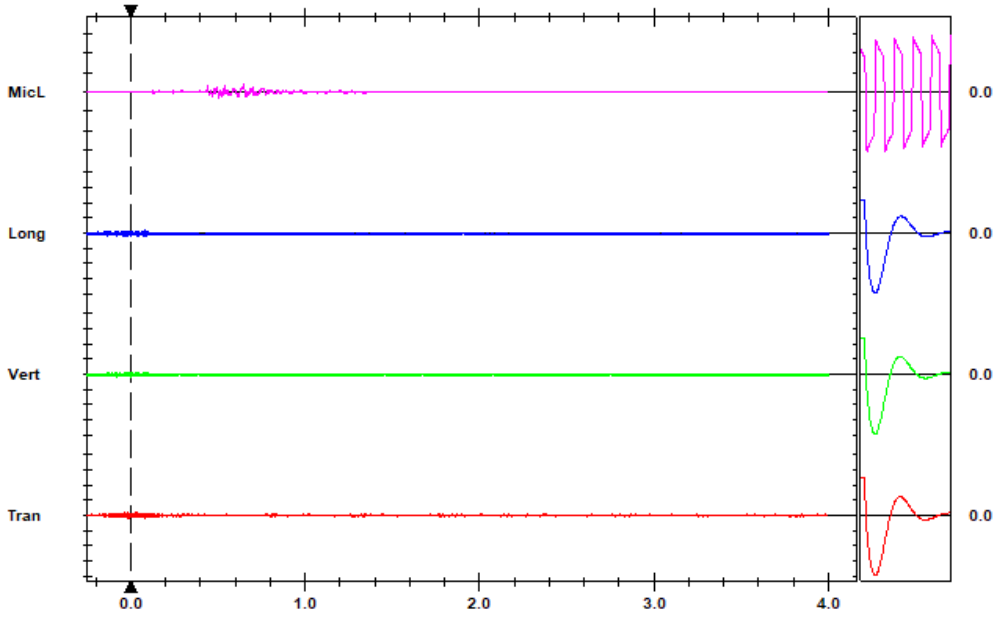
Microphone Linear Weighting
PSPL 105.5 dB(L) at 0.646 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 467 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	-0.035	0.000	0.001	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 0.648 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

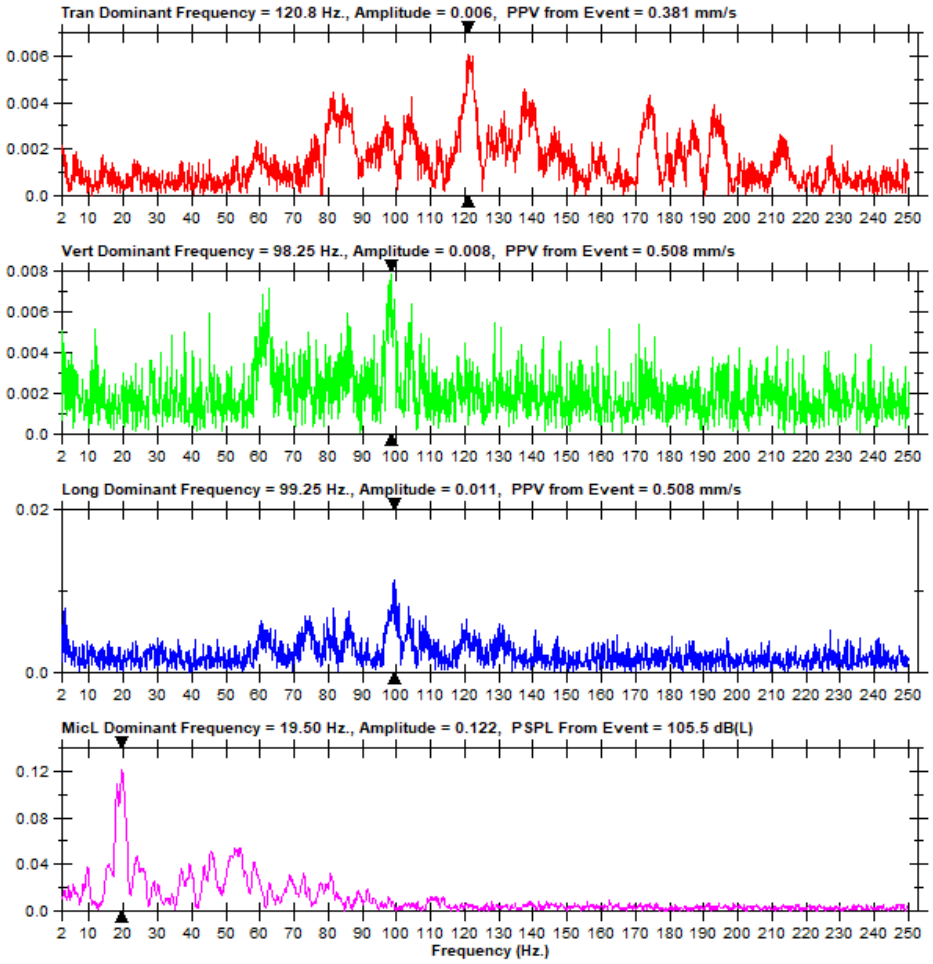
FFT Report

Date/Time	Vert at 10:31:01 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG5.7P0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 96 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 10:31:00 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG5.7O0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 137 m

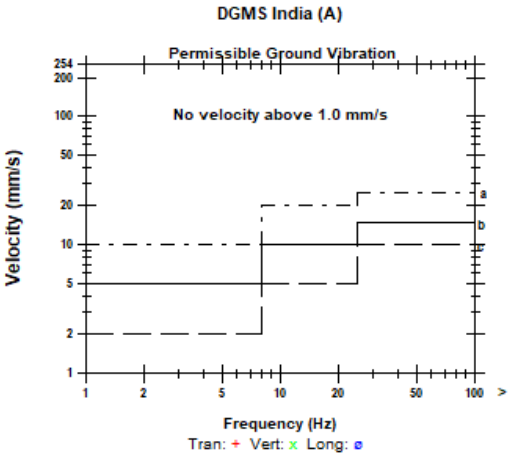
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

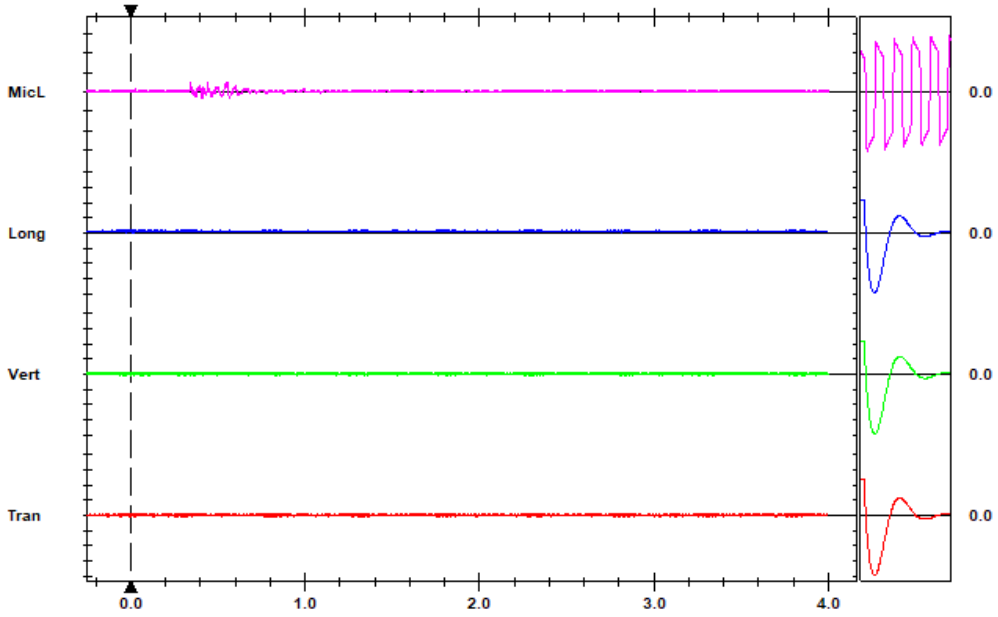
Microphone Linear Weighting
PSPL 108.4 dB(L) at 0.553 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	57	Hz
Time (Rel. to Trig)	0.826	-0.068	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.017	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.539 mm/s at 0.018 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

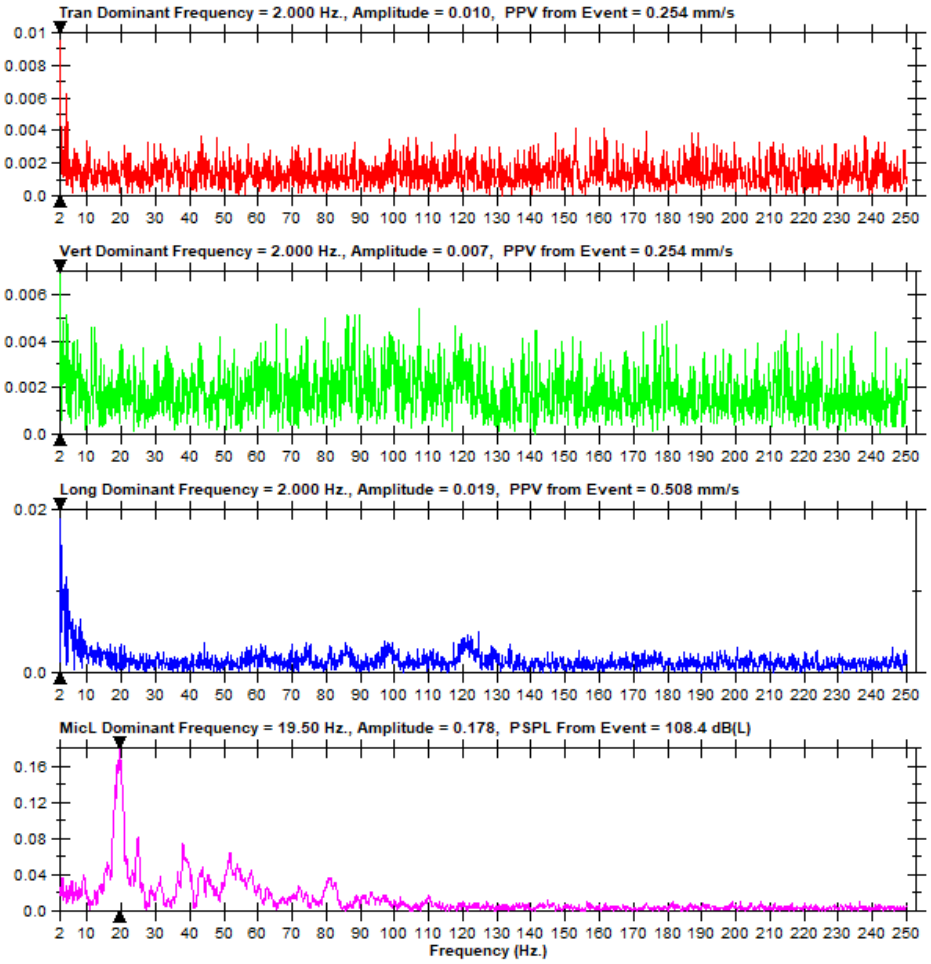
FFT Report

Date/Time	Long at 10:31:00 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG5.7O0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.370 Kg, MCPD - 0.370 Kg, Total Charge - 7.50 Kg, Distance - 137 m



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Event Report

Date/Time Vert at 10:34:41 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTG5.DT0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 104 m

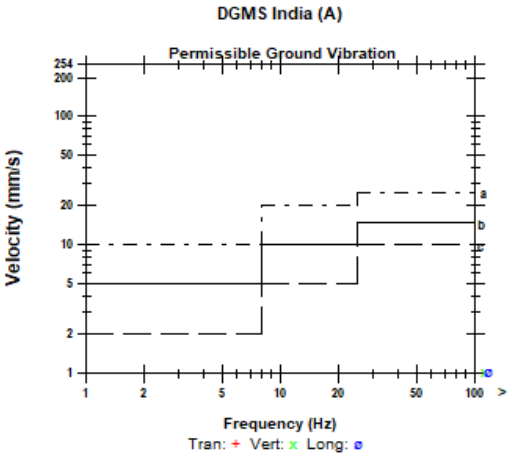
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

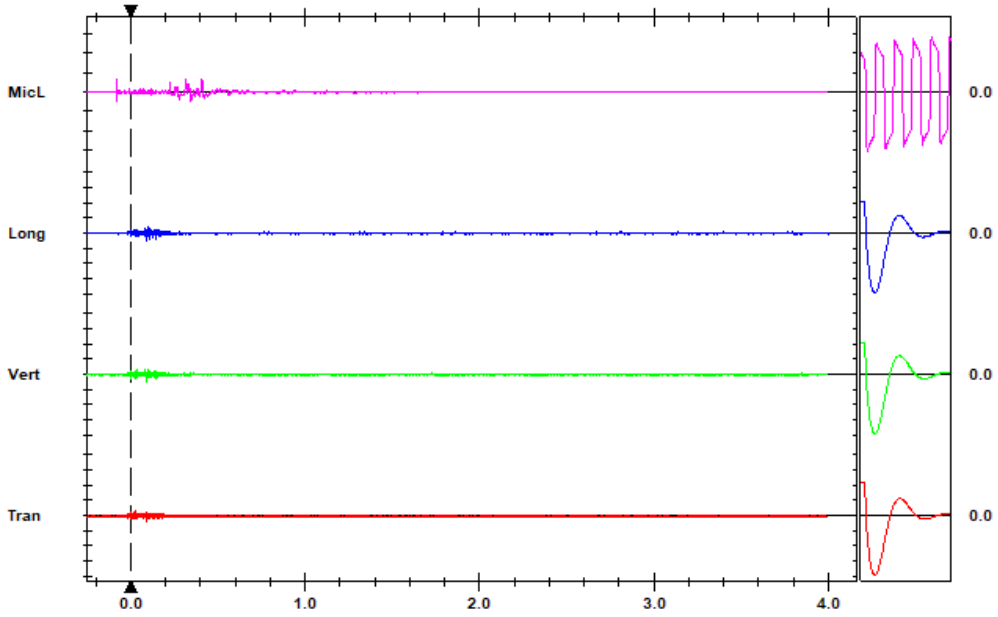
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Microphone Linear Weighting
PSPL 110.2 dB(L) at -0.080 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 485 mv)

	Tran	Vert	Long	
PPV	0.889	1.016	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.092	0.089	0.094	sec
Peak Acceleration	0.080	0.066	0.093	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.8	3.5	3.7	

Peak Vector Sum 1.150 mm/s at 0.094 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

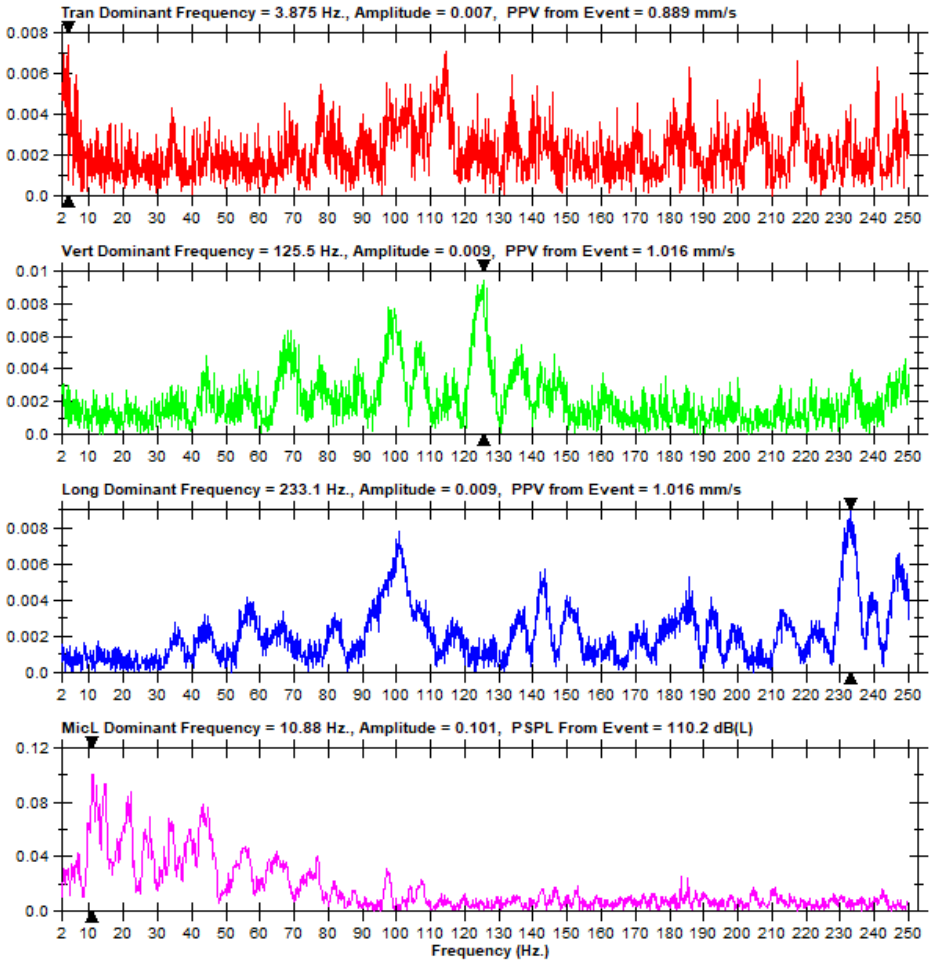
FFT Report

Date/Time	Vert at 10:34:41 December 22, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTG5.DT0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 104 m



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Event Report

Date/Time Tran at 10:34:37 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTG5.DP0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 168 m

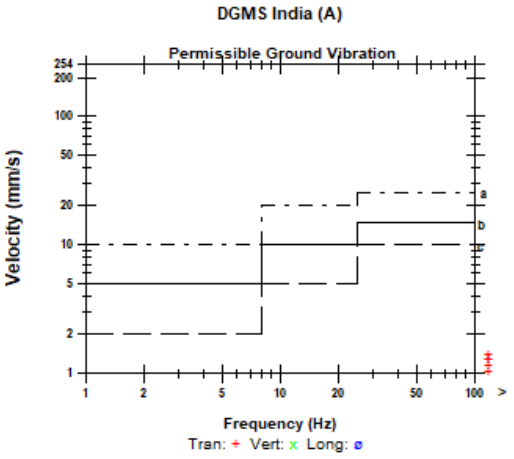
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

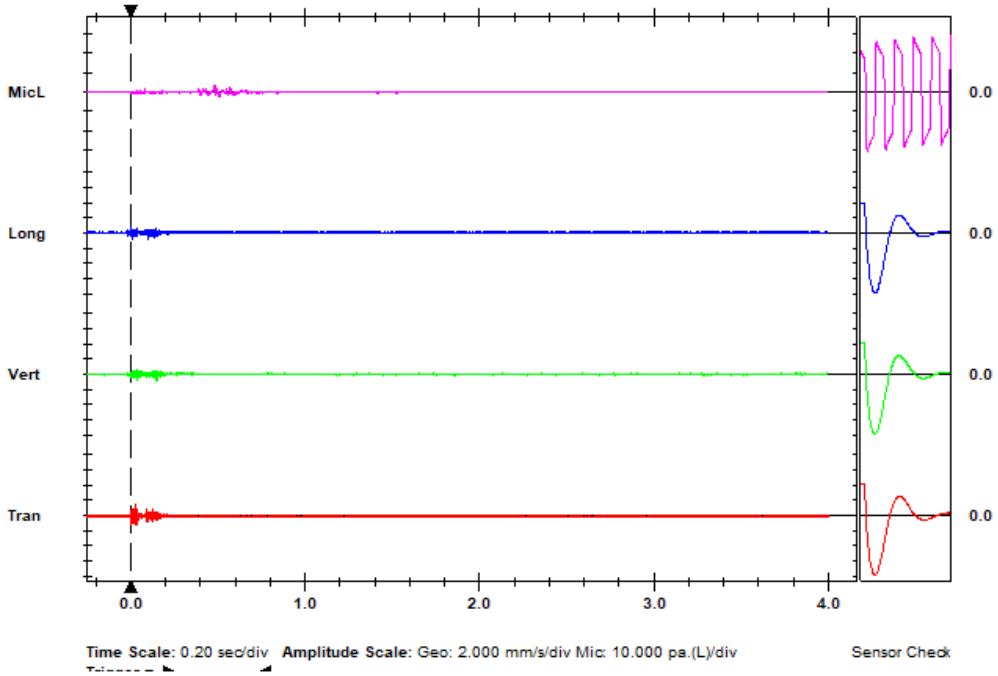
Microphone Linear Weighting
PSPL 103.5 dB(L) at 0.480 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	1.397	0.762	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.029	0.037	0.004	sec
Peak Acceleration	0.106	0.053	0.053	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.6	Hz
Overswing Ratio	3.4	3.4	3.5	

Peak Vector Sum 1.508 mm/s at 0.033 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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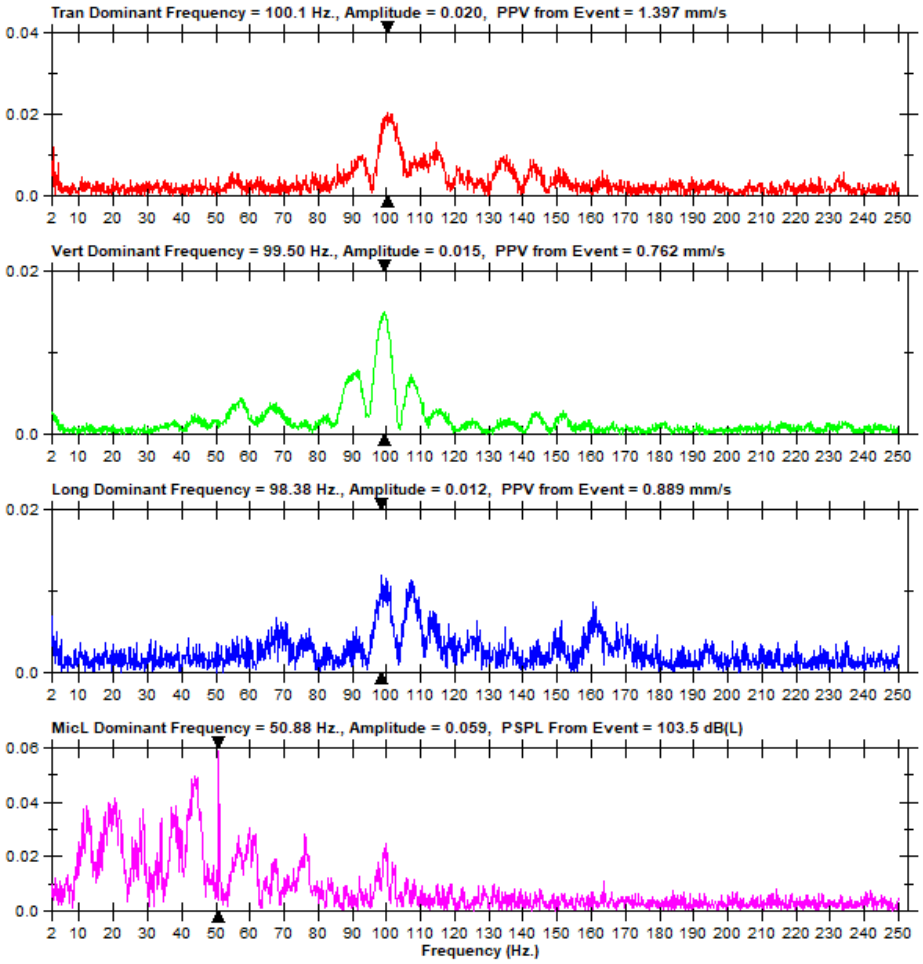
FFT Report

Date/Time	Tran at 10:34:37 December 22, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTG5.DP0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 168 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 10:34:42 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTG5.DU0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 185 m

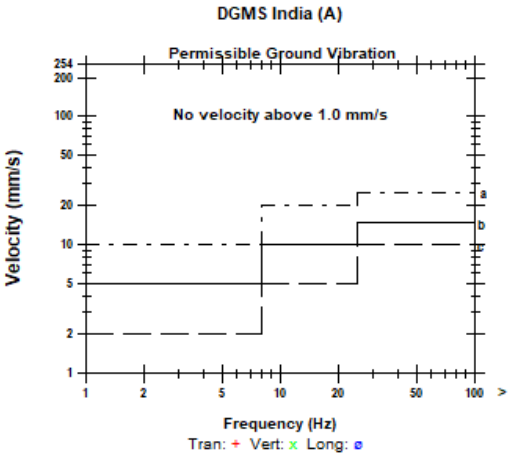
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

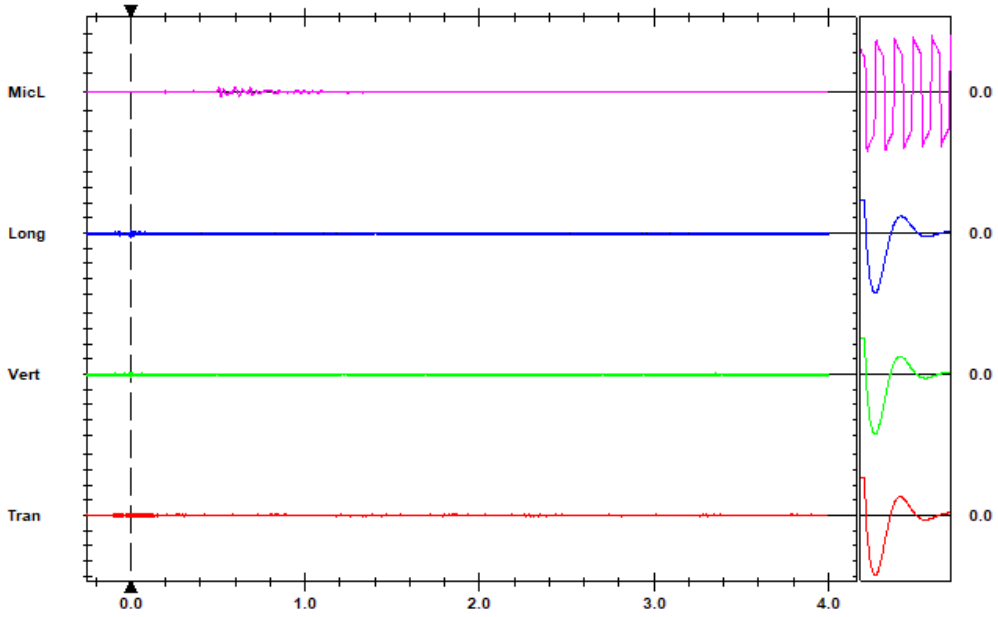
Microphone Linear Weighting
PSPL 102.8 dB(L) at 0.504 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 497 mv)

	Tran	Vert	Long	
PPV	0.254	0.381	0.635	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	-0.092	0.003	0.006	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 0.660 mm/s at 0.006 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

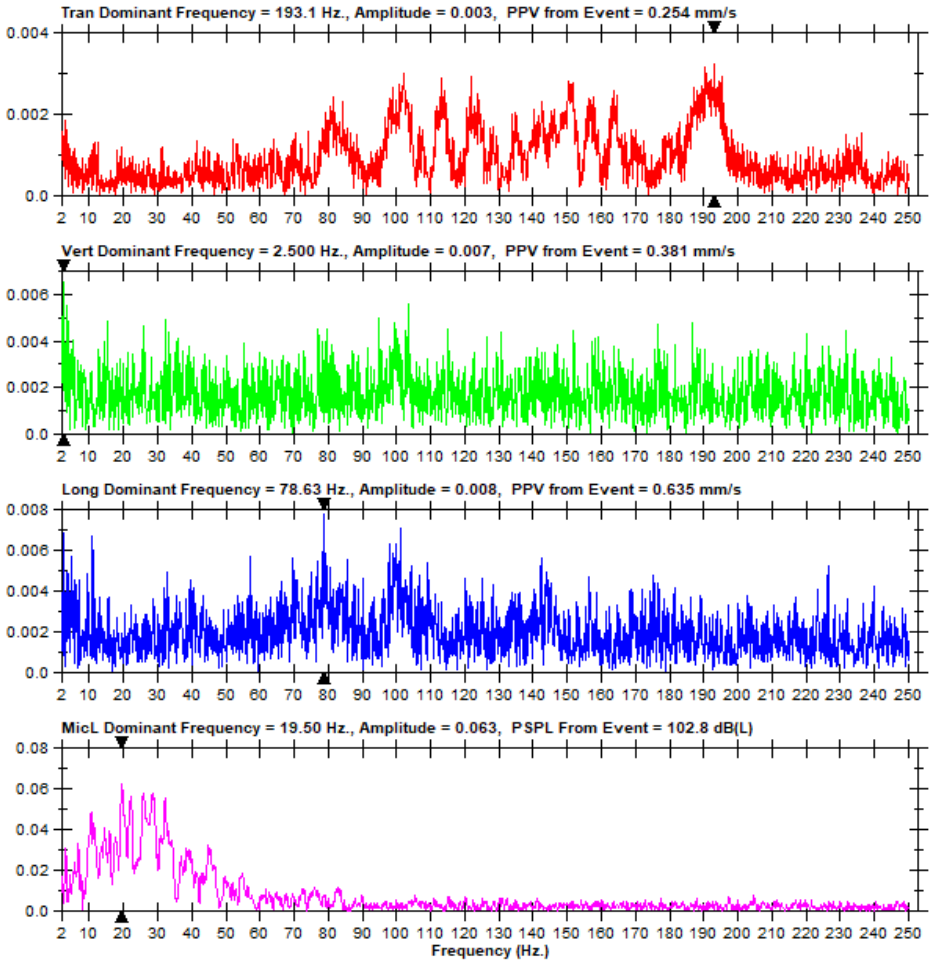
FFT Report

Date/Time	Long at 10:34:42 December 22, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTG5.DU0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 185 m



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Event Report

Date/Time Long at 10:34:41 December 22, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTG5.DT0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 250 m

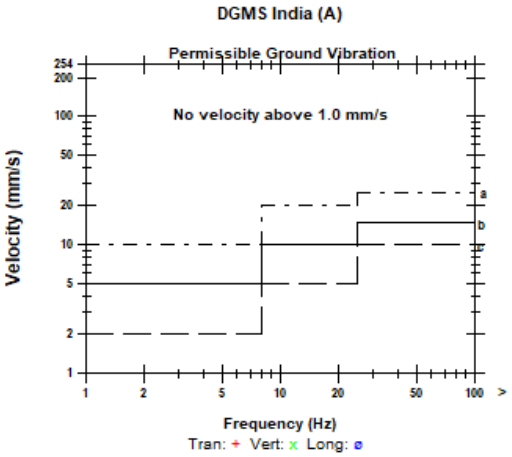
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

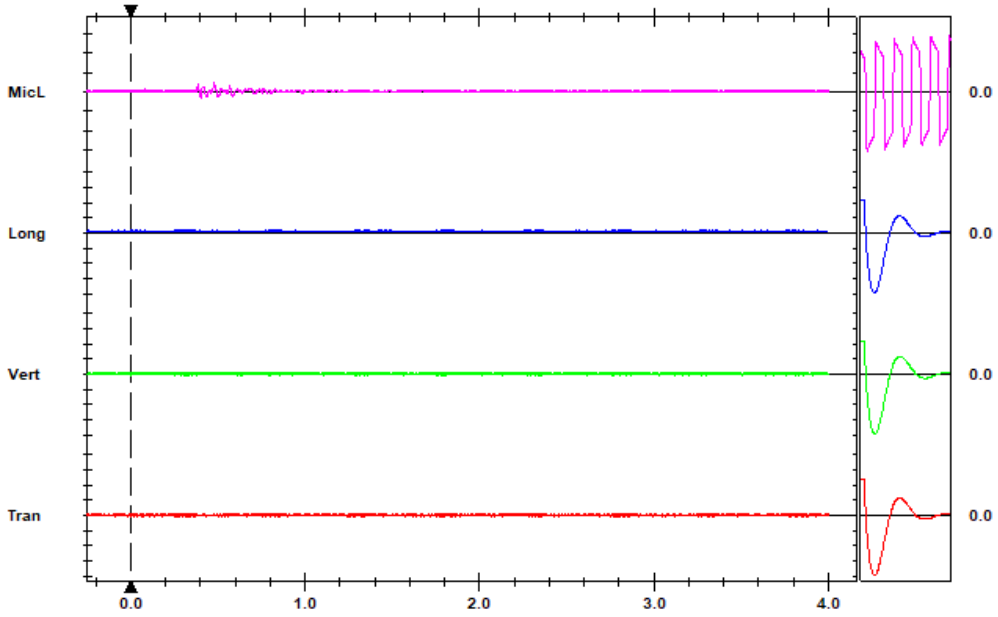
Microphone Linear Weighting
PSPL 107.5 dB(L) at 0.479 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 466 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	64	Hz
Time (Rel. to Trig)	2.258	0.003	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.7	3.6	3.8	

Peak Vector Sum 0.524 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

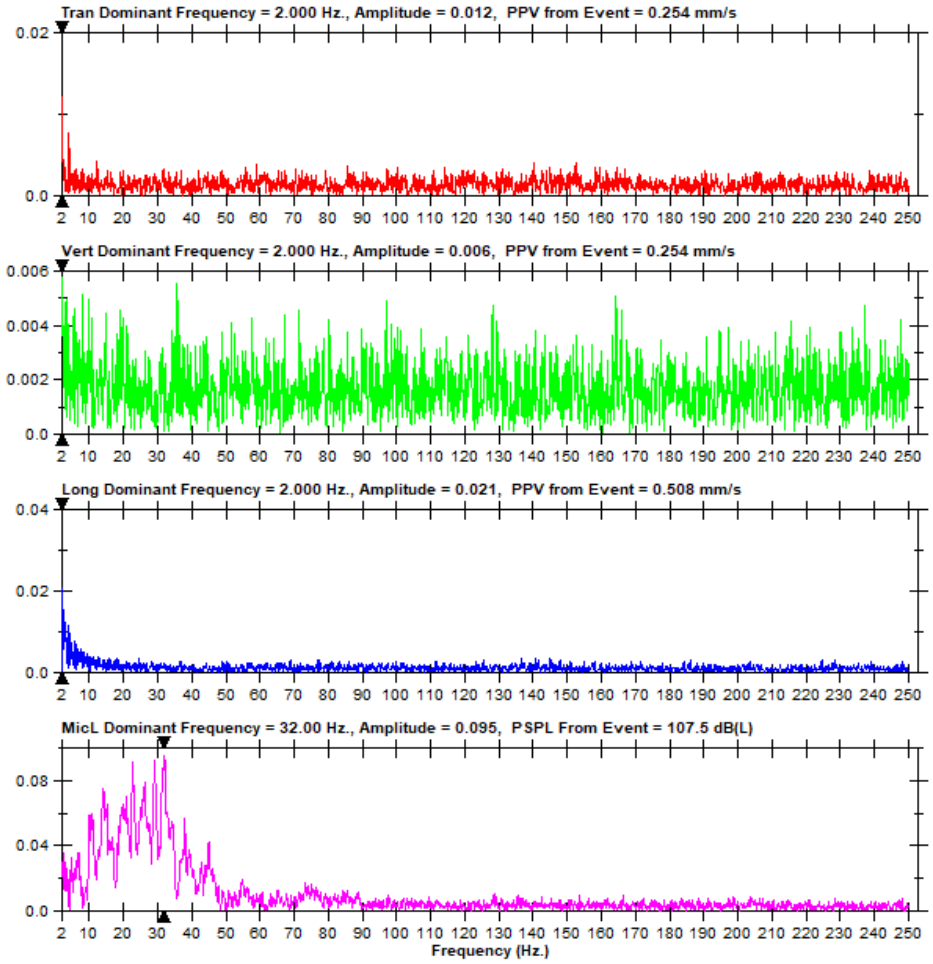
FFT Report

Date/Time	Long at 10:34:41 December 22, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTG5.DT0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela (District - Trivandrum)

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.400 Kg, MCPD - 0.400 Kg, Total Charge - 4.00 Kg, Distance - 250 m



Printed: February 20, 2023 (V 10.72 - 10.72)

ANNEXURE-4

Event and FFT Reports of Ground Vibration Recorded at Parackal Stone Quarry of M/s Parackal Granite Kerala Private, Ernakulam District

Instantel

Event Report

Date/Time Tran at 12:22:05 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.CT0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 55 m

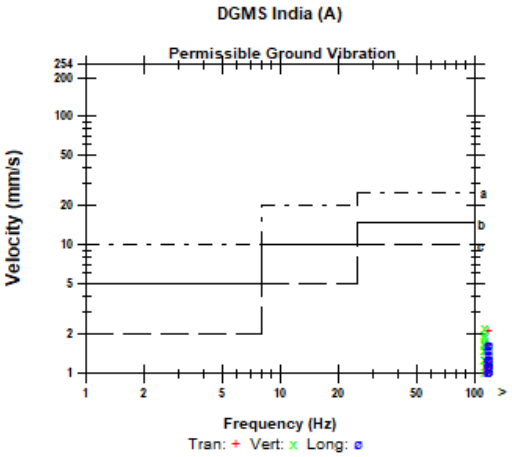
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

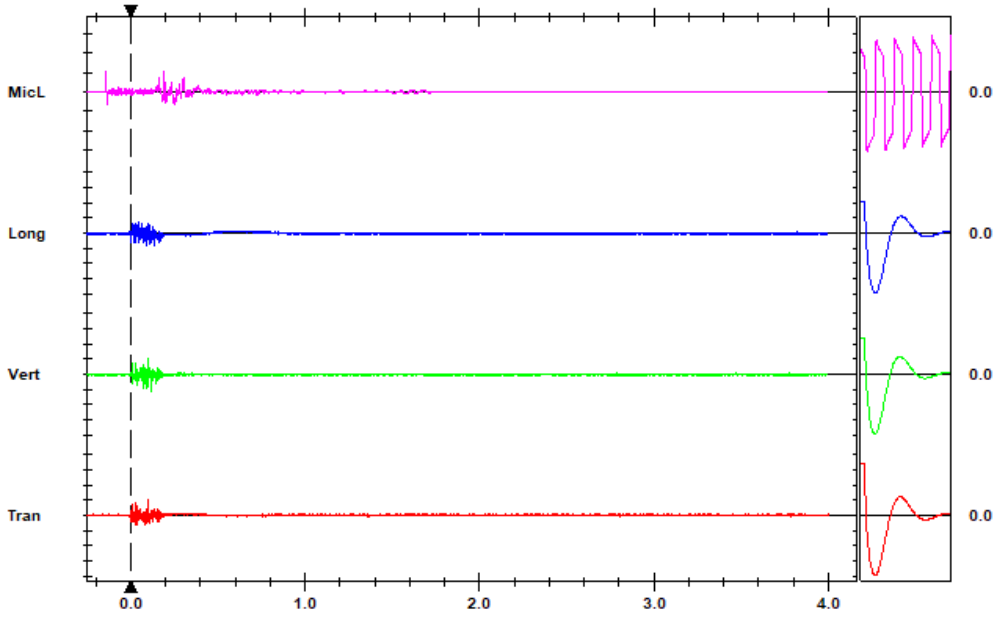
Microphone Linear Weighting
PSPL 114.8 dB(L) at -0.139 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	2.159	2.286	1.651	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.104	0.115	0.095	sec
Peak Acceleration	0.239	0.239	0.199	g
Peak Displacement	0.002	0.002	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 2.508 mm/s at 0.095 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

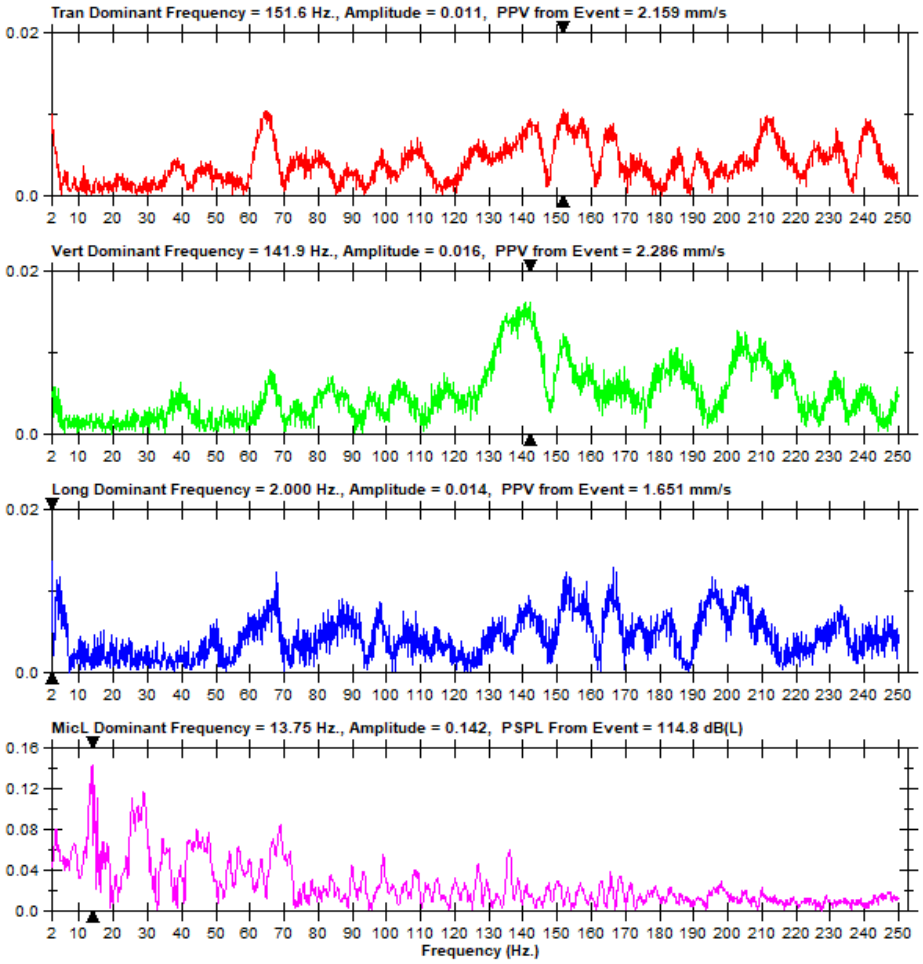
FFT Report

Date/Time	Tran at 12:22:05 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.CT0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 55 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:22:05 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

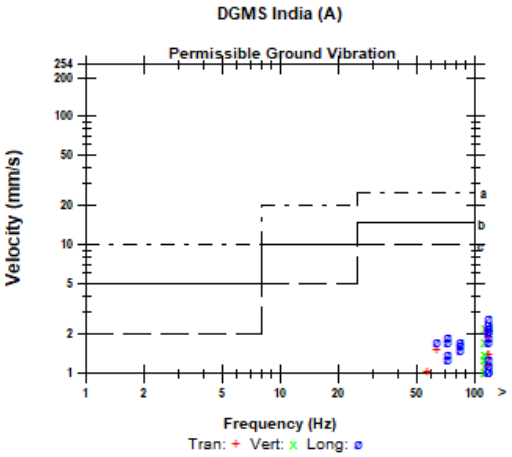
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

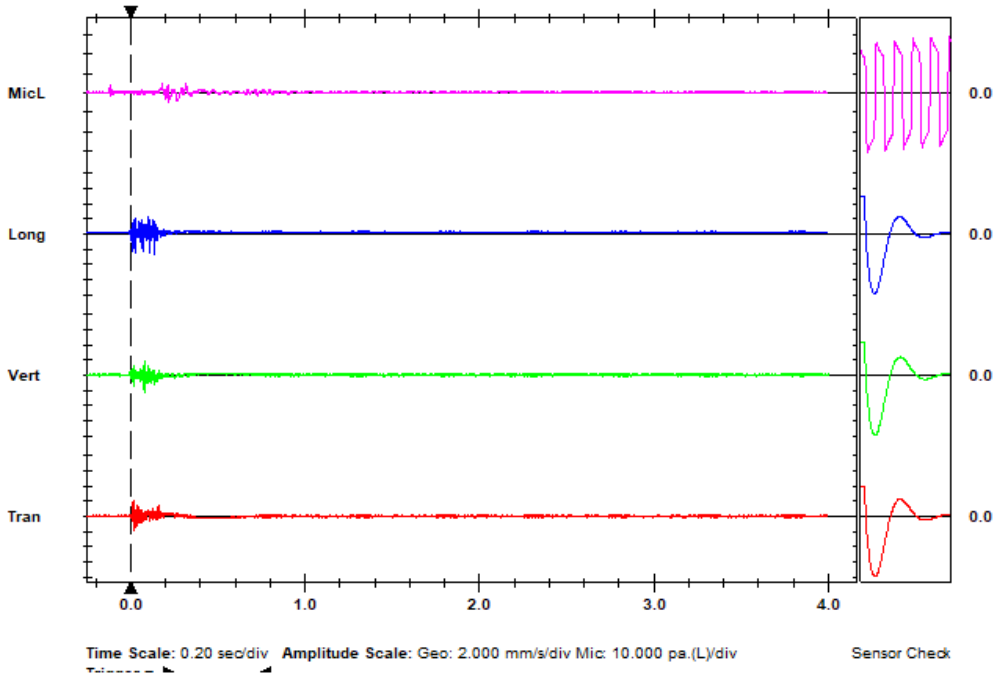
Microphone Linear Weighting
PSPL 107.5 dB(L) at 0.182 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	2.159	2.286	2.667	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.022	0.081	0.136	sec
Peak Acceleration	0.172	0.225	0.212	g
Peak Displacement	0.010	0.002	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 2.899 mm/s at 0.015 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRE.CT0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 62 m





Printed: February 20, 2023 (V 10.72 - 10.72)

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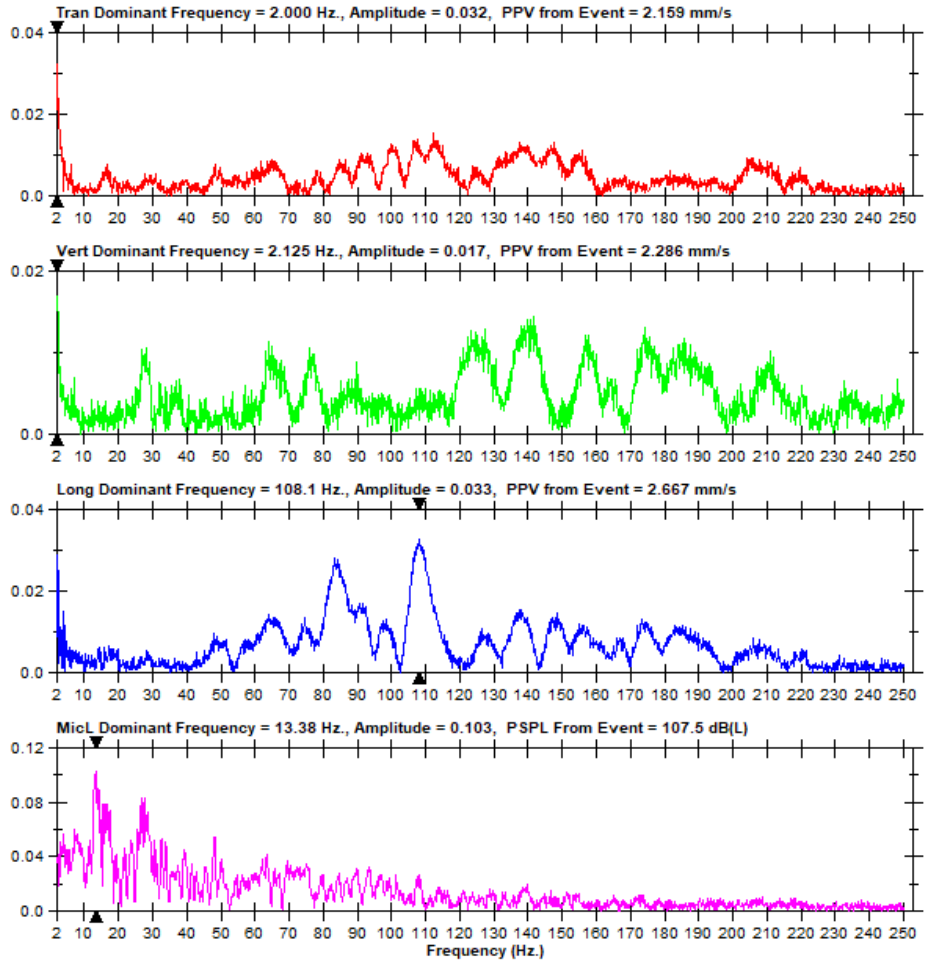
FFT Report

Date/Time	Long at 12:22:05 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRE.CT0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 62 m



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Event Report

Date/Time Long at 12:22:04 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRE.CS0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 129 m

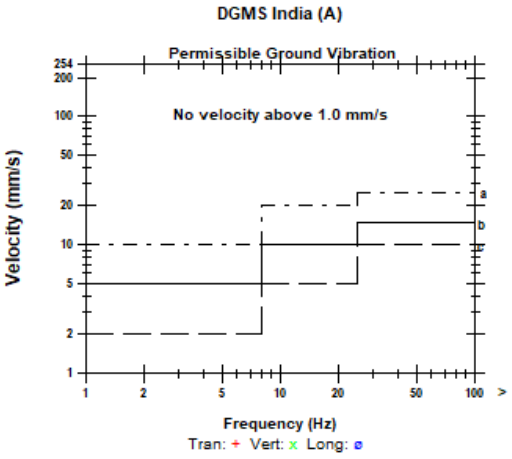
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

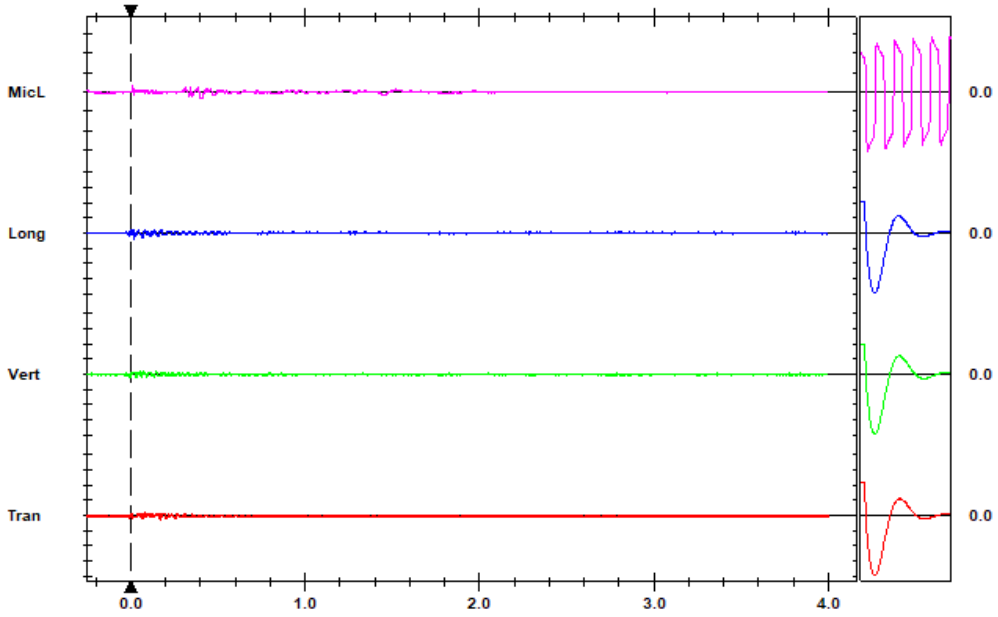
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.402 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	0.762	mm/s
ZC Freq	51	51	51	Hz
Time (Rel. to Trig)	0.168	0.031	0.022	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.002	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.813 mm/s at 0.022 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

Instantel

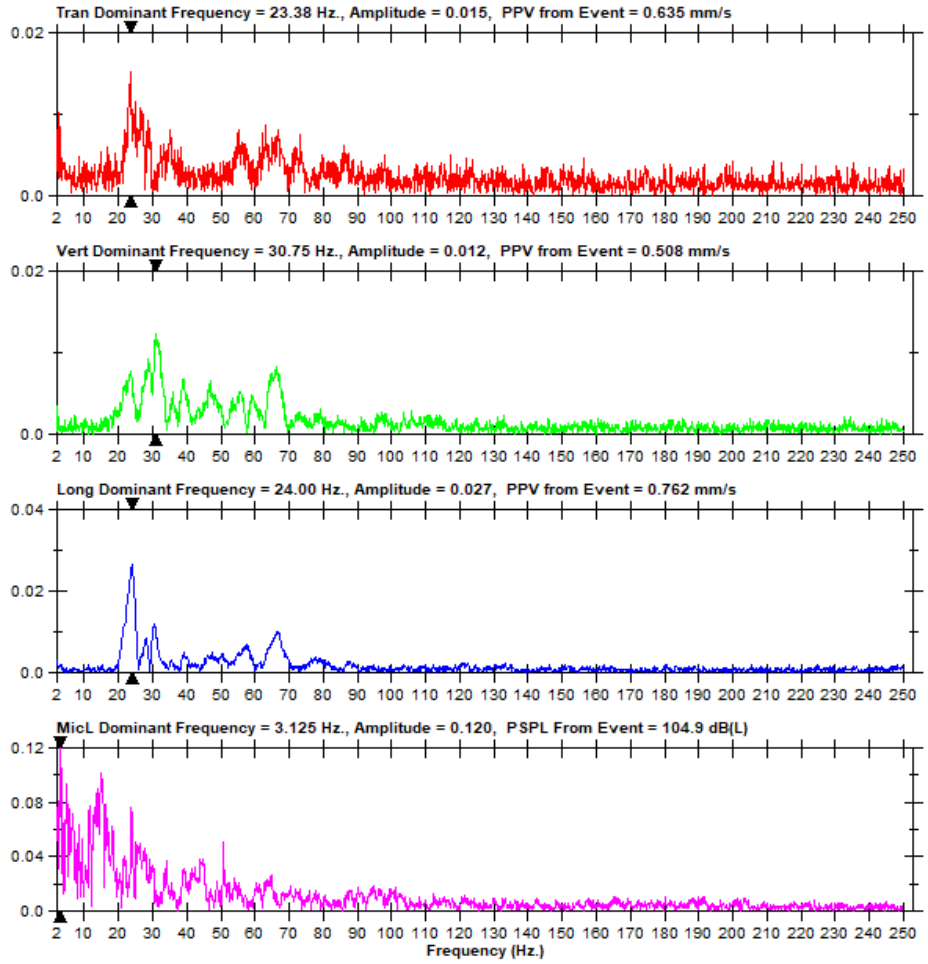
FFT Report

Date/Time	Long at 12:22:04 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRE.CS0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.37 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 129 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:22:58 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.EA0
Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.625 Kg, Distance - 51 m

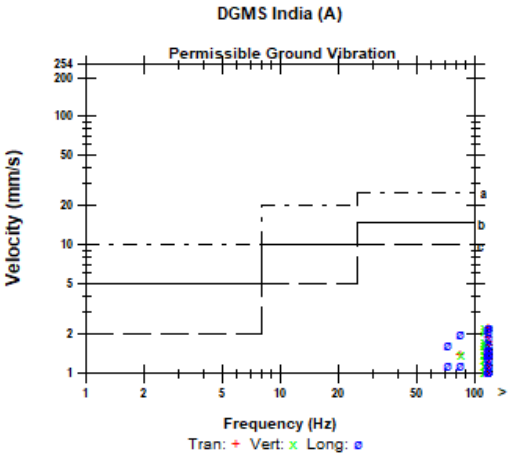
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

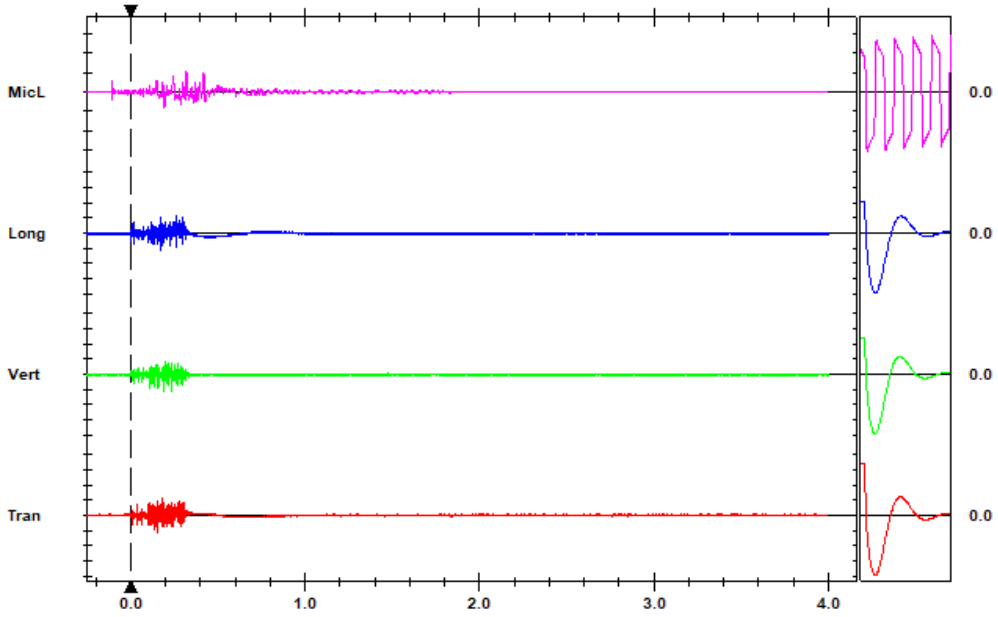
Microphone Linear Weighting
PSPL 114.4 dB(L) at 0.320 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 499 mv)

	Tran	Vert	Long	
PPV	2.286	2.286	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.183	0.188	0.177	sec
Peak Acceleration	0.292	0.212	0.305	g
Peak Displacement	0.002	0.003	0.049	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 2.750 mm/s at 0.177 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

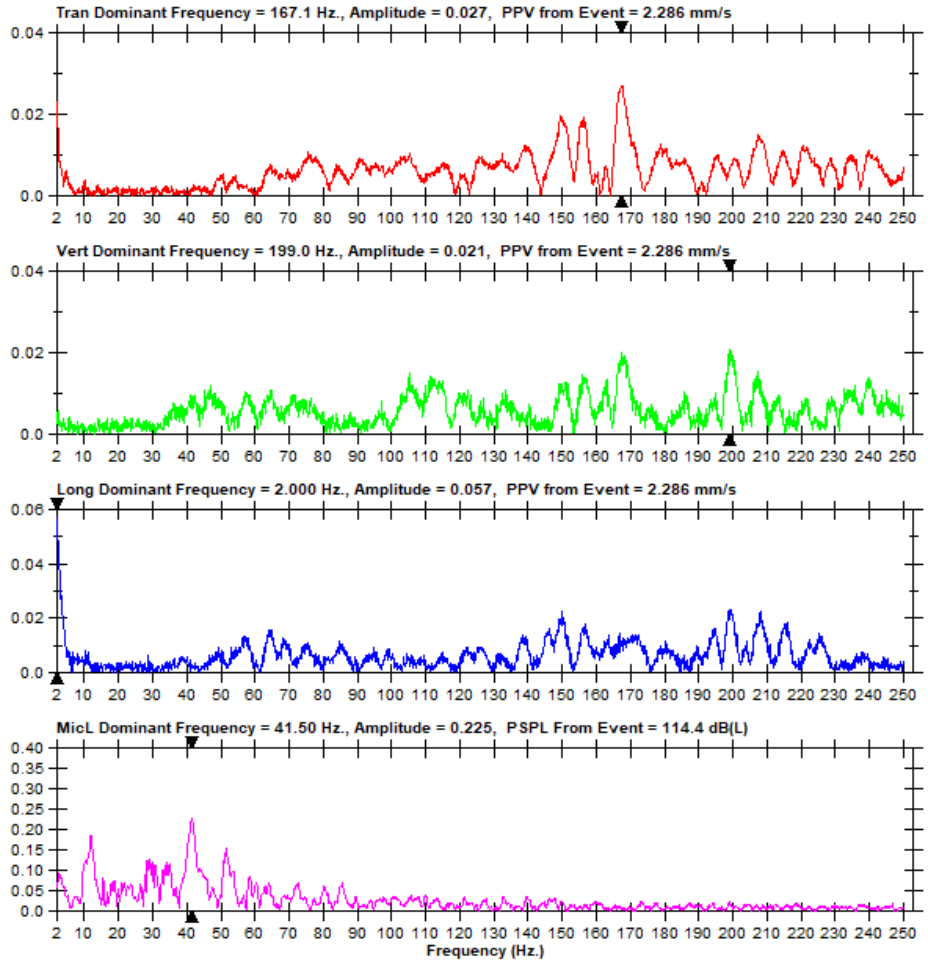
FFT Report

Date/Time	Long at 12:22:58 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.EA0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.625 Kg, Distance - 51 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:22:58 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

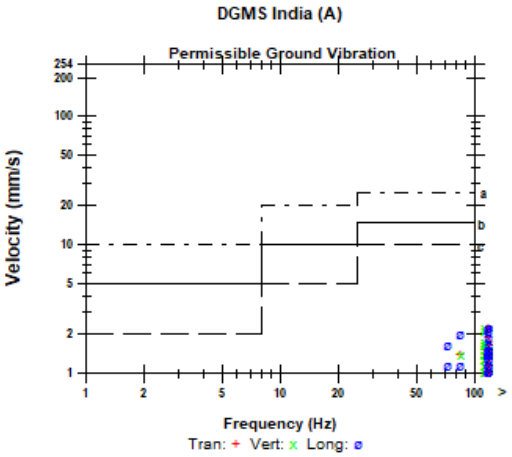
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

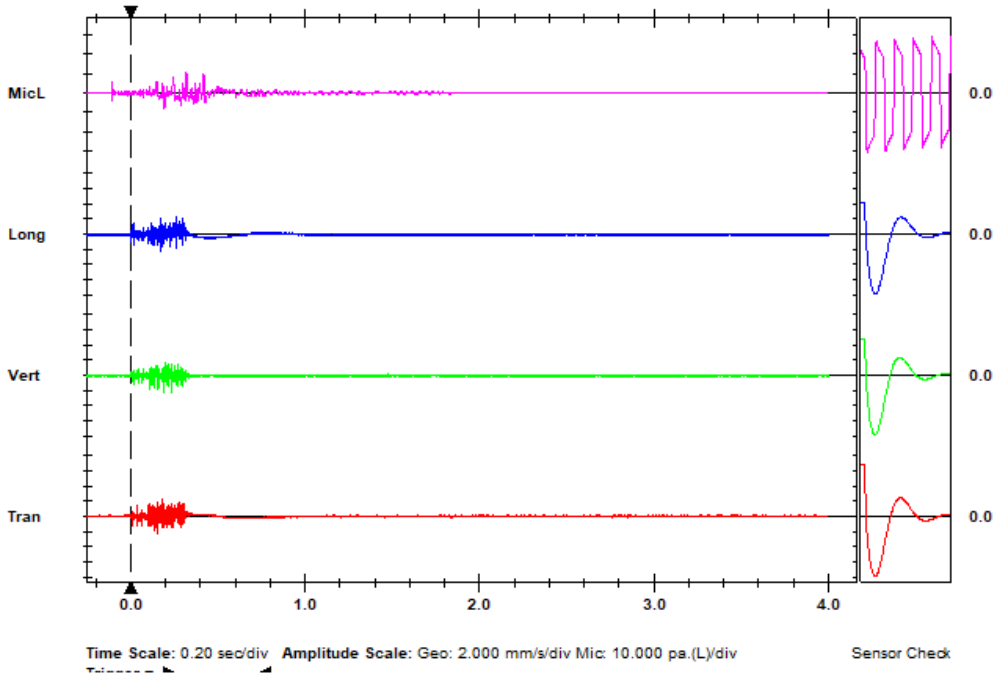
Microphone Linear Weighting
PSPL 114.4 dB(L) at 0.320 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 499 mv)

	Tran	Vert	Long	
PPV	2.286	2.286	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.183	0.188	0.177	sec
Peak Acceleration	0.292	0.212	0.305	g
Peak Displacement	0.002	0.003	0.049	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 2.750 mm/s at 0.177 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.EA0
Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.625 Kg, Distance - 51 m





Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

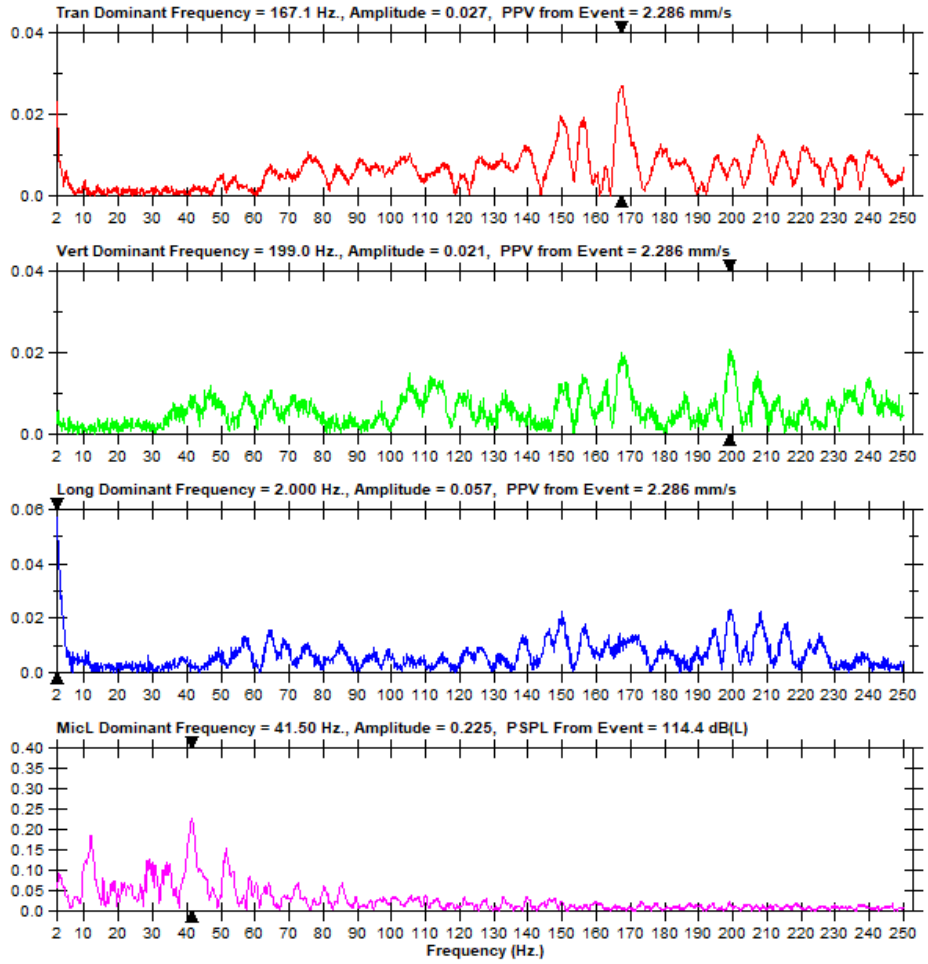
FFT Report

Date/Time	Long at 12:22:58 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.EA0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.625 Kg, Distance - 51 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 12:22:58 December 28, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps

Serial Number	BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level	6.4 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	S606JTRE.EA0

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 73 m

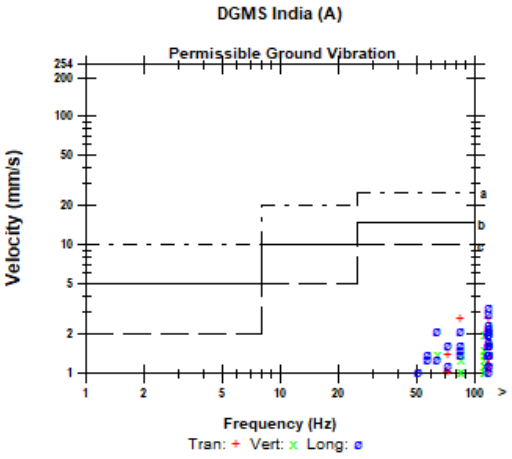
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

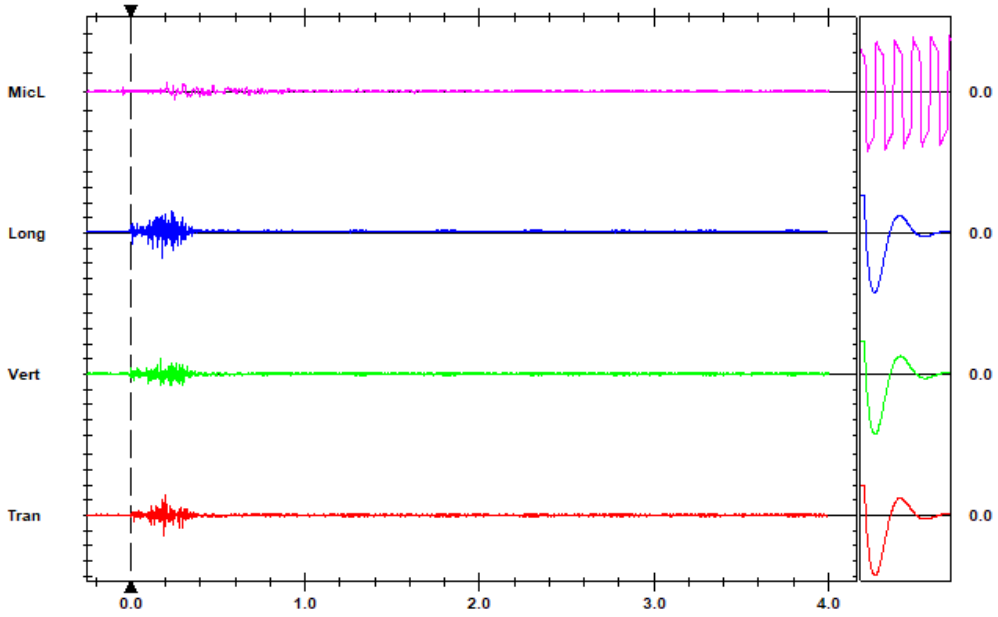
Microphone	Linear Weighting
PSPL	107.0 dB(L) at 0.209 sec
ZC Freq	21 Hz
Channel Test	Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	2.667	2.032	3.302	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.191	0.172	0.180	sec
Peak Acceleration	0.172	0.119	0.225	g
Peak Displacement	0.005	0.003	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 3.334 mm/s at 0.180 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

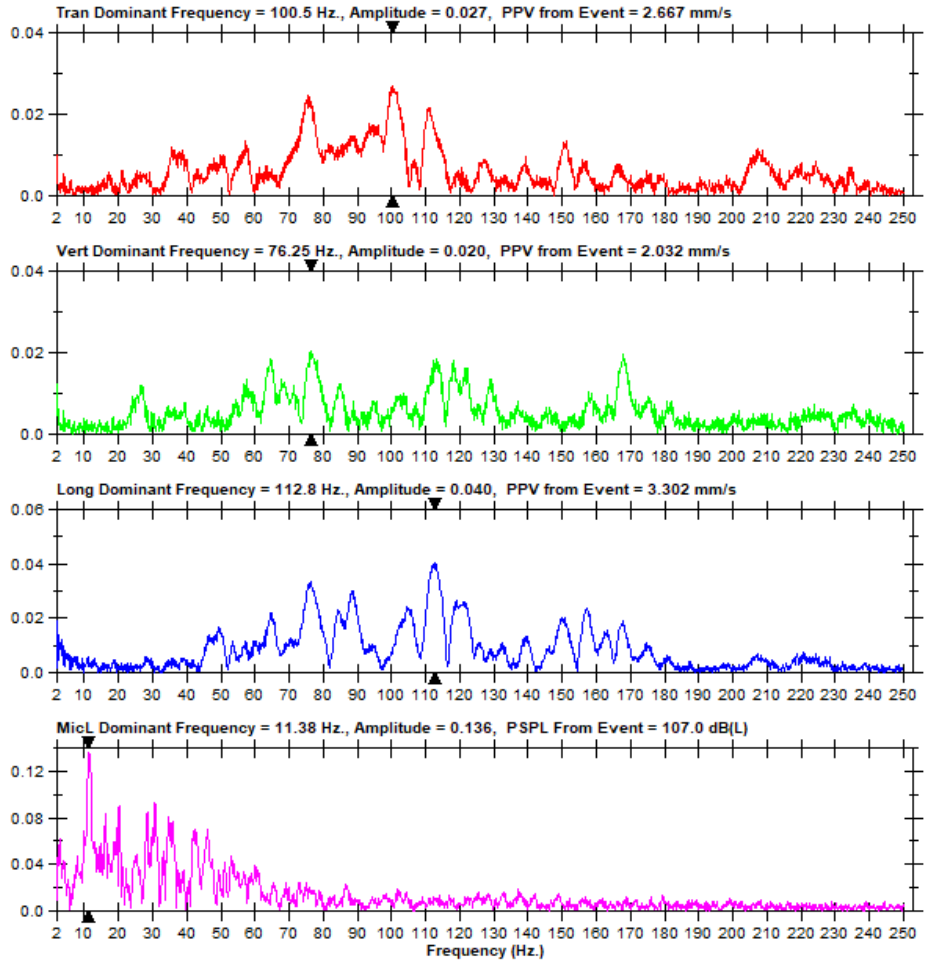
FFT Report

Date/Time	Vert at 12:22:58 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRE.EA0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 73 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 12:22:57 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRE.E90
Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 111 m

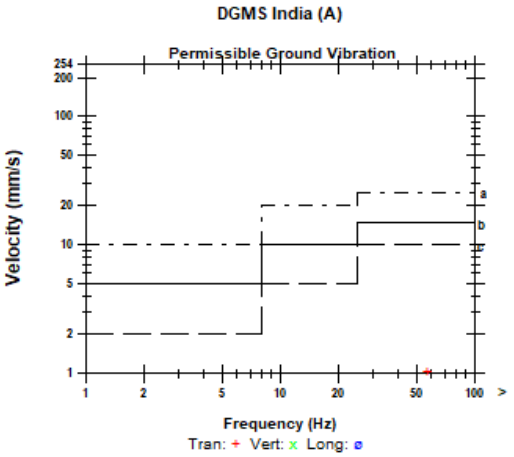
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

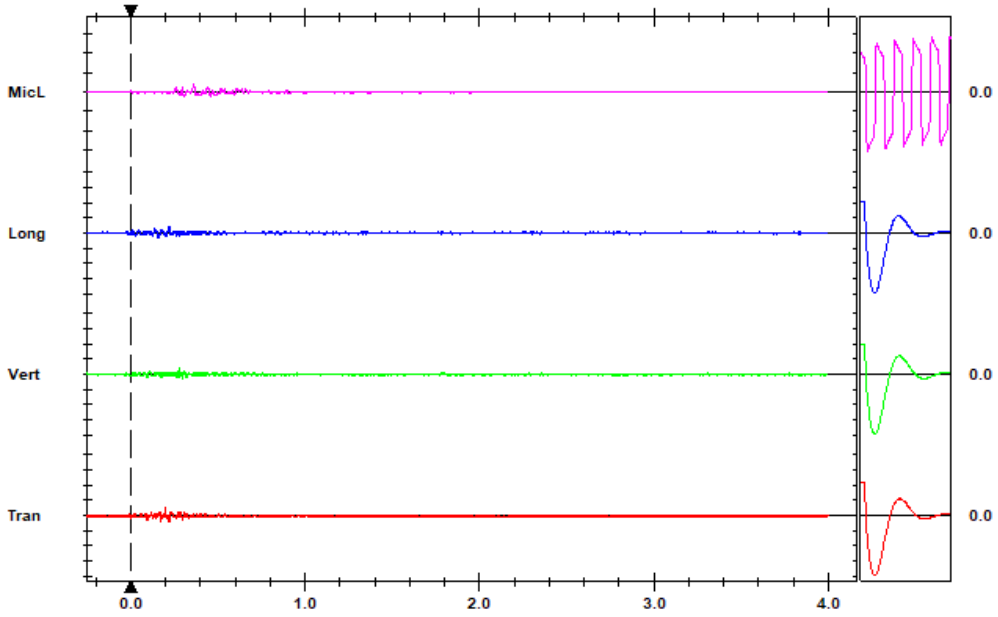
Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.362 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.016	0.762	0.762	mm/s
ZC Freq	57	73	43	Hz
Time (Rel. to Trig)	0.199	0.276	0.221	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.198 mm/s at 0.221 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

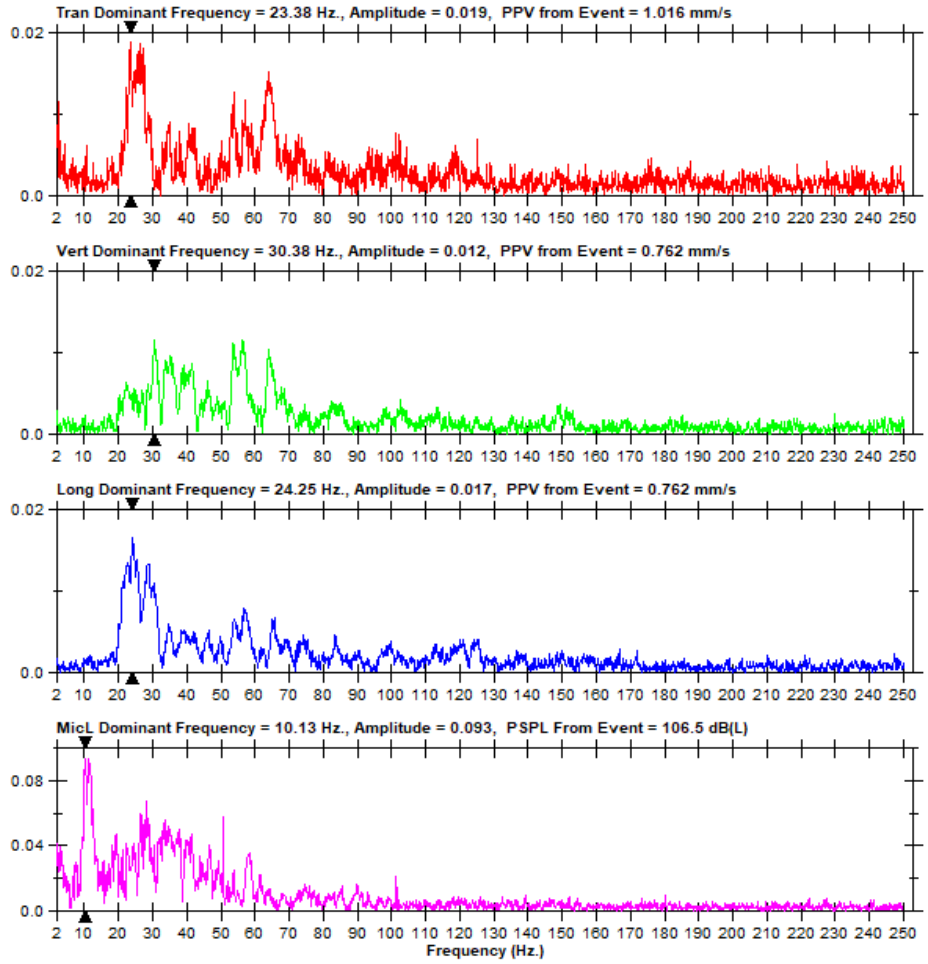
FFT Report

Date/Time	Tran at 12:22:57 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRE.E90

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 111 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Vert at 12:22:59 December 28, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTRE.EB0

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

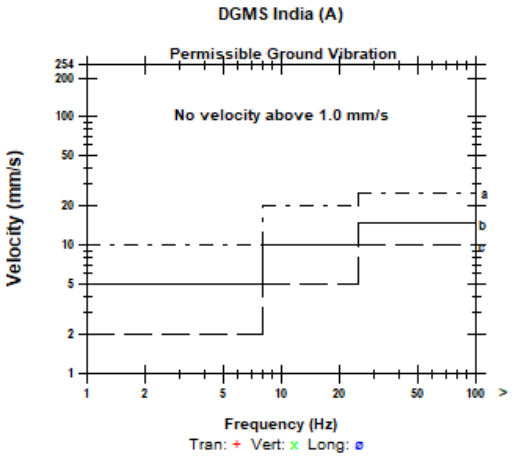
Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 228 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

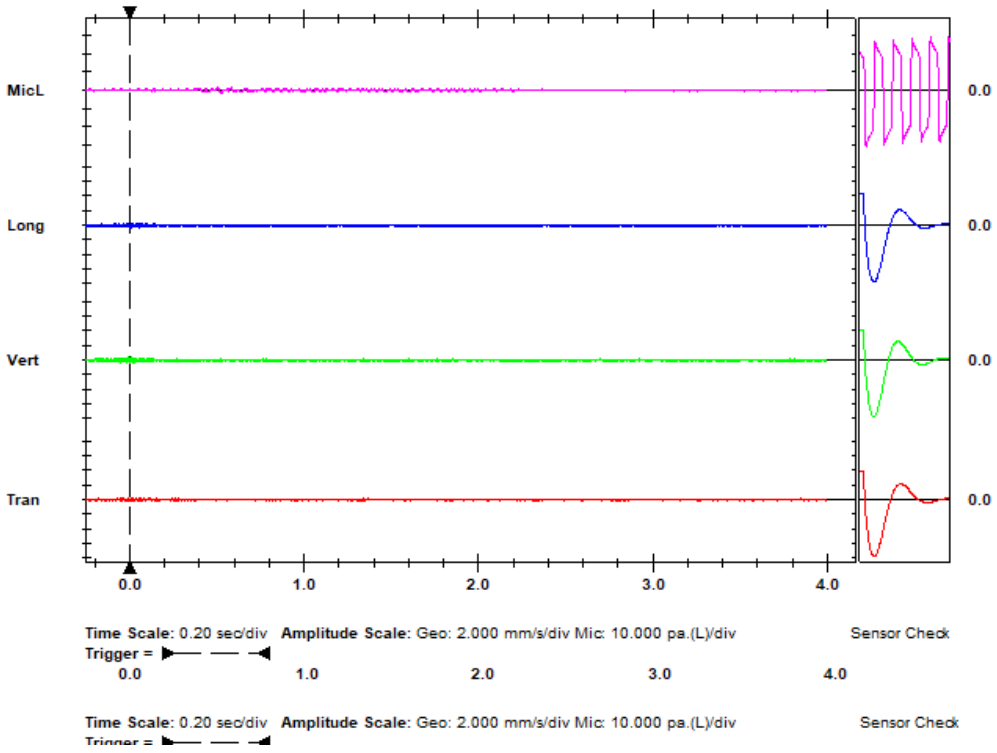
Microphone	Linear Weighting
PSPL	100.0 dB(L) at 0.504 sec
ZC Freq	26 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.381	mm/s
ZC Freq	>100	73	>100	Hz
Time (Rel. to Trig)	-0.017	0.000	0.005	sec
Peak Acceleration	0.013	0.027	0.027	g
Peak Displacement	0.000	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.568 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Instantel

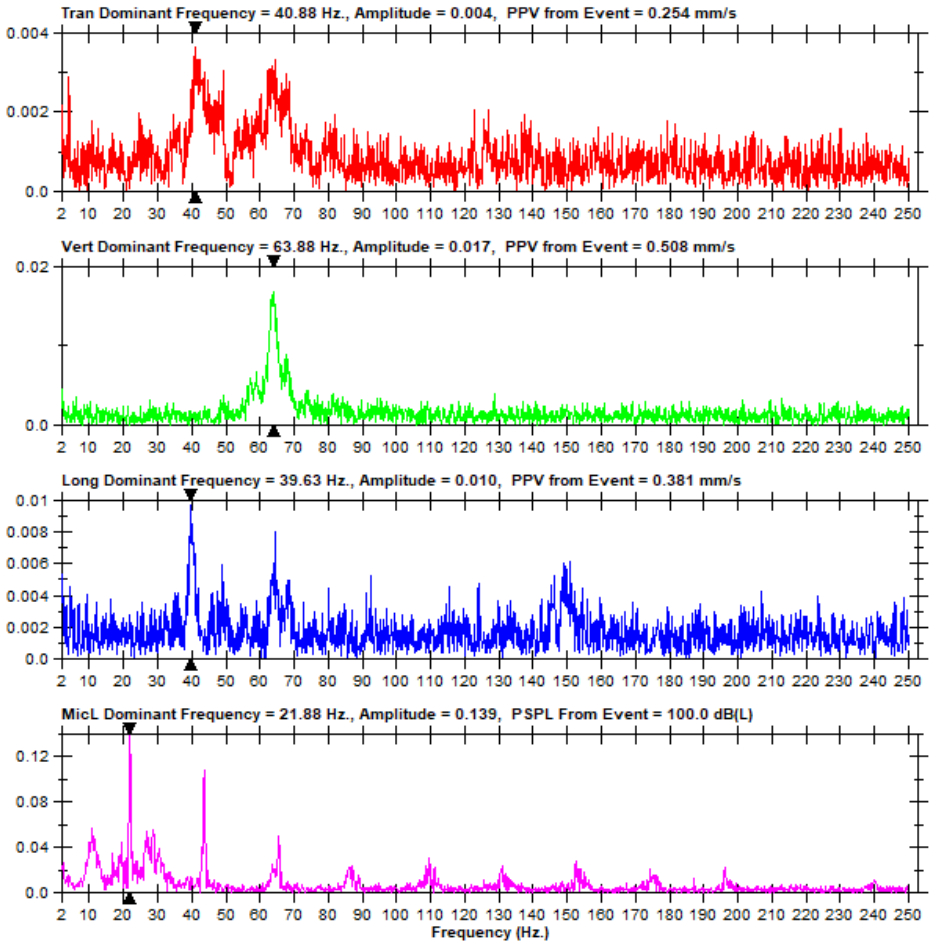
FFT Report

Date/Time	Vert at 12:22:59 December 28, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JTRE.EB0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 228 m



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Event Report

Date/Time Tran at 12:22:57 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRE.E90
Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 275 m

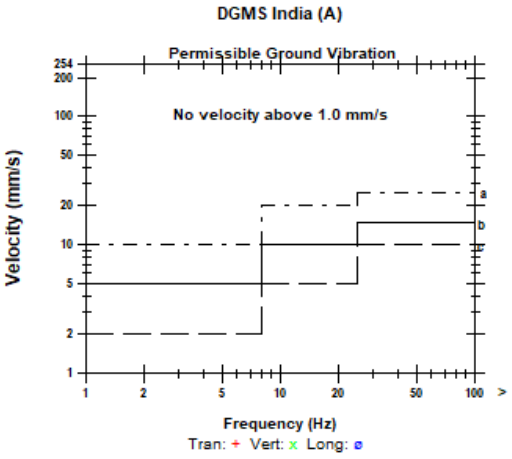
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

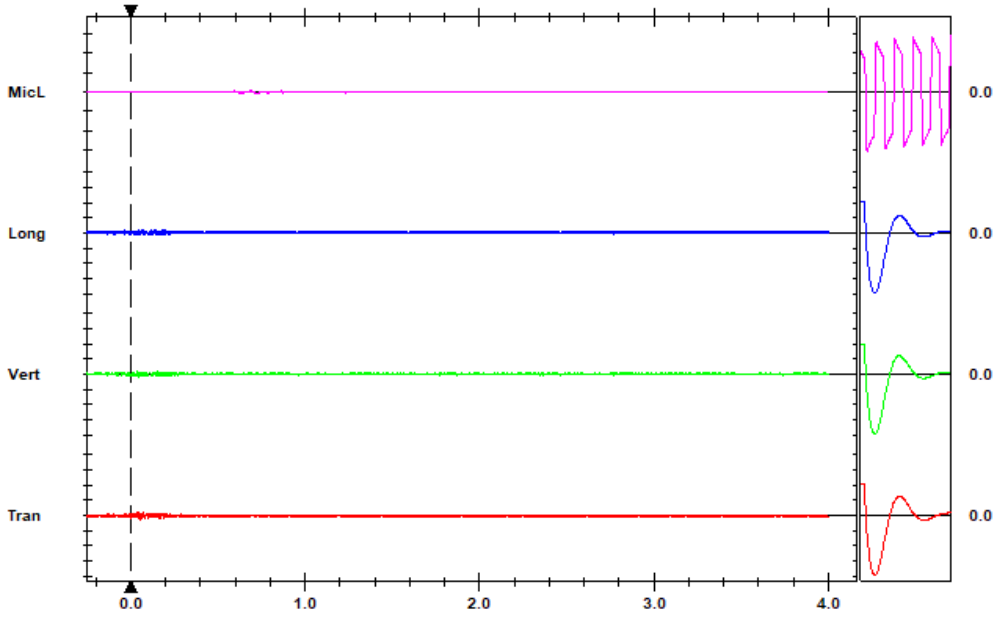
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.643 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.381	mm/s
ZC Freq	73	85	>100	Hz
Time (Rel. to Trig)	0.052	0.035	-0.032	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.648 mm/s at 0.052 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

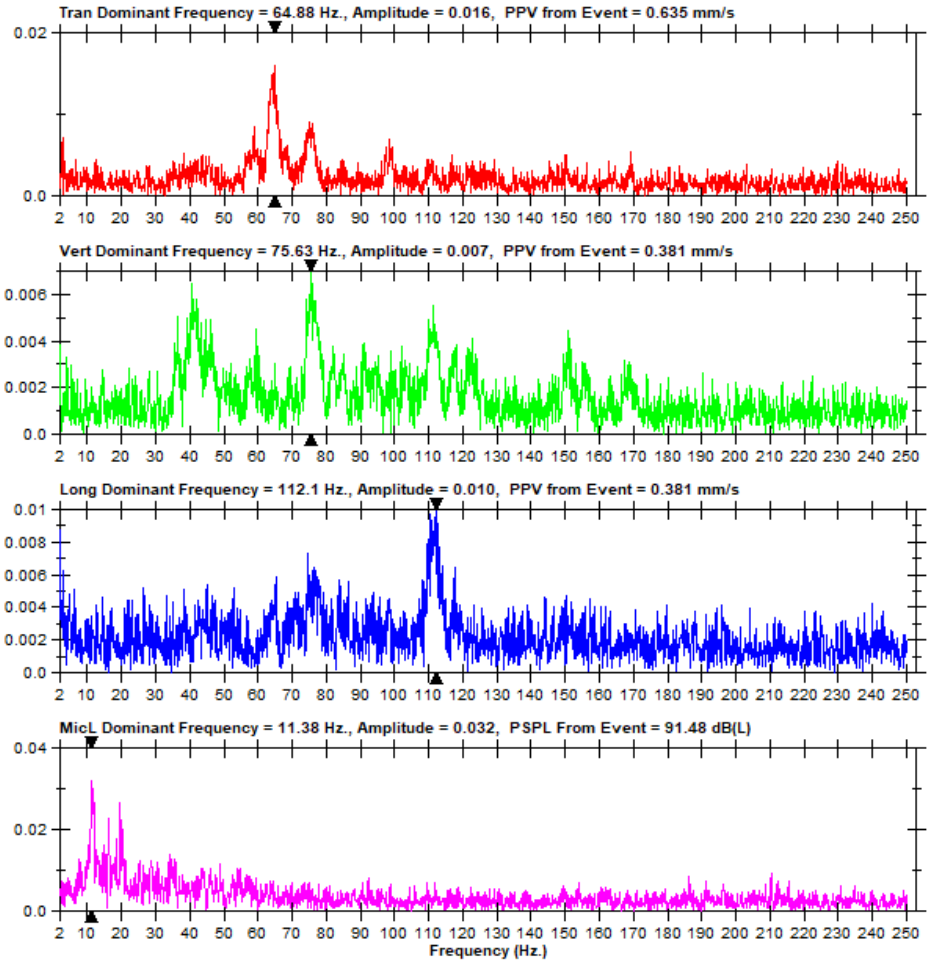
FFT Report

Date/Time	Tran at 12:22:57 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRE.E90

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 23, Hole Depth - 1.8 m, Charge/hole - 0.33 Kg, MCPD - 0.375 Kg, Total Charge - 7.265 Kg, Distance - 275 m



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Event Report

Date/Time Long at 12:24:16 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.GG0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 56 m

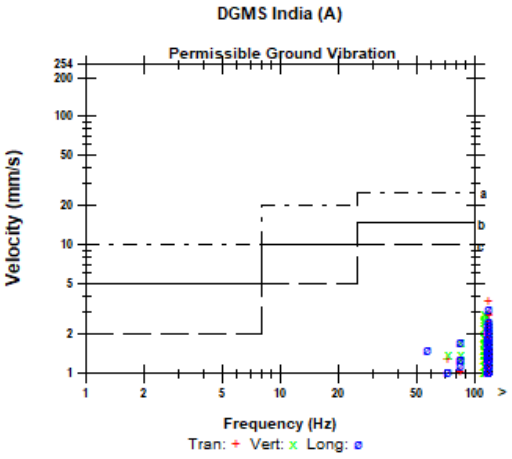
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

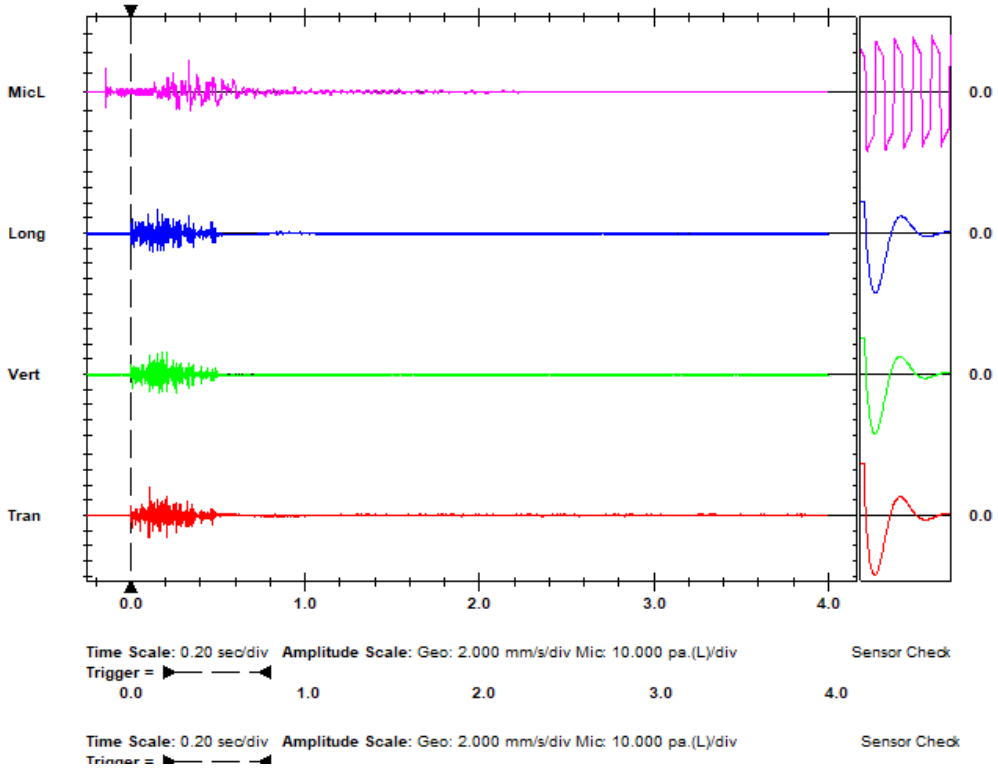
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 118.2 dB(L) at 0.334 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 481 mv)

	Tran	Vert	Long	
PPV	3.683	2.921	3.175	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.106	0.178	0.151	sec
Peak Acceleration	0.411	0.345	0.292	g
Peak Displacement	0.003	0.003	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.6	3.9	

Peak Vector Sum 4.361 mm/s at 0.106 sec





Instantel

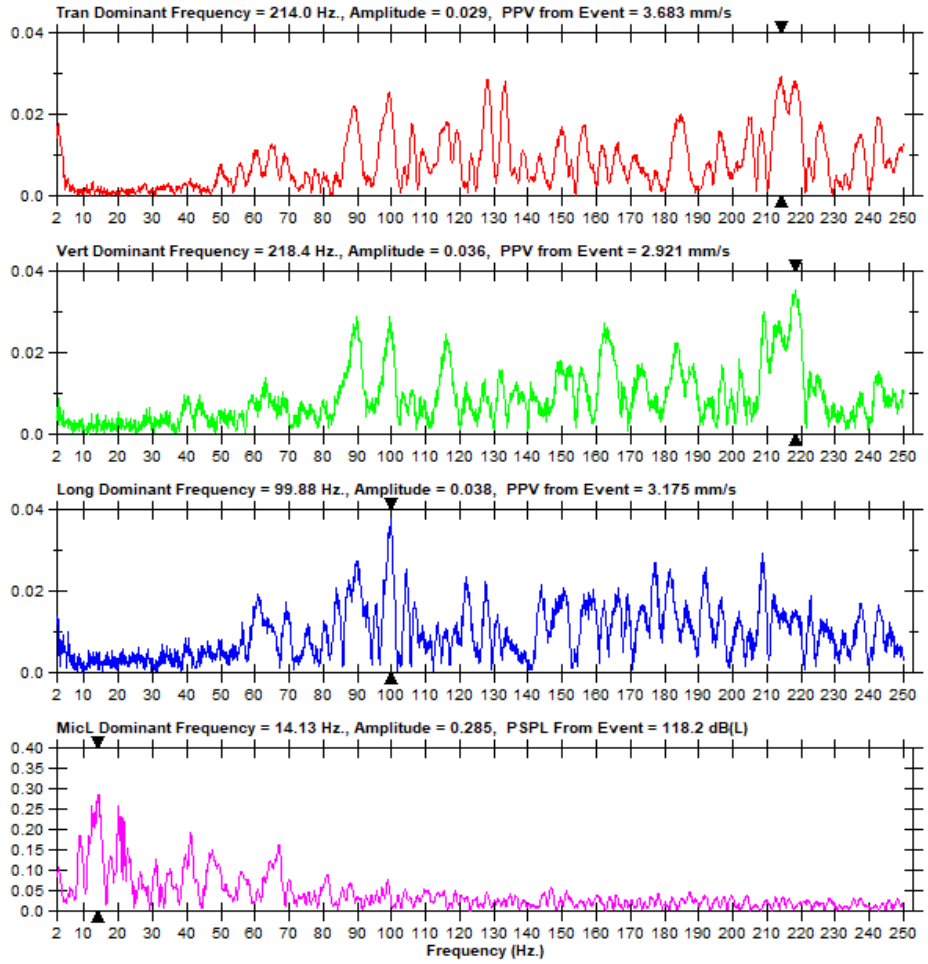
FFT Report

Date/Time	Long at 12:24:16 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.GG0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 56 m



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Event Report

Date/Time Vert at 12:24:17 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRE.GH0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 64 m

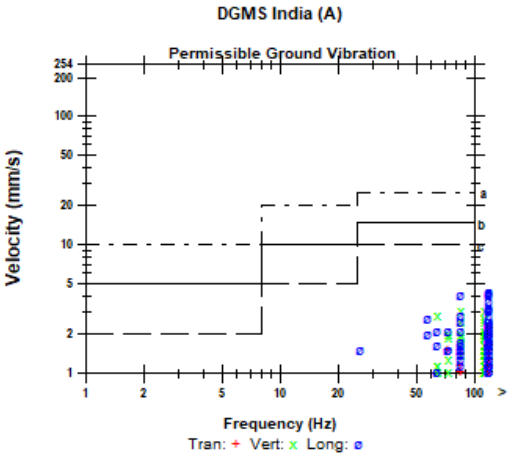
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

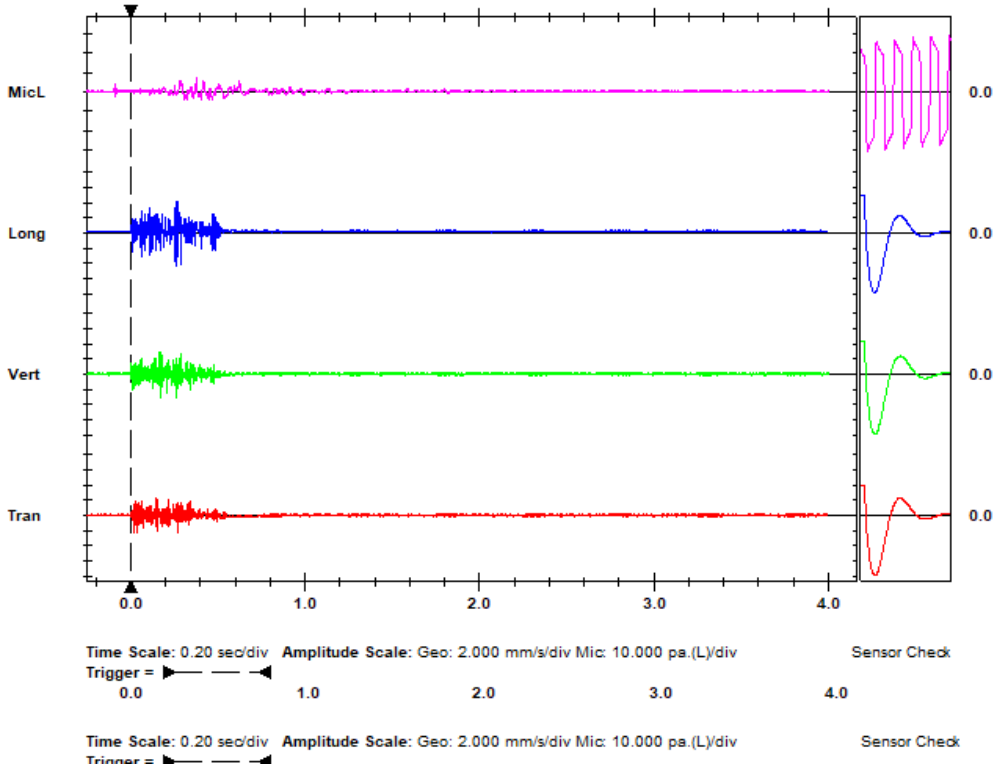
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 111.5 dB(L) at 0.378 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	2.286	3.048	4.318	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.021	0.172	0.263	sec
Peak Acceleration	0.159	0.292	0.292	g
Peak Displacement	0.003	0.006	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 4.829 mm/s at 0.263 sec





Instantel

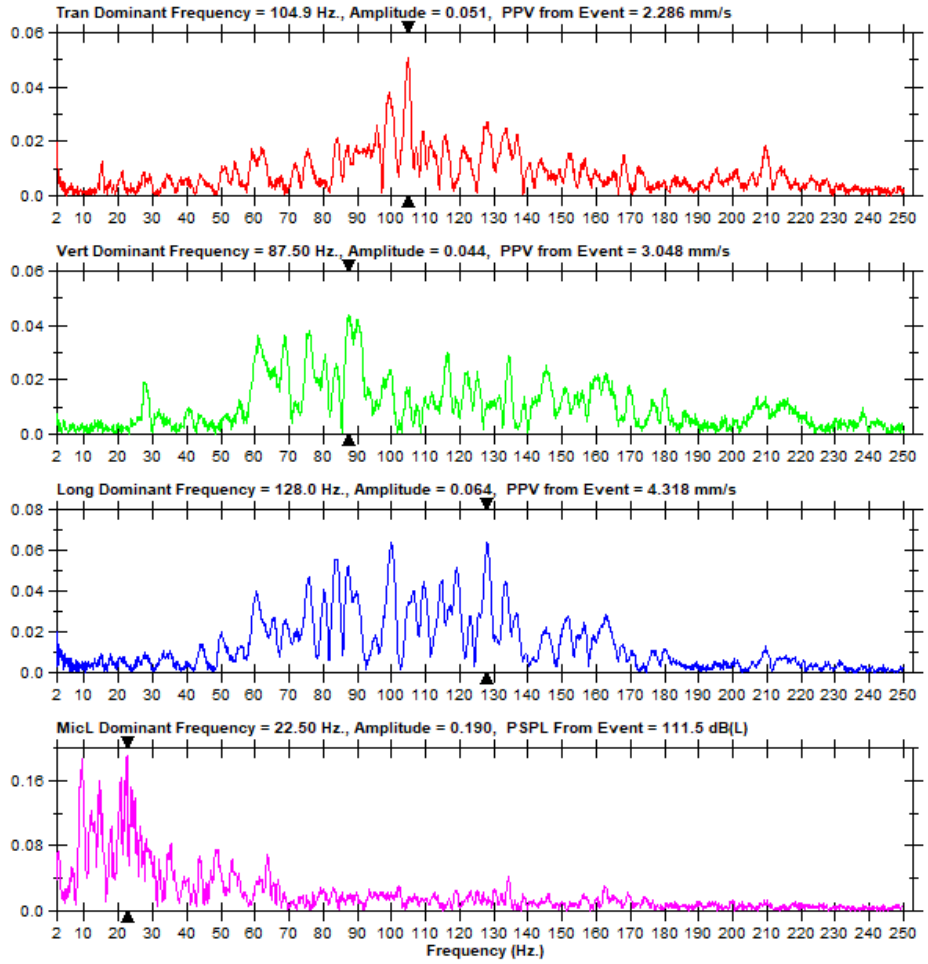
FFT Report

Date/Time	Vert at 12:24:17 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRE.GH0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 64 m



Printed: February 20, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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Event Report

Date/Time Tran at 12:24:15 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRE.GF0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 130 m

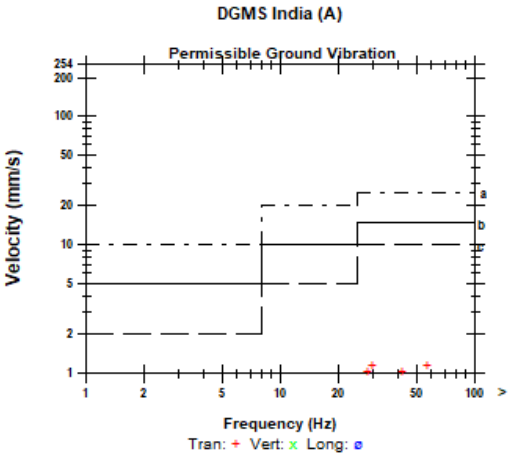
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

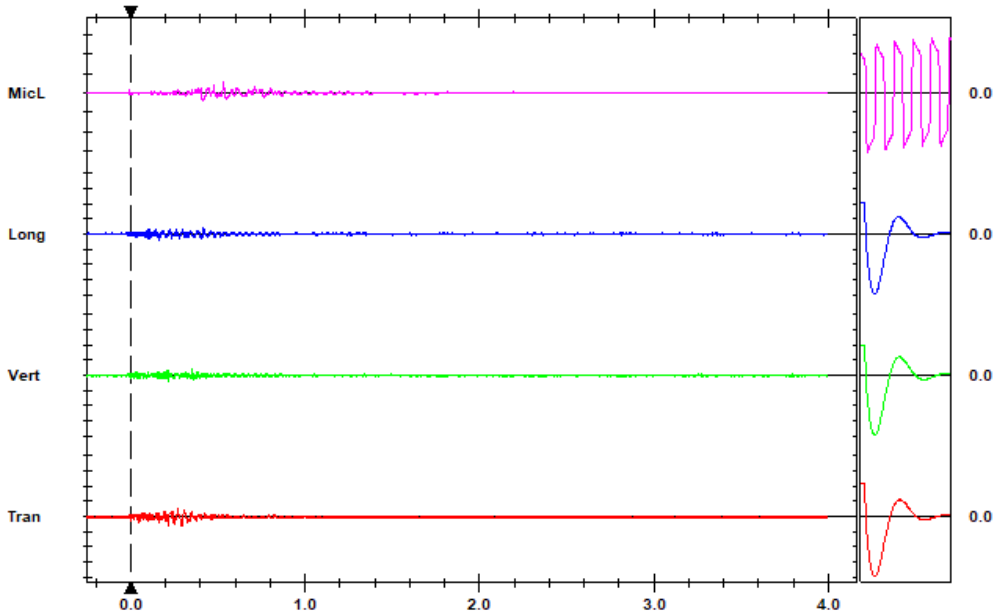
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.532 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.143	0.889	0.762	mm/s
ZC Freq	57	57	64	Hz
Time (Rel. to Trig)	0.215	0.218	0.165	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.006	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.212 mm/s at 0.216 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

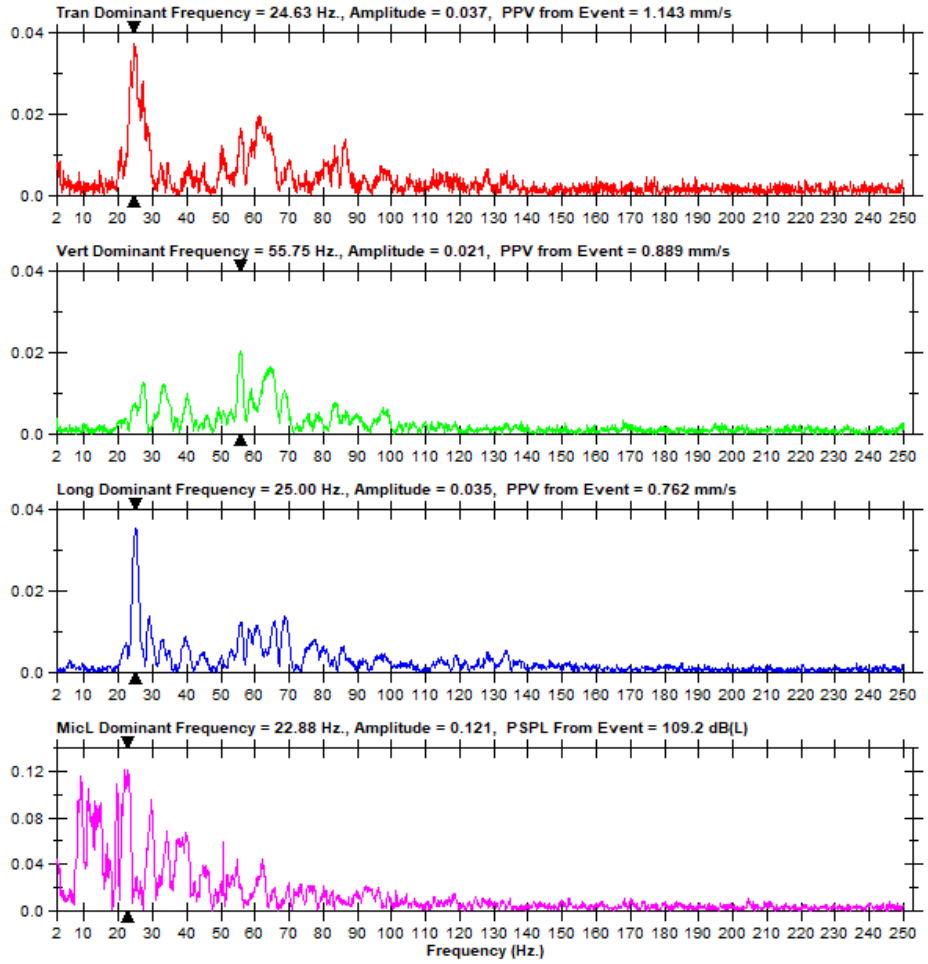
FFT Report

Date/Time	Tran at 12:24:15 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRE.GF0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 130 m



Instantel

Event Report

Date/Time Tran at 12:23:12 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

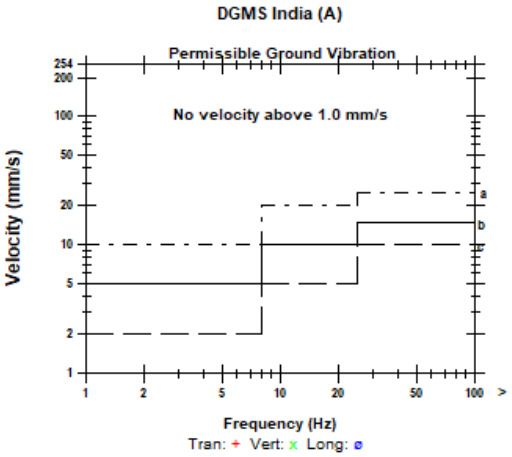
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

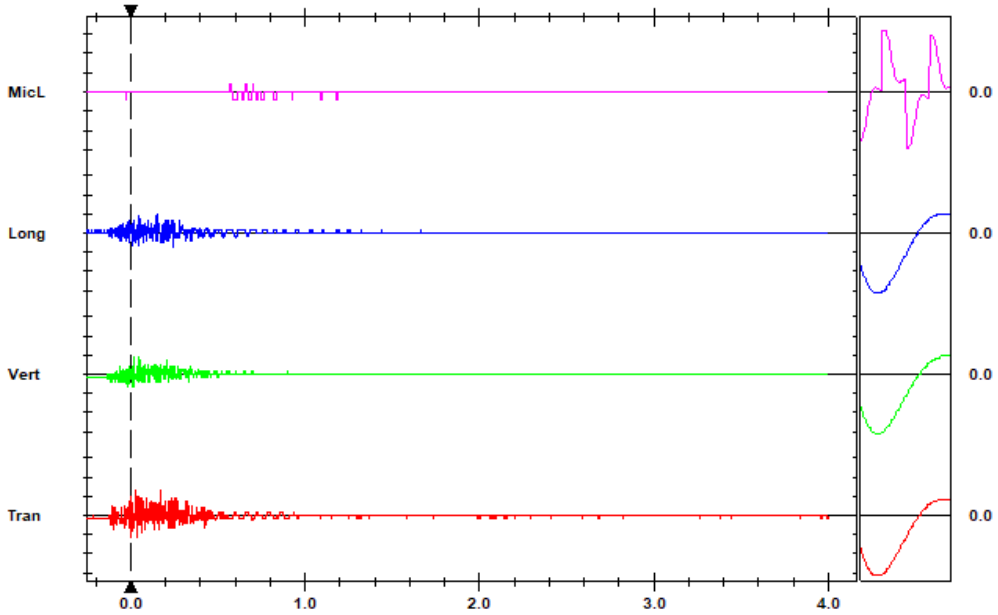
Microphone Linear Weighting
PSPL 100.00 dB(L) at -0.022 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.635	0.445	0.508	mm/s
ZC Freq	73	85	73	Hz
Time (Rel. to Trig)	0.029	0.021	0.151	sec
Peak Acceleration	0.033	0.027	0.020	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 0.683 mm/s at 0.052 sec
N/A: Not Applicable

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.2O0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 220 m





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

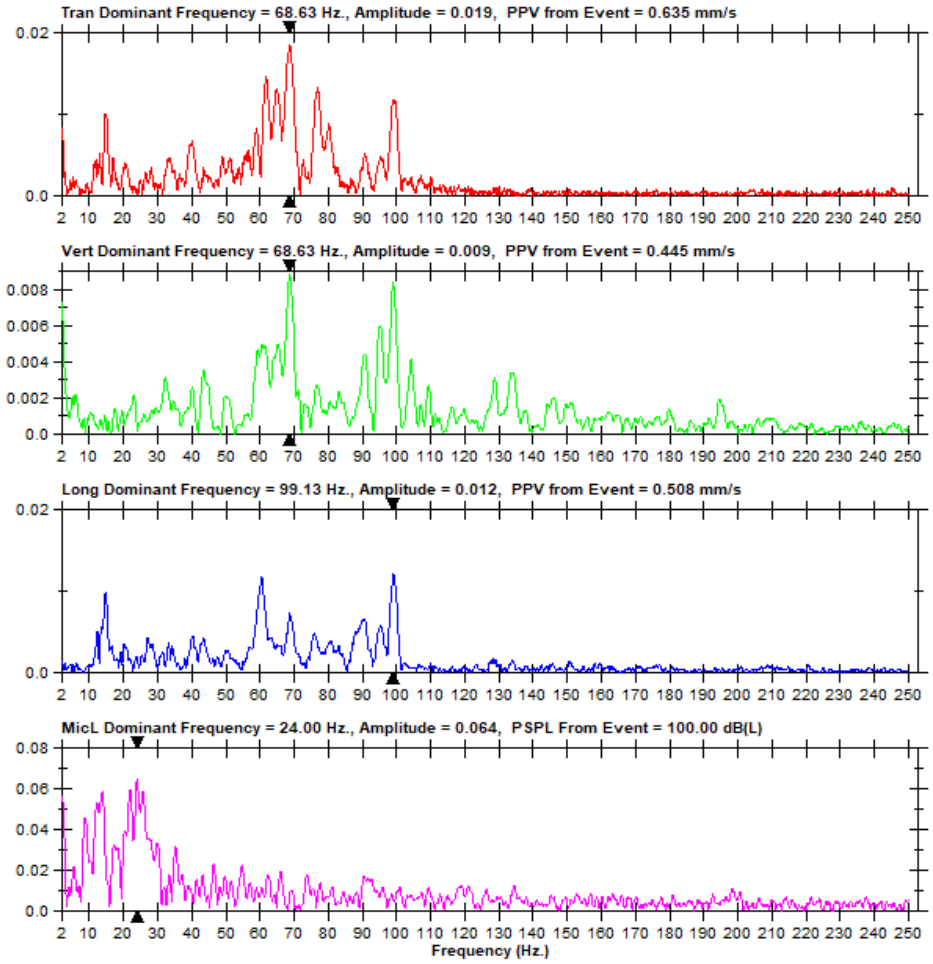
FFT Report

Date/Time	Tran at 12:23:12 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.2O0

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 220 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 12:24:15 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRE.GF0
Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 262 m

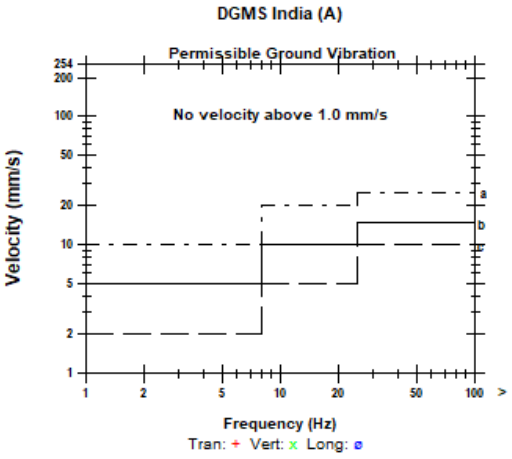
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

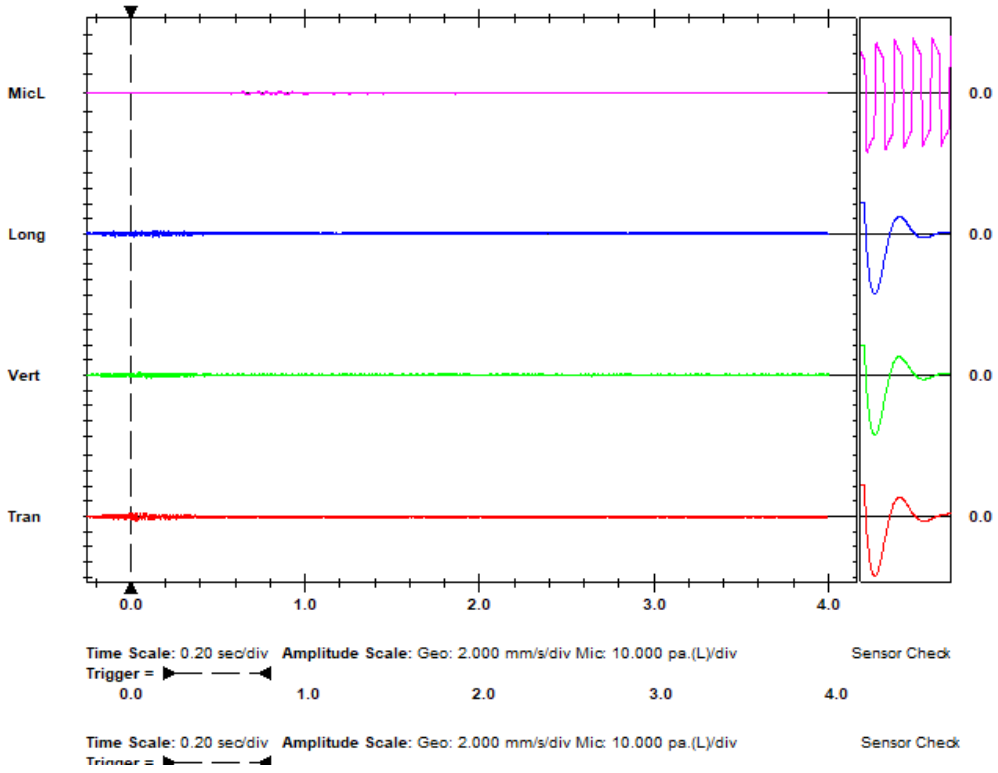
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.661 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.508	mm/s
ZC Freq	73	>100	>100	Hz
Time (Rel. to Trig)	0.032	0.050	0.144	sec
Peak Acceleration	0.027	0.040	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.648 mm/s at 0.032 sec





Instantel

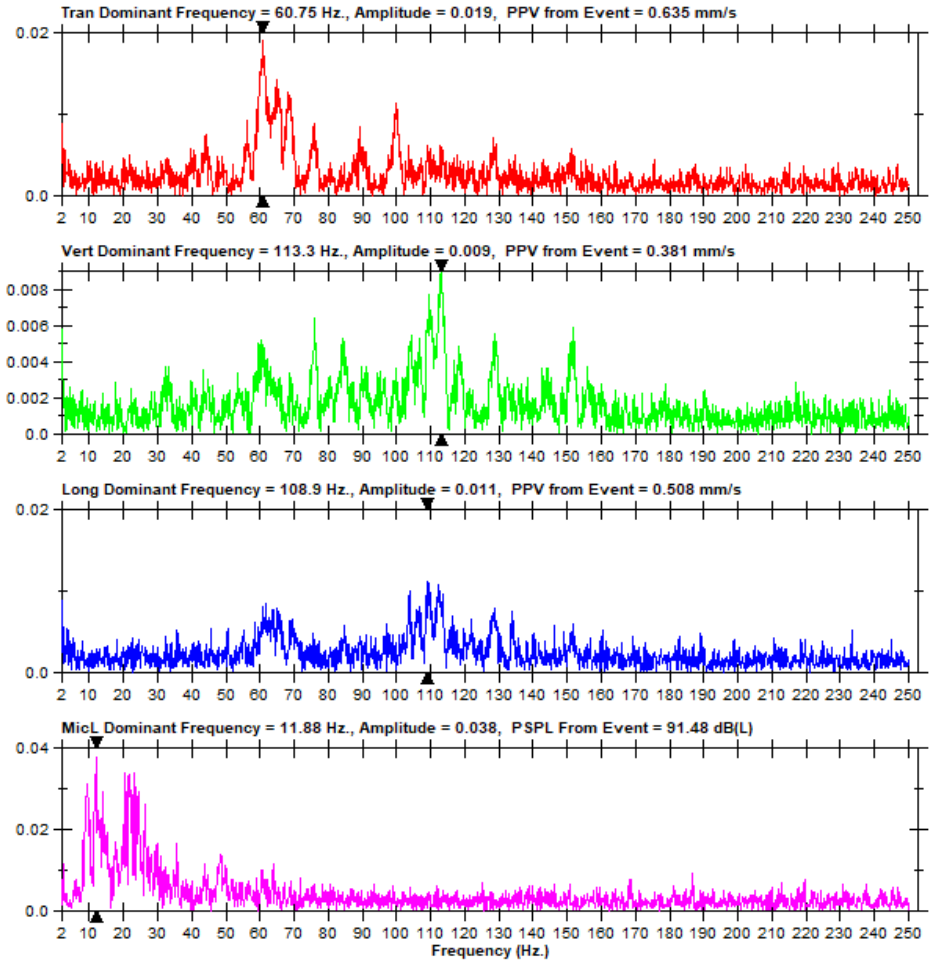
FFT Report

Date/Time	Tran at 12:24:15 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRE.GF0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 40, Hole Depth - 1.8 m, Charge/hole - 0.366 Kg, MCPD - 0.375 Kg, Total Charge - 14.625 Kg, Distance - 262 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 12:25:46 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.IY0
Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 51 m

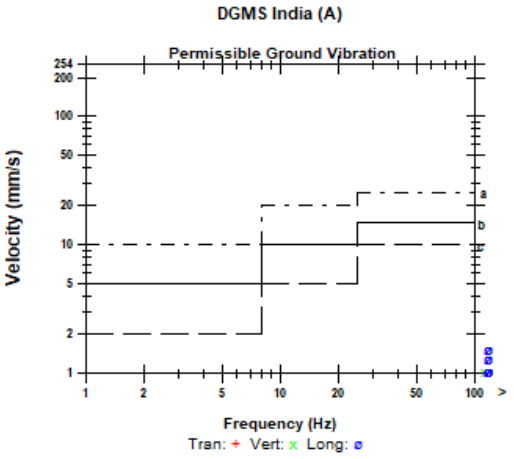
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

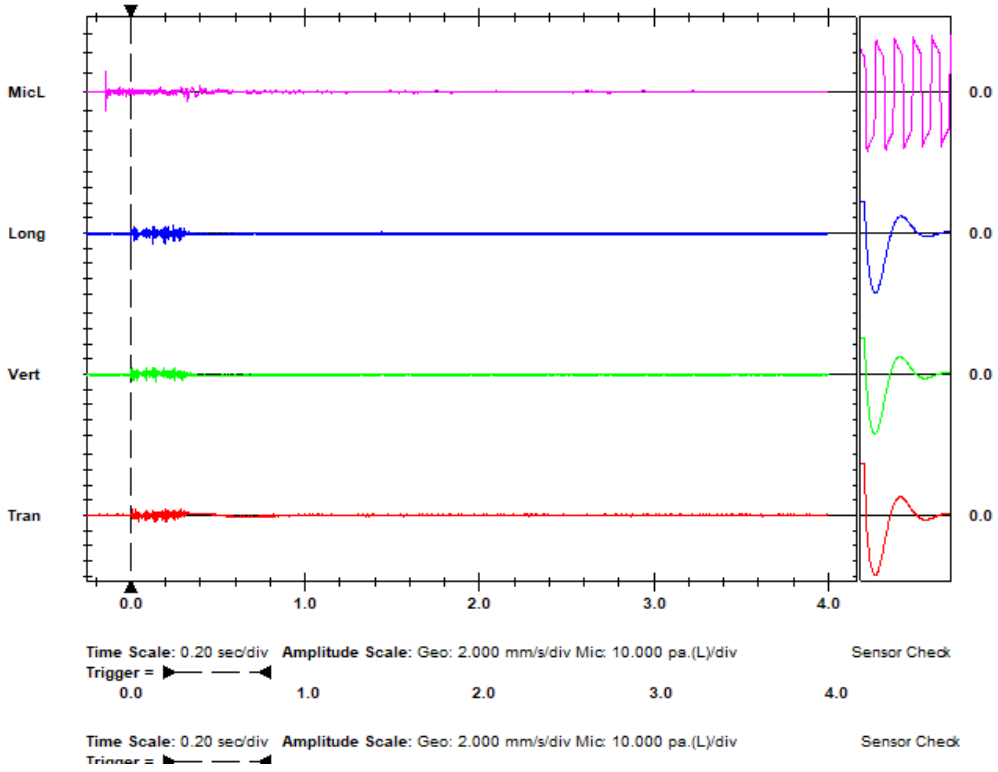
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 114.4 dB(L) at -0.143 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.889	1.016	1.524	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.136	0.146	0.131	sec
Peak Acceleration	0.119	0.146	0.159	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.805 mm/s at 0.131 sec





Instantel

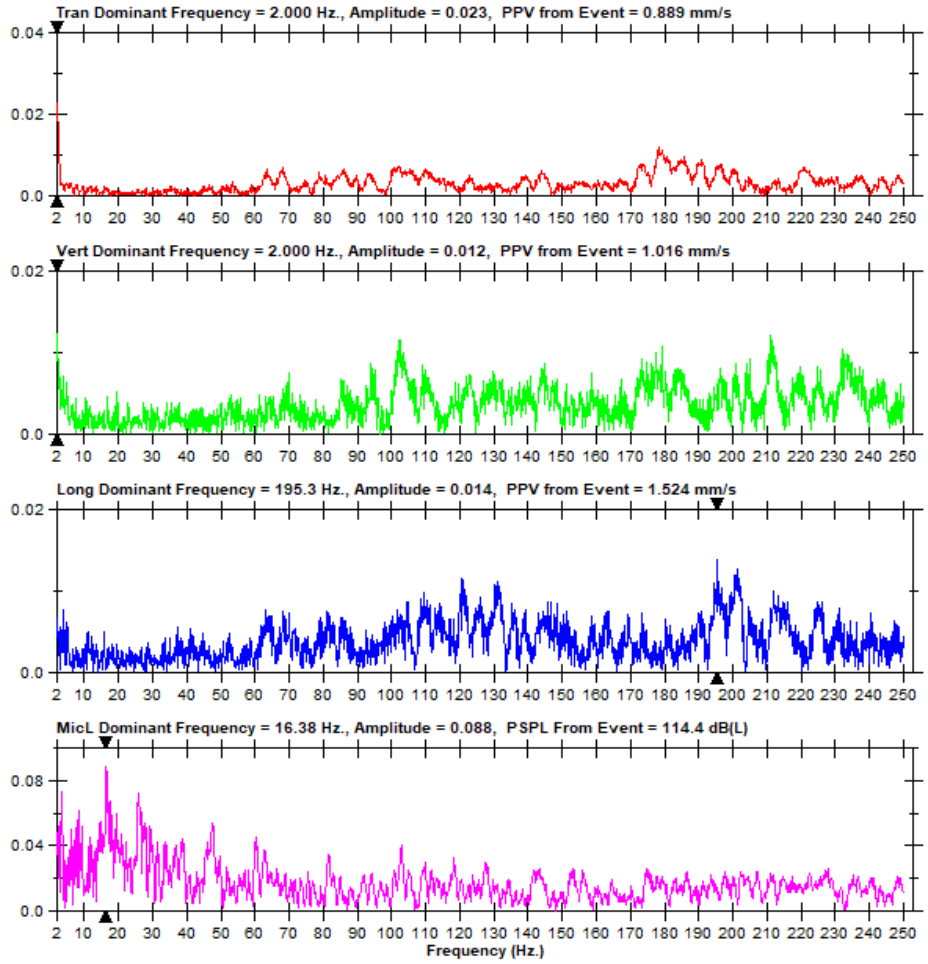
FFT Report

Date/Time	Long at 12:25:46 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.IY0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 51 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 12:25:47 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRE.IZ0
Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 73 m

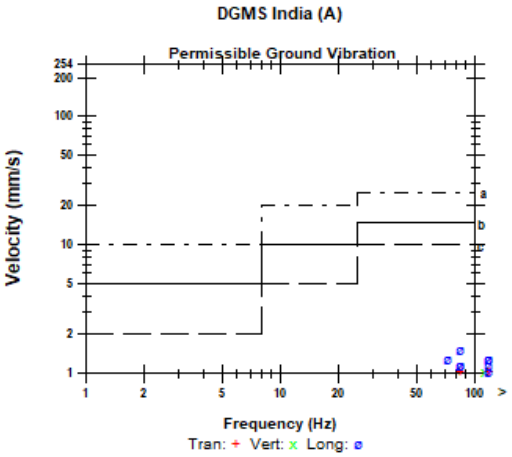
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

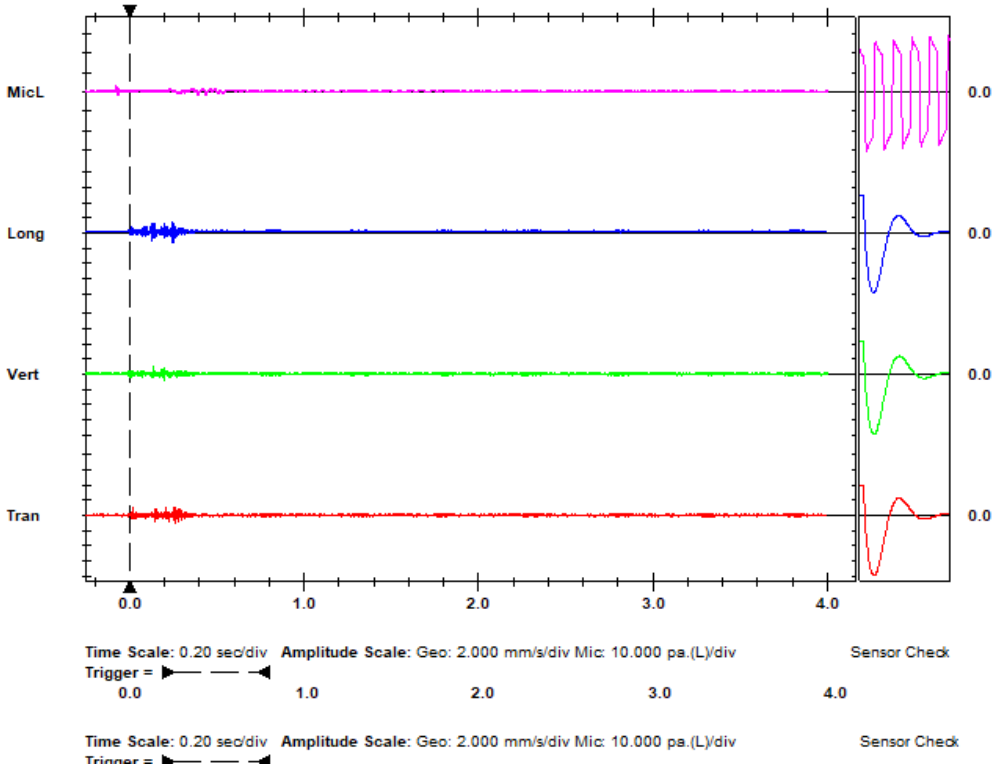
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 103.5 dB(L) at -0.075 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	1.016	1.016	1.524	mm/s
ZC Freq	85	>100	85	Hz
Time (Rel. to Trig)	0.022	0.135	0.244	sec
Peak Acceleration	0.080	0.066	0.106	g
Peak Displacement	0.002	0.001	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.535 mm/s at 0.244 sec





Instantel

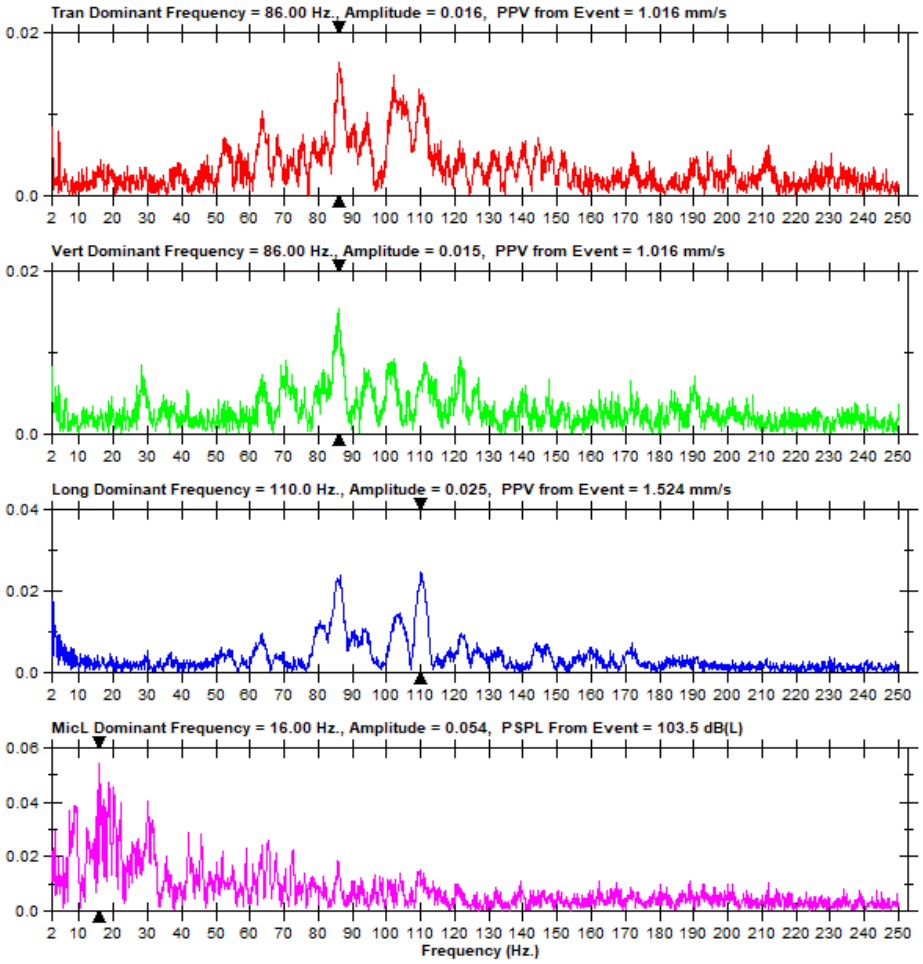
FFT Report

Date/Time	Long at 12:25:47 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRE.IZ0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 73 m



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Event Report

Date/Time Tran at 12:25:46 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRE.IY0
Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 112 m

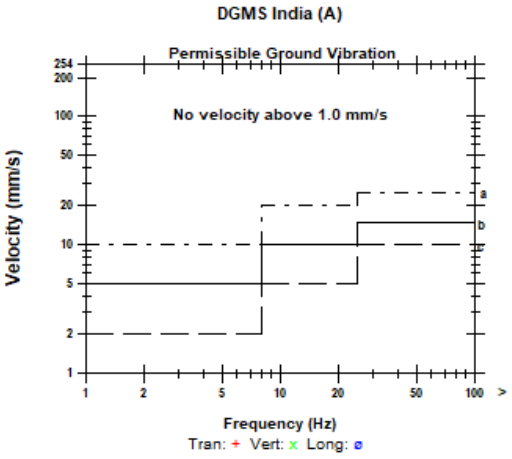
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

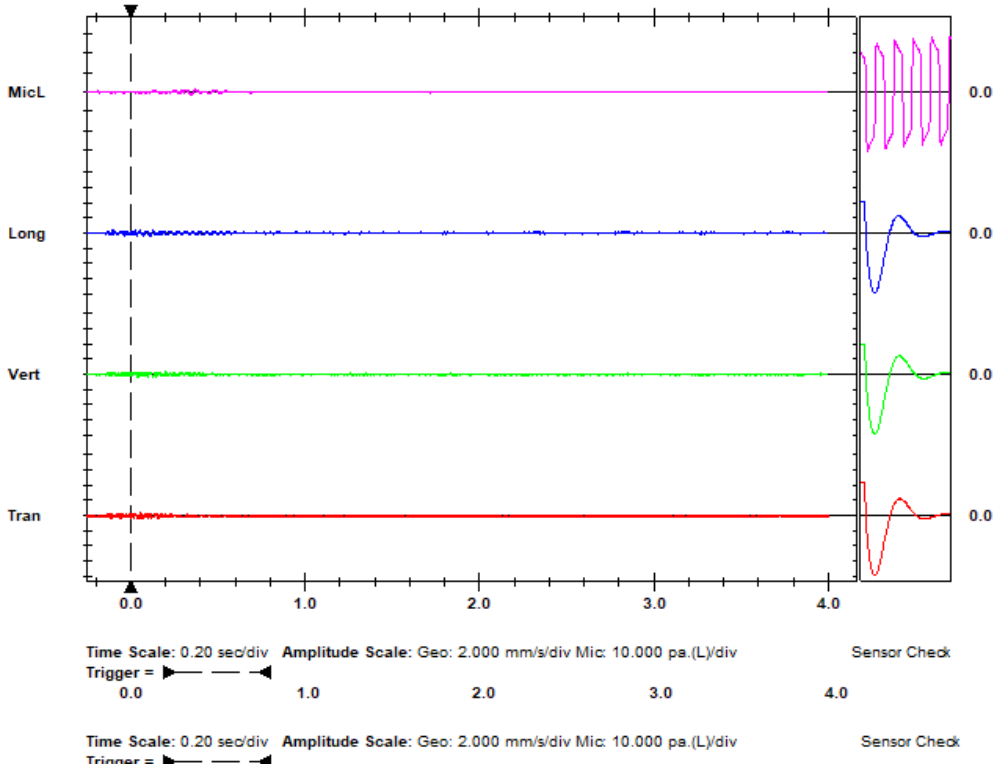
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 97.50 dB(L) at 0.344 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.381	mm/s
ZC Freq	64	73	>100	Hz
Time (Rel. to Trig)	0.000	0.040	-0.104	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.635 mm/s at 0.057 sec





Instantel

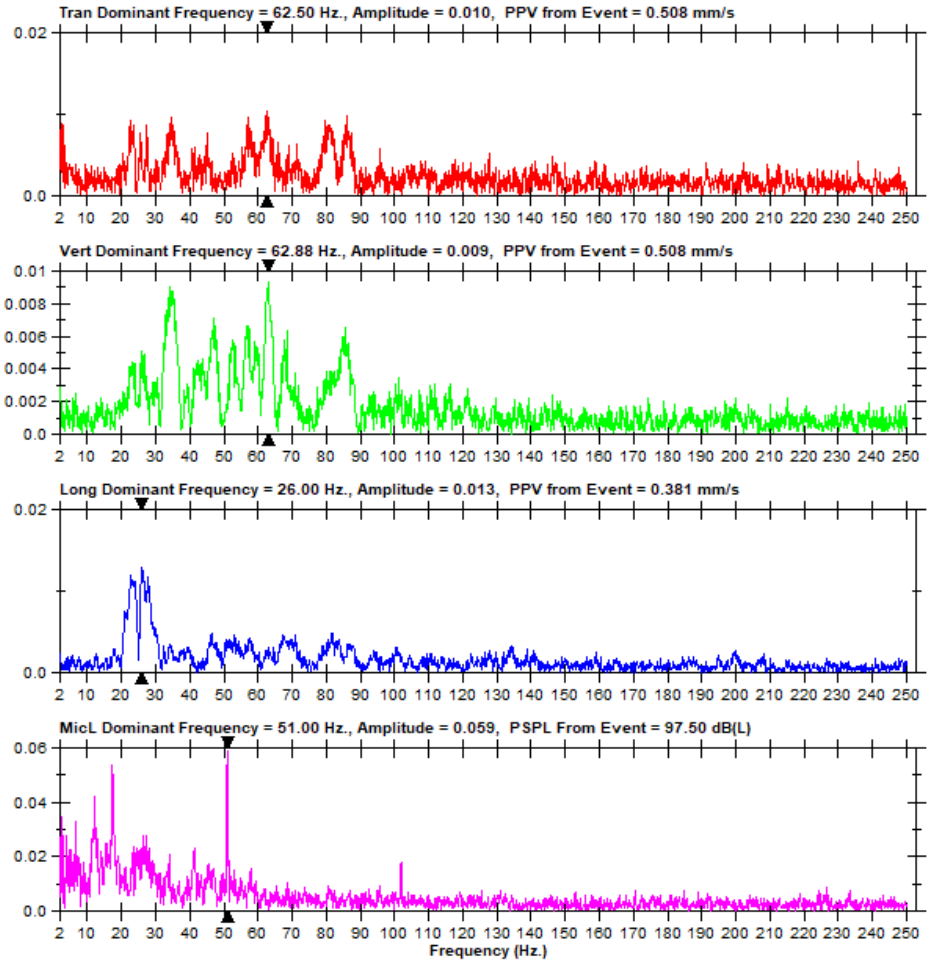
FFT Report

Date/Time	Tran at 12:25:46 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRE.IY0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 22, Hole Depth - 1.8 m, Charge/hole - 0.295 Kg, MCPD - 0.375 Kg, Total Charge - 6.50 Kg, Distance - 112 m



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Event Report

Date/Time Long at 12:34:50 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRE.Y20
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 51 m

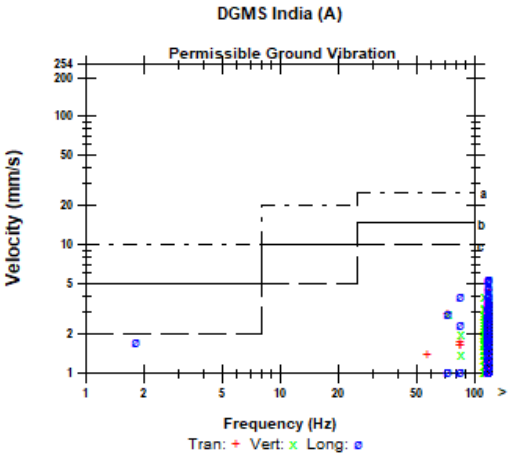
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

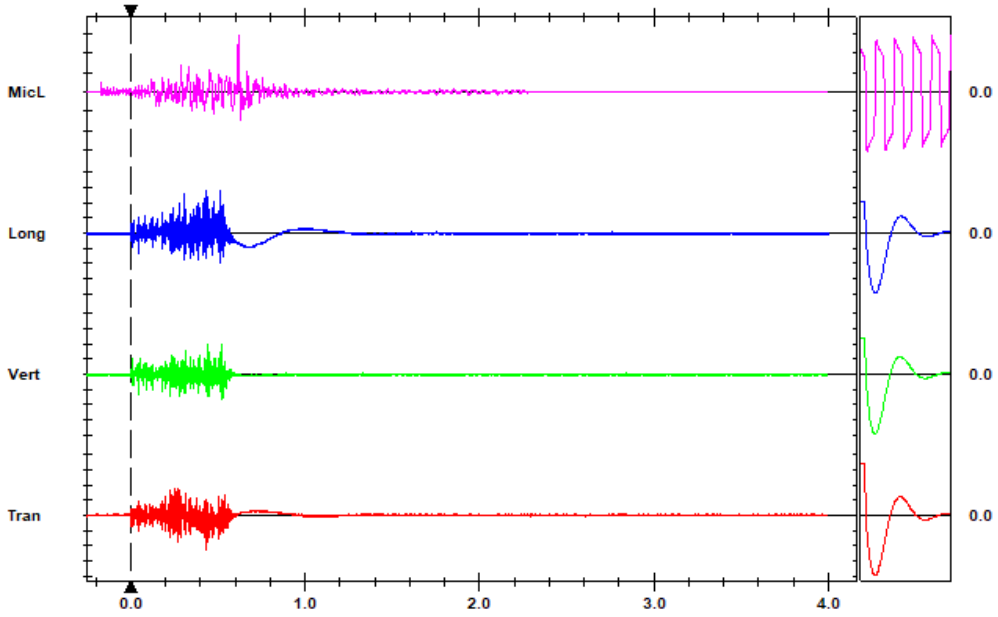
Microphone Linear Weighting
PSPL 123.4 dB(L) at 0.617 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	4.445	3.937	5.461	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.431	0.446	0.434	sec
Peak Acceleration	0.490	0.424	0.583	g
Peak Displacement	0.060	0.004	0.170	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 5.882 mm/s at 0.518 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

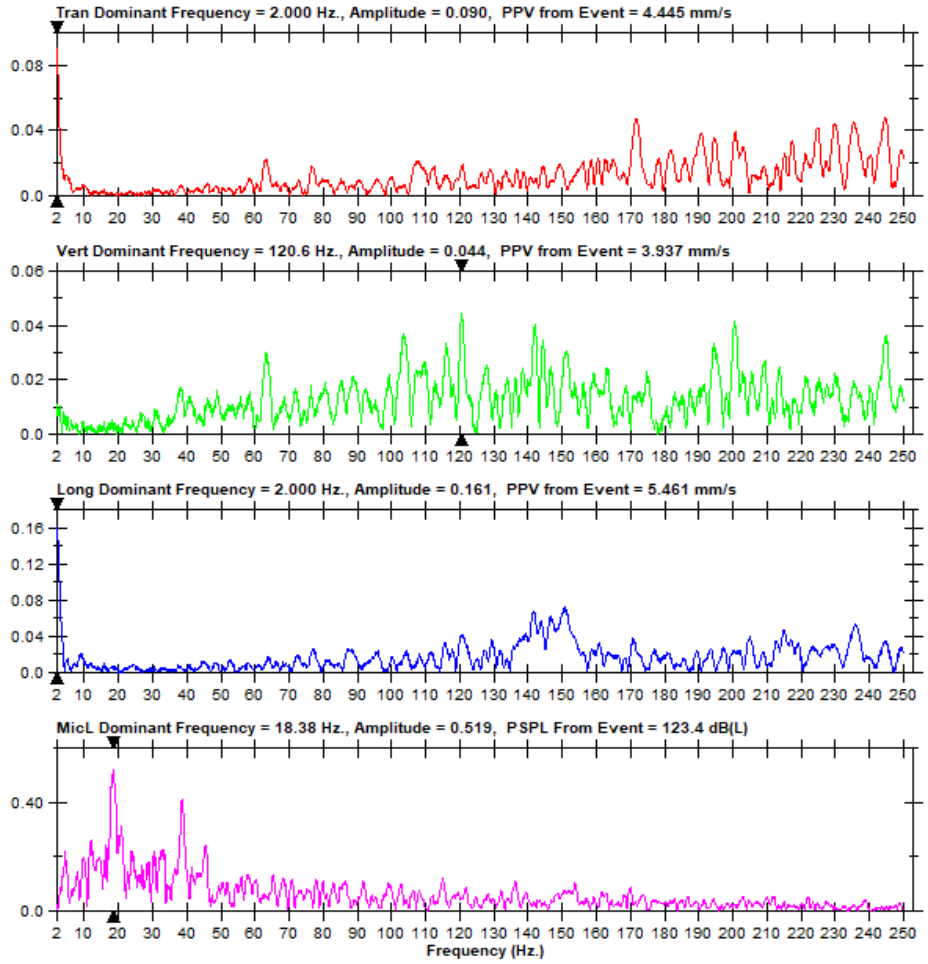
FFT Report

Date/Time	Long at 12:34:50 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRE.Y20

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 51 m



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Event Report

Date/Time Vert at 12:34:51 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRE.Y30
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 77 m

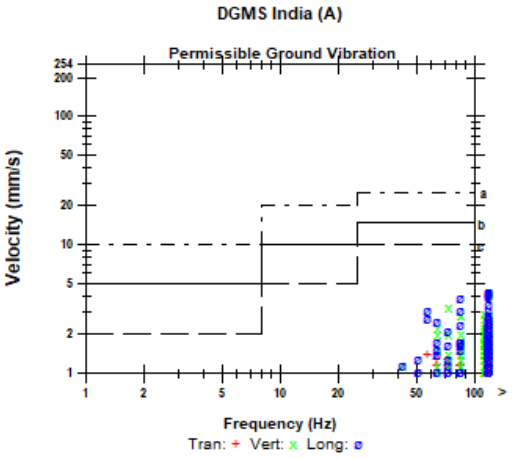
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

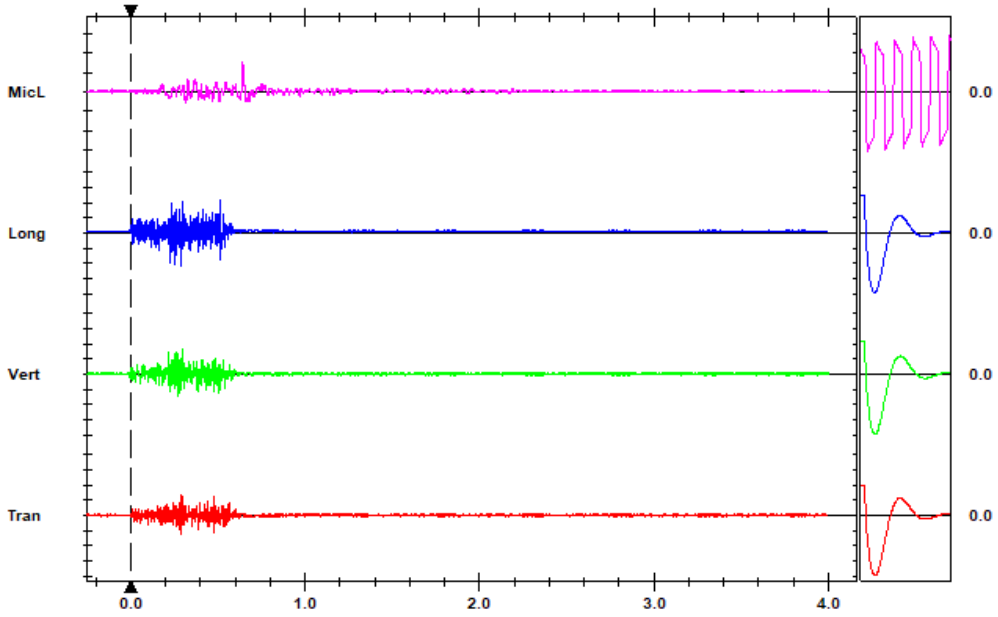
Microphone Linear Weighting
PSPL 117.9 dB(L) at 0.644 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	2.667	3.302	4.318	mm/s
ZC Freq	>100	73	>100	Hz
Time (Rel. to Trig)	0.287	0.298	0.292	sec
Peak Acceleration	0.225	0.265	0.292	g
Peak Displacement	0.004	0.005	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 5.585 mm/s at 0.297 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

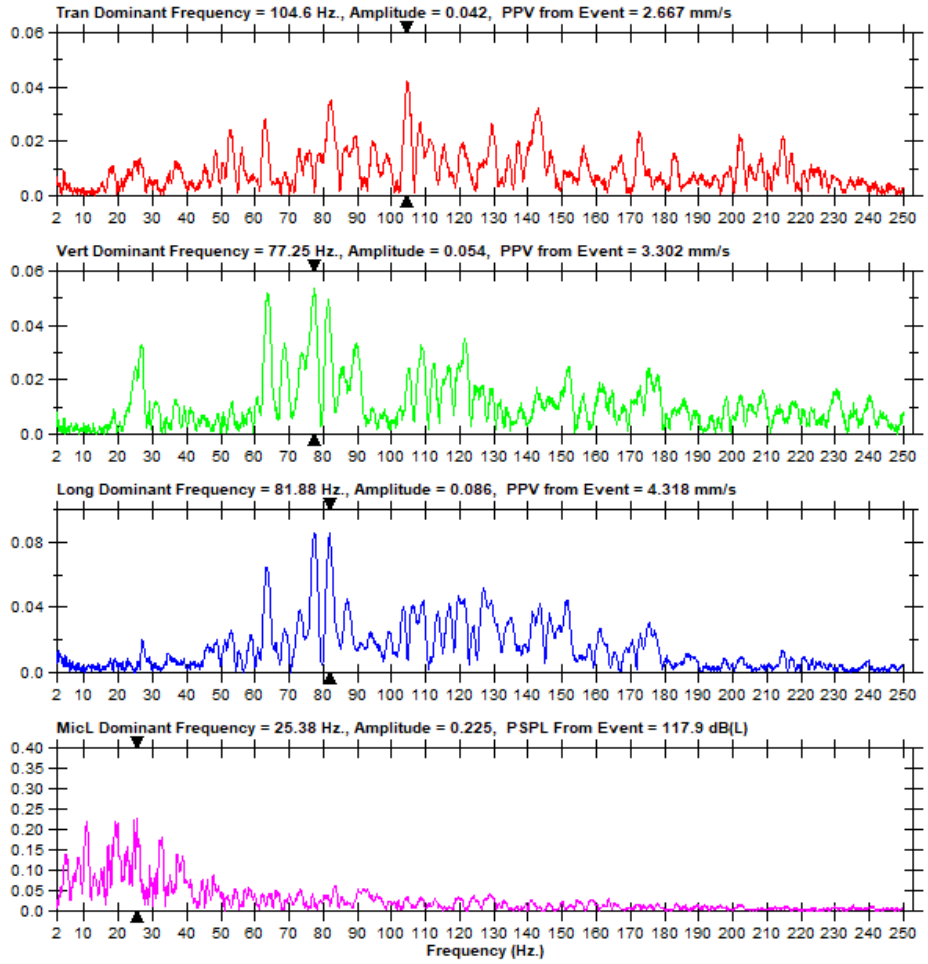
FFT Report

Date/Time	Vert at 12:34:51 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRE.Y30

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 77 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 12:34:49 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRE.Y10
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 107 m

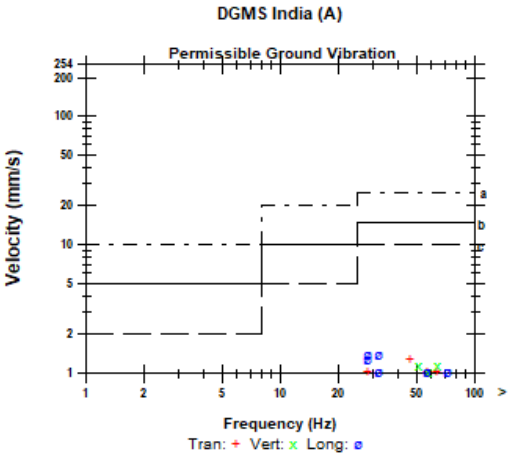
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

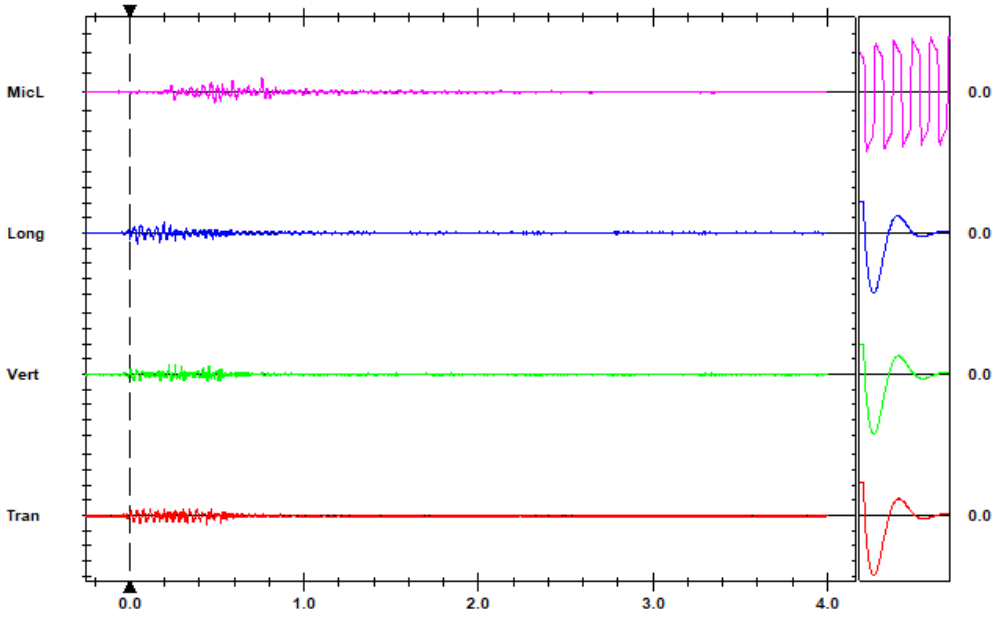
Microphone Linear Weighting
PSPL 111.2 dB(L) at 0.761 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.270	1.143	1.397	mm/s
ZC Freq	47	51	28	Hz
Time (Rel. to Trig)	0.444	0.226	0.046	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.006	0.005	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.611 mm/s at 0.175 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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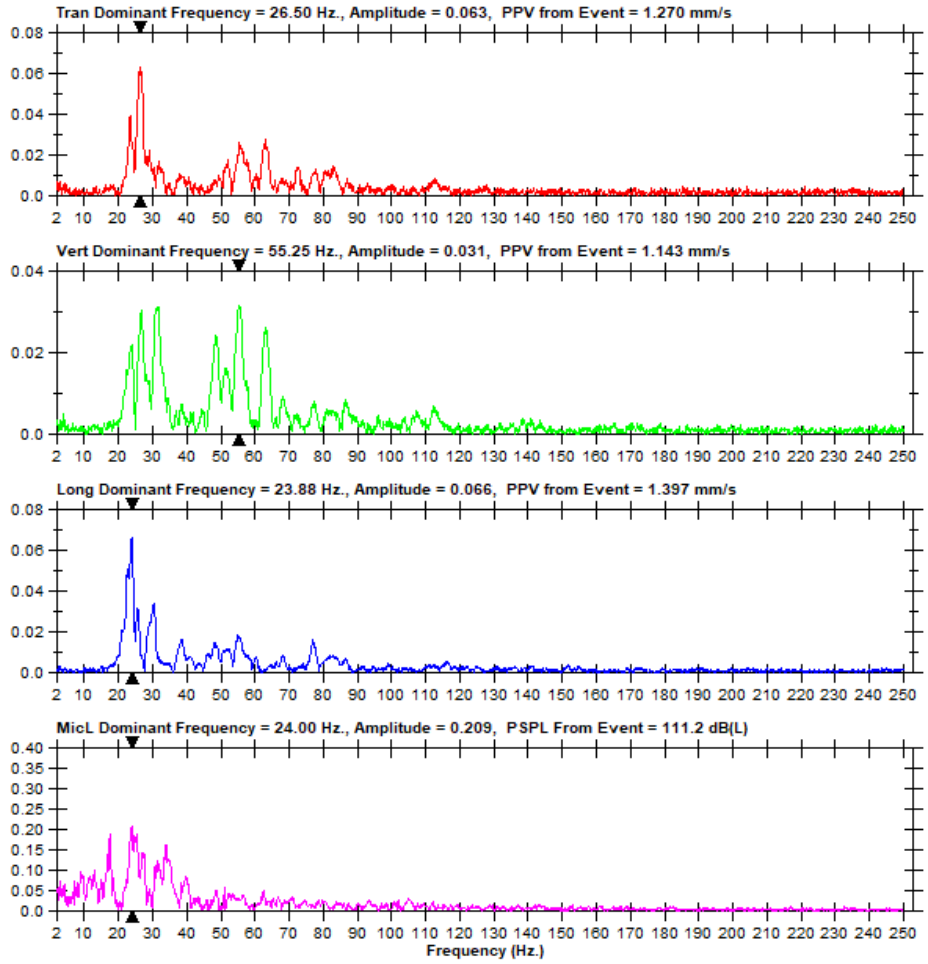
FFT Report

Date/Time	Long at 12:34:49 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRE.Y10

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg,
MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 107 m



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Event Report

Date/Time	Long at 12:33:32 December 28, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221228123332.IDFW

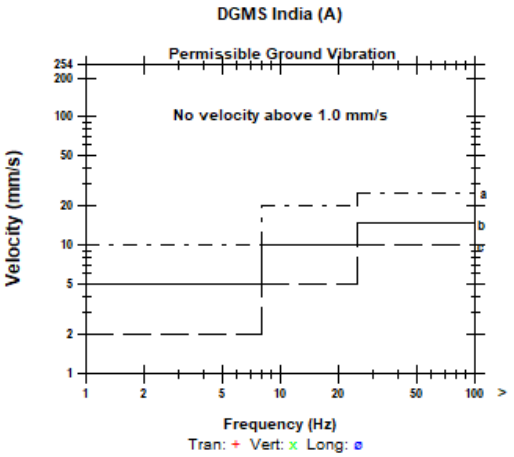
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

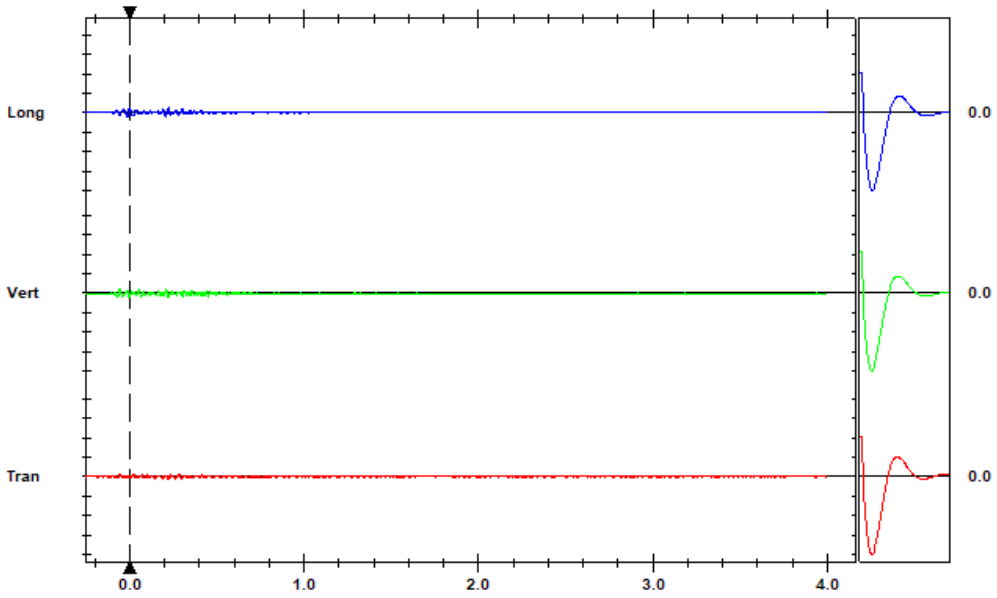
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 157 m

	Tran	Vert	Long	
PPV	0.300	0.473	0.520	mm/s
ZC Freq	26	34	30	Hz
Time (Rel. to Trig)	0.287	-0.056	0.000	sec
Peak Acceleration	0.013	0.016	0.015	g
Peak Displacement	0.001	0.002	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.718 mm/s at 0.223 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

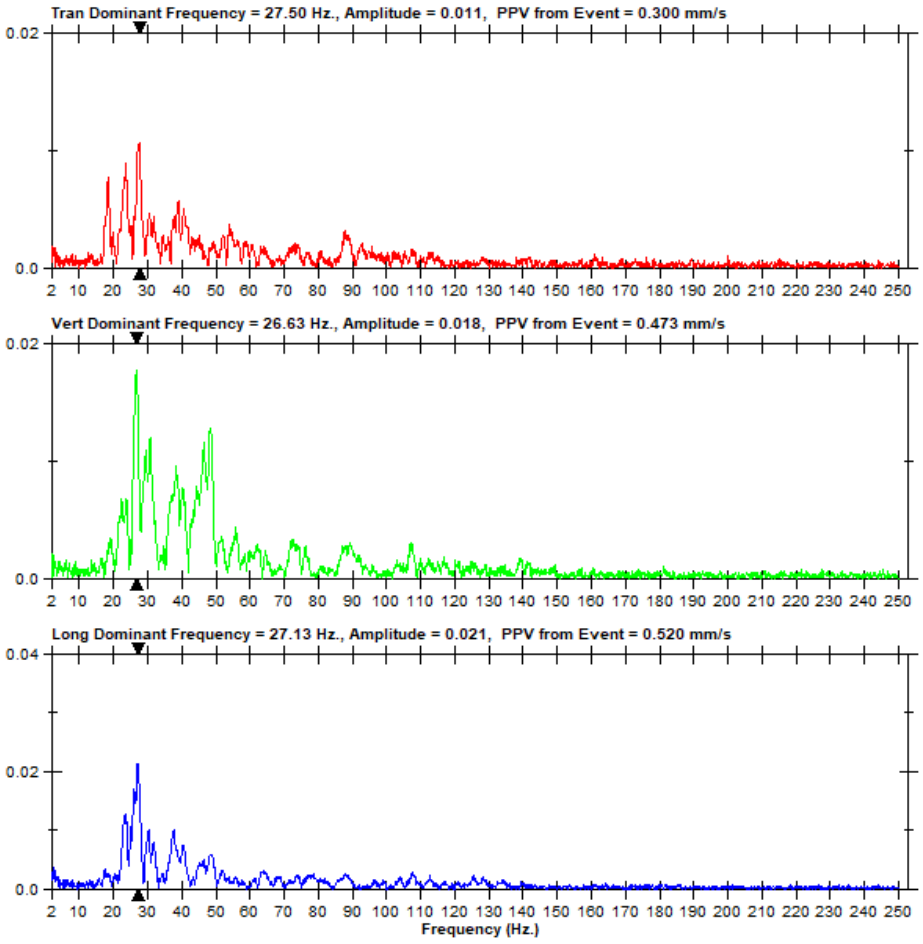
FFT Report

Date/Time	Long at 12:33:32 December 28, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20221228123332.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 157 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 12:33:45 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.K90
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 242 m

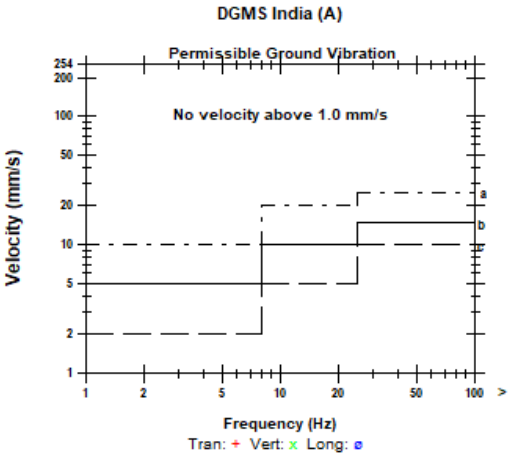
Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

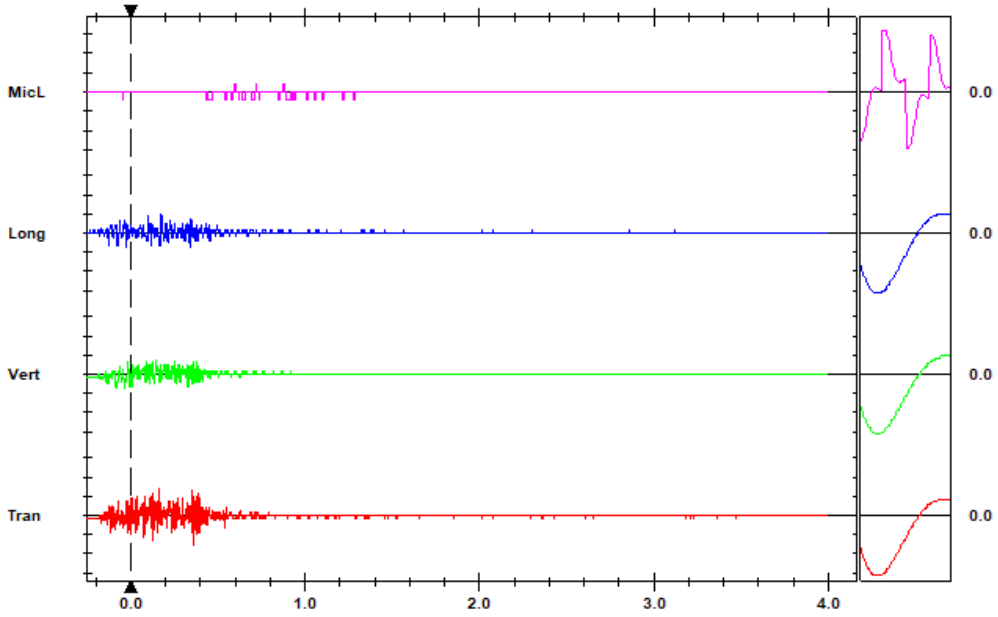
Microphone Linear Weighting
PSPL 100.00 dB(L) at -0.039 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.762	0.381	0.508	mm/s
ZC Freq	64	51	32	Hz
Time (Rel. to Trig)	0.363	-0.032	0.176	sec
Peak Acceleration	0.033	0.027	0.020	g
Peak Displacement	0.002	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 0.826 mm/s at 0.364 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

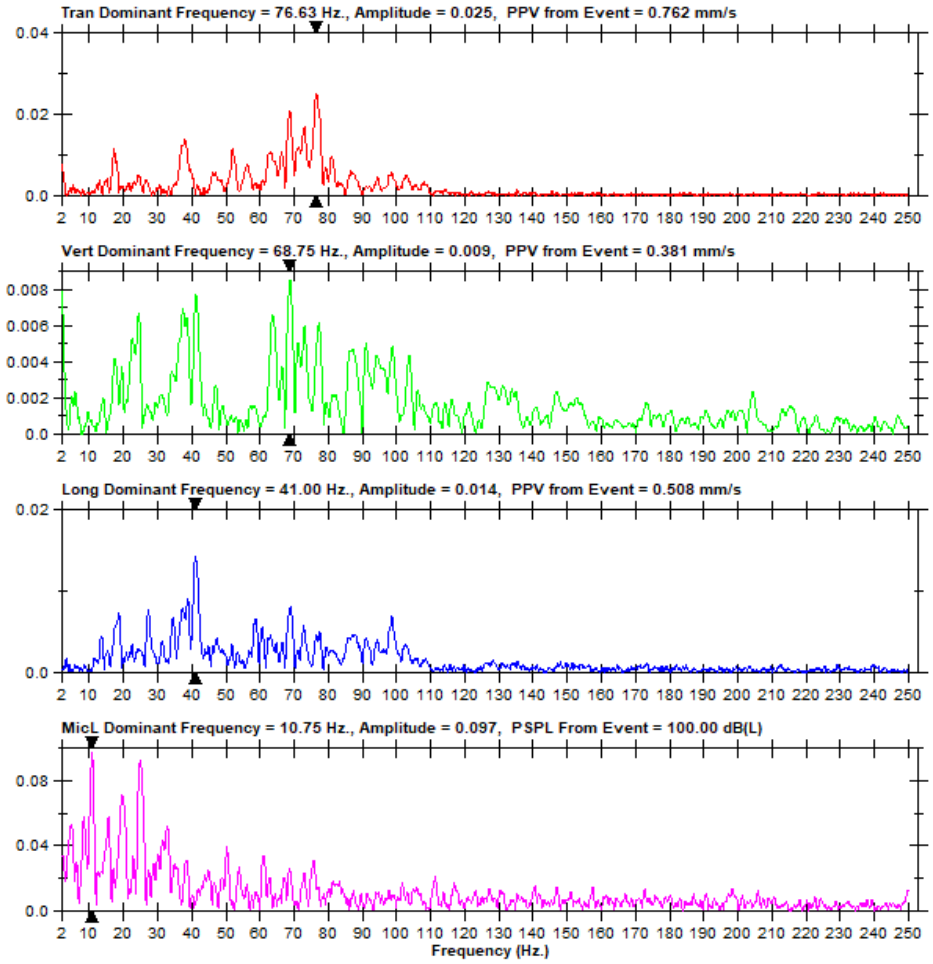
FFT Report

Date/Time	Tran at 12:33:45 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.K90

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 242 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 12:34:49 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRE.Y10
Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 279 m

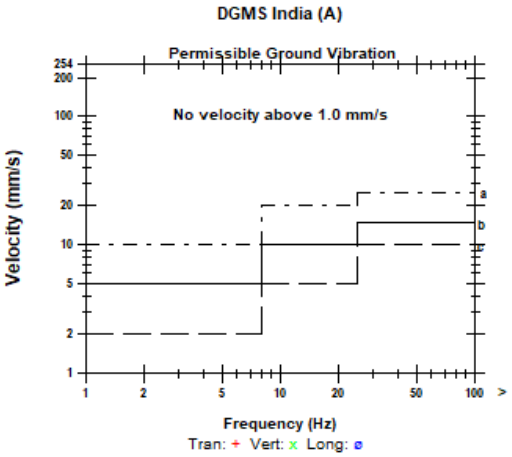
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

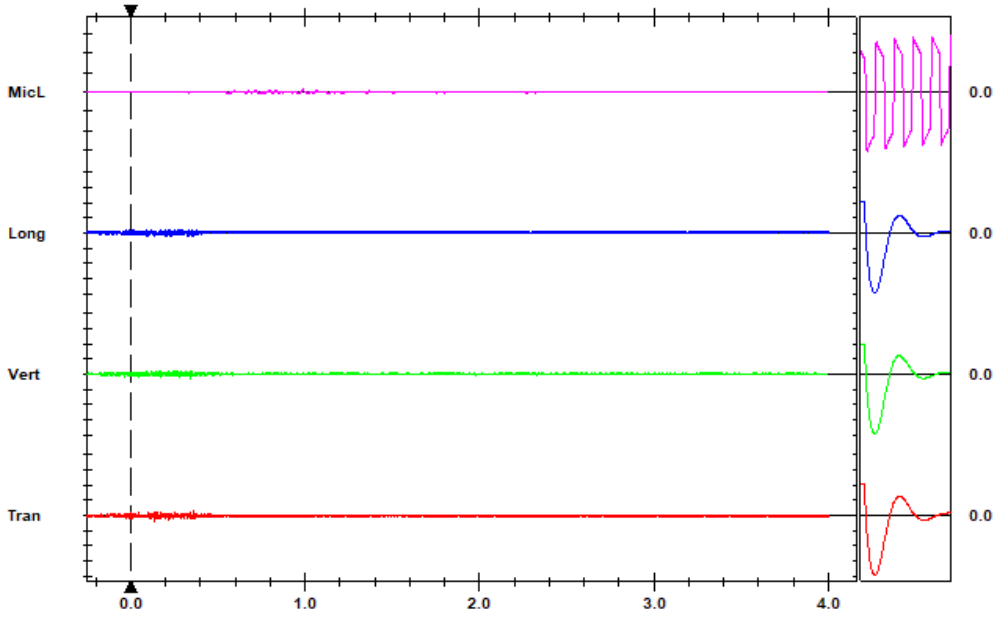
Microphone Linear Weighting
PSPL 97.50 dB(L) at 0.987 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.135	0.345	0.333	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.813 mm/s at 0.135 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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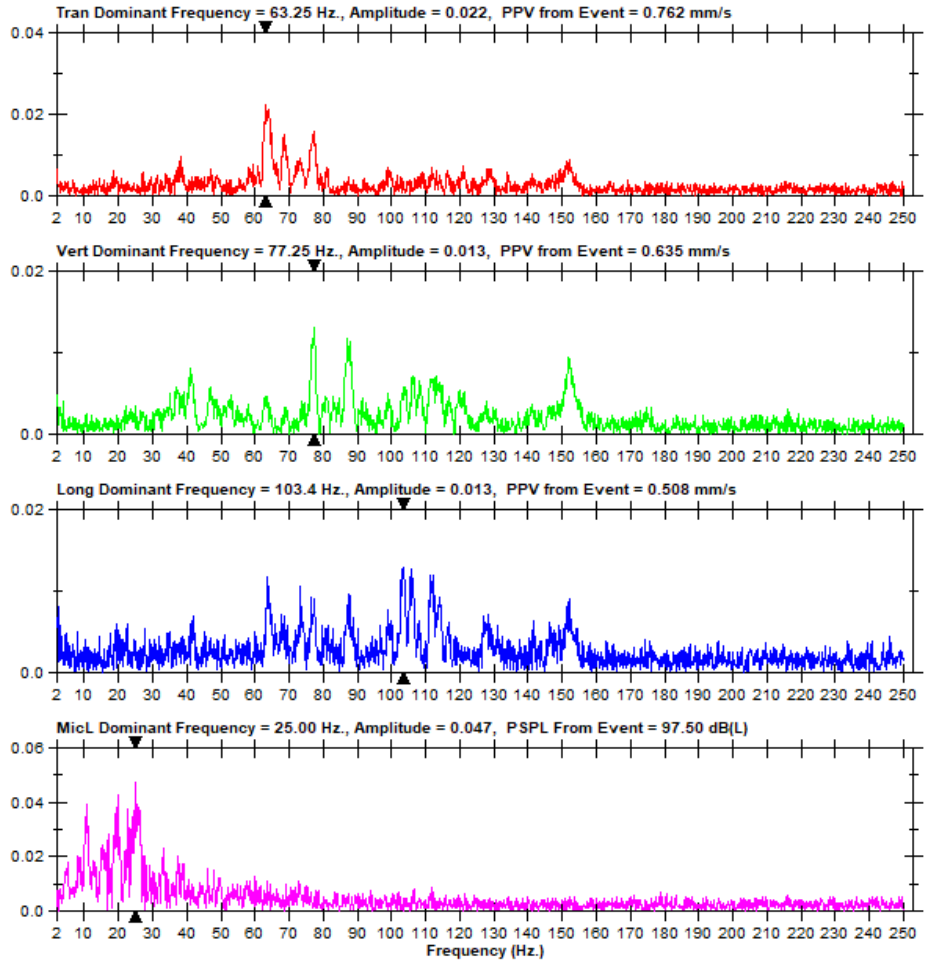
FFT Report

Date/Time	Tran at 12:34:49 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRE.Y10

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 47, Hole Depth - 1.8 m, Charge/hole - 0.362 Kg, MCPD - 0.375 Kg, Total Charge - 17.00 Kg, Distance - 279 m



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Event Report

Date/Time Vert at 12:36:12 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRF.0C0
Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 41 m

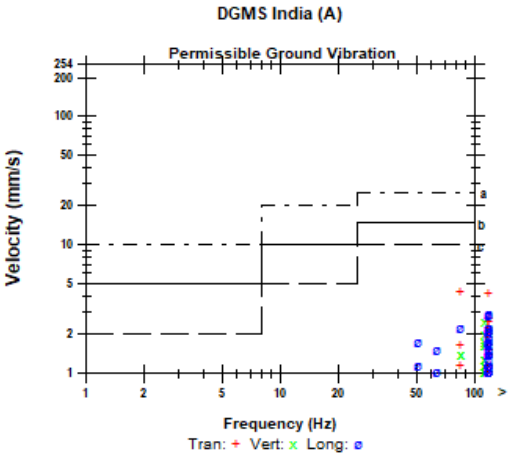
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

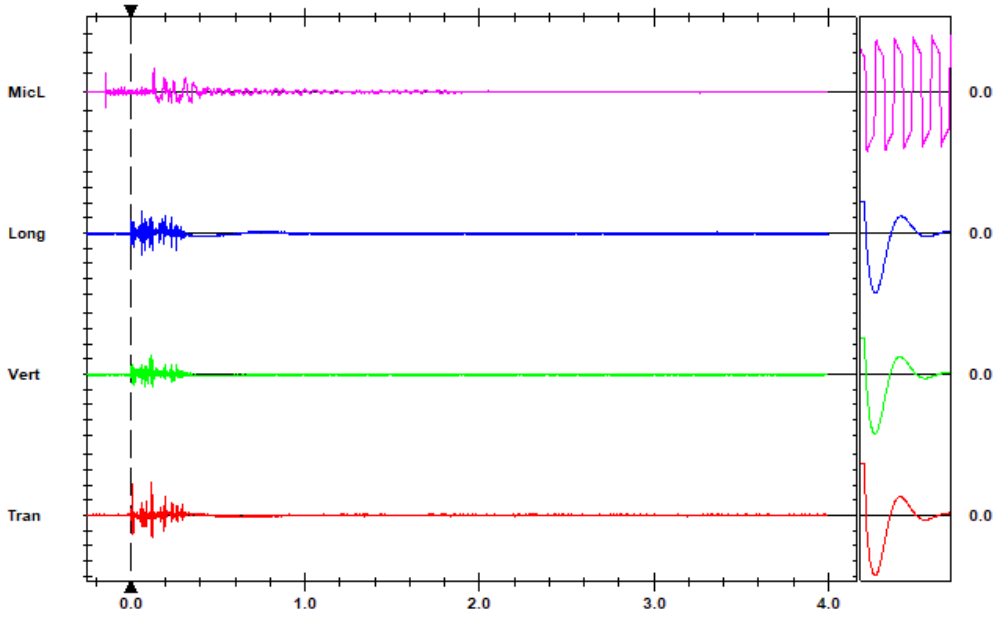
Microphone Linear Weighting
PSPL 115.7 dB(L) at 0.134 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 488 mv)

	Tran	Vert	Long	
PPV	4.318	2.540	2.921	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.122	0.121	0.066	sec
Peak Acceleration	0.437	0.265	0.398	g
Peak Displacement	0.005	0.002	0.037	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 4.355 mm/s at 0.122 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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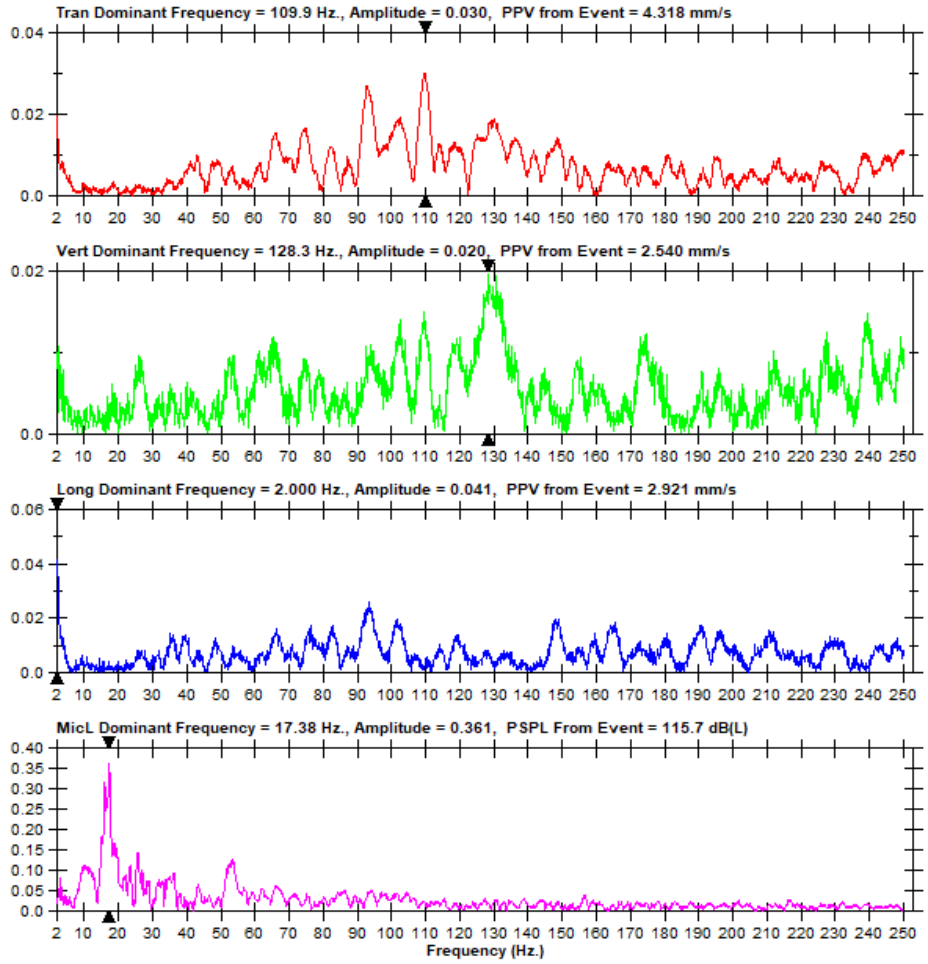
FFT Report

Date/Time	Vert at 12:36:12 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRF.0C0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 41 m



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Event Report

Date/Time Vert at 12:36:13 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRF.0D0
Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 64 m

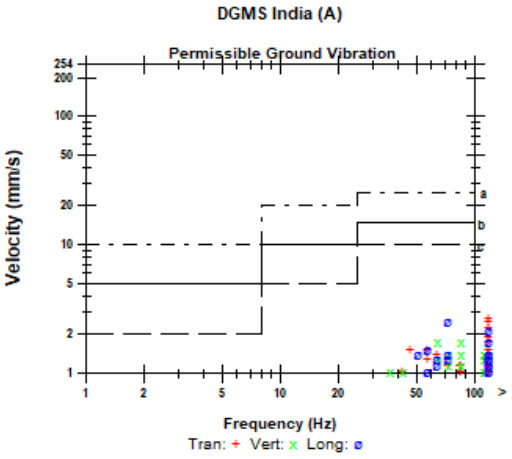
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

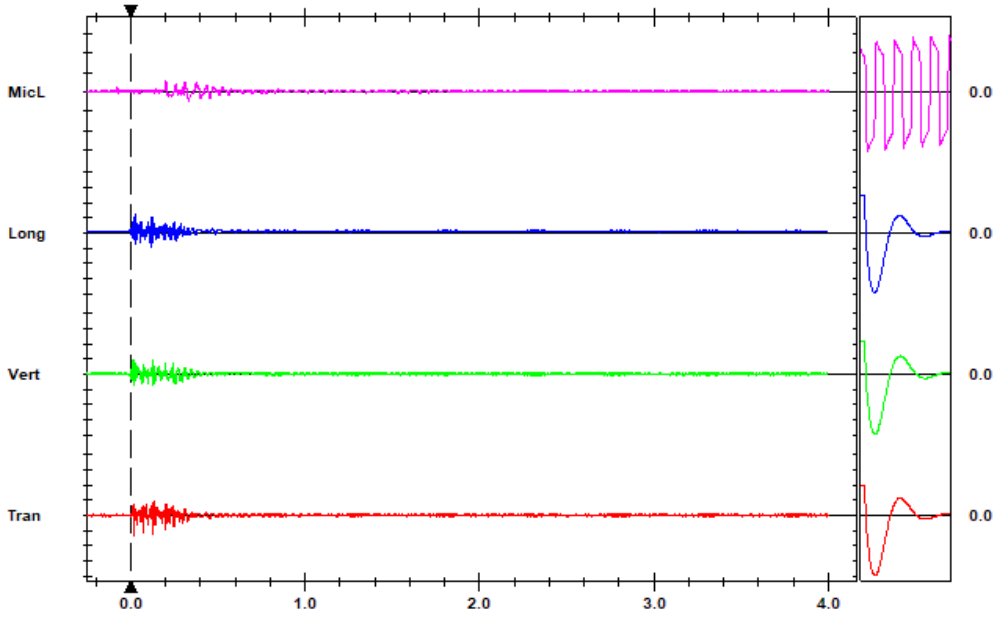
Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.202 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	2.667	1.778	2.540	mm/s
ZC Freq	>100	85	73	Hz
Time (Rel. to Trig)	0.019	0.015	0.024	sec
Peak Acceleration	0.172	0.119	0.133	g
Peak Displacement	0.004	0.005	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 2.968 mm/s at 0.024 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

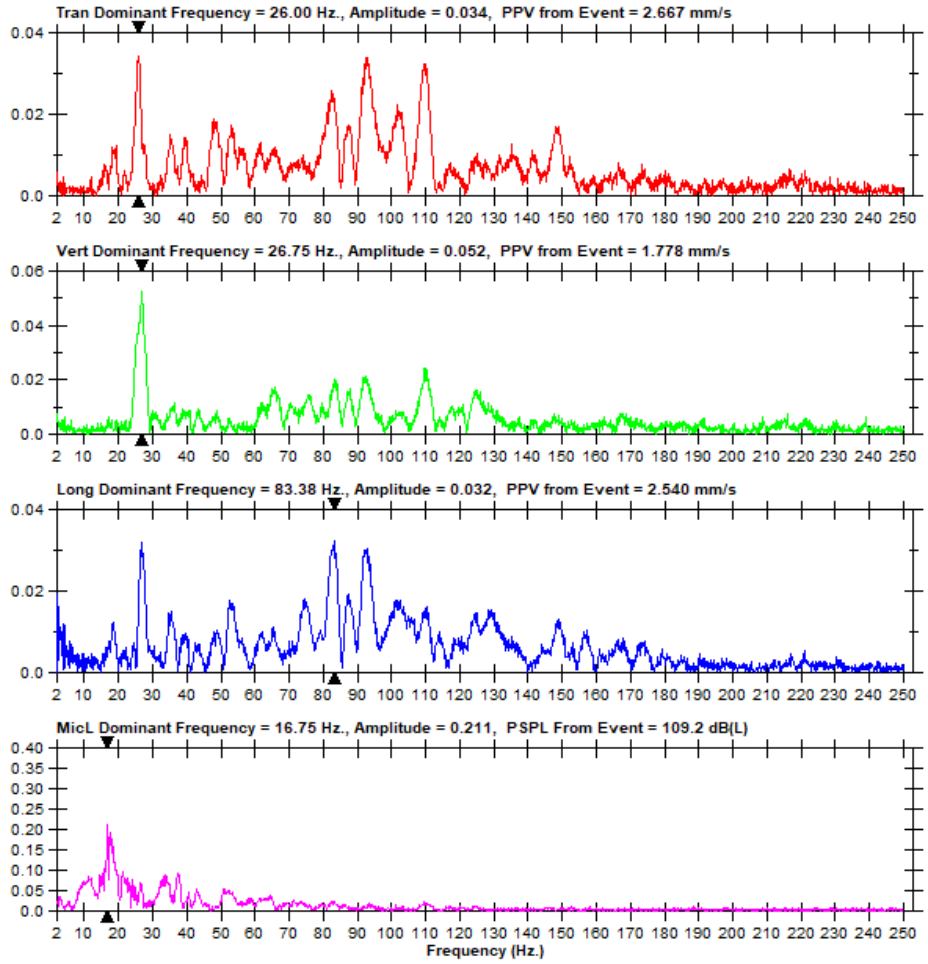
FFT Report

Date/Time	Vert at 12:36:13 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRF.0D0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg,
MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 64 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:36:11 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRF.0B0
Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 106 m

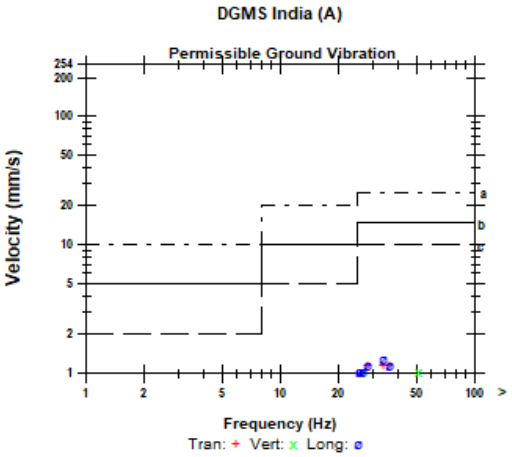
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

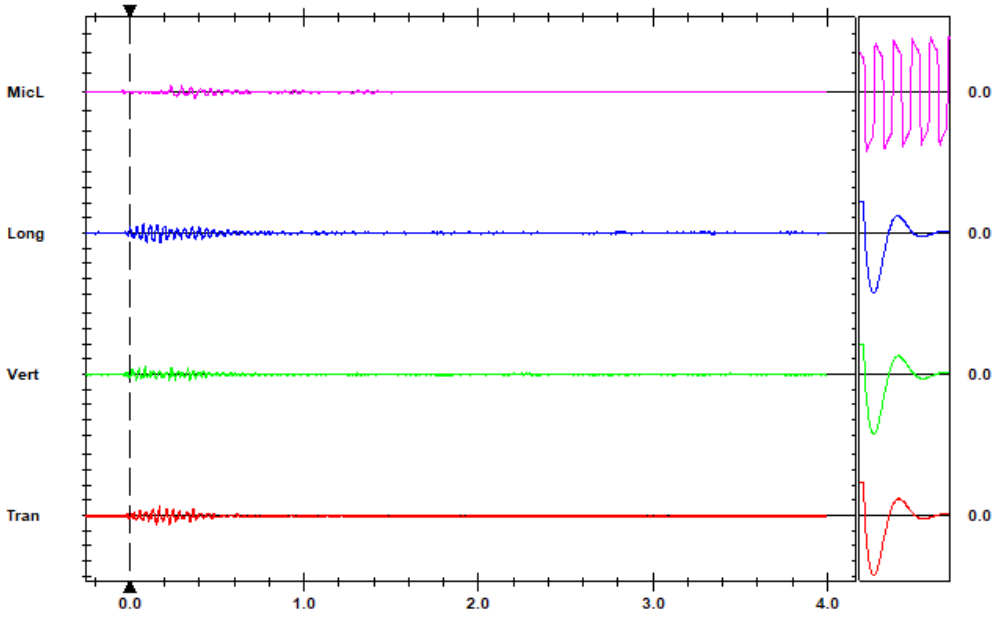
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.299 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.143	1.016	1.270	mm/s
ZC Freq	28	51	34	Hz
Time (Rel. to Trig)	0.158	0.090	0.177	sec
Peak Acceleration	0.053	0.027	0.040	g
Peak Displacement	0.006	0.004	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.576 mm/s at 0.158 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

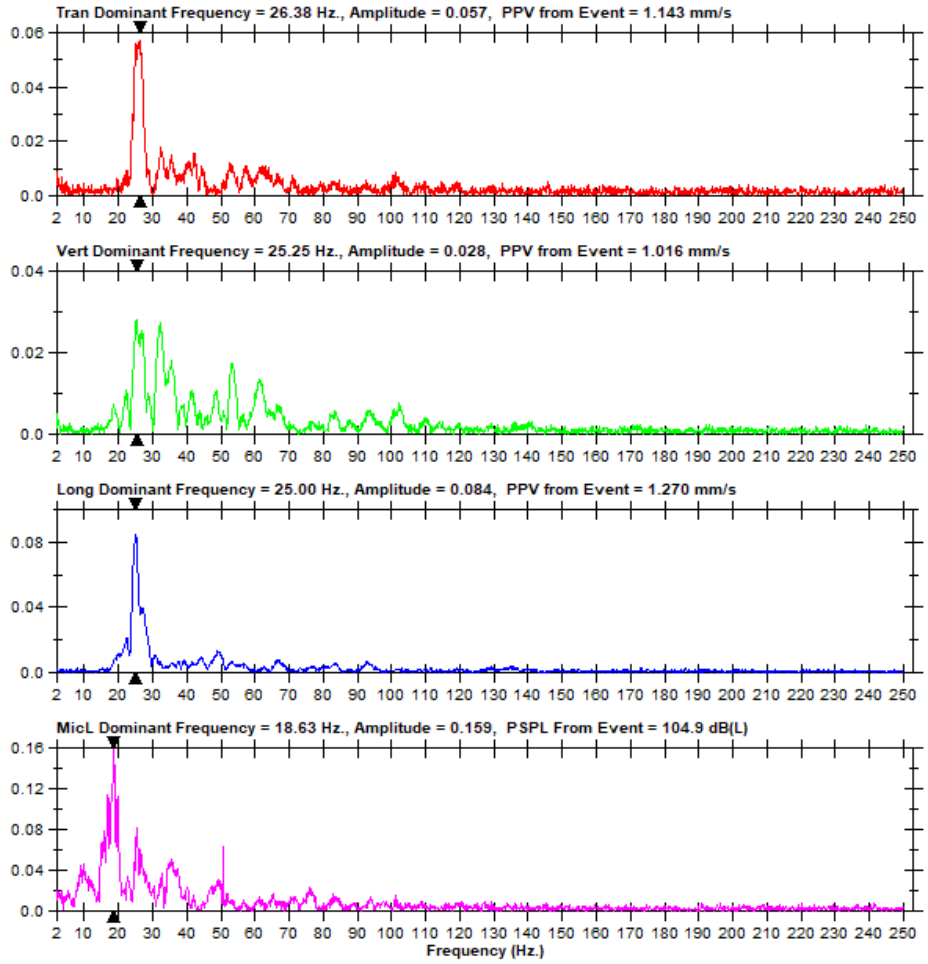
FFT Report

Date/Time	Long at 12:36:11 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRF.0B0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg,
MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 106 m



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Event Report

Date/Time	Long at 12:34:54 December 28, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221228123454.IDFW

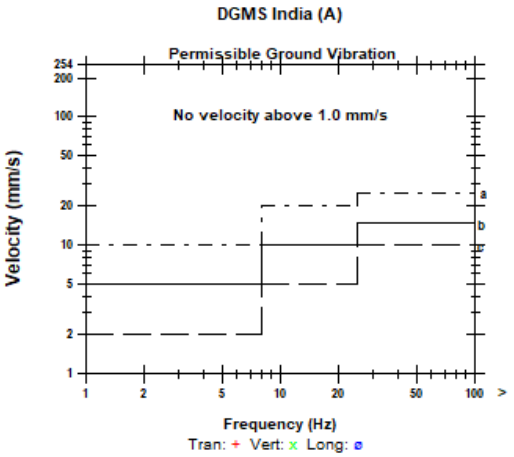
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 156 m

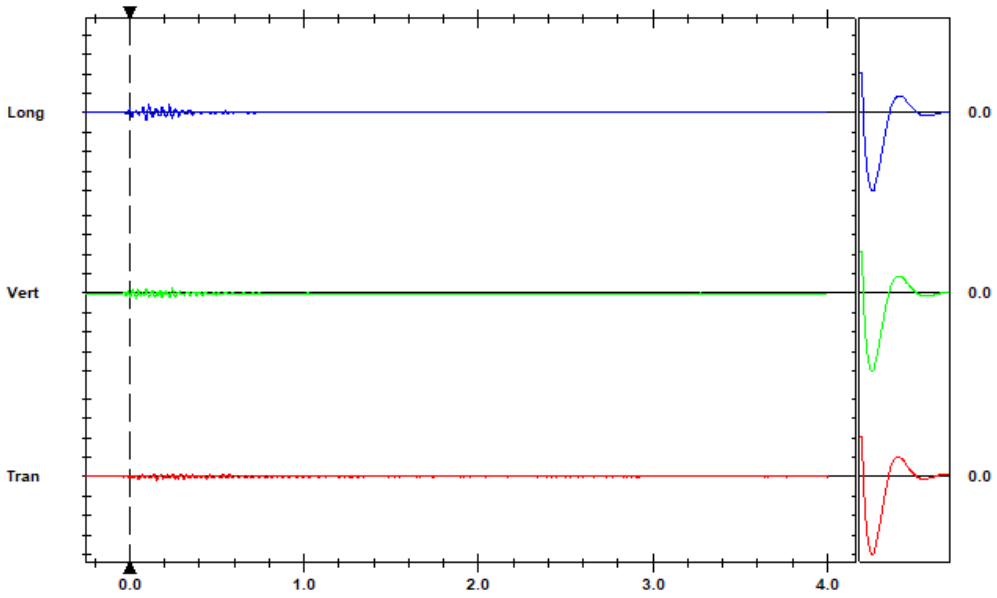
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

	Tran	Vert	Long	
PPV	0.370	0.575	0.859	mm/s
ZC Freq	39	32	27	Hz
Time (Rel. to Trig)	0.156	0.037	0.109	sec
Peak Acceleration	0.011	0.013	0.019	g
Peak Displacement	0.002	0.003	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 0.942 mm/s at 0.109 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

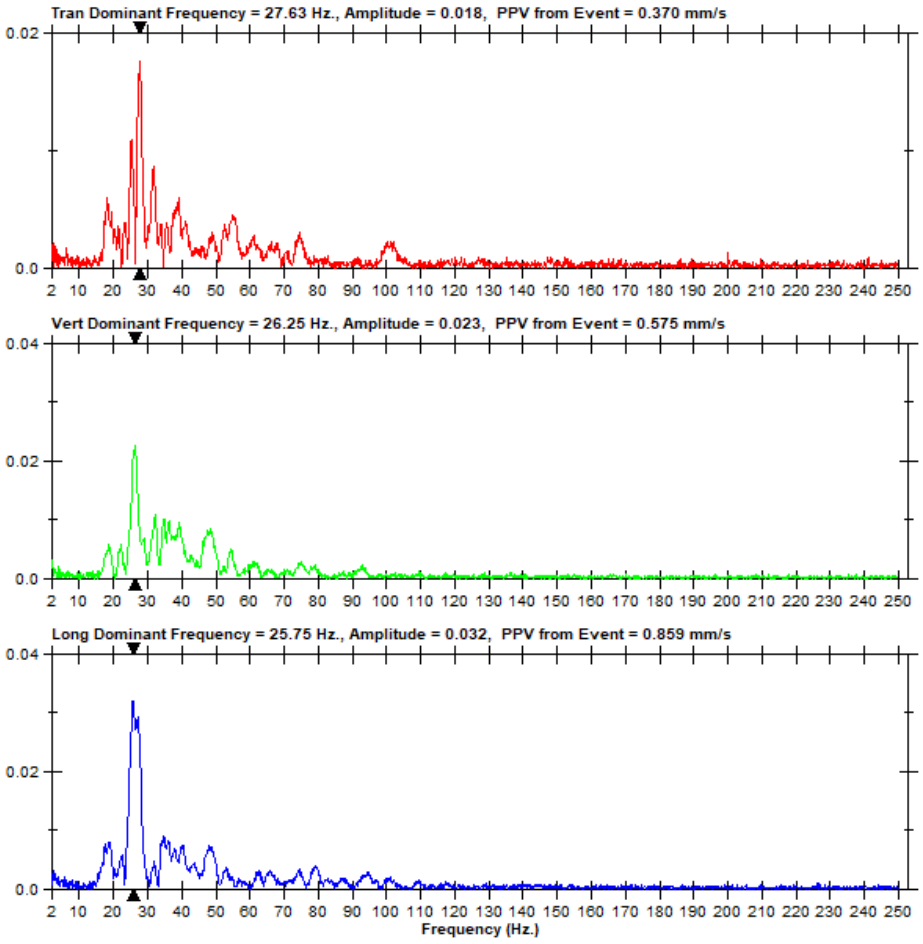
FFT Report

Date/Time	Long at 12:34:54 December 28, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20221228123454.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 156 m



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Event Report

Date/Time Tran at 12:35:07 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.MJ0
Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 222 m

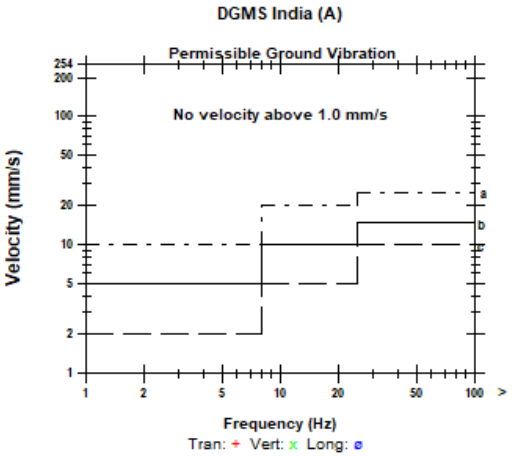
Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

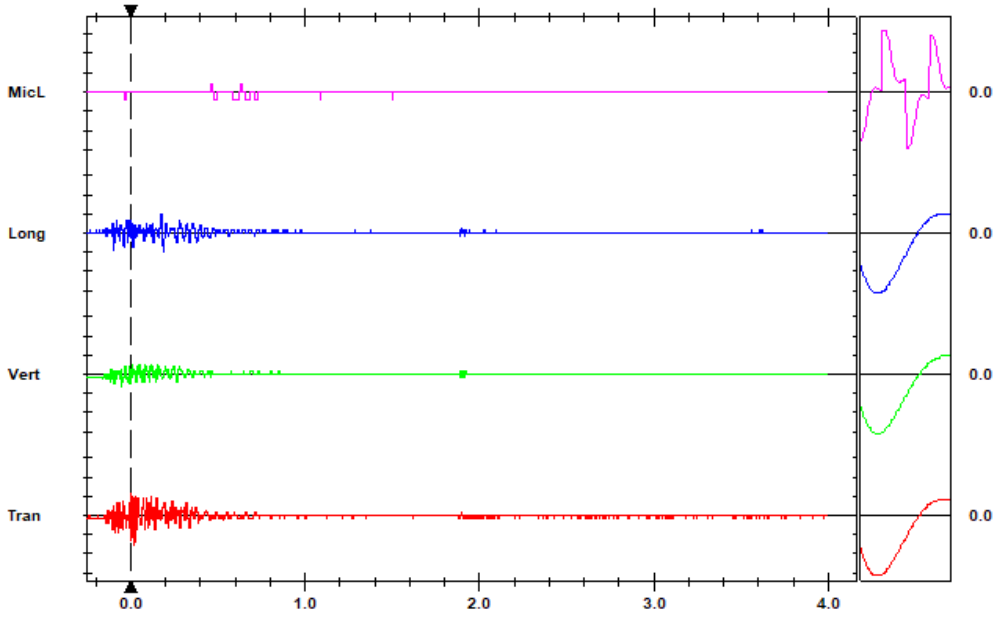
Microphone Linear Weighting
PSPL 100.00 dB(L) at -0.026 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.762	0.318	0.508	mm/s
ZC Freq	64	64	34	Hz
Time (Rel. to Trig)	0.024	-0.049	0.175	sec
Peak Acceleration	0.033	0.013	0.020	g
Peak Displacement	0.002	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 0.762 mm/s at 0.024 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

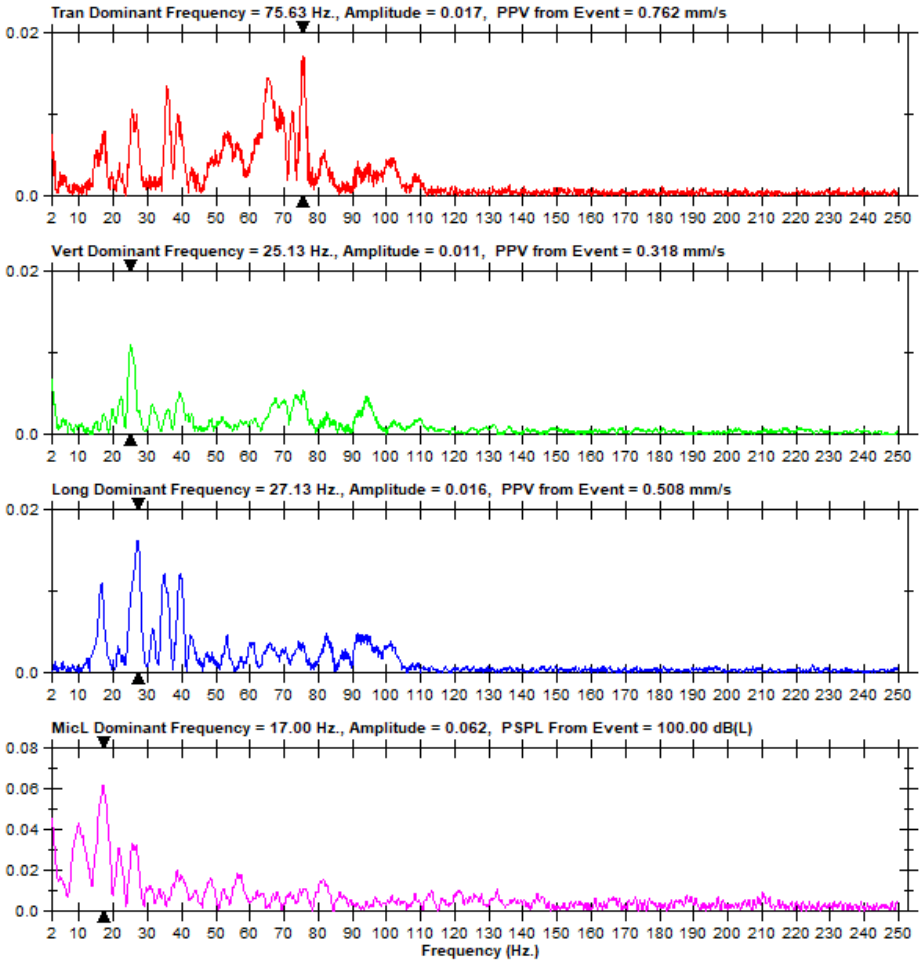
FFT Report

Date/Time	Tran at 12:35:07 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.MJ0

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 222 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:36:11 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

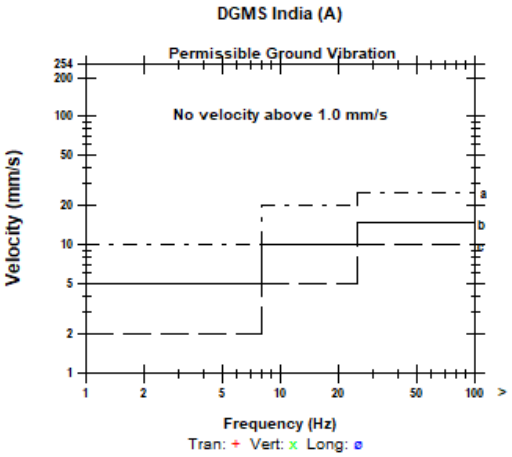
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.732 sec
ZC Freq 64 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

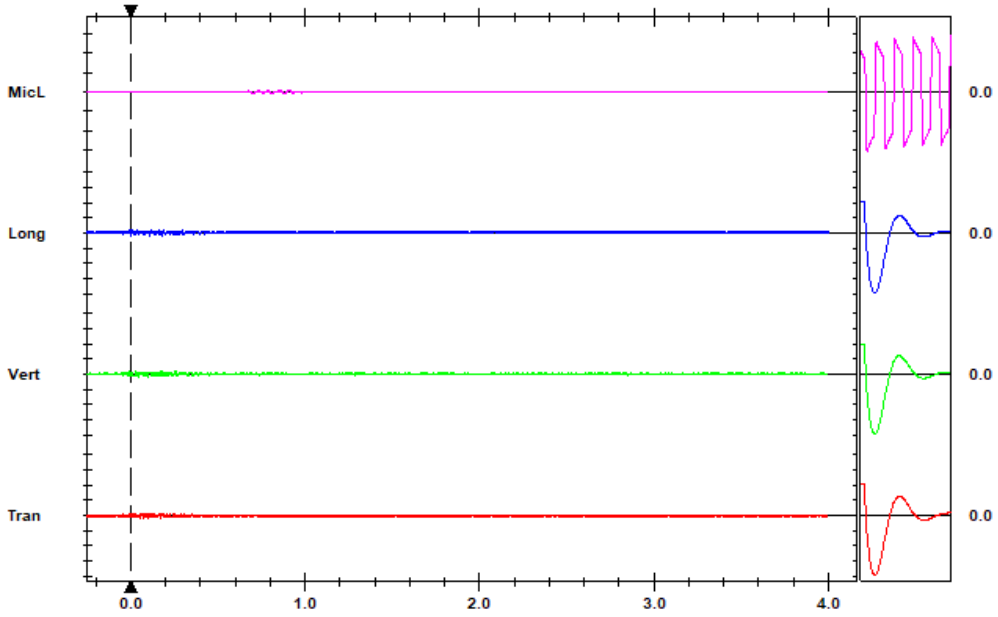
	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	64	85	Hz
Time (Rel. to Trig)	0.053	0.029	0.000	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.582 mm/s at 0.008 sec

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRF.0B0
Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 264 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

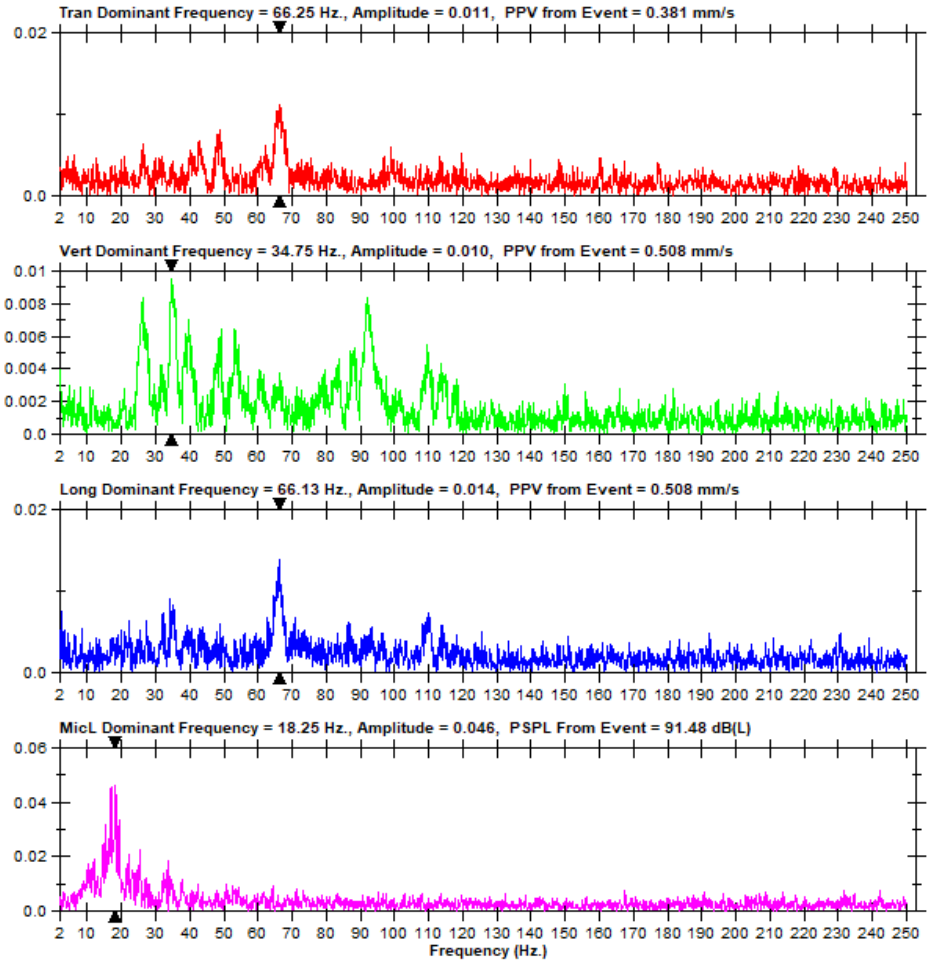
FFT Report

Date/Time	Long at 12:36:11 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRF.0B0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 19, Hole Depth - 1.8 m, Charge/hole - 0.304 Kg, MCPD - 0.3125 Kg, Total Charge - 5.775 Kg, Distance - 264 m



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Event Report

Date/Time Long at 12:37:37 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRF.2P0
Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 62 m

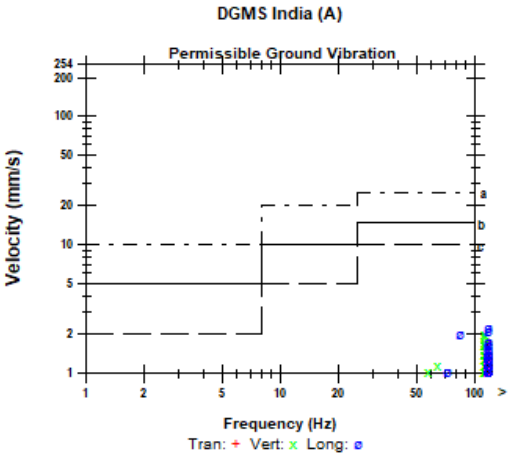
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

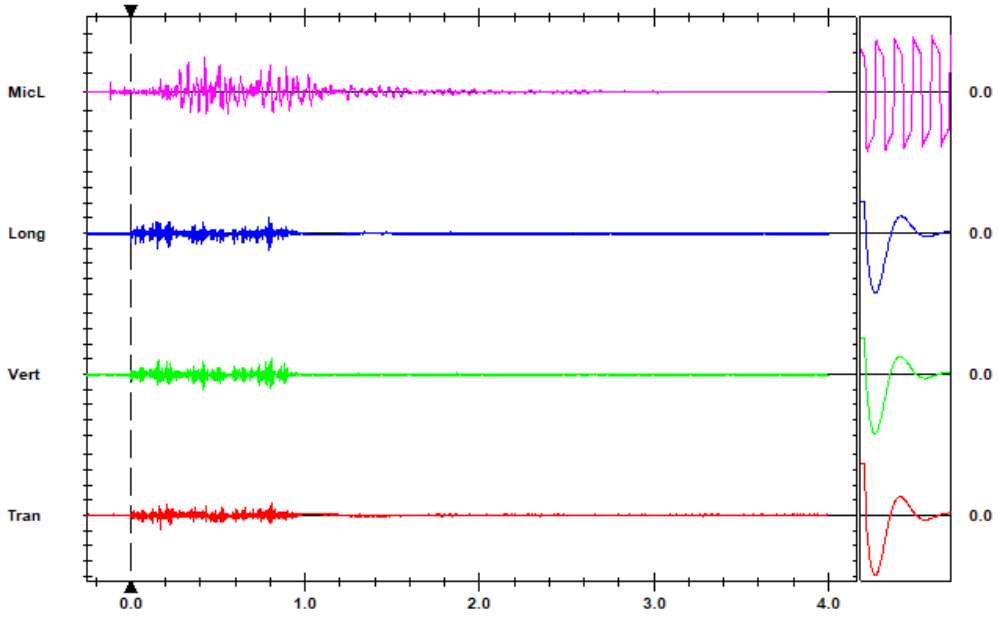
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 119.0 dB(L) at 0.427 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 502 mv)

	Tran	Vert	Long	
PPV	1.778	2.032	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.169	0.416	0.796	sec
Peak Acceleration	0.172	0.225	0.252	g
Peak Displacement	0.002	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 2.420 mm/s at 0.794 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

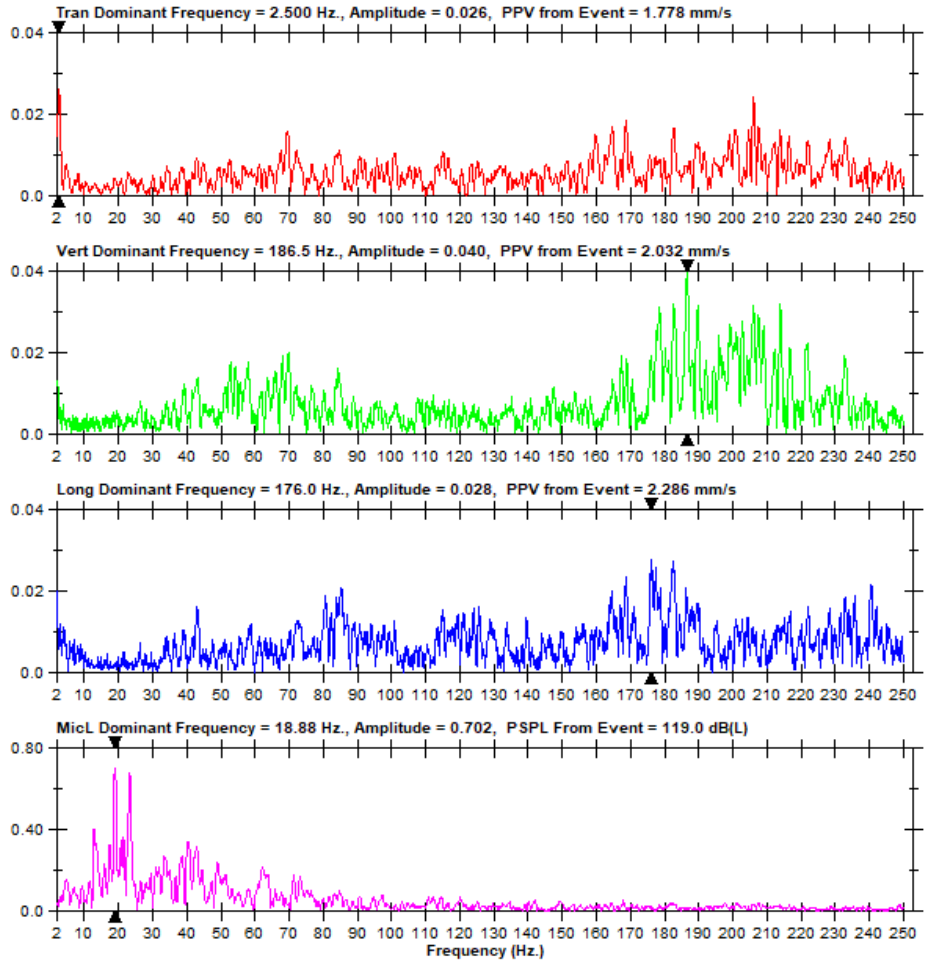
FFT Report

Date/Time	Long at 12:37:37 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRF.2P0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 62 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:37:37 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

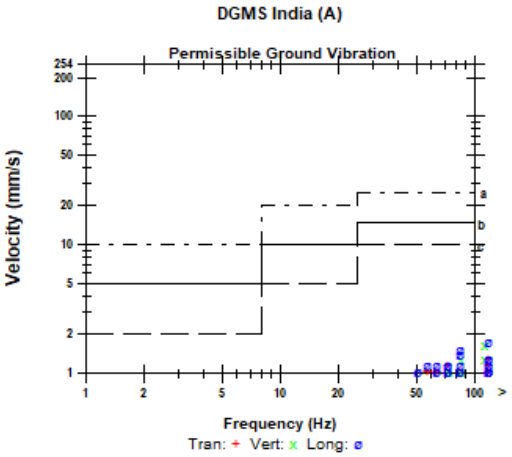
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

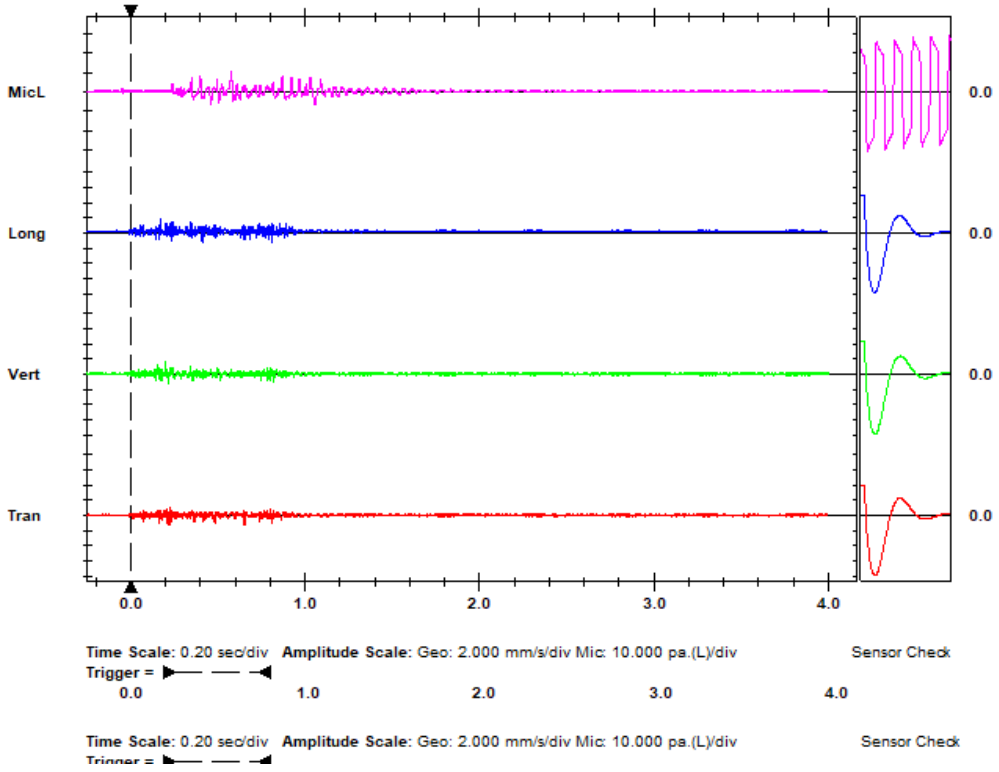
Microphone Linear Weighting
PSPL 114.4 dB(L) at 0.578 sec
ZC Freq 16 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	1.270	1.651	1.778	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.652	0.198	0.169	sec
Peak Acceleration	0.093	0.080	0.106	g
Peak Displacement	0.002	0.003	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.926 mm/s at 0.169 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRF.2P0
Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 96 m





Instantel

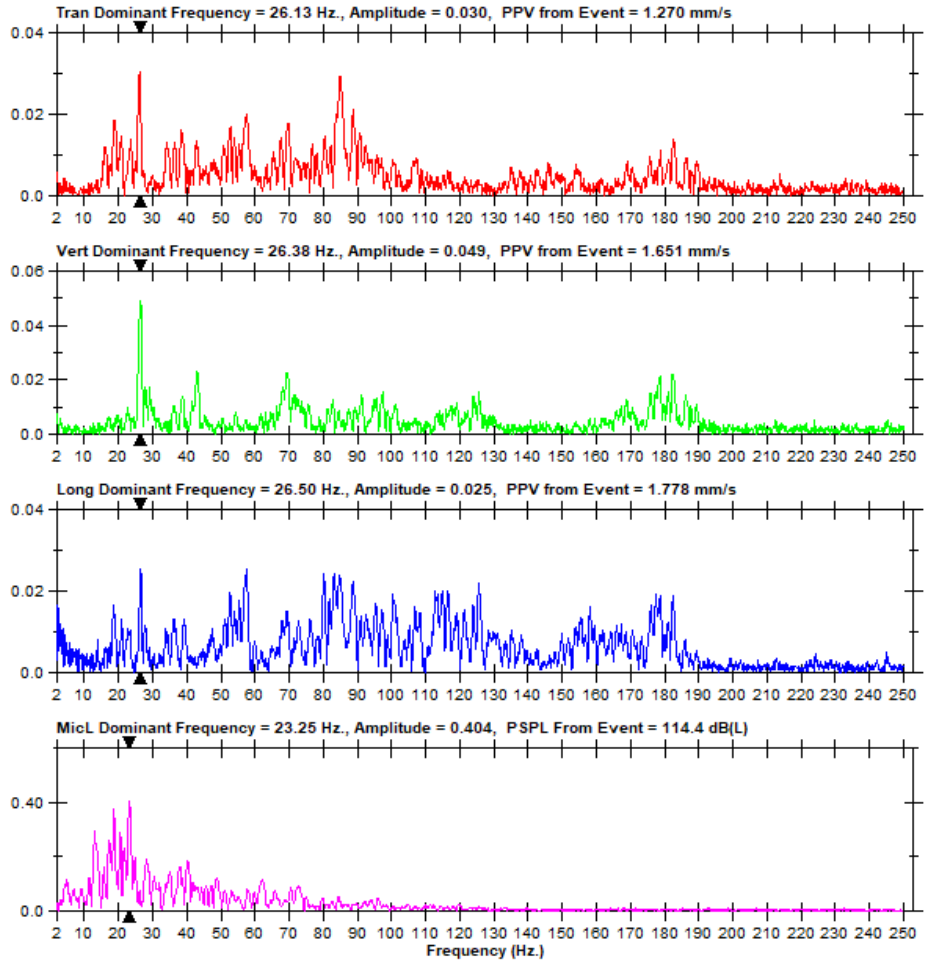
FFT Report

Date/Time	Long at 12:37:37 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRF.2P0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg,
MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 96 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 12:37:36 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRF.2O0
Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 98 m

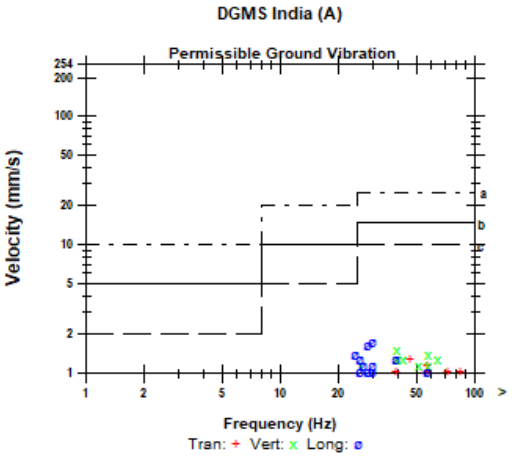
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

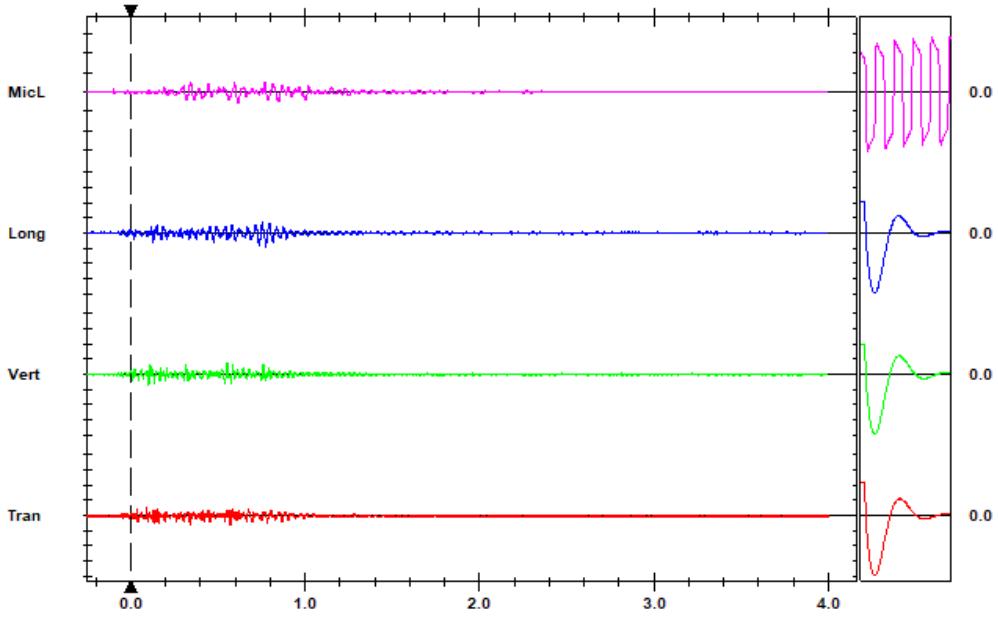
Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.616 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.270	1.524	1.778	mm/s
ZC Freq	47	39	30	Hz
Time (Rel. to Trig)	0.573	0.552	0.776	sec
Peak Acceleration	0.053	0.066	0.040	g
Peak Displacement	0.005	0.006	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.867 mm/s at 0.776 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

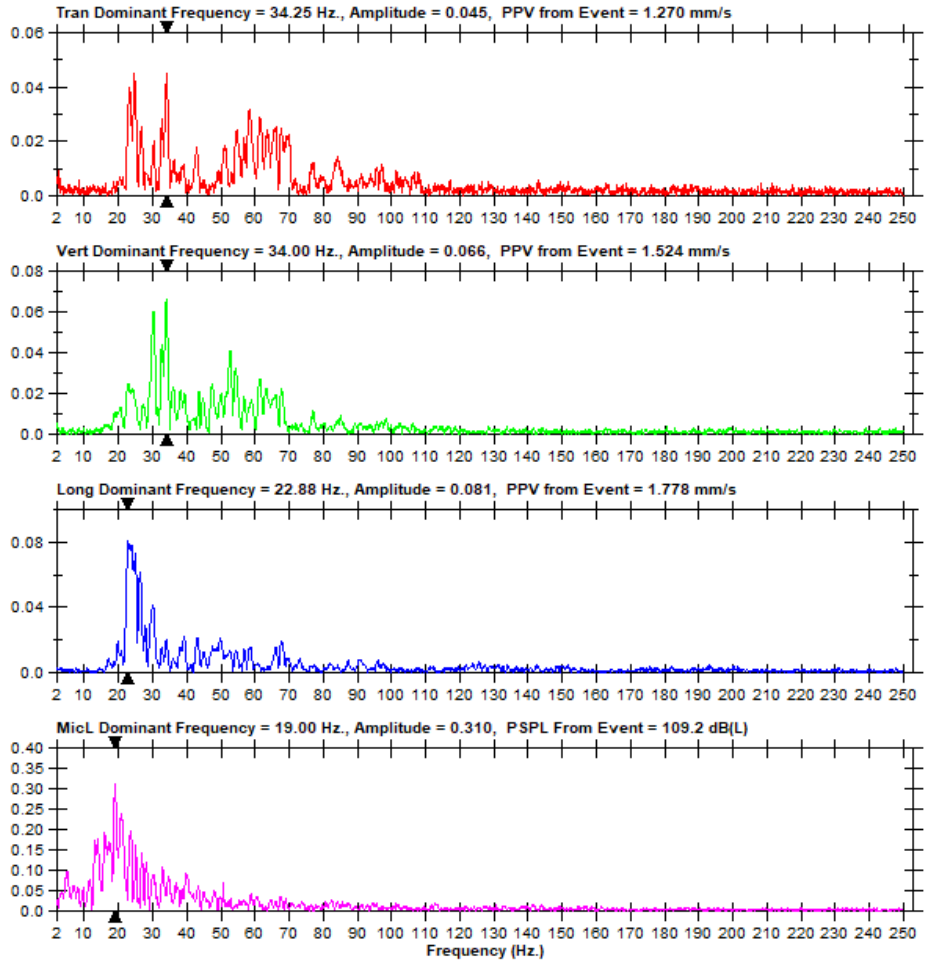
FFT Report

Date/Time	Long at 12:37:36 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRF.2O0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg,
MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 98 m



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Event Report

Date/Time	Long at 12:36:18 December 28, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221228123618.IDFW

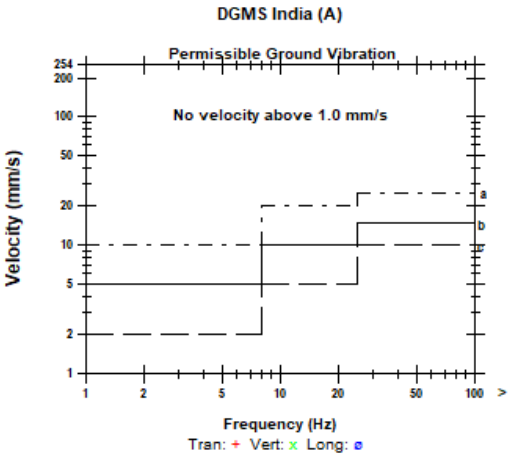
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 144 m

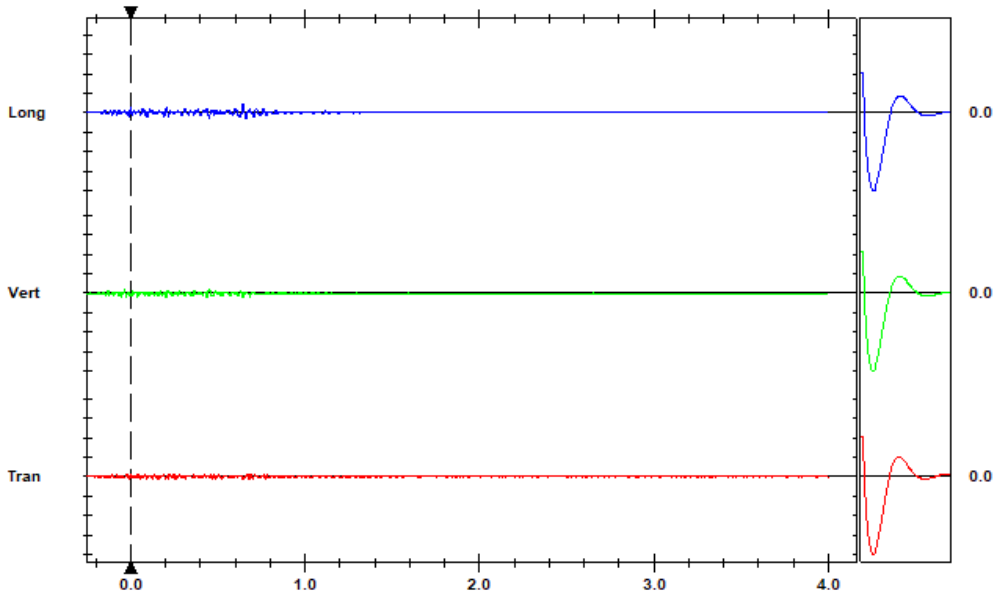
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

	Tran	Vert	Long	
PPV	0.292	0.426	0.835	mm/s
ZC Freq	47	43	30	Hz
Time (Rel. to Trig)	0.247	0.203	0.645	sec
Peak Acceleration	0.014	0.016	0.018	g
Peak Displacement	0.001	0.002	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.958 mm/s at 0.645 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

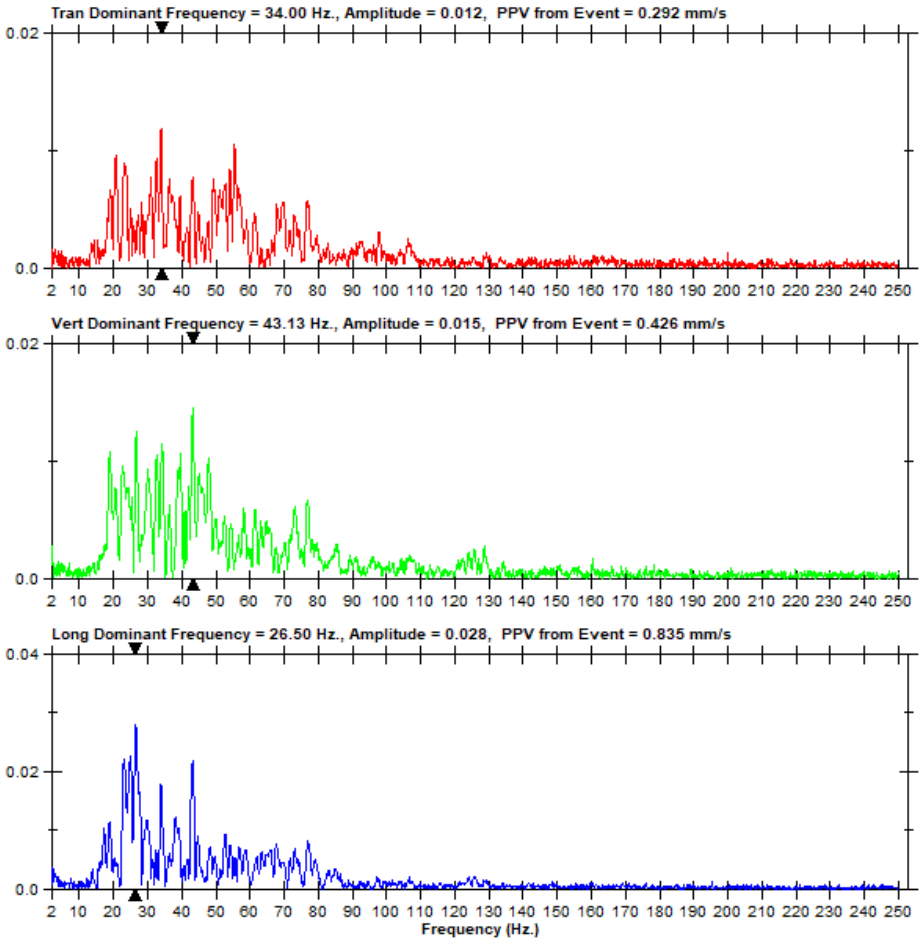
FFT Report

Date/Time	Long at 12:36:18 December 28, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20221228123618.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg,
MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 144 m



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Event Report

Date/Time	Vert at 12:37:38 December 28, 2022
Trigger Source	Geo: 0.510 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JTRF.2Q0

Notes

Location:	On ground Surface
Client:	Kerela State Pollution Control Board
User Name:	CSIR-CIMFR
General:	Blast vibration Monatring at Kerela Stat

Post Event Notes

Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 212 m

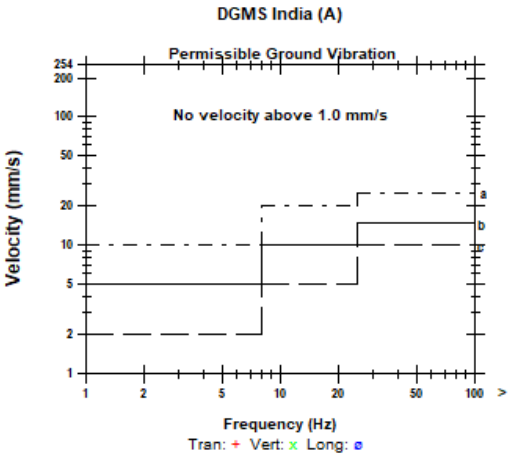
Extended Notes

Ground vibration study due to blasting at different quarries in the state of Kerela

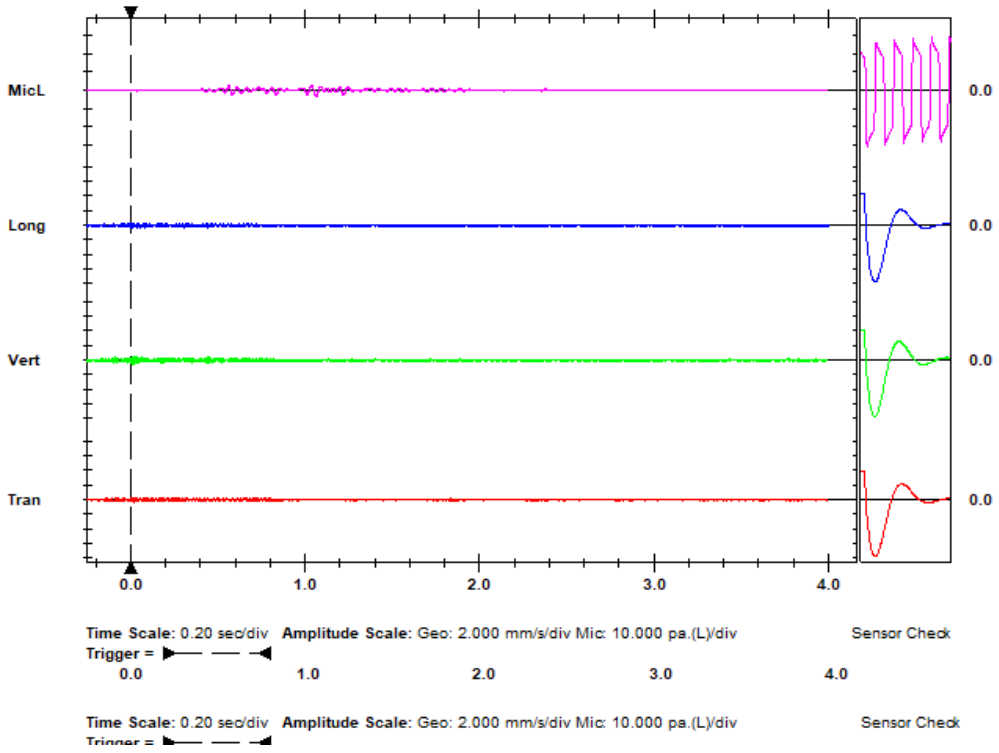
Microphone	Linear Weighting
PSPL	103.5 dB(L) at 1.061 sec
ZC Freq	18 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 529 mv)

	Tran	Vert	Long	
PPV	0.381	0.635	0.508	mm/s
ZC Freq	>100	73	57	Hz
Time (Rel. to Trig)	0.016	0.015	0.008	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.751 mm/s at 0.016 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Instantel

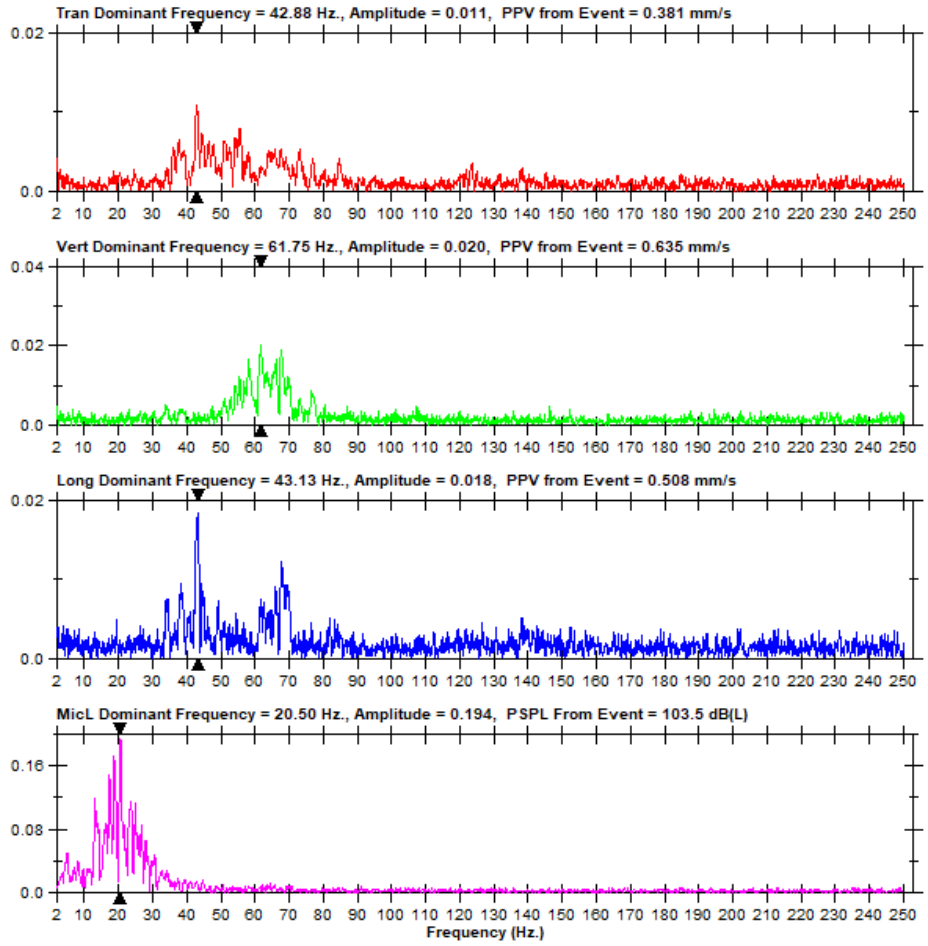
FFT Report

Date/Time	Vert at 12:37:38 December 28, 2022	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JTRF.2Q0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR
General: Blast vibration Monatring at Kerela Stat

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg,
MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 212 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 12:36:31 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

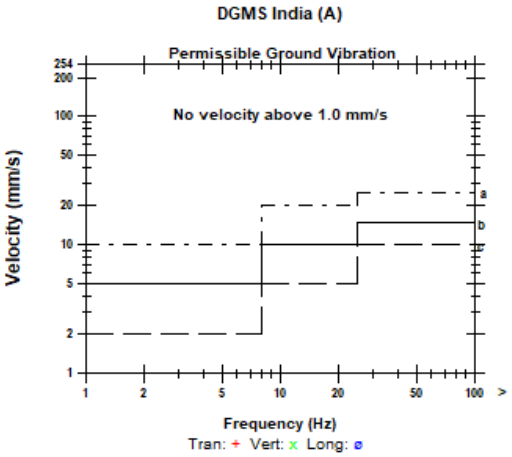
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

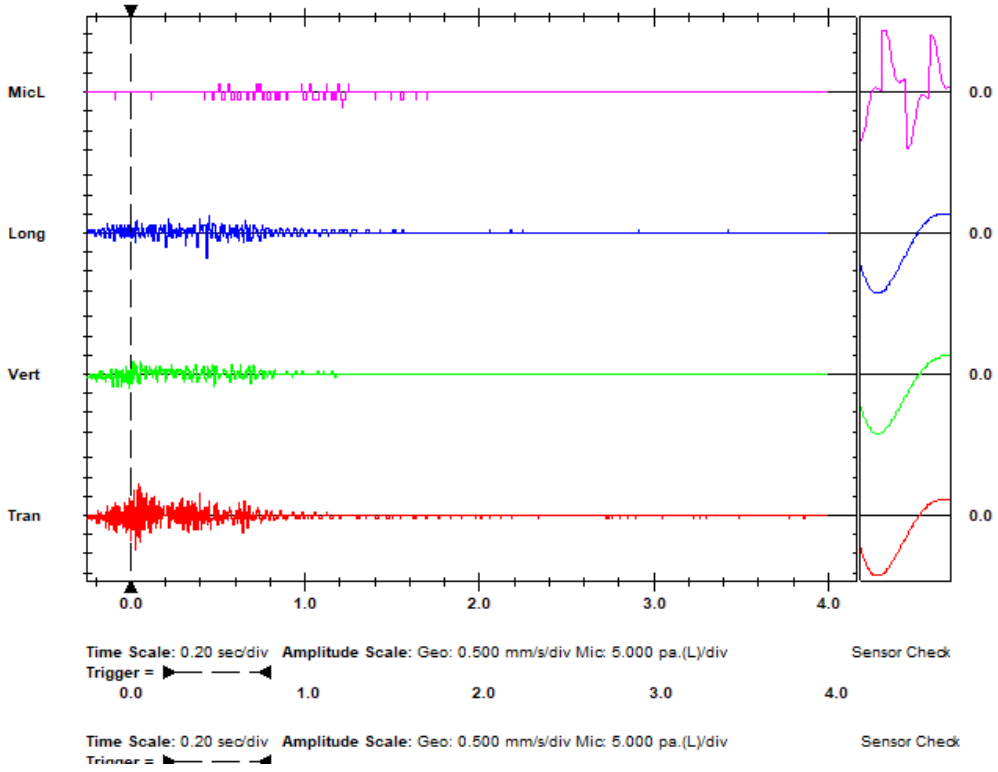
Microphone Linear Weighting
PSPL 106.0 dB(L) at 1.218 sec
ZC Freq 22 Hz
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.889	0.381	0.635	mm/s
ZC Freq	73	57	37	Hz
Time (Rel. to Trig)	0.029	-0.003	0.437	sec
Peak Acceleration	0.040	0.020	0.020	g
Peak Displacement	0.002	0.001	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 0.953 mm/s at 0.029 sec

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.OV0
Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 261 m





Instantel

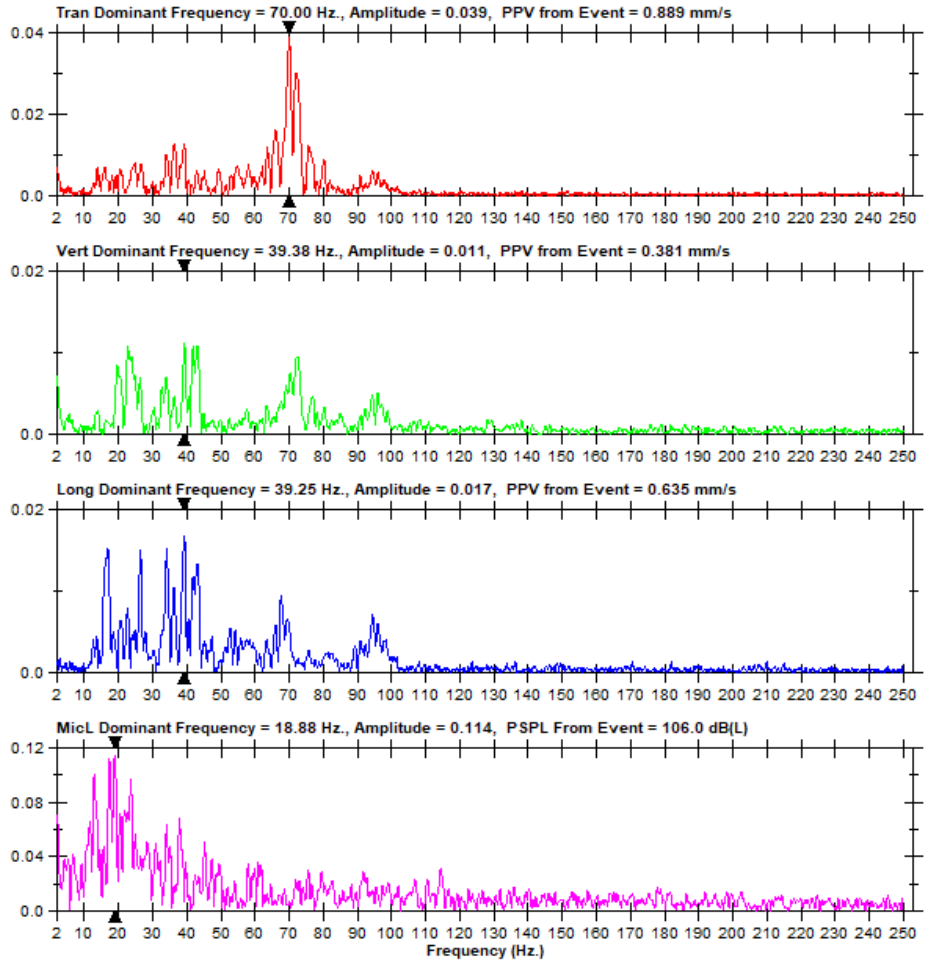
FFT Report

Date/Time	Tran at 12:36:31 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.OV0

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 261 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:37:36 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRF.2O0
Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg, MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 296 m

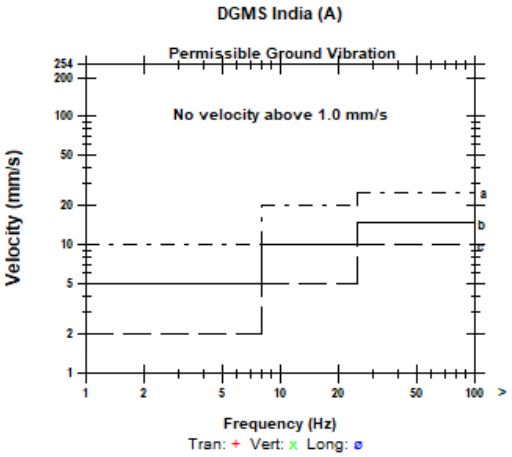
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

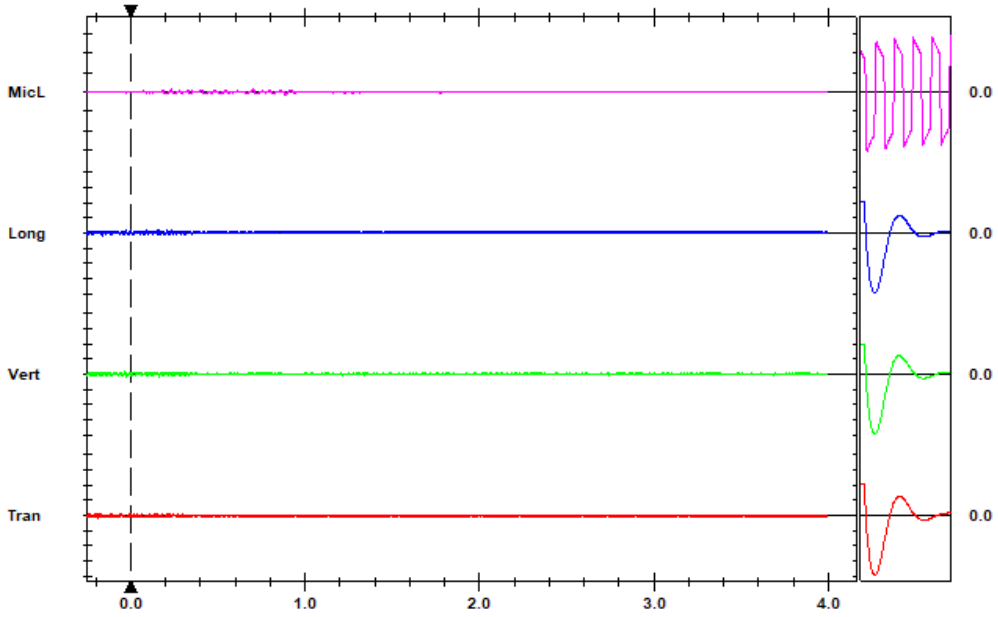
Microphone Linear Weighting
PSPL 97.50 dB(L) at 0.888 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	0.508	mm/s
ZC Freq	>100	57	57	Hz
Time (Rel. to Trig)	-0.184	-0.032	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.539 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

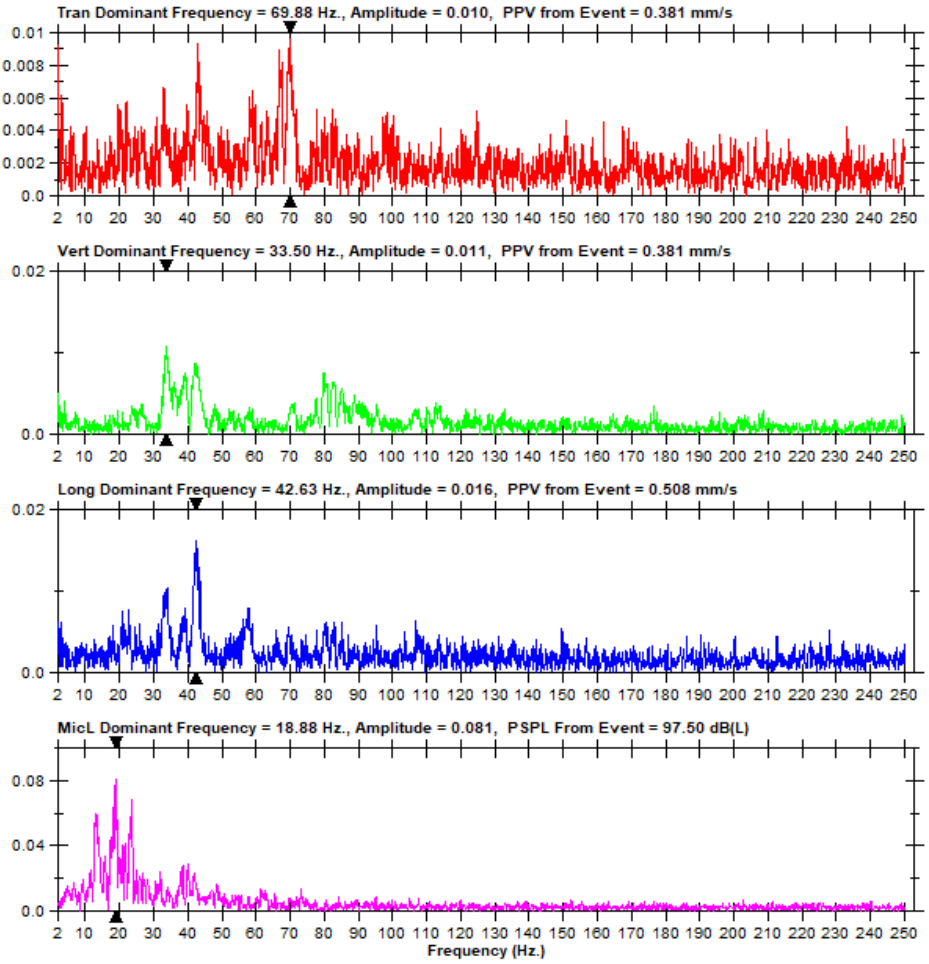
FFT Report

Date/Time	Long at 12:37:36 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRF.2O0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 56, Hole Depth - 1.8 m, Charge/hole - 0.339 Kg,
MCPD - 0.375 Kg, Total Charge - 19.00 Kg, Distance - 296 m



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Event Report

Date/Time Long at 12:39:00 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

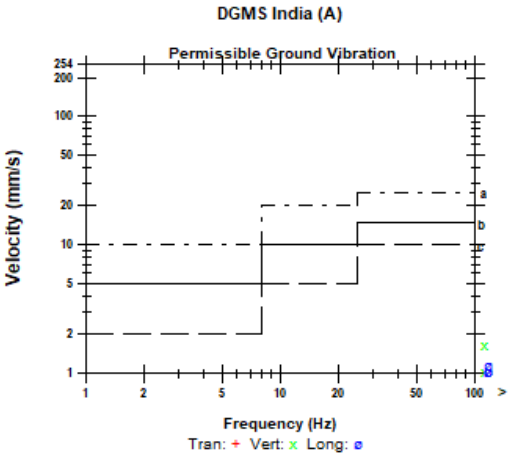
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

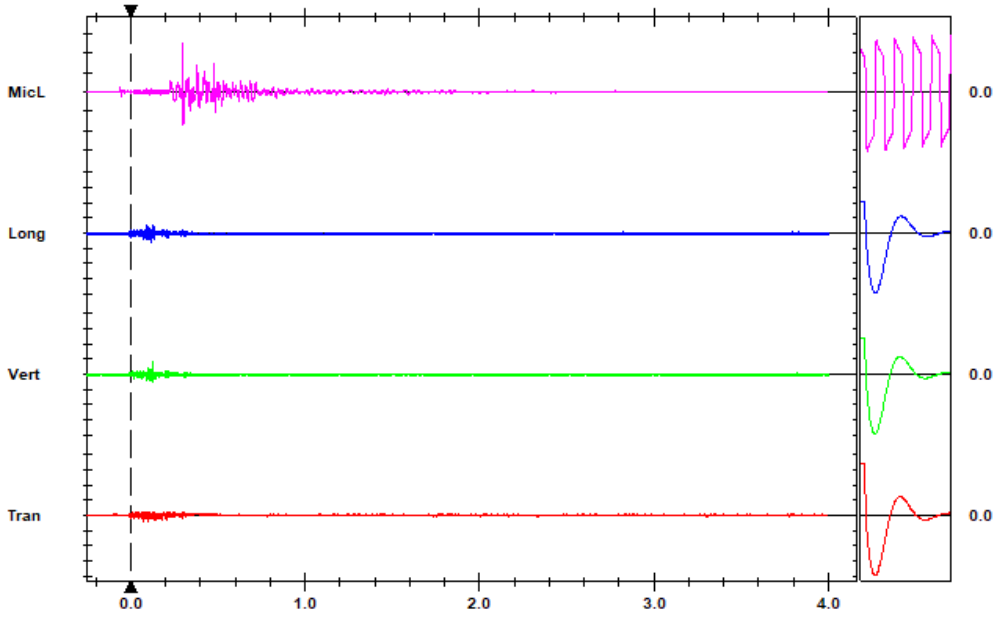
Microphone Linear Weighting
PSPL 121.9 dB(L) at 0.297 sec
ZC Freq 73 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	0.762	1.651	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.071	0.126	0.118	sec
Peak Acceleration	0.080	0.146	0.106	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.773 mm/s at 0.126 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRF.500
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 51 m





Instantel

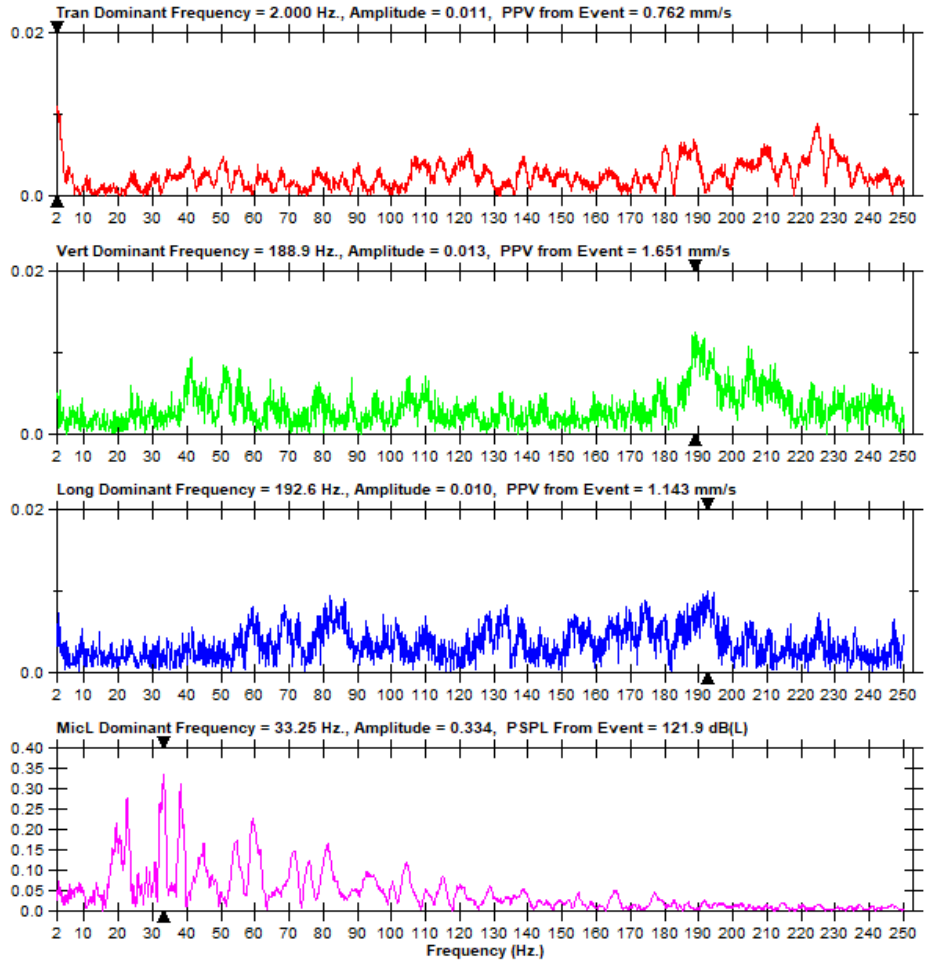
FFT Report

Date/Time	Long at 12:39:00 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRF.500

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg,
MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 51 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:39:01 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

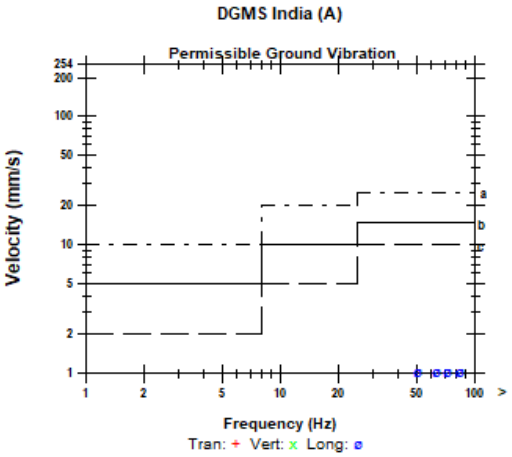
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

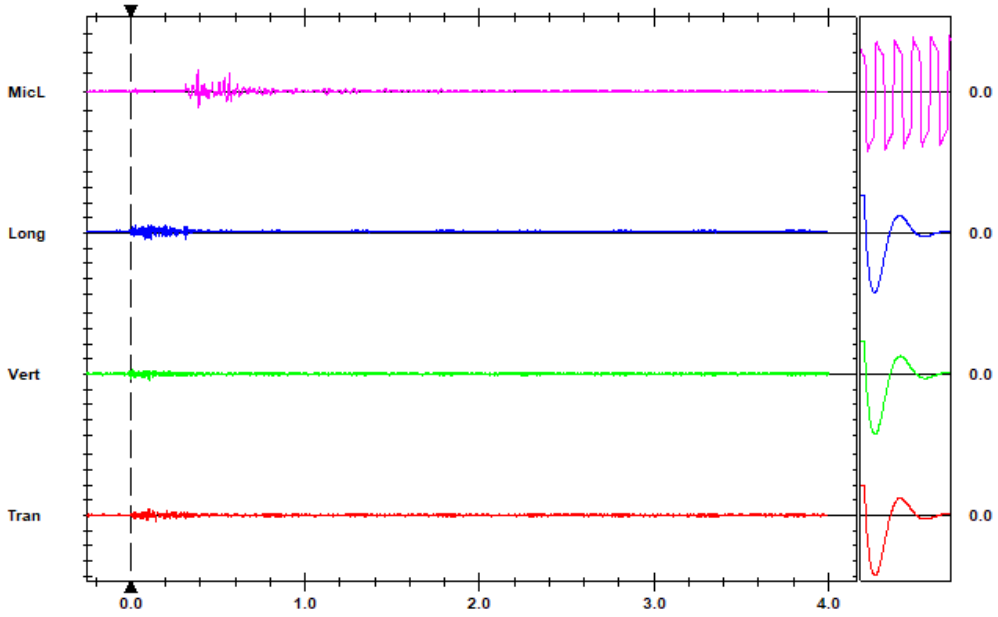
Microphone Linear Weighting
PSPL 115.2 dB(L) at 0.385 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	0.762	0.762	1.016	mm/s
ZC Freq	85	57	51	Hz
Time (Rel. to Trig)	0.104	0.105	0.027	sec
Peak Acceleration	0.053	0.053	0.093	g
Peak Displacement	0.001	0.002	0.021	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.150 mm/s at 0.103 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRF.510
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 78 m





Instantel

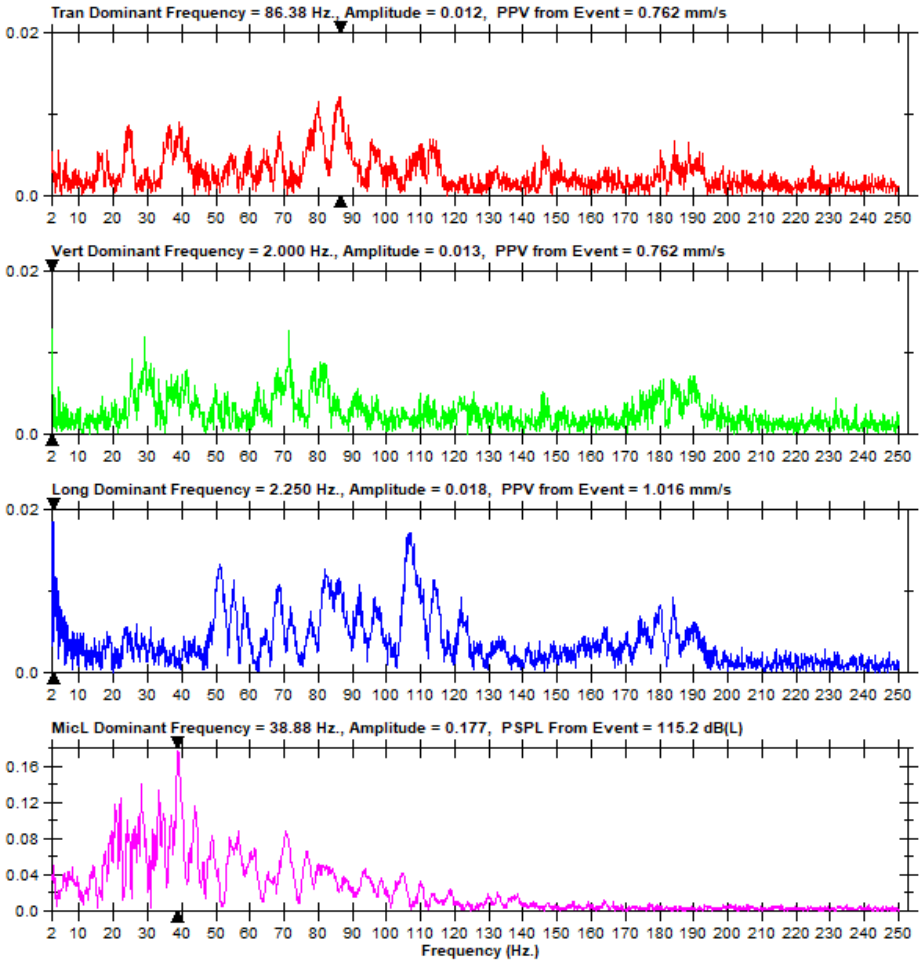
FFT Report

Date/Time	Long at 12:39:01 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRF.510

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg,
MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 78 m



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Event Report

Date/Time Tran at 12:38:59 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRF.4Z0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 104 m

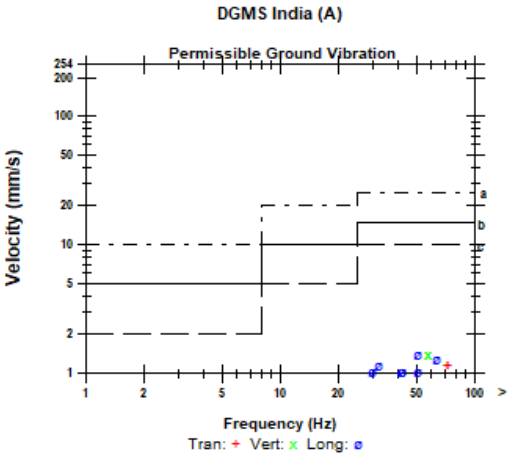
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

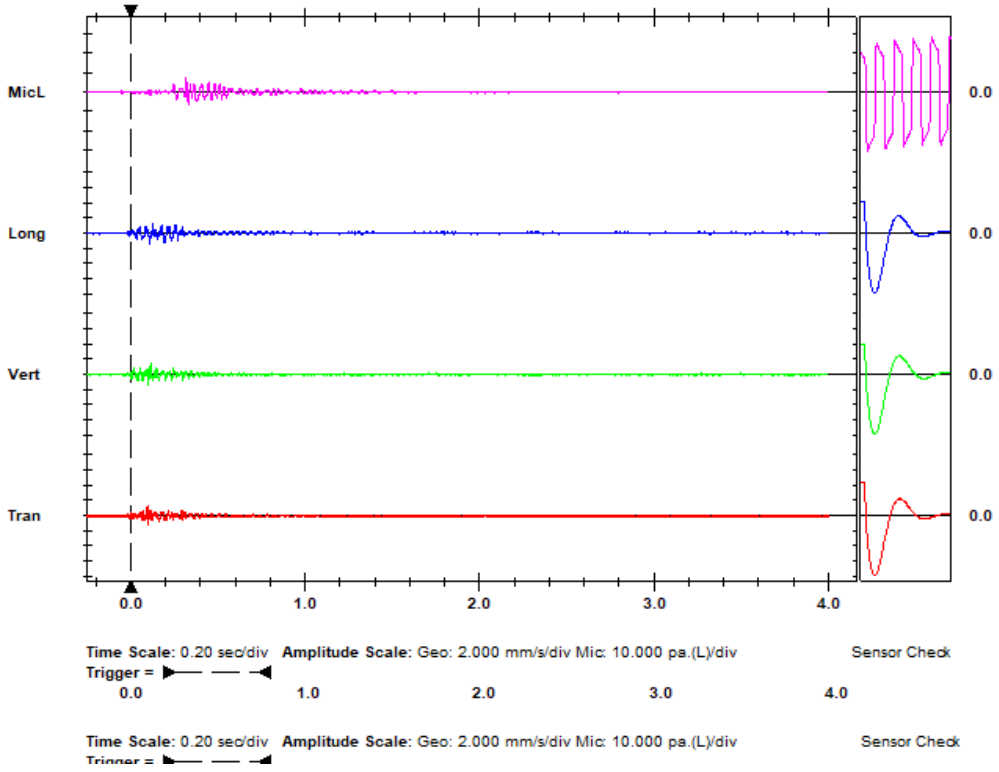
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 111.8 dB(L) at 0.316 sec
ZC Freq 57 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.143	1.397	1.397	mm/s
ZC Freq	73	57	51	Hz
Time (Rel. to Trig)	0.097	0.103	0.111	sec
Peak Acceleration	0.066	0.053	0.066	g
Peak Displacement	0.003	0.003	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.845 mm/s at 0.103 sec





Instantel

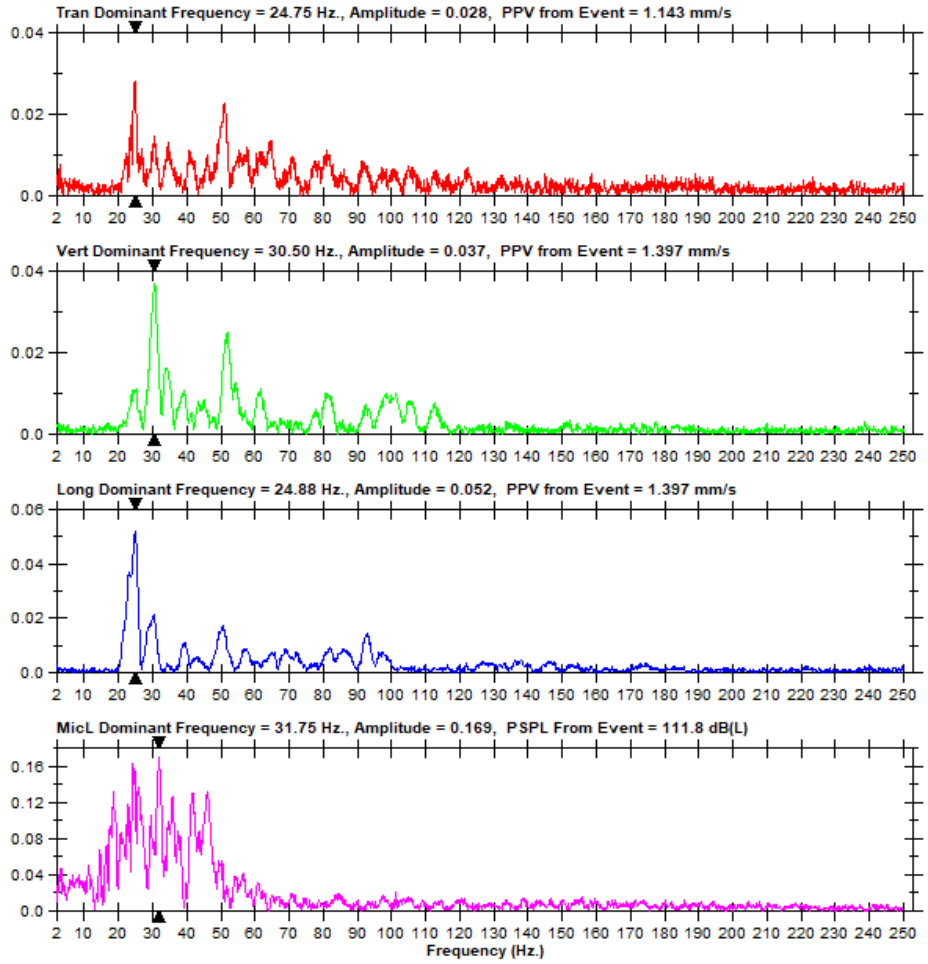
FFT Report

Date/Time	Tran at 12:38:59 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRF.4Z0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg,
MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 104 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Long at 12:37:42 December 28, 2022
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20221228123742.IDFW

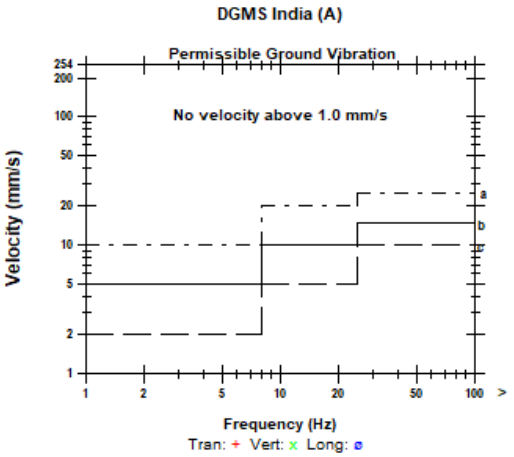
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 152 m

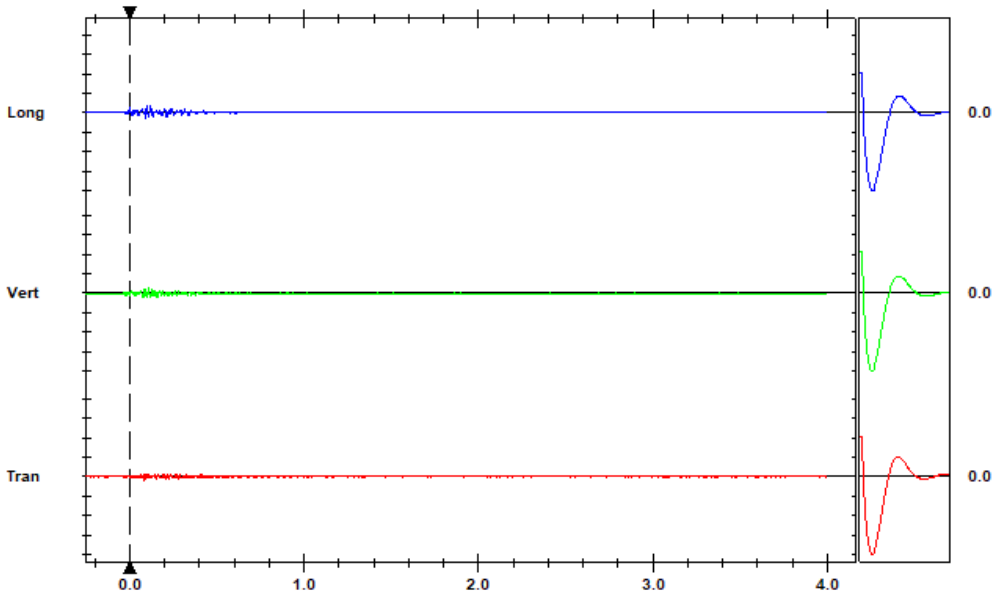
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

	Tran	Vert	Long	
PPV	0.363	0.544	0.709	mm/s
ZC Freq	57	57	64	Hz
Time (Rel. to Trig)	0.081	0.108	0.098	sec
Peak Acceleration	0.017	0.020	0.030	g
Peak Displacement	0.001	0.002	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.1	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.862 mm/s at 0.099 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

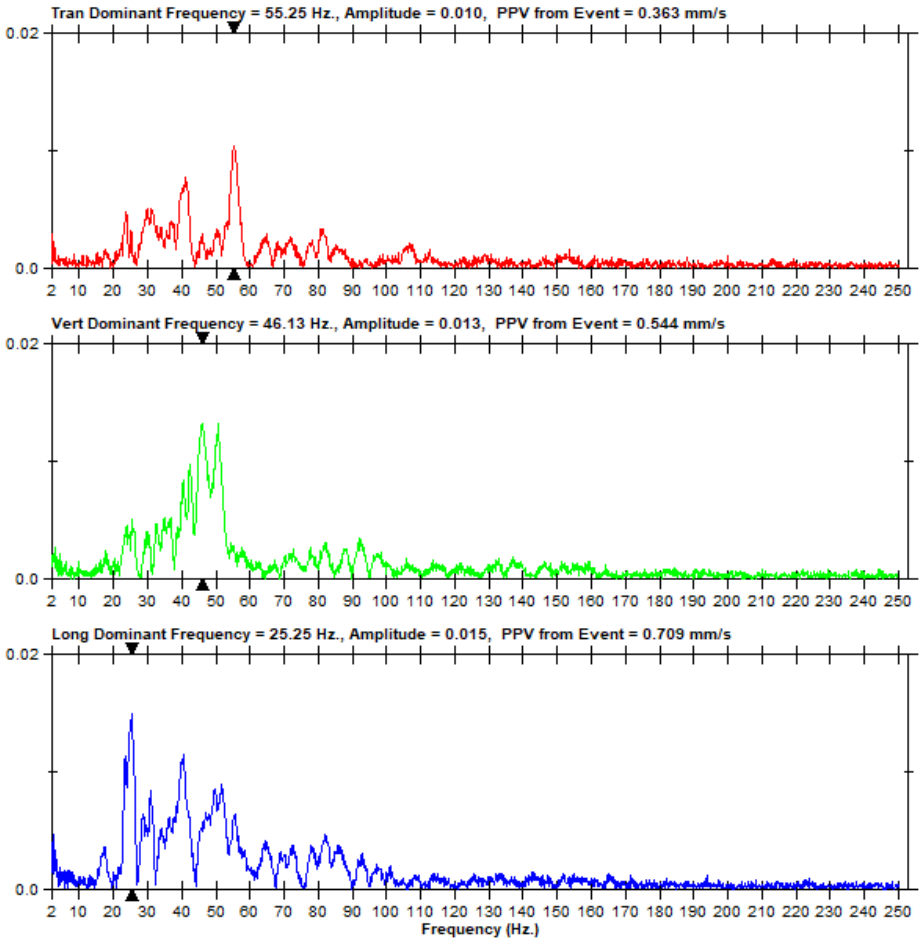
FFT Report

Date/Time	Long at 12:37:42 December 28, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20221228123742.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 152 m



Printed: February 20, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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Event Report

Date/Time Tran at 12:37:54 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.R60
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 244 m

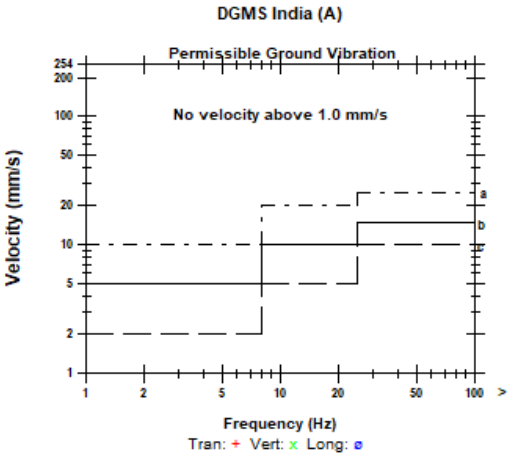
Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

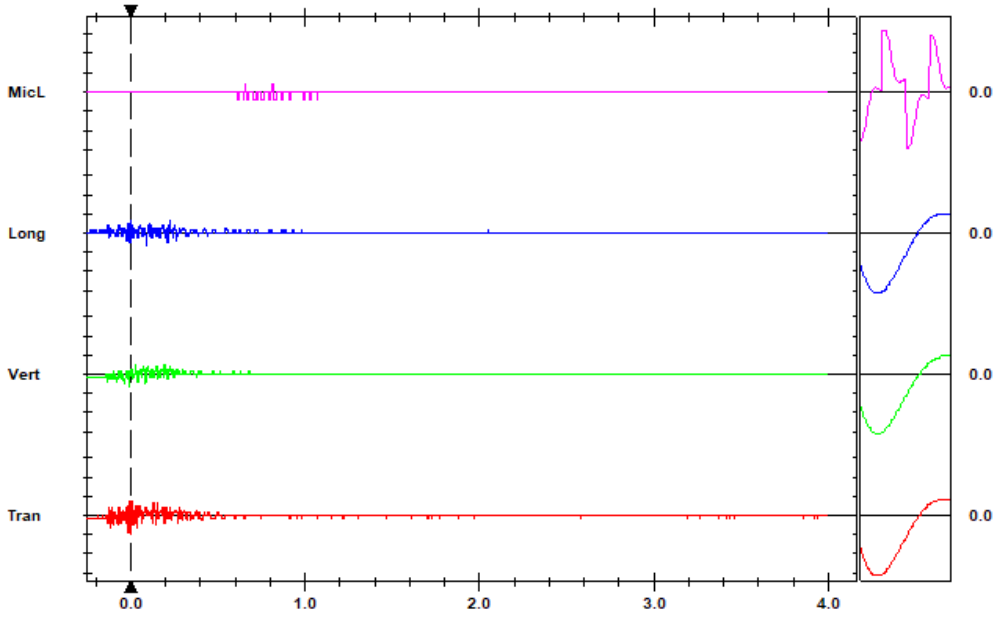
Microphone Linear Weighting
PSPL 100.00 dB(L) at 0.611 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.508	0.318	0.318	mm/s
ZC Freq	85	64	64	Hz
Time (Rel. to Trig)	0.001	-0.004	0.004	sec
Peak Acceleration	0.027	0.013	0.013	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 0.540 mm/s at 0.000 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

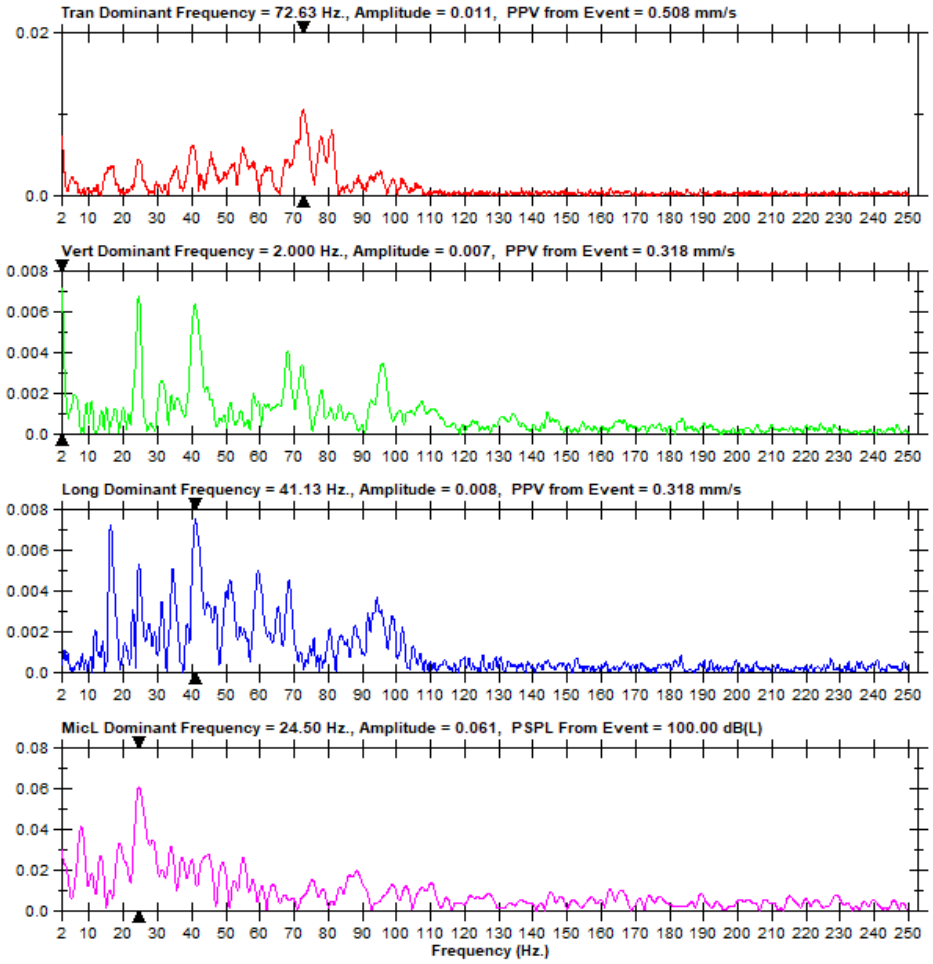
FFT Report

Date/Time	Tran at 12:37:54 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.R60

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 244 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 12:42:47 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

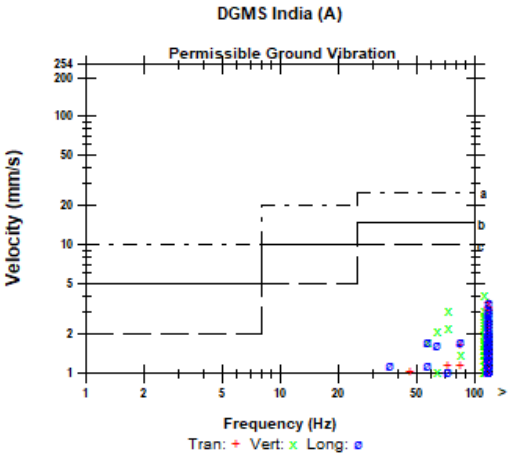
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

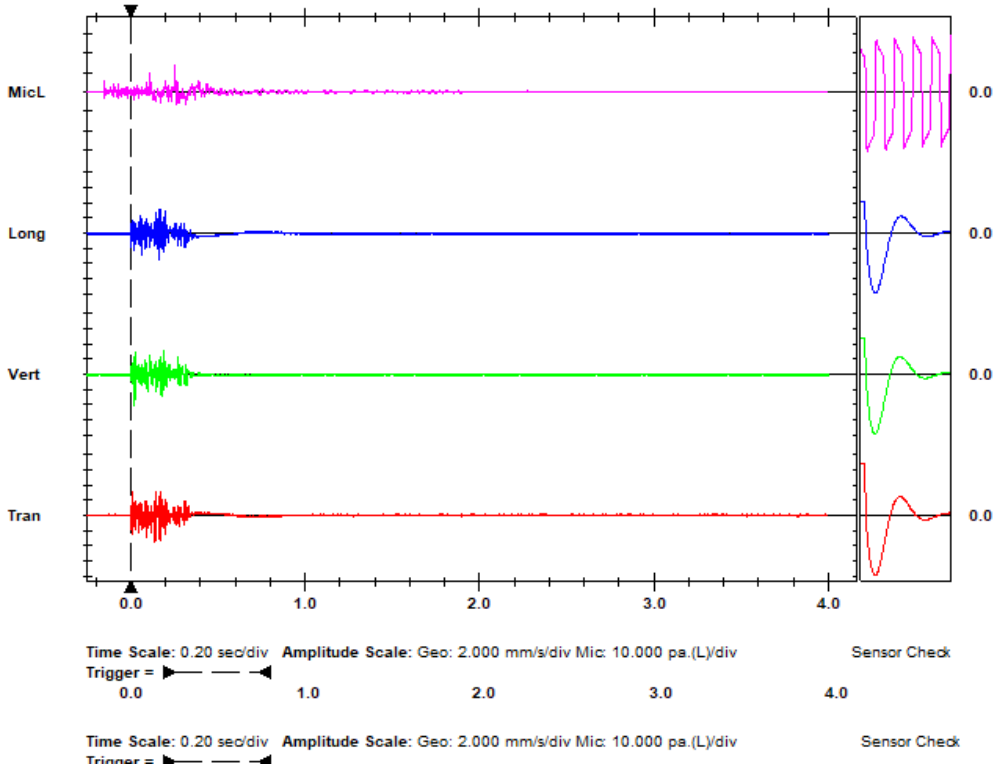
Microphone Linear Weighting
PSPL 117.1 dB(L) at 0.255 sec
ZC Freq 22 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	3.556	4.064	3.556	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.139	0.023	0.166	sec
Peak Acceleration	0.477	0.345	0.424	g
Peak Displacement	0.012	0.005	0.033	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 5.042 mm/s at 0.174 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRF.BB0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 67 m





Instantel

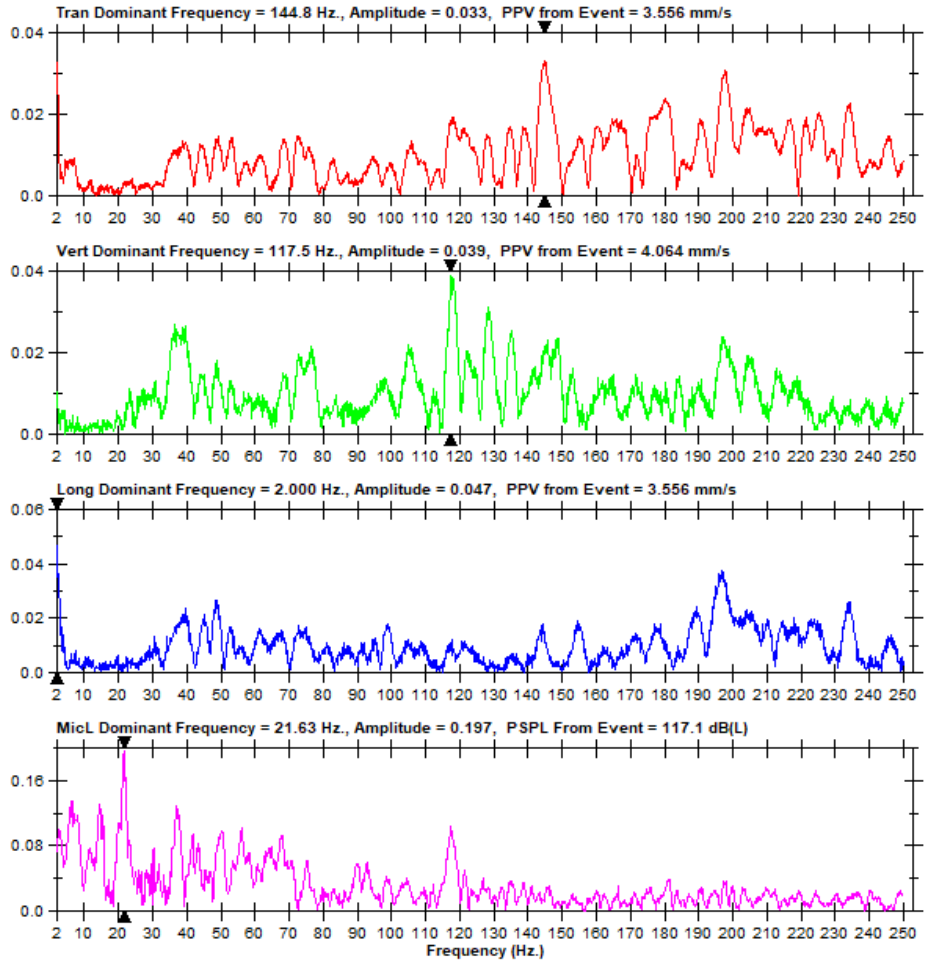
FFT Report

Date/Time	Vert at 12:42:47 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRF.BB0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 67 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 12:42:48 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

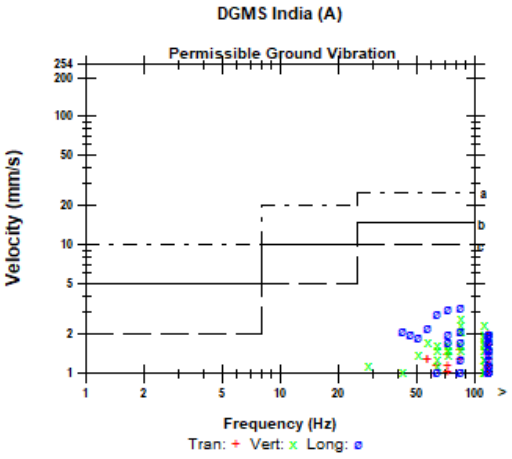
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.319 sec
ZC Freq 37 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

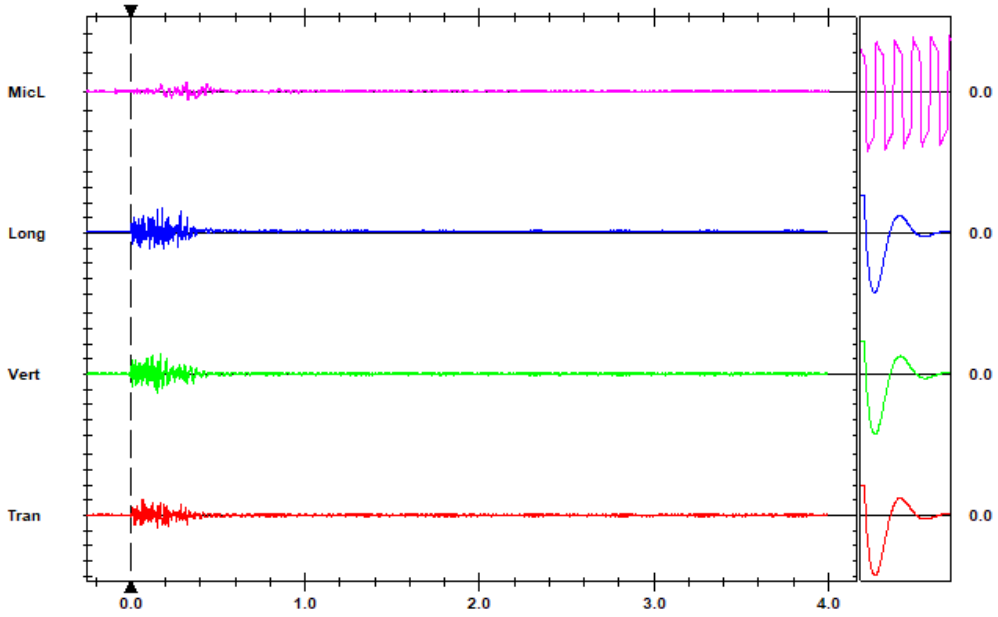
	Tran	Vert	Long	
PPV	2.032	2.667	3.302	mm/s
ZC Freq	>100	85	85	Hz
Time (Rel. to Trig)	0.068	0.175	0.183	sec
Peak Acceleration	0.172	0.172	0.225	g
Peak Displacement	0.004	0.005	0.021	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 3.619 mm/s at 0.183 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRF.BC0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 100 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

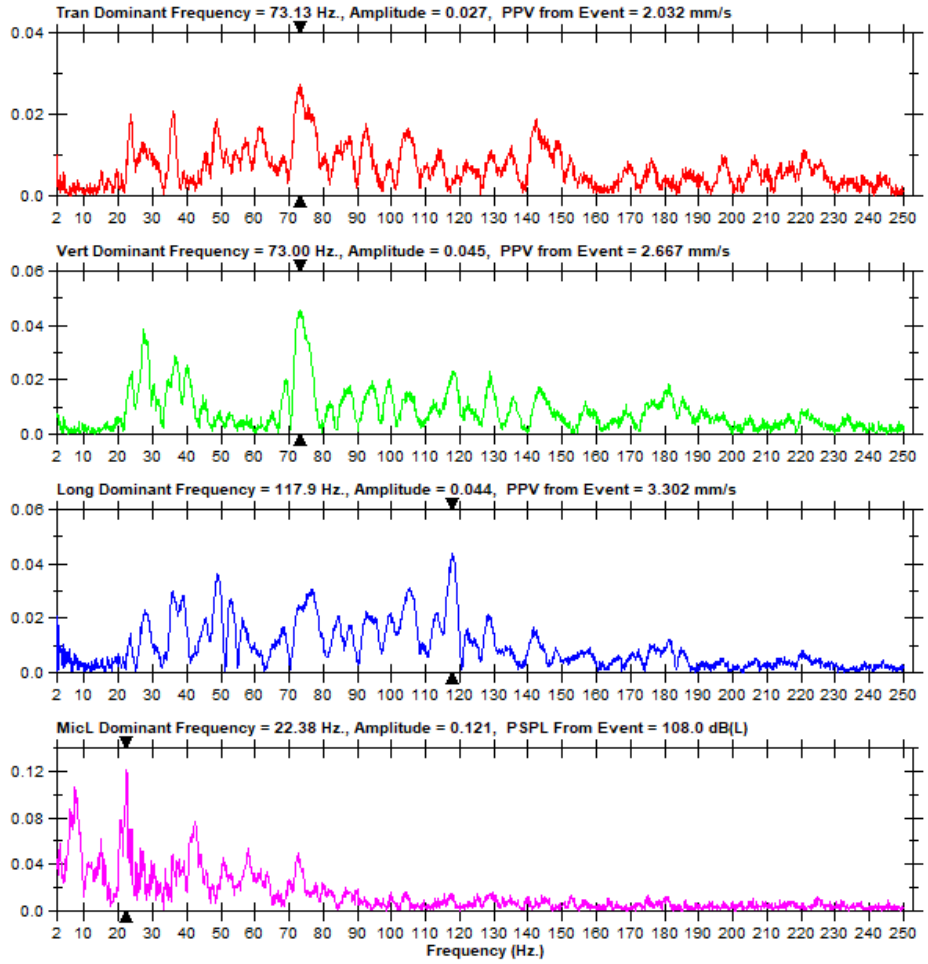
FFT Report

Date/Time	Vert at 12:42:48 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRF.BC0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 100 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 12:42:46 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRF.BA0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 97 m

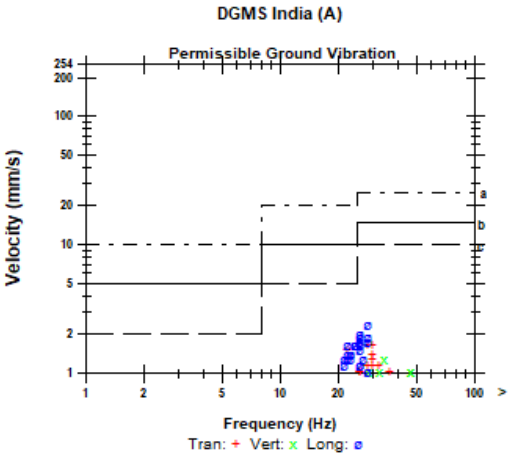
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

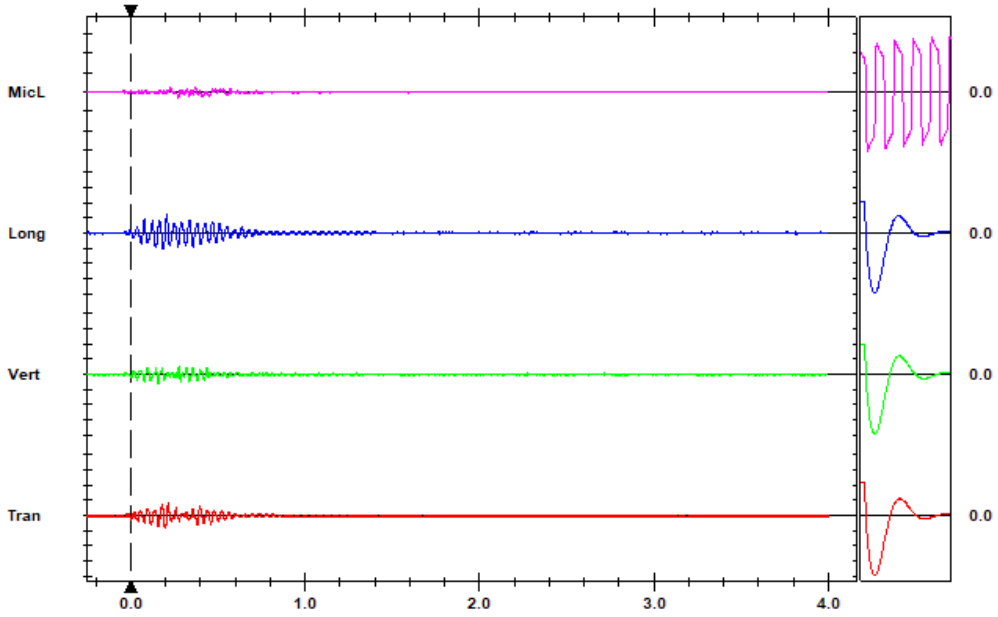
Microphone Linear Weighting
PSPL 103.5 dB(L) at 0.274 sec
ZC Freq 19 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	1.651	1.270	2.413	mm/s
ZC Freq	28	34	28	Hz
Time (Rel. to Trig)	0.195	0.159	0.206	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.010	0.006	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 2.495 mm/s at 0.206 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

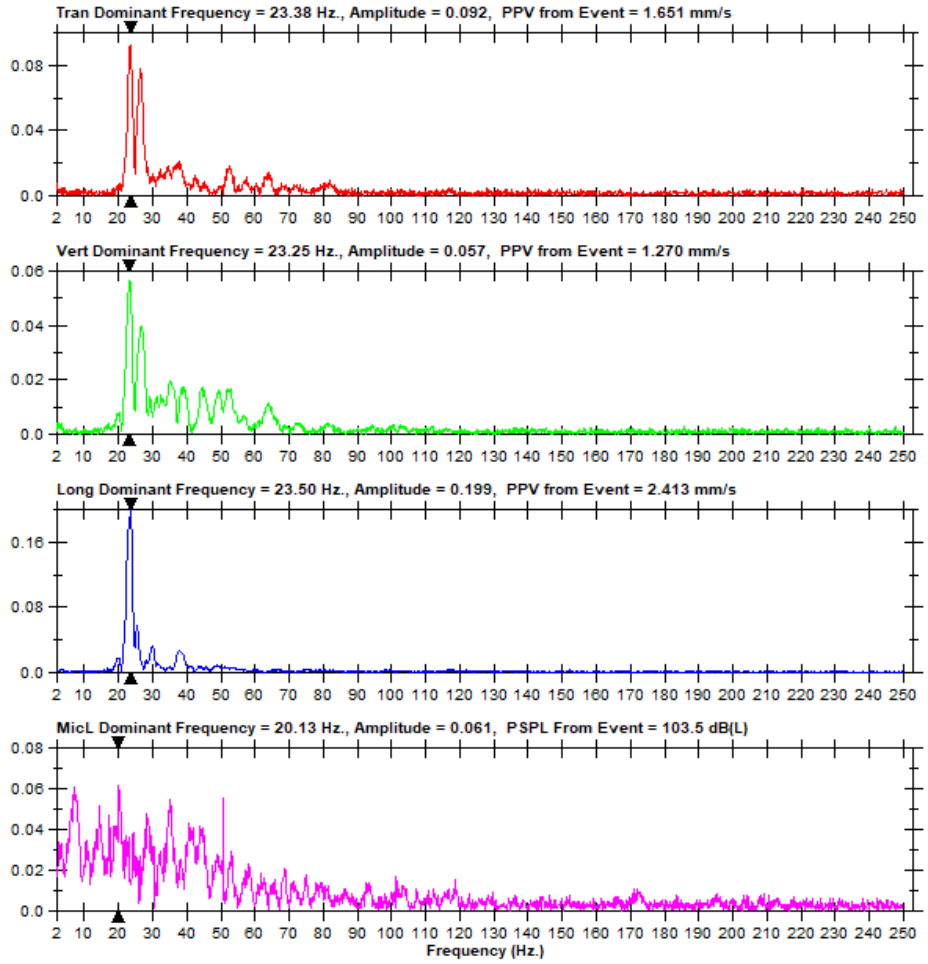
FFT Report

Date/Time	Tran at 12:42:46 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRF.BA0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg,
MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 97 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:41:29 December 28, 2022
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20221228124129.IDFW

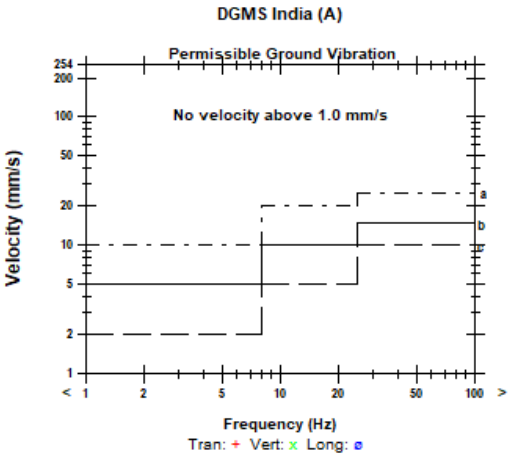
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 143 m

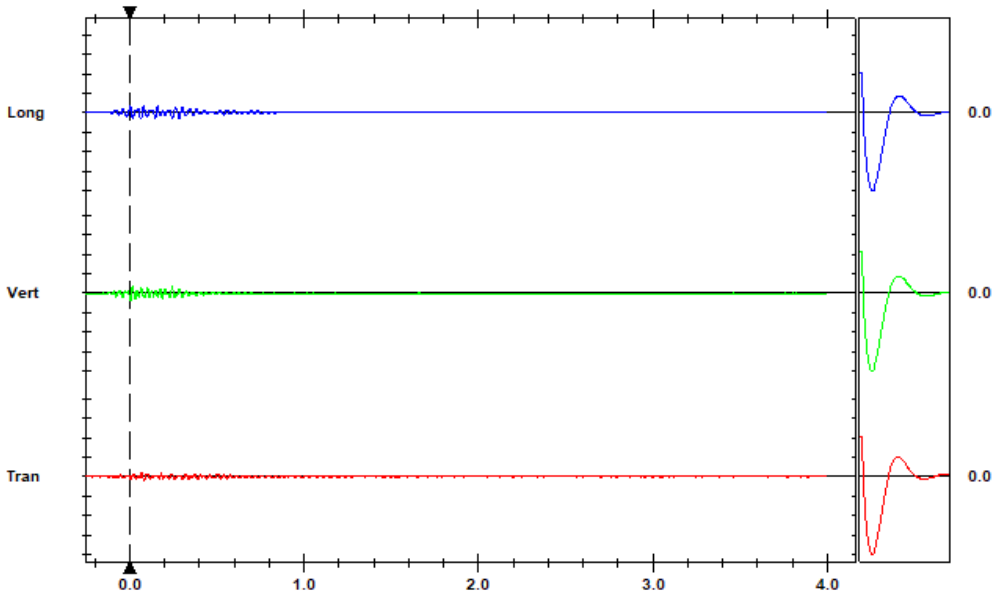
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

	Tran	Vert	Long	
PPV	0.426	0.772	0.796	mm/s
ZC Freq	37	34	28	Hz
Time (Rel. to Trig)	0.069	0.004	0.081	sec
Peak Acceleration	0.016	0.022	0.026	g
Peak Displacement	0.002	0.003	0.052	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 1.077 mm/s at 0.004 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

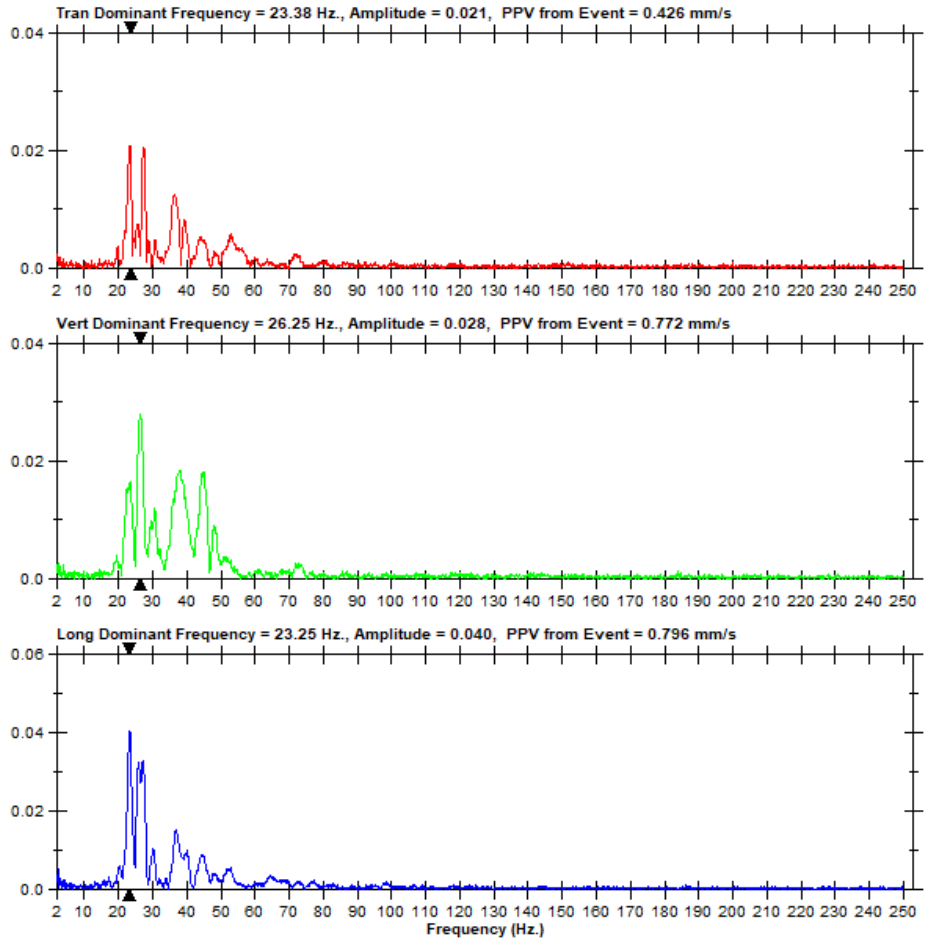
FFT Report

Date/Time	Long at 12:41:29 December 28, 2022	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20221228124129.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 143 m



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Event Report

Date/Time Tran at 12:41:41 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.XH0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 264 m

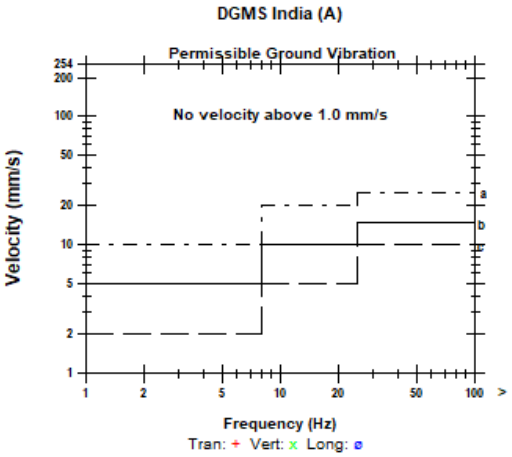
Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

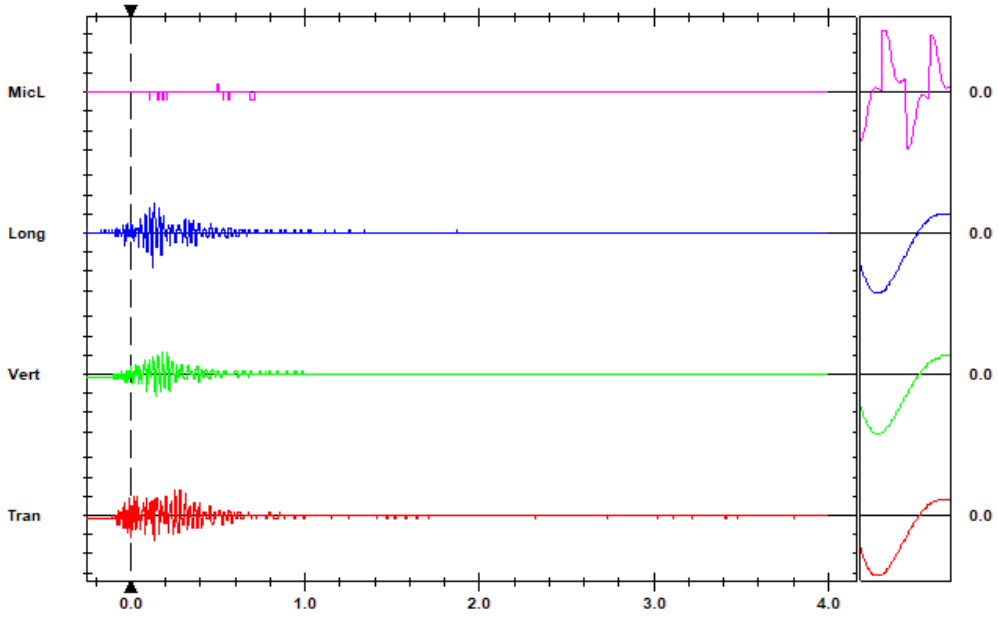
Microphone Linear Weighting
PSPL 100.00 dB(L) at 0.109 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	0.635	0.572	0.889	mm/s
ZC Freq	51	43	51	Hz
Time (Rel. to Trig)	0.135	0.145	0.125	sec
Peak Acceleration	0.027	0.020	0.033	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 1.032 mm/s at 0.136 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

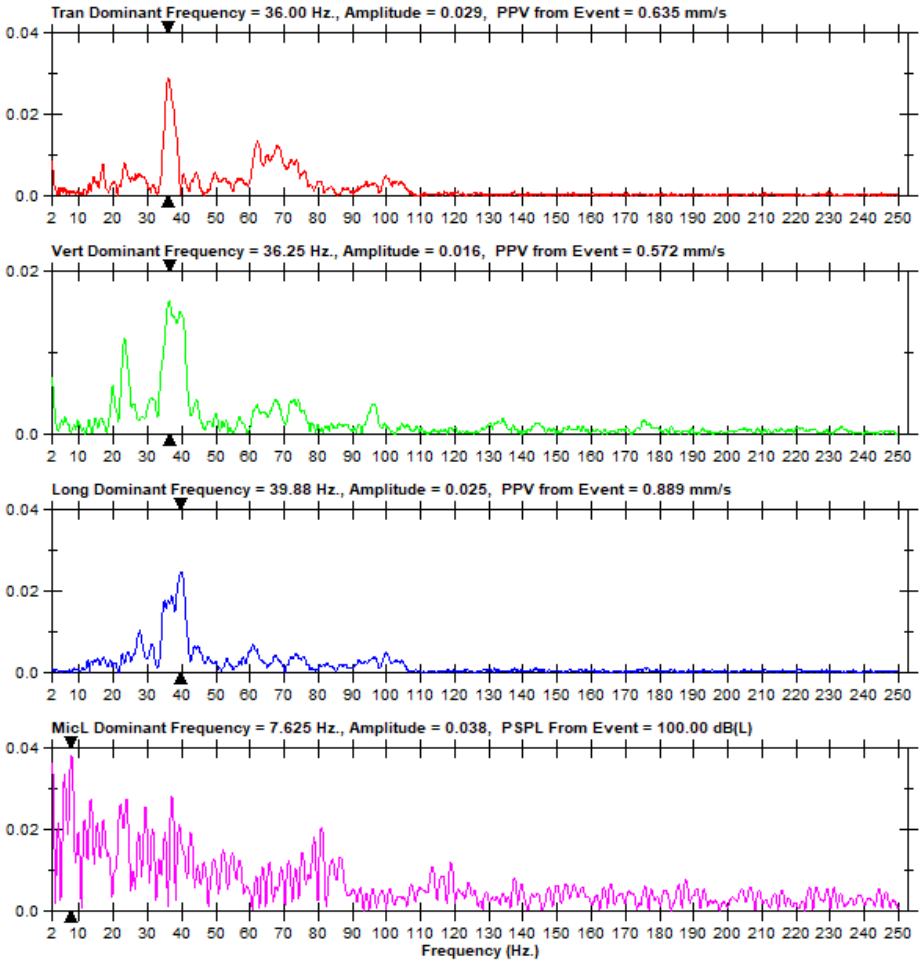
FFT Report

Date/Time	Tran at 12:41:41 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.XH0

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 264 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:42:46 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JTRF.BA0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg, MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 300 m

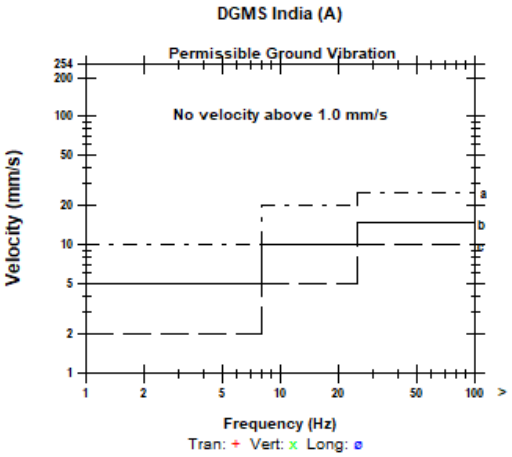
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

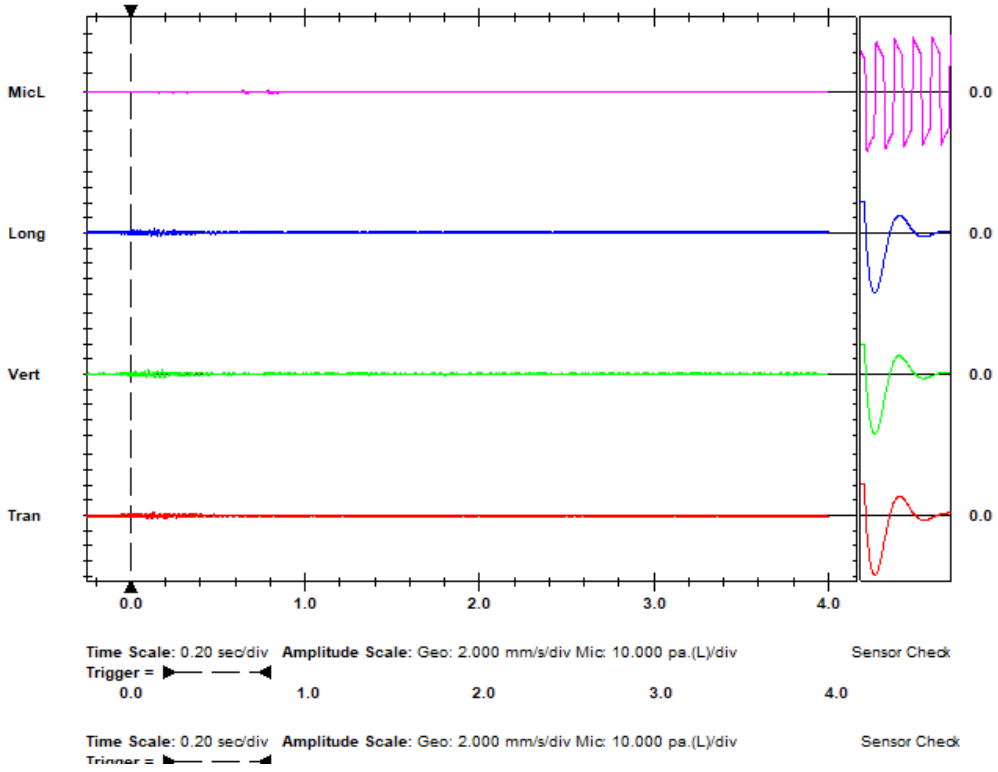
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL <88 dB(L)
ZC Freq >100 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 496 mv)

	Tran	Vert	Long	
PPV	0.508	0.635	0.635	mm/s
ZC Freq	57	85	64	Hz
Time (Rel. to Trig)	0.123	0.104	0.136	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.696 mm/s at 0.136 sec
N/A: Not Applicable





Instantel

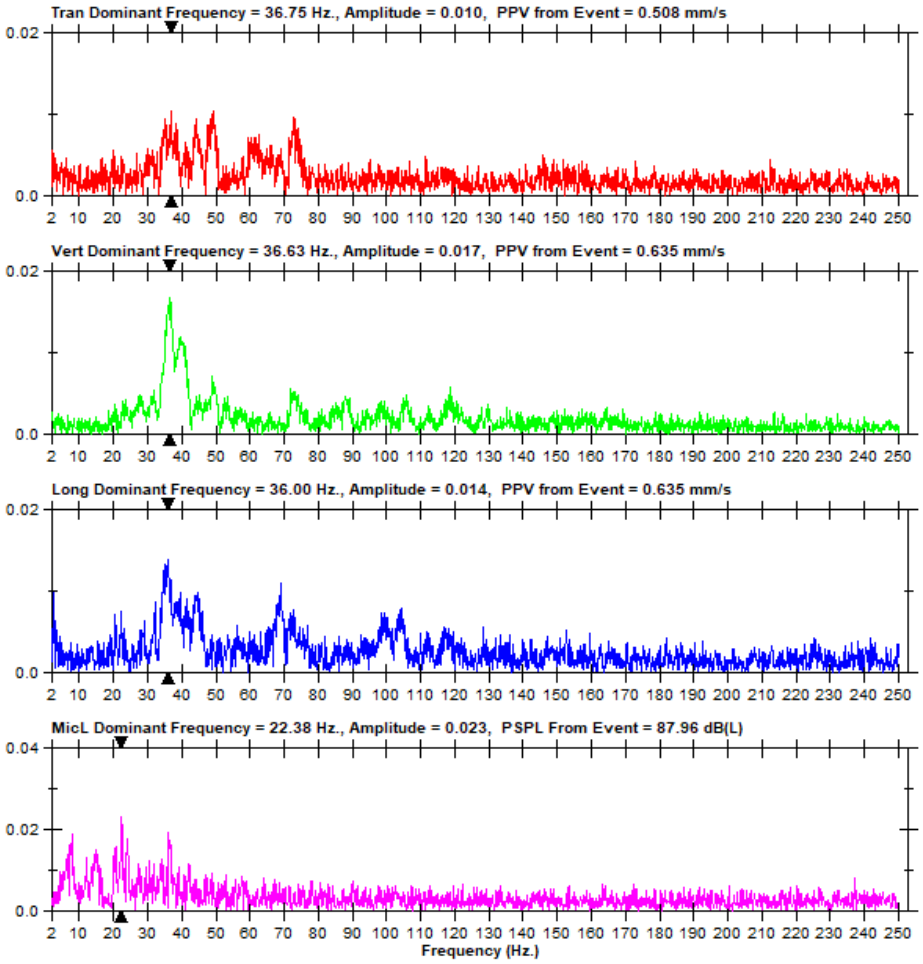
FFT Report

Date/Time	Long at 12:42:46 December 28, 2022	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JTRF.BA0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.368 Kg,
MCPD - 0.375 Kg, Total Charge - 7.375 Kg, Distance - 300 m



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Event Report

Date/Time Long at 12:44:09 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JTRF.DL0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 50 m

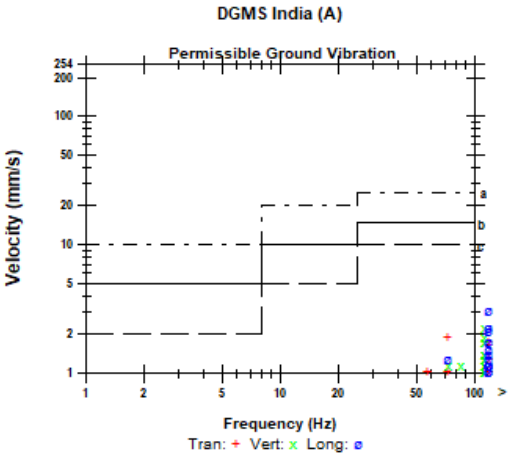
Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

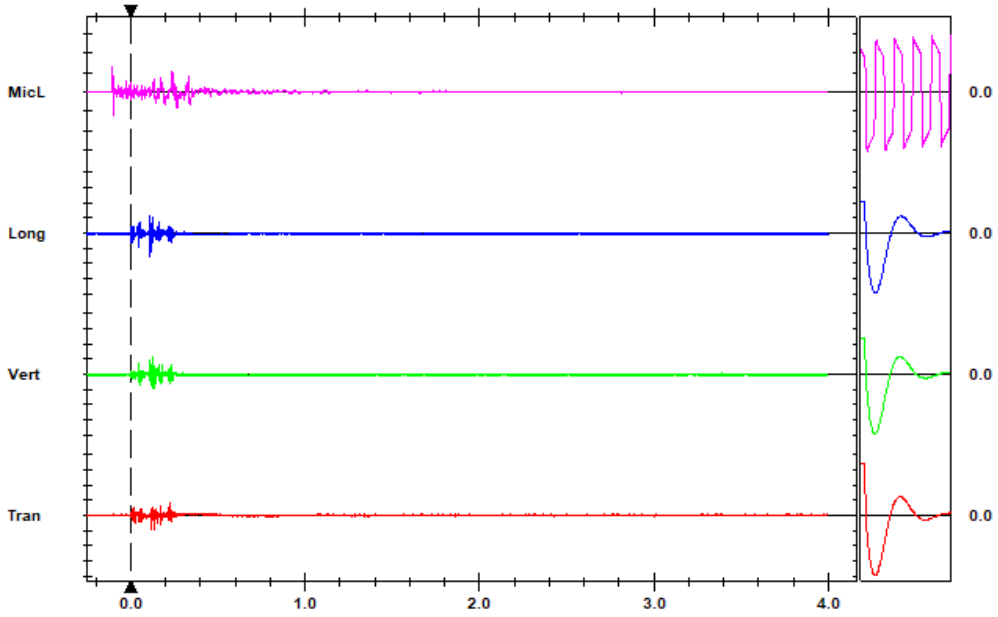
Microphone Linear Weighting
PSPL 116.3 dB(L) at -0.103 sec
ZC Freq >100 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 444 mv)

	Tran	Vert	Long	
PPV	1.905	2.286	3.048	mm/s
ZC Freq	73	>100	>100	Hz
Time (Rel. to Trig)	0.134	0.129	0.113	sec
Peak Acceleration	0.133	0.186	0.305	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 3.265 mm/s at 0.113 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

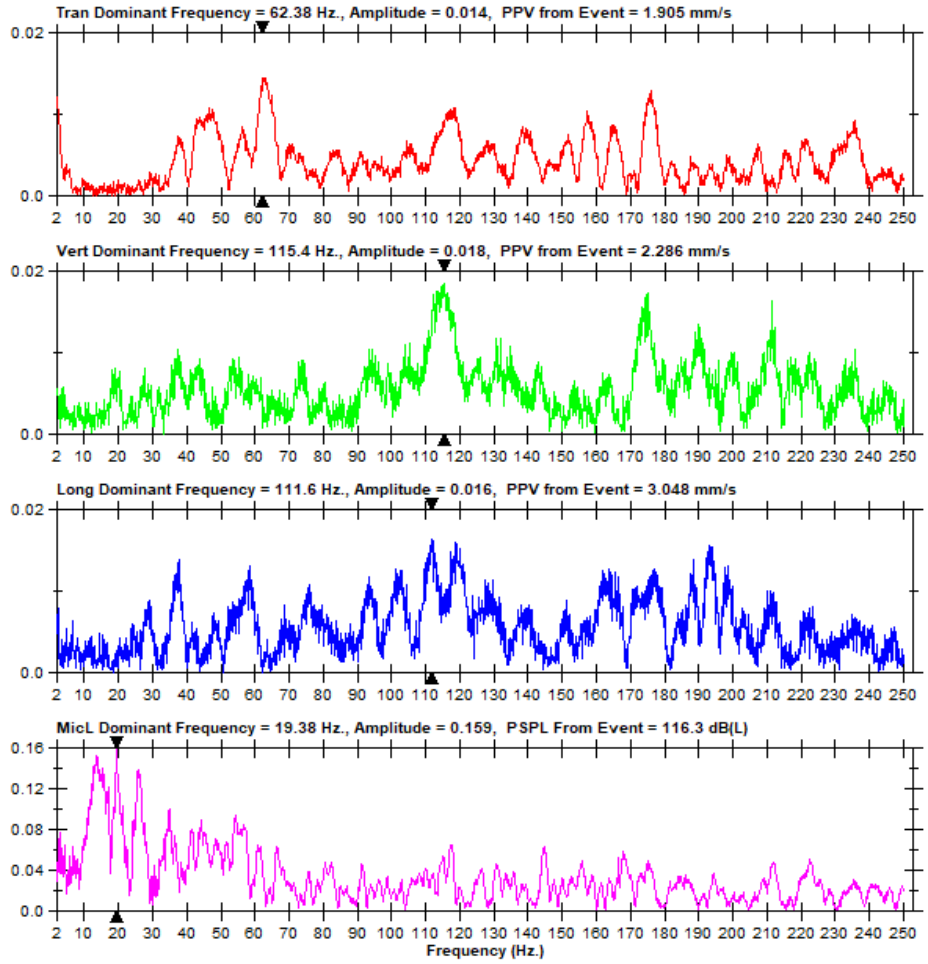
FFT Report

Date/Time	Long at 12:44:09 December 28, 2022	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JTRF.DL0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg,
MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 50 m



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Event Report

Date/Time Vert at 12:44:10 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

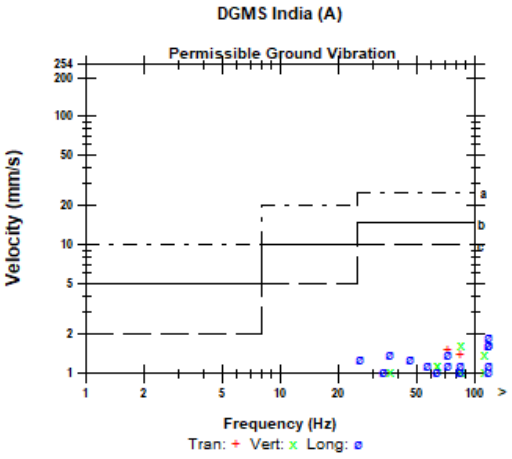
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

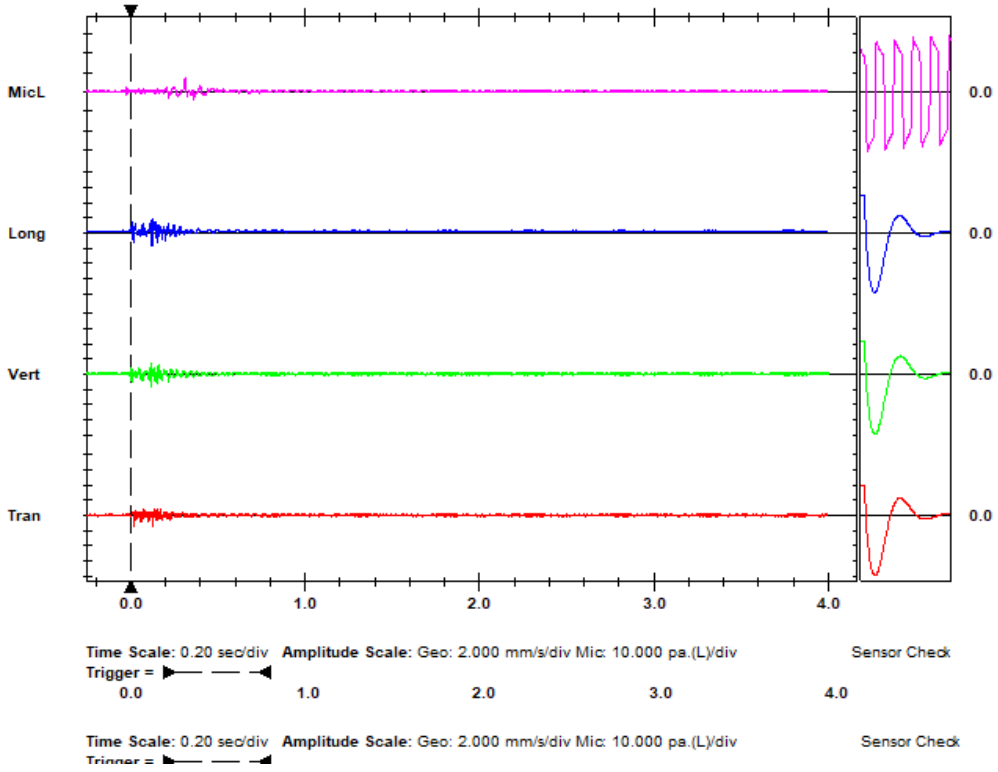
Microphone Linear Weighting
PSPL 110.9 dB(L) at 0.313 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 450 mv)

	Tran	Vert	Long	
PPV	1.524	1.651	1.905	mm/s
ZC Freq	73	85	>100	Hz
Time (Rel. to Trig)	0.022	0.116	0.123	sec
Peak Acceleration	0.106	0.106	0.119	g
Peak Displacement	0.003	0.003	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.6	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 2.067 mm/s at 0.117 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JTRF.DM0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 80 m





Instantel

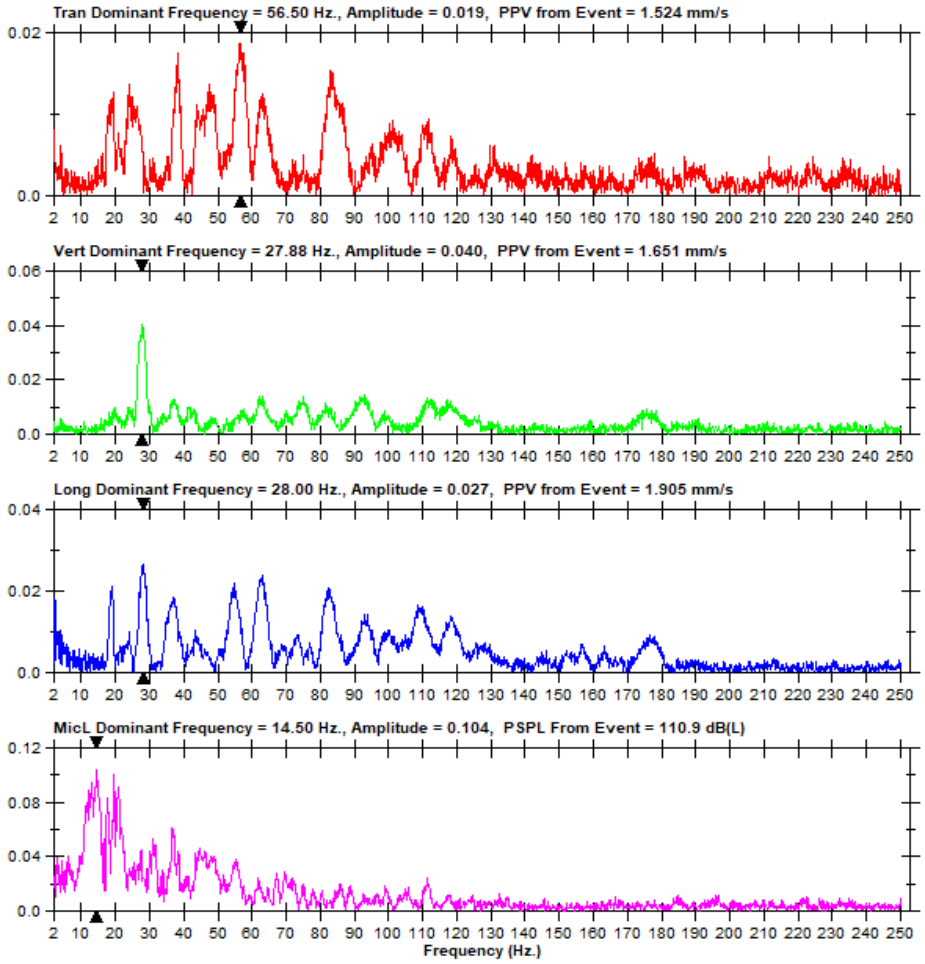
FFT Report

Date/Time	Vert at 12:44:10 December 28, 2022	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JTRF.DM0

Notes
Location: On Ground Surface
Client: Kerela State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 80 m



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Event Report

Date/Time Long at 12:44:08 December 28, 2022
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JTRF.DK0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance -103 m

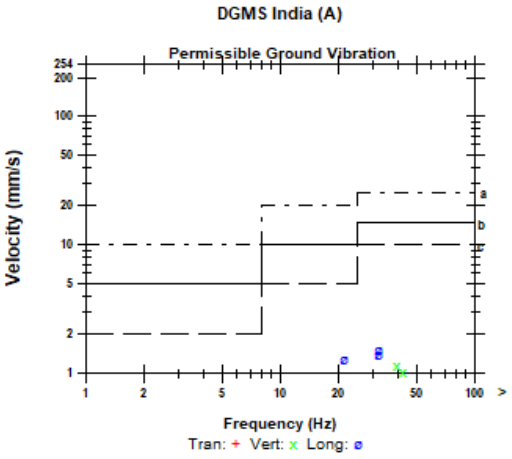
Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

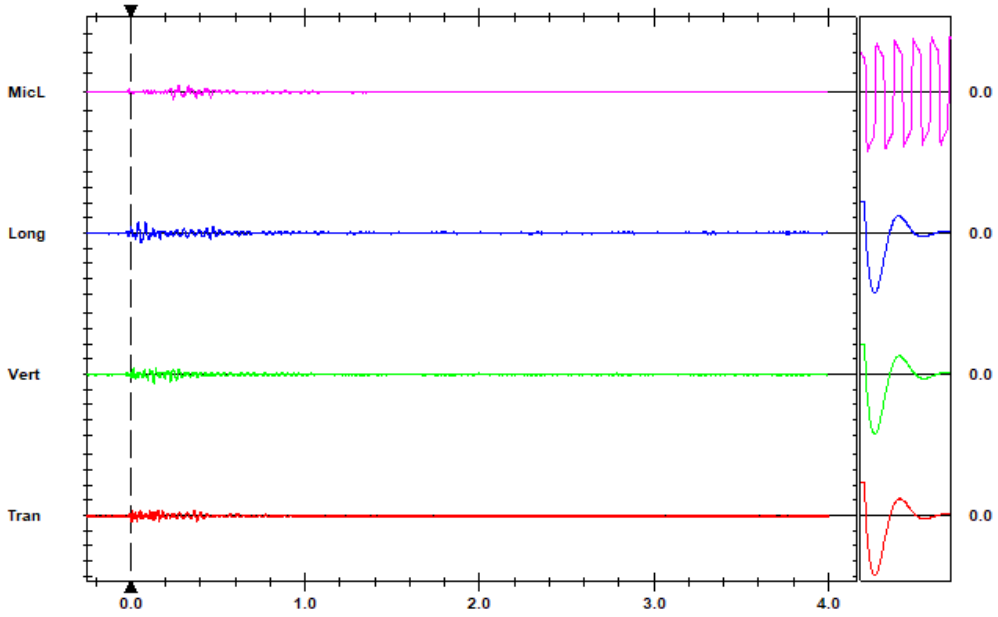
Microphone Linear Weighting
PSPL 105.5 dB(L) at 0.245 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	0.762	1.143	1.524	mm/s
ZC Freq	64	39	32	Hz
Time (Rel. to Trig)	0.005	0.133	0.045	sec
Peak Acceleration	0.053	0.053	0.040	g
Peak Displacement	0.004	0.005	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.576 mm/s at 0.046 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

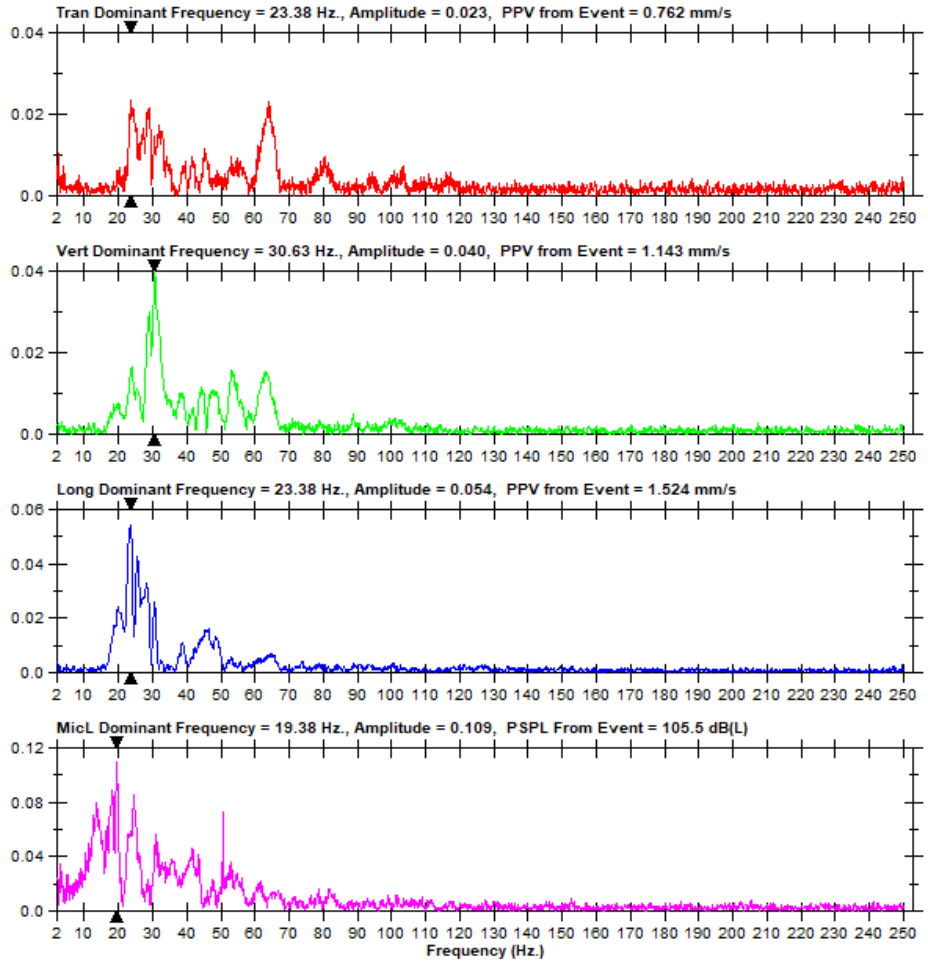
FFT Report

Date/Time	Long at 12:44:08 December 28, 2022	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JTRF.DK0

Notes
Location: On the Ground Surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg,
MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance -103 m



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Event Report

Date/Time Tran at 12:43:02 December 28, 2022
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number 3456 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 6, 2022 by CIMFR Dhanbad
File Name E456JTT9.ZQ0
Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 245 m

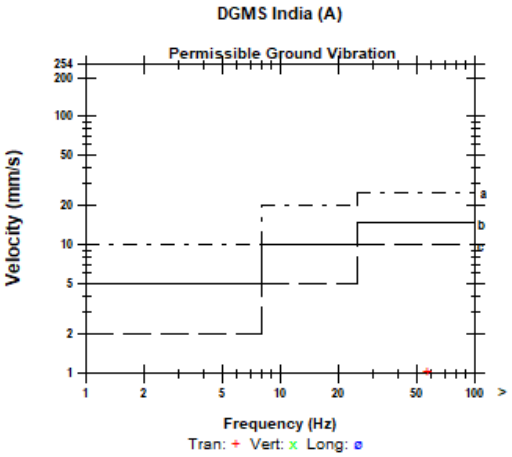
Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

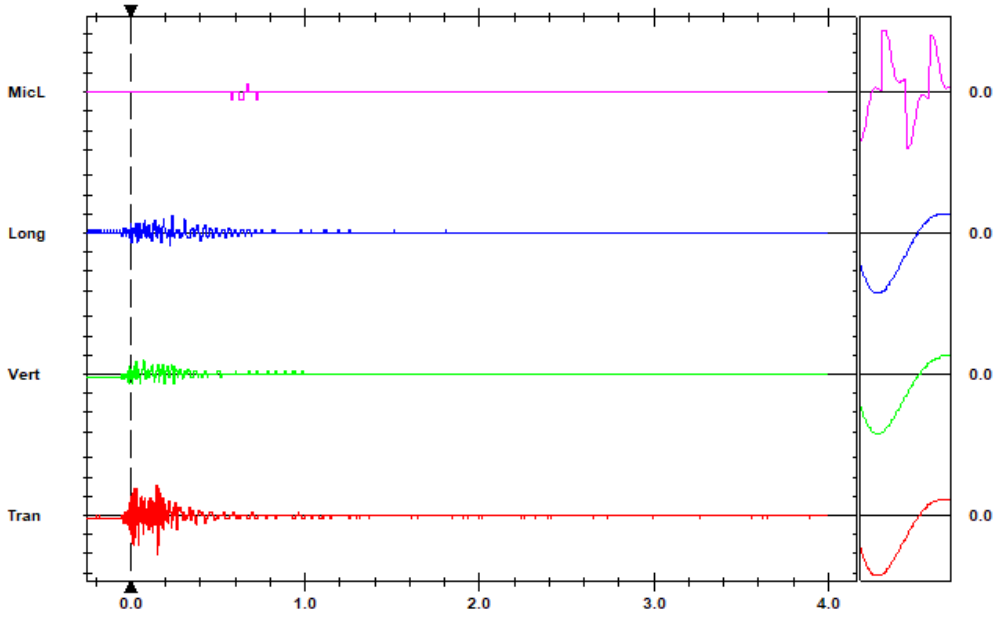
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Microphone Linear Weighting
PSPL 100.00 dB(L) at 0.581 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 446 mv)

	Tran	Vert	Long	
PPV	1.016	0.381	0.445	mm/s
ZC Freq	57	39	37	Hz
Time (Rel. to Trig)	0.158	0.075	0.240	sec
Peak Acceleration	0.040	0.013	0.013	g
Peak Displacement	0.003	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	8.0	Hz
Overswing Ratio	3.9	3.3	3.2	

Peak Vector Sum 1.048 mm/s at 0.158 sec
N/A: Not Applicable





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 mm/s/div Mic: 5.000 pa.(L)/div Sensor Check
Trigger =

Instantel

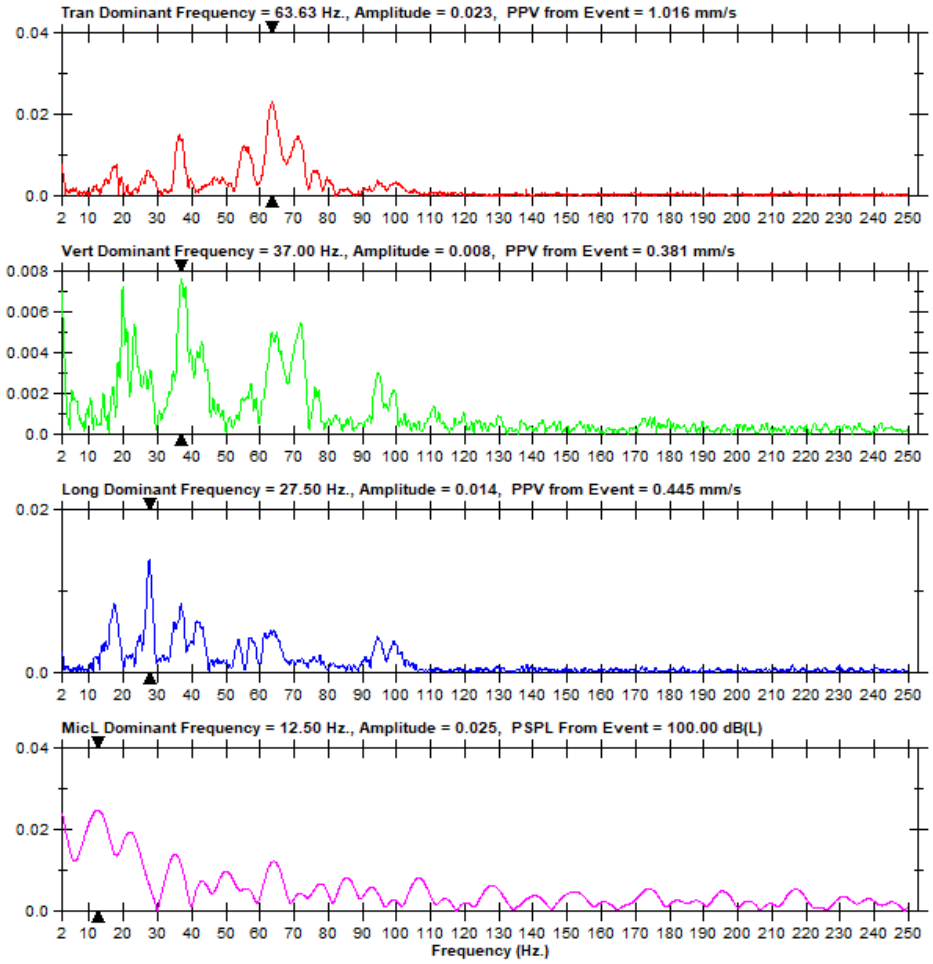
FFT Report

Date/Time	Tran at 12:43:02 December 28, 2022	**Serial Number**	3456 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 6, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	E456JTT9.ZQ0

Notes
Location: On ground surface
Client: Kerela State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,Dhanbad
Converted: December 28, 2022 17:57:47 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerela

Post Event Notes
Total No. of holes - 11, Hole Depth - 1.8 m, Charge/hole - 0.363 Kg, MCPD - 0.375 Kg, Total Charge - 4.00 Kg, Distance - 245 m



Printed: February 20, 2023 (V 10.72 - 10.72)

ANNEXURE-5

Event and FFT Reports of Ground Vibration Recorded at Rubble Stone Quarry of M/s United Granites Pvt. Ltd., Idukki District

Instantel

Event Report

Date/Time Tran at 12:51:07 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2J.P70
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg, MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 129 m

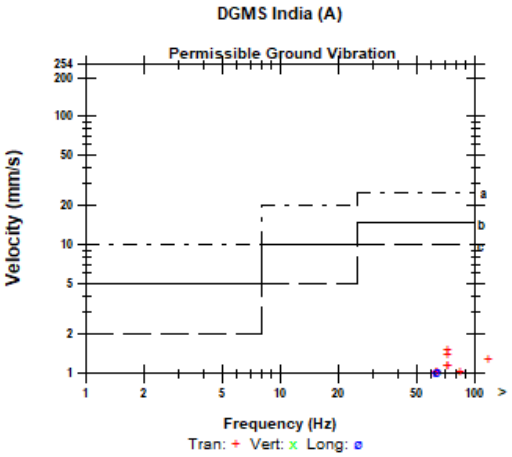
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

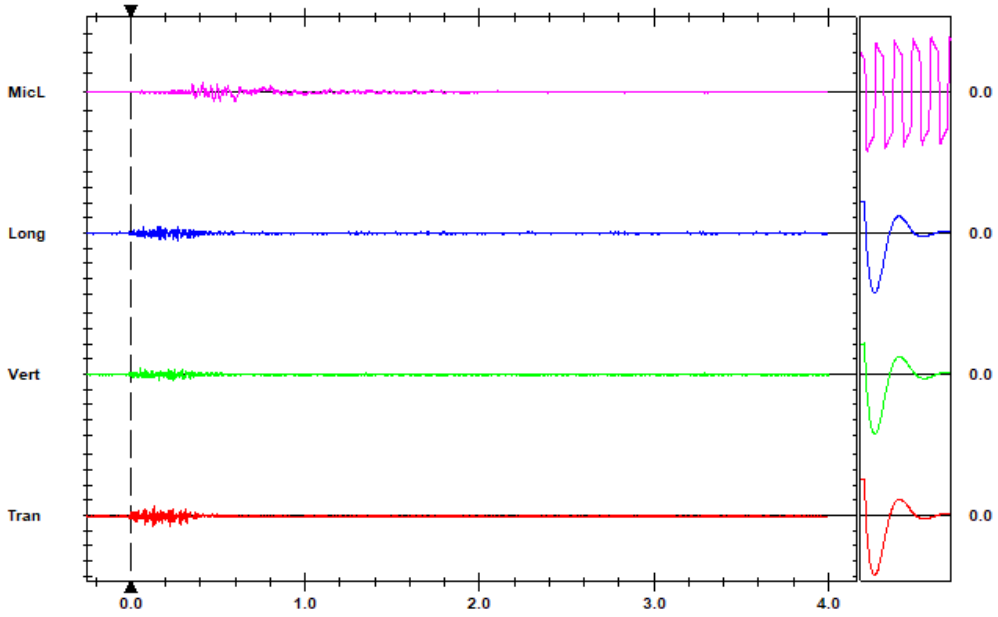
Microphone Linear Weighting
PSPL 108.4 dB(L) at 0.513 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	1.524	0.889	1.016	mm/s
ZC Freq	73	73	64	Hz
Time (Rel. to Trig)	0.132	0.163	0.269	sec
Peak Acceleration	0.080	0.053	0.053	g
Peak Displacement	0.003	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.545 mm/s at 0.132 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

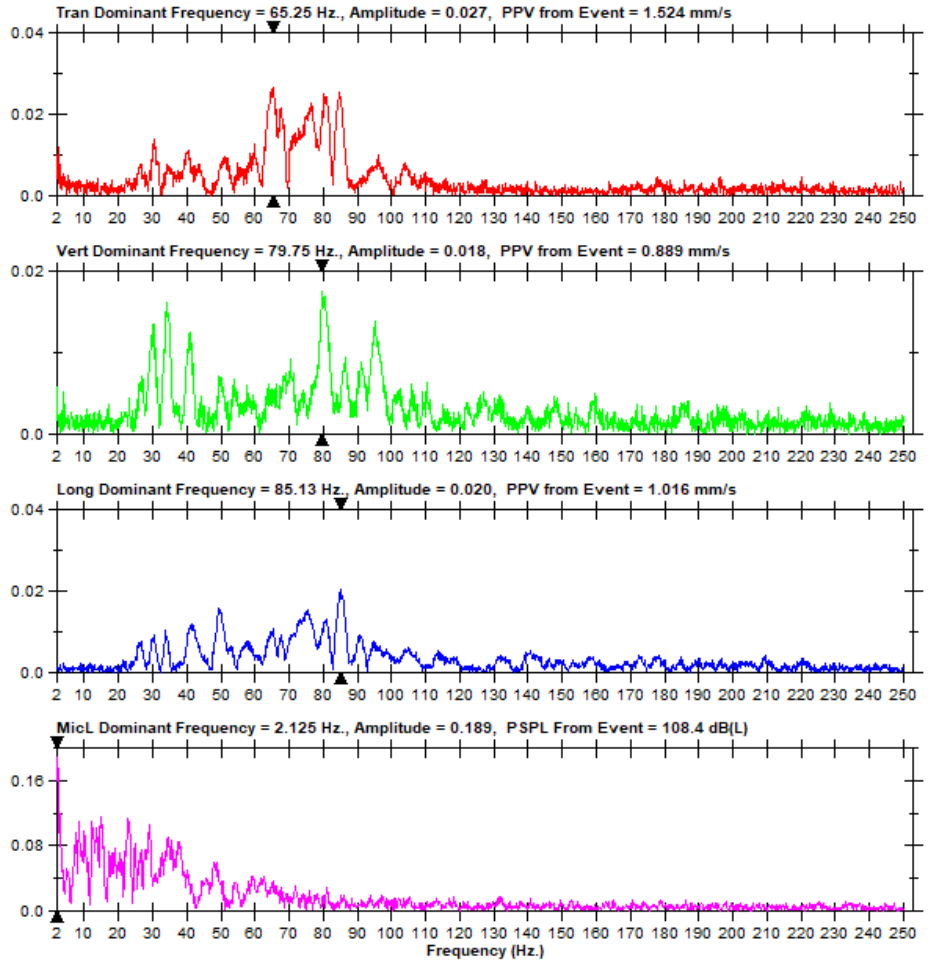
FFT Report

Date/Time	Tran at 12:51:07 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2J.P70

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg, MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 129 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 12:51:10 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2J.PA0
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg, MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 185 m

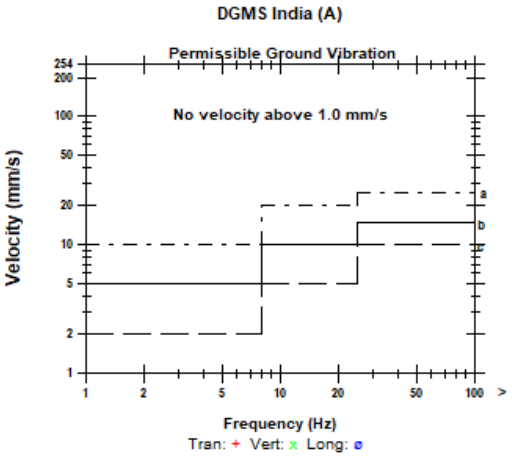
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

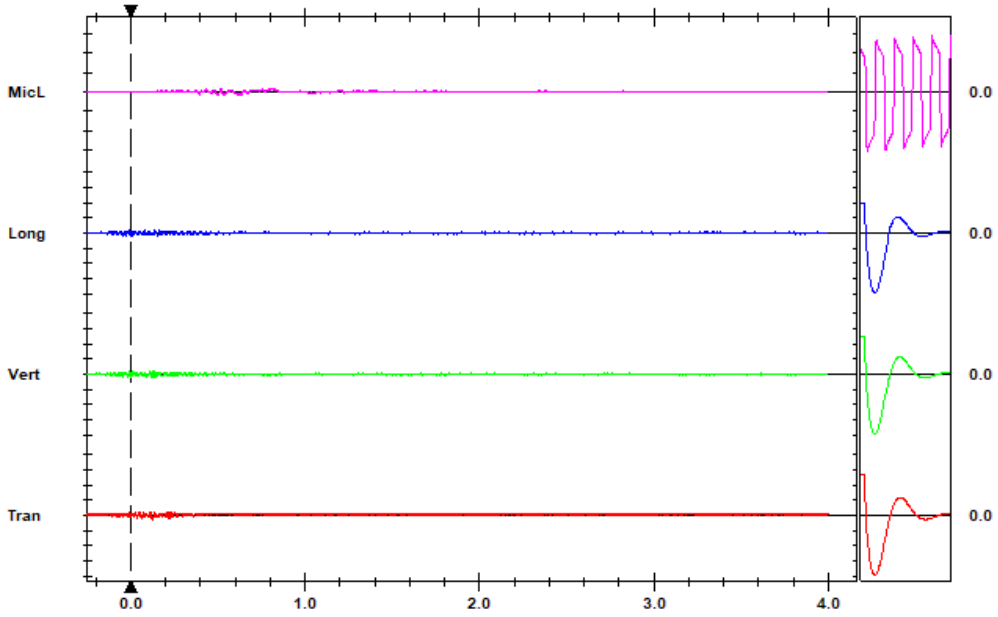
Microphone Linear Weighting
PSPL 98.84 dB(L) at 0.532 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 568 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	0.508	mm/s
ZC Freq	47	85	64	Hz
Time (Rel. to Trig)	0.128	0.000	0.153	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.002	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.9	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 0.648 mm/s at 0.124 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

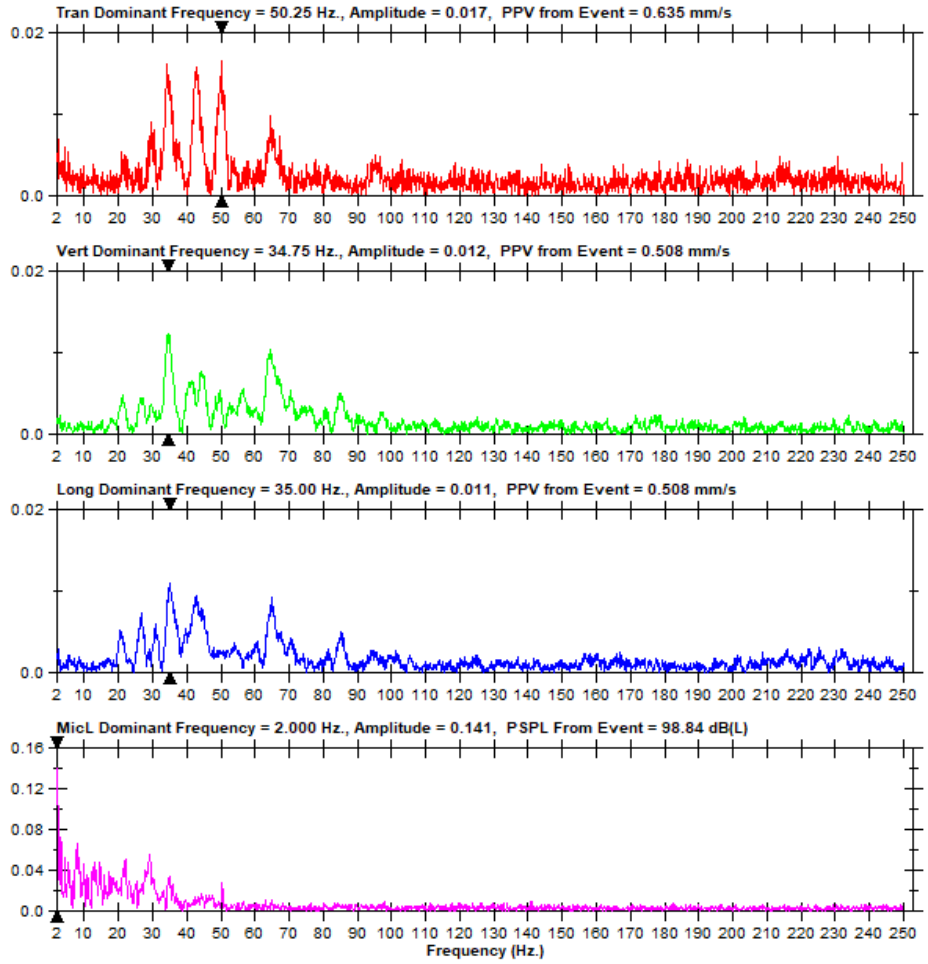
FFT Report

Date/Time	Vert at 12:51:10 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2J.PA0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg, MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 185 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 12:51:09 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2J.P90

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

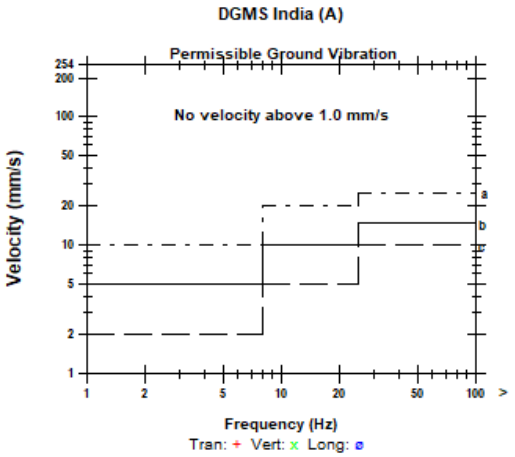
Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg, MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 222 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

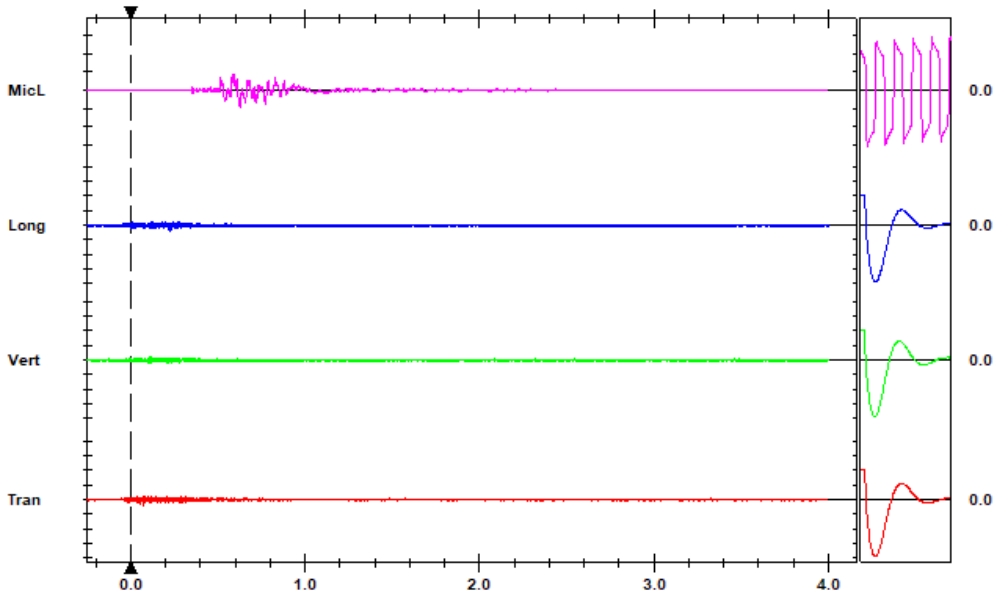
Microphone	Linear Weighting
PSPL	113.1 dB(L) at 0.627 sec
ZC Freq	20 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 445 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	0.762	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.076	0.117	0.227	sec
Peak Acceleration	0.066	0.053	0.053	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 0.925 mm/s at 0.076 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

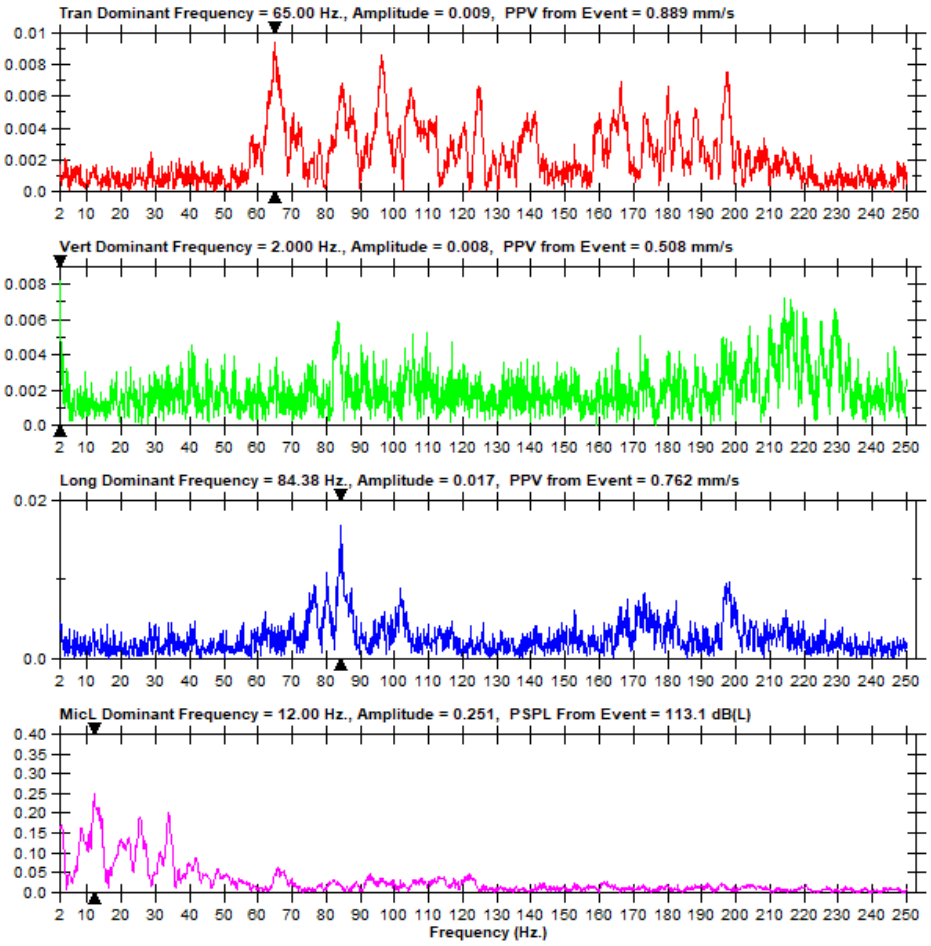
FFT Report

Date/Time	Long at 12:51:09 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2J.P90
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 41, Hole Depth - 2.4 m, Charge/hole - 0.646Kg,
MCPD - 0.65 Kg, Total Charge - 26.525 Kg, Distance - 222 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 12:54:46 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2J.VA0
Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 119 m

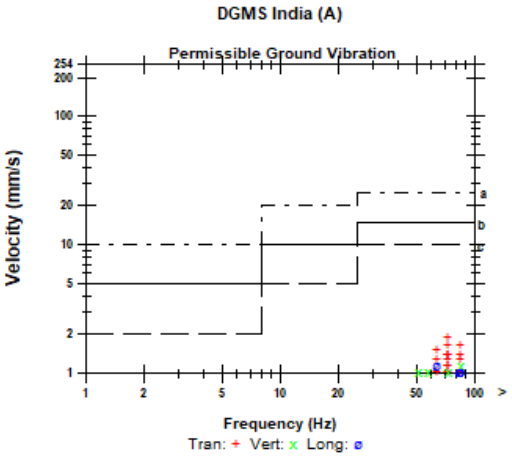
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

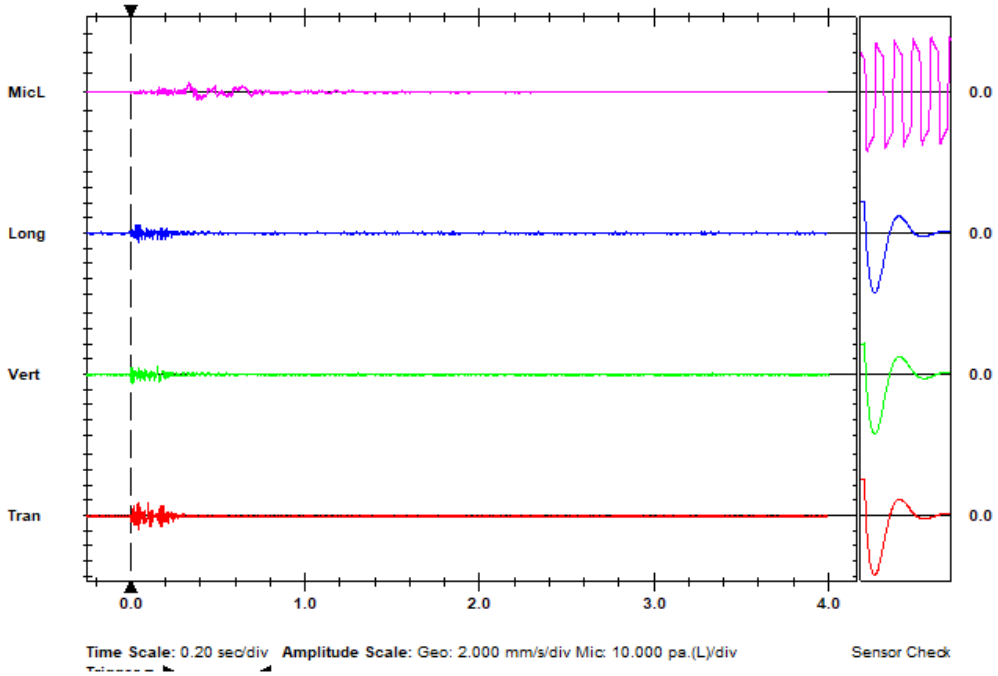
Microphone Linear Weighting
PSPL 107.5 dB(L) at 0.336 sec
ZC Freq 12 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	1.905	1.143	1.143	mm/s
ZC Freq	73	85	64	Hz
Time (Rel. to Trig)	0.044	0.007	0.050	sec
Peak Acceleration	0.093	0.066	0.066	g
Peak Displacement	0.004	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 2.148 mm/s at 0.050 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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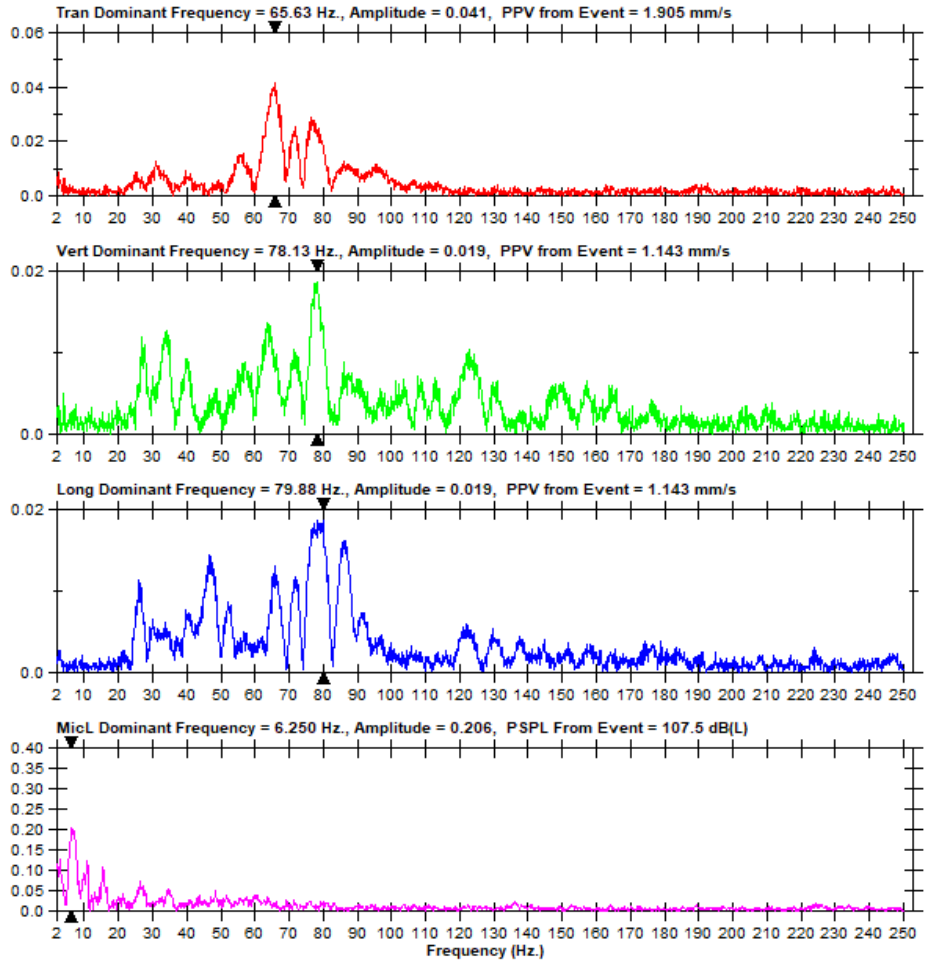
FFT Report

Date/Time	Vert at 12:54:46 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2J.VA0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 119 m



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Event Report

Date/Time Tran at 13:02:41 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.8H0
Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 178 m

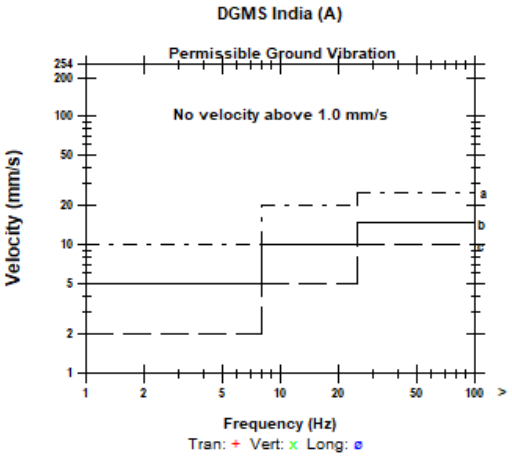
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

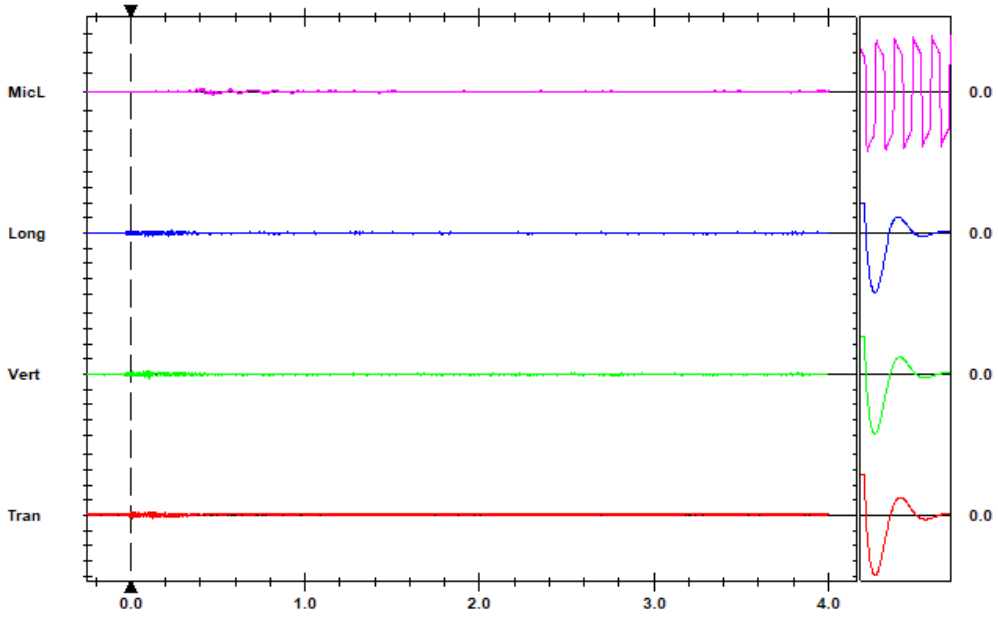
Microphone Linear Weighting
PSPL 98.84 dB(L) at 0.569 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 528 mv)

	Tran	Vert	Long	
PPV	0.508	0.635	0.381	mm/s
ZC Freq	>100	73	>100	Hz
Time (Rel. to Trig)	0.000	0.111	0.084	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.9	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 0.648 mm/s at 0.111 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

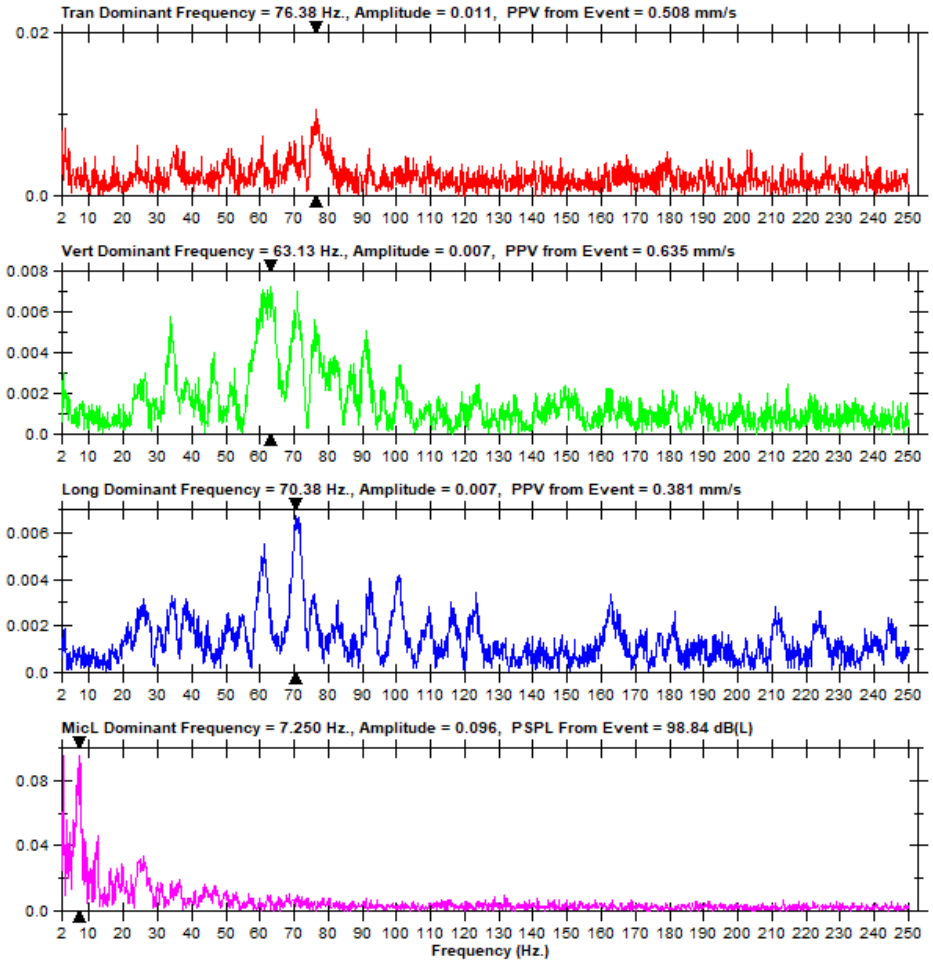
FFT Report

Date/Time	Tran at 13:02:41 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.8H0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 178 m



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Event Report

Date/Time	Long at 12:54:48 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2J.VC0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

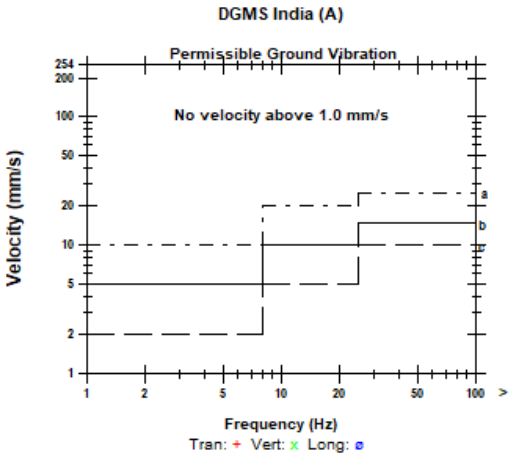
Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 226 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

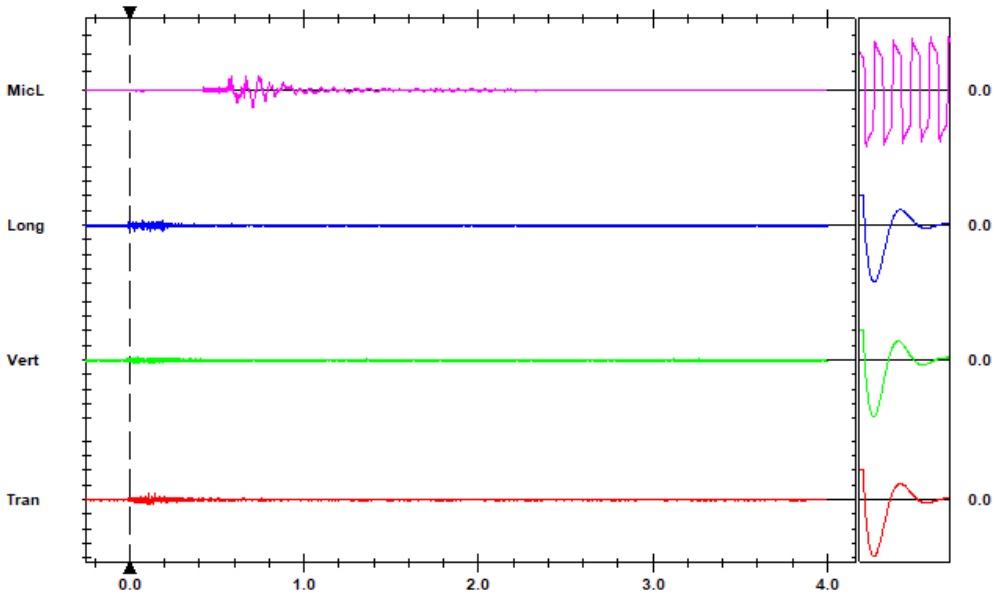
Microphone	Linear Weighting
PSPL	113.1 dB(L) at 0.705 sec
ZC Freq	14 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 516 mv)

	Tran	Vert	Long	
PPV	0.762	0.508	0.762	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.109	0.024	0.029	sec
Peak Acceleration	0.066	0.040	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.024 mm/s at 0.119 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

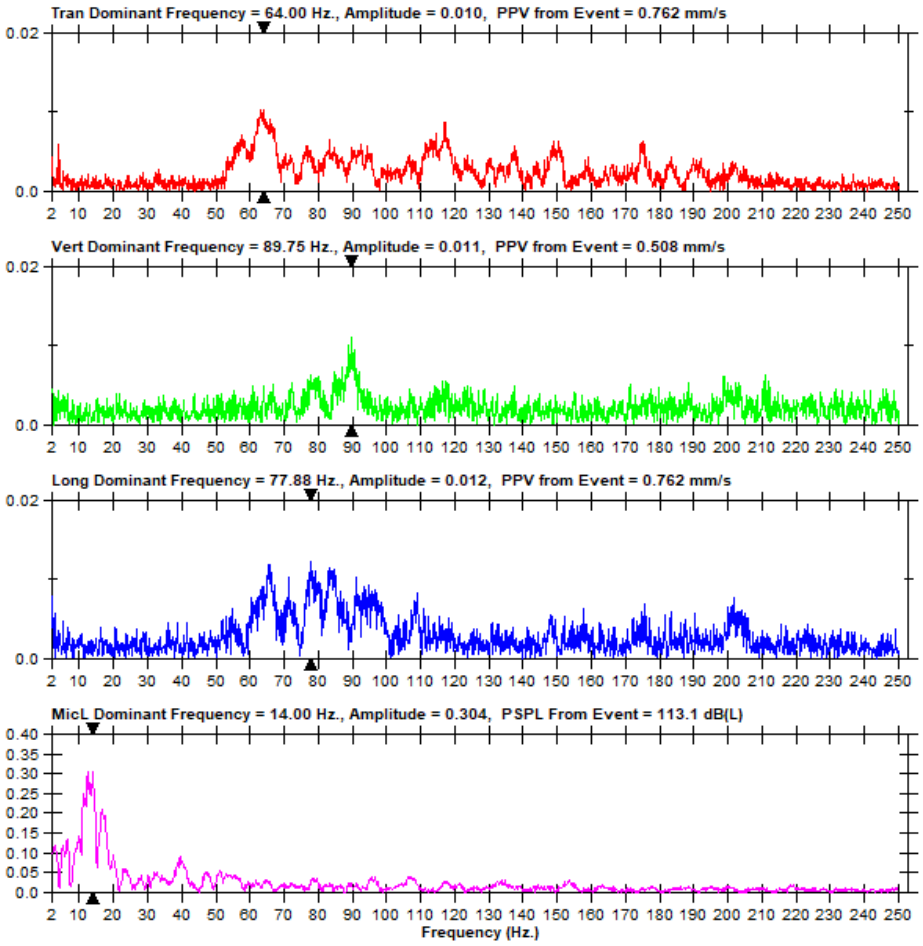
FFT Report

Date/Time	Long at 12:54:48 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2J.VC0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 26, Hole Depth - 2.4 m, Charge/hole - 0.65 Kg, MCPD - 1.3 Kg, Total Charge - 16.90 Kg, Distance - 226 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 12:58:16 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2K.140
Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg, MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 105 m

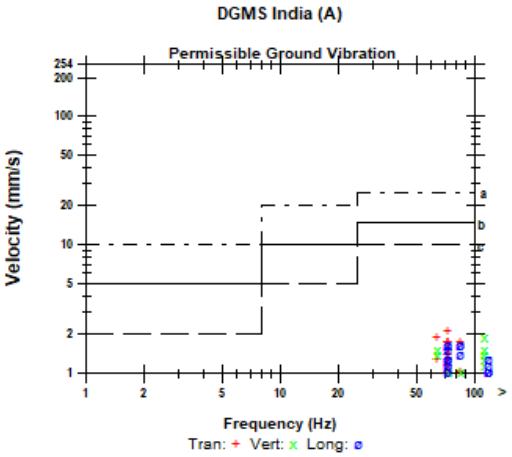
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

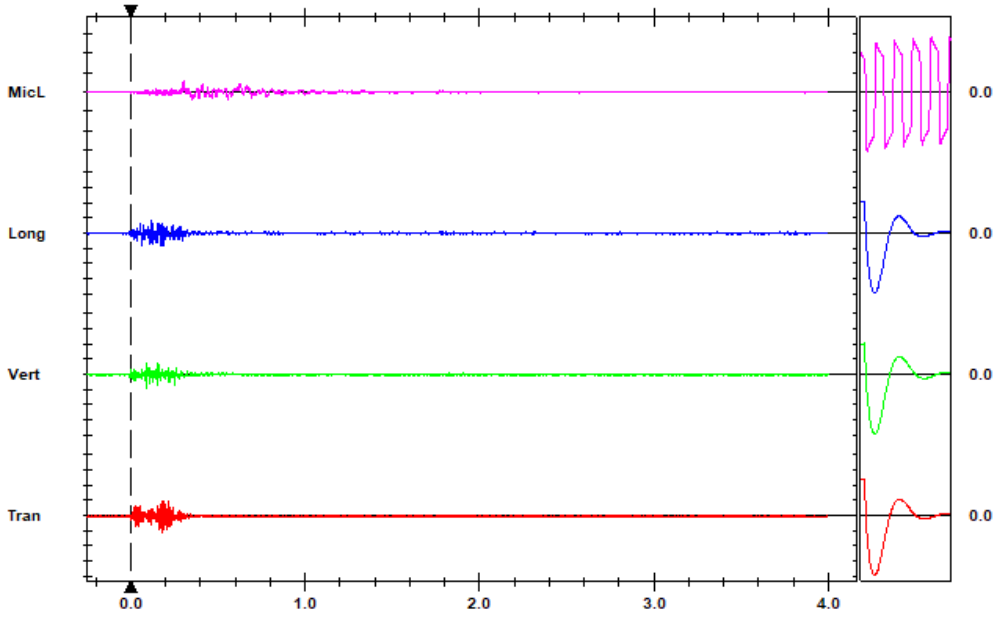
Microphone Linear Weighting
PSPL 109.5 dB(L) at 0.304 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	2.159	1.905	1.651	mm/s
ZC Freq	73	>100	73	Hz
Time (Rel. to Trig)	0.179	0.094	0.063	sec
Peak Acceleration	0.106	0.133	0.106	g
Peak Displacement	0.004	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 2.556 mm/s at 0.179 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

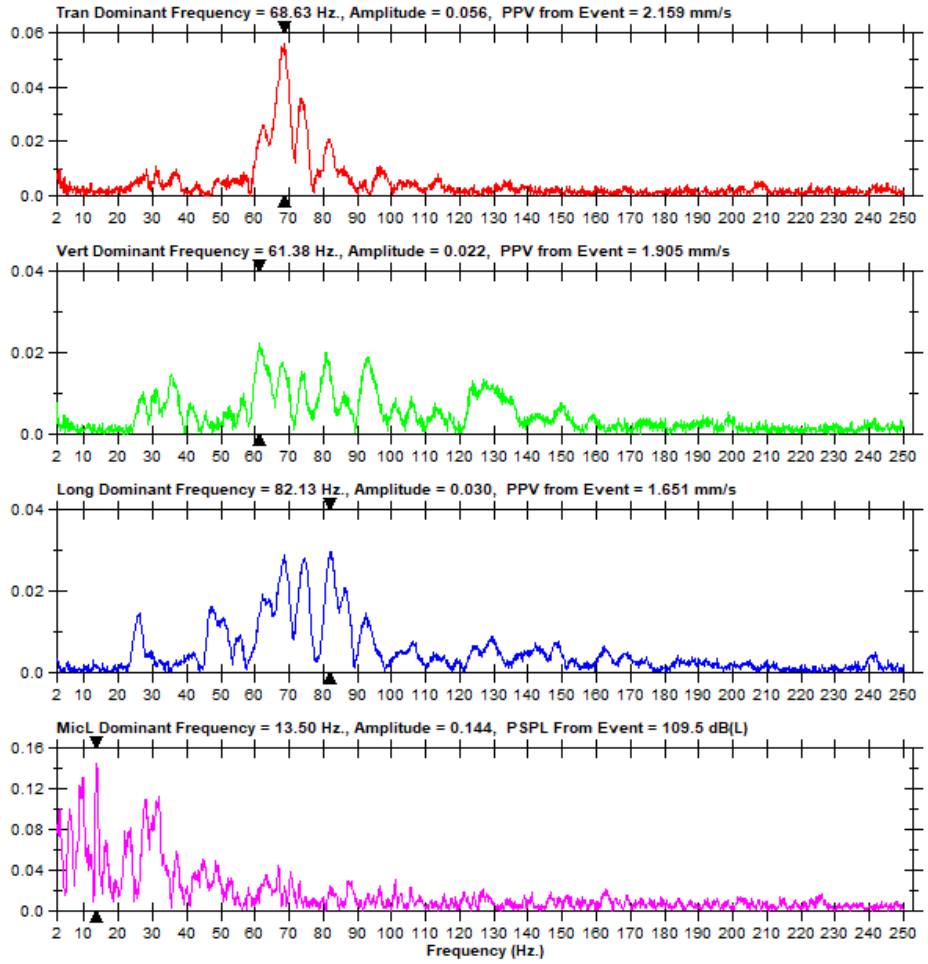
FFT Report

Date/Time	Vert at 12:58:16 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2K.140

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg,
MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 105 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 12:58:19 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.170
Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg, MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 164 m

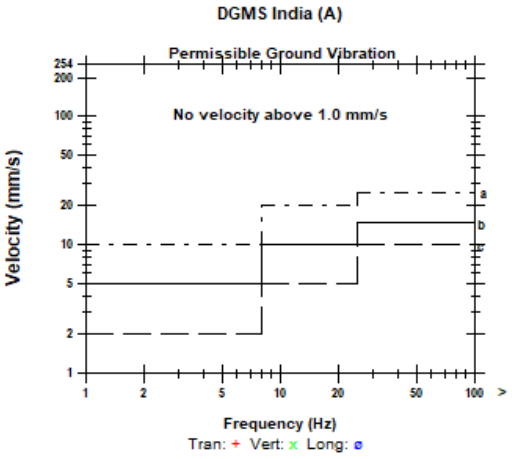
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

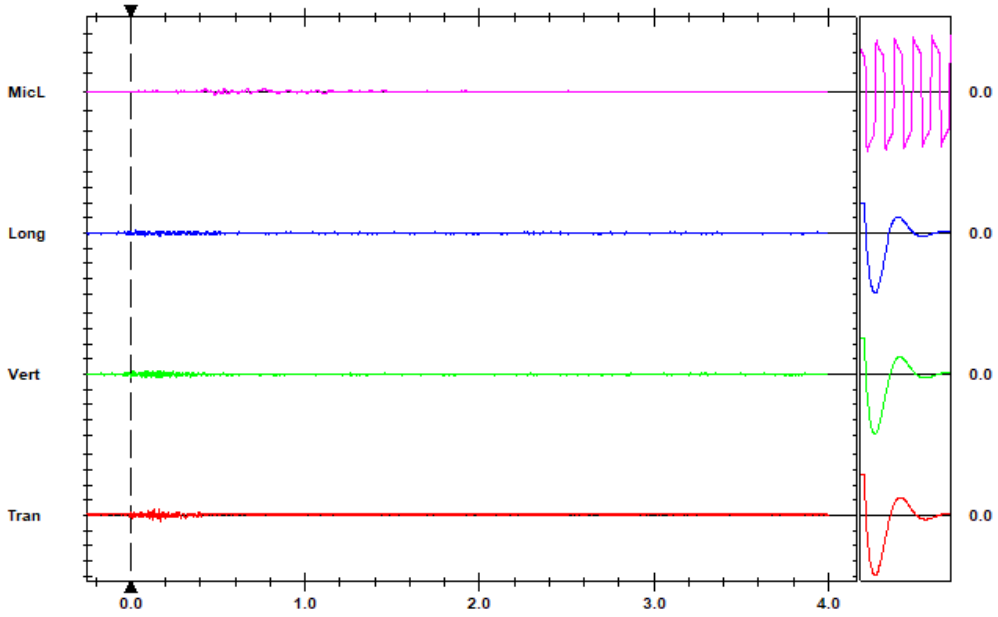
Microphone Linear Weighting
PSPL 98.84 dB(L) at 0.427 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 583 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	0.381	mm/s
ZC Freq	57	73	85	Hz
Time (Rel. to Trig)	0.161	0.067	0.029	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.9	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 0.889 mm/s at 0.161 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

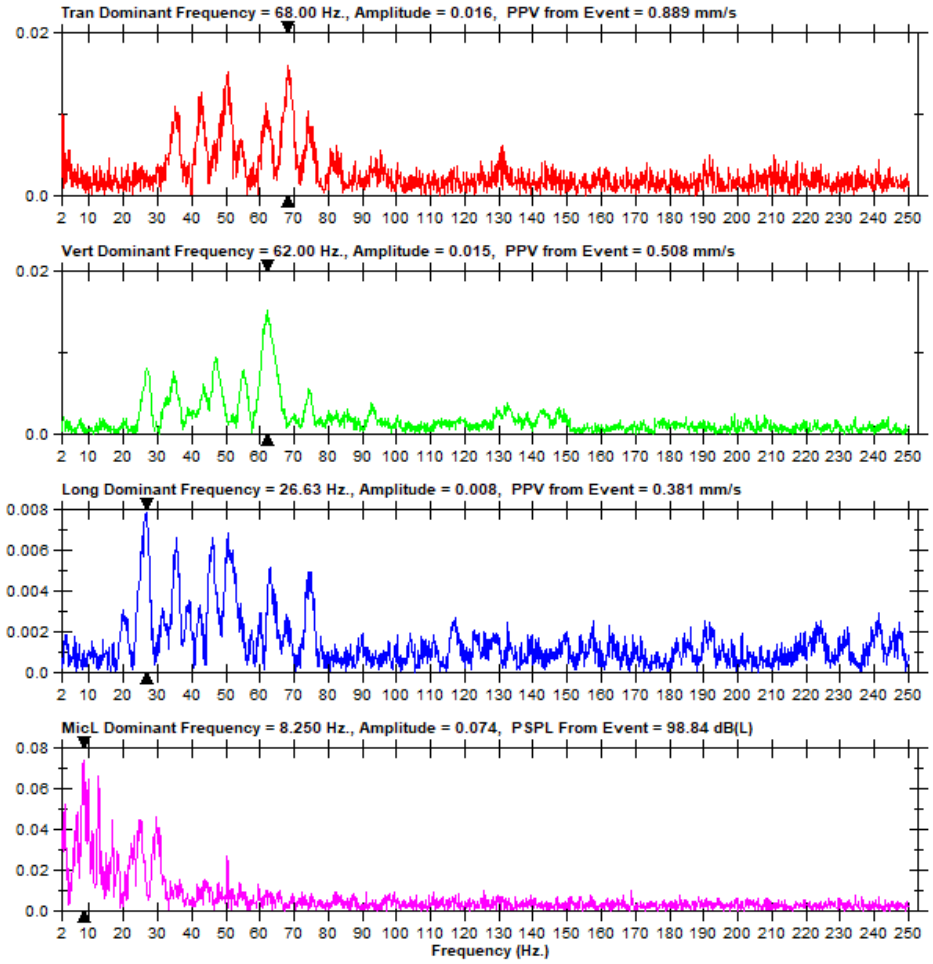
FFT Report

Date/Time	Tran at 12:58:19 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.170

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg, MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 164 m



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Event Report

Date/Time	Vert at 12:58:39 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103125839.IDFW

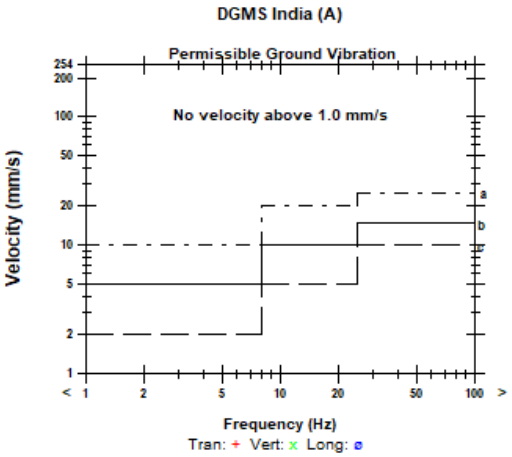
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg, MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 215 m

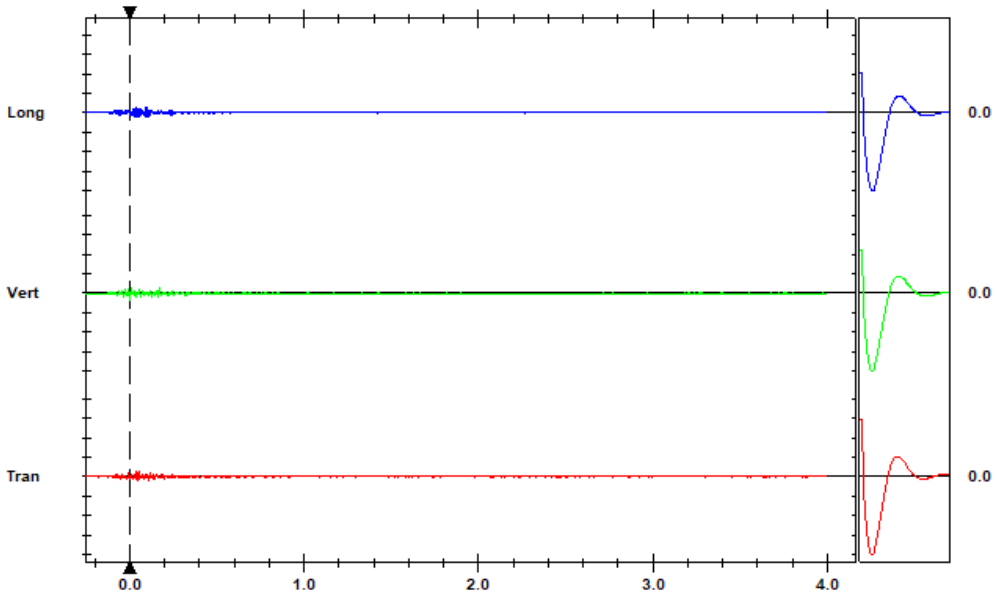
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.567	0.638	0.583	mm/s
ZC Freq	57	51	57	Hz
Time (Rel. to Trig)	0.041	0.001	0.096	sec
Peak Acceleration	0.026	0.027	0.020	g
Peak Displacement	0.003	0.002	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 0.679 mm/s at 0.041 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

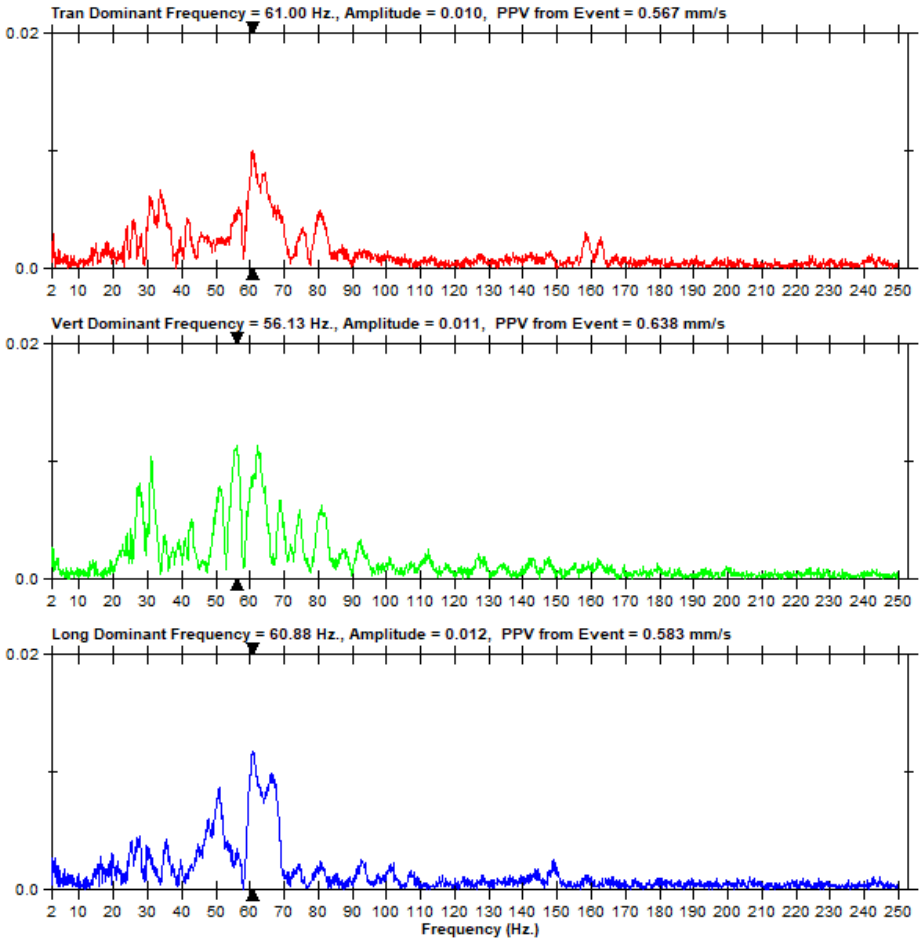
FFT Report

Date/Time	Vert at 12:58:39 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103125839.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg,
MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 215 m



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Event Report

Date/Time	Long at 12:58:18 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2K.160

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

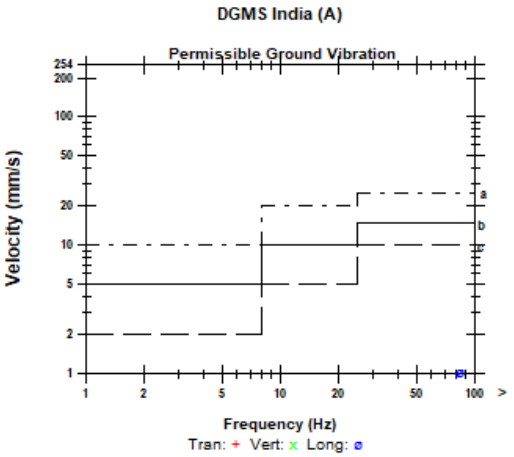
Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg, MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 238 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

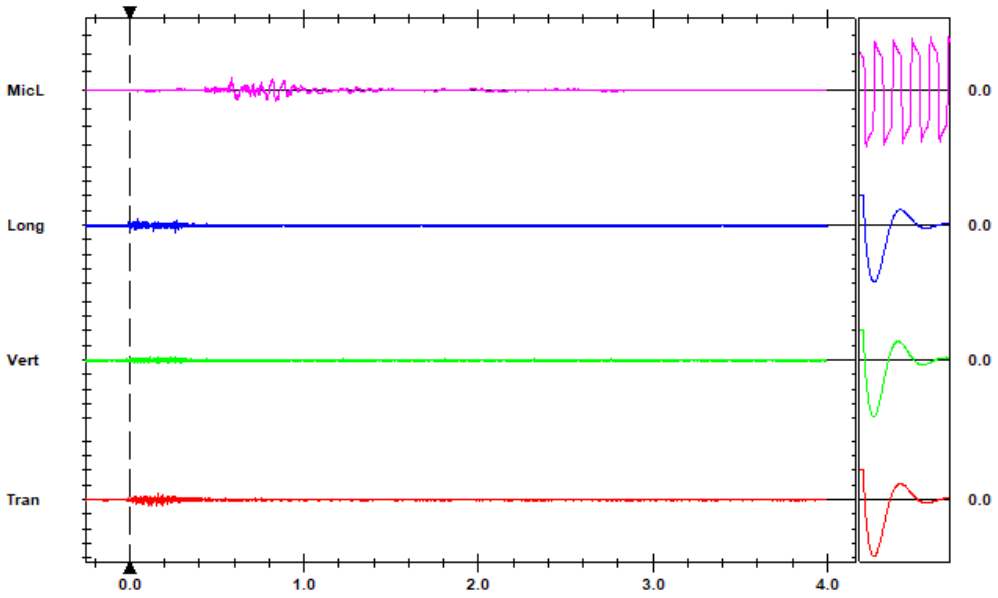
Microphone	Linear Weighting
PSPL	110.9 dB(L) at 0.588 sec
ZC Freq	23 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 522 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	1.016	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.187	0.109	0.266	sec
Peak Acceleration	0.066	0.053	0.053	g
Peak Displacement	0.001	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.092 mm/s at 0.266 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

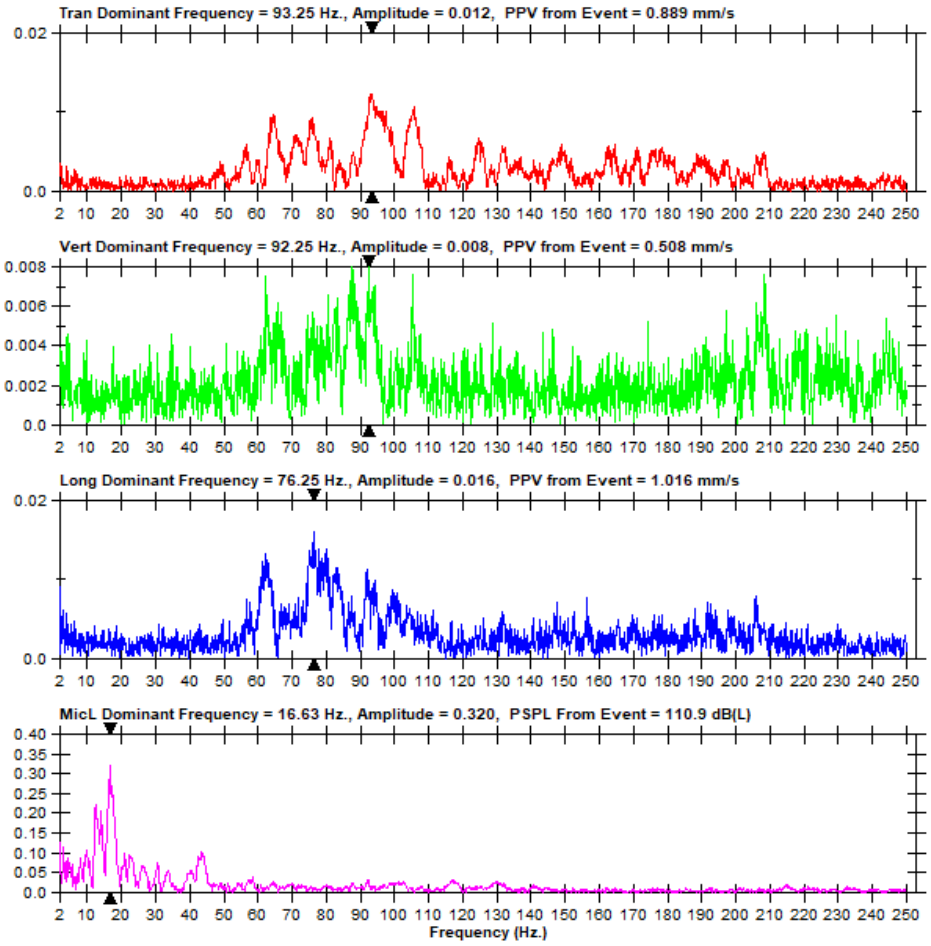
FFT Report

Date/Time	Long at 12:58:18 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2K.160
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 27, Hole Depth - 2.4 m, Charge/hole - 0.625 Kg,
MCPD - 0.65 Kg, Total Charge - 16.90 Kg, Distance - 238 m



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Event Report

Date/Time Vert at 13:02:38 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2K.8E0
Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg, MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 84 m

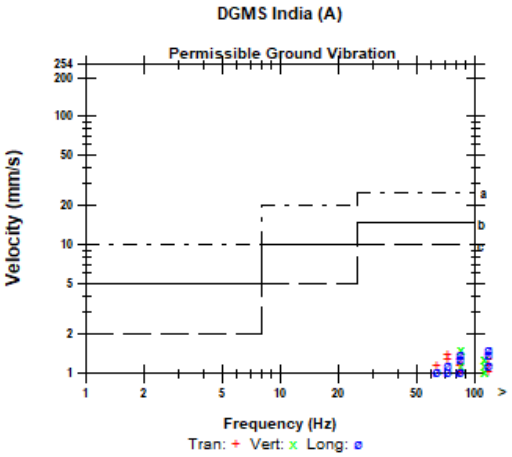
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

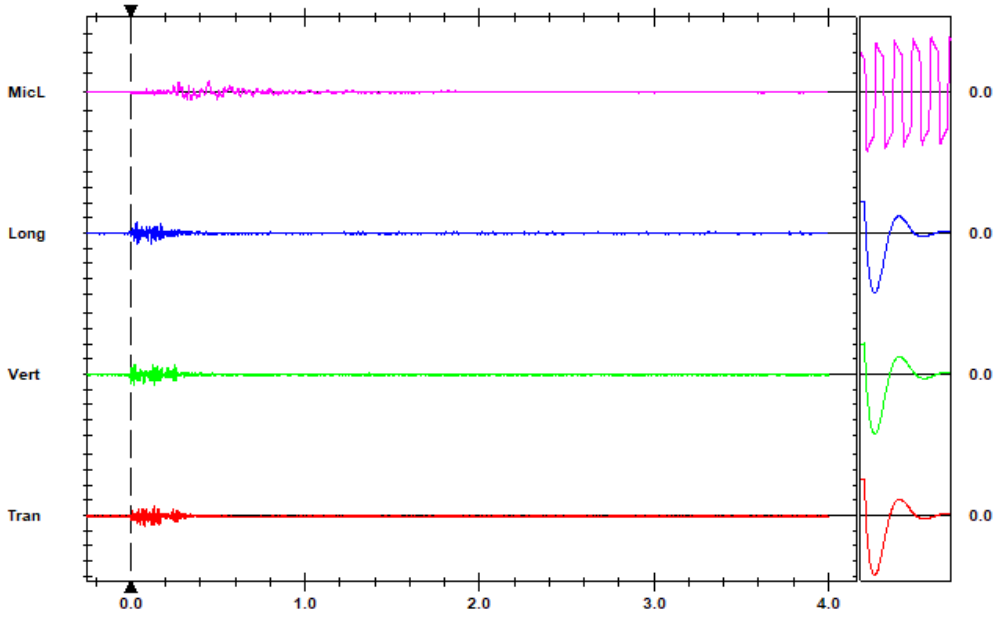
Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.448 sec
ZC Freq 17 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	1.397	1.524	1.524	mm/s
ZC Freq	73	85	>100	Hz
Time (Rel. to Trig)	0.086	0.020	0.117	sec
Peak Acceleration	0.106	0.133	0.093	g
Peak Displacement	0.003	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.972 mm/s at 0.135 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

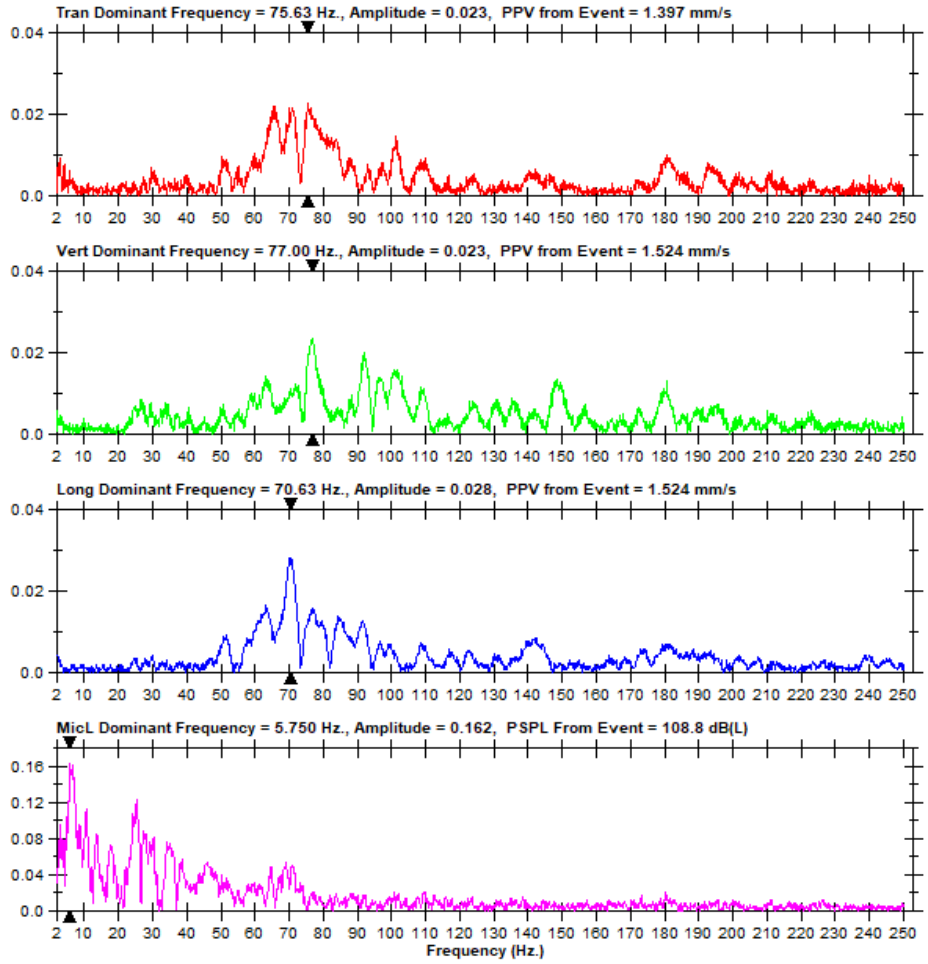
FFT Report

Date/Time	Vert at 13:02:38 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2K.8E0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg,
MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 84 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 13:02:41 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.8H0
Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg, MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 144 m

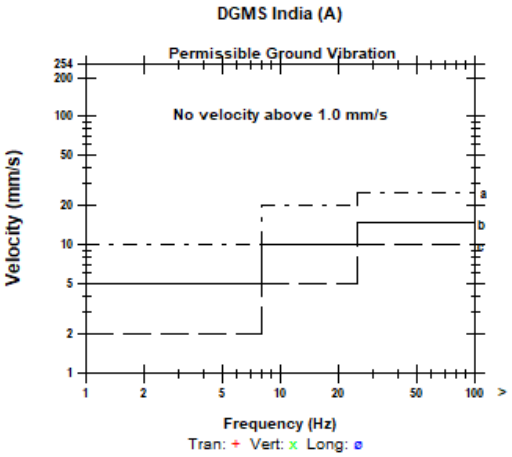
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

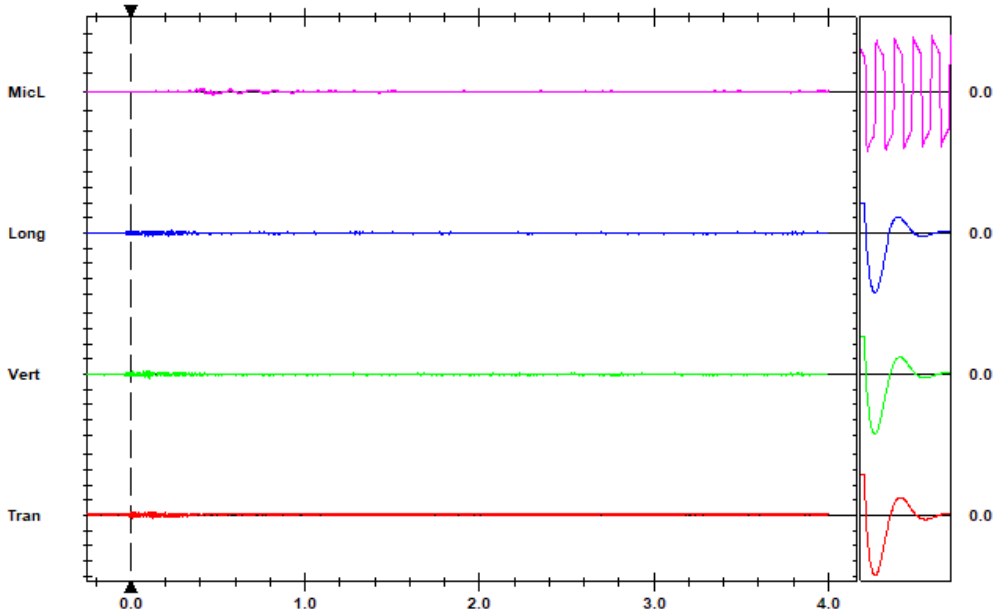
Microphone Linear Weighting
PSPL 98.84 dB(L) at 0.569 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 528 mv)

	Tran	Vert	Long	
PPV	0.508	0.635	0.381	mm/s
ZC Freq	>100	73	>100	Hz
Time (Rel. to Trig)	0.000	0.111	0.084	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.9	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 0.648 mm/s at 0.111 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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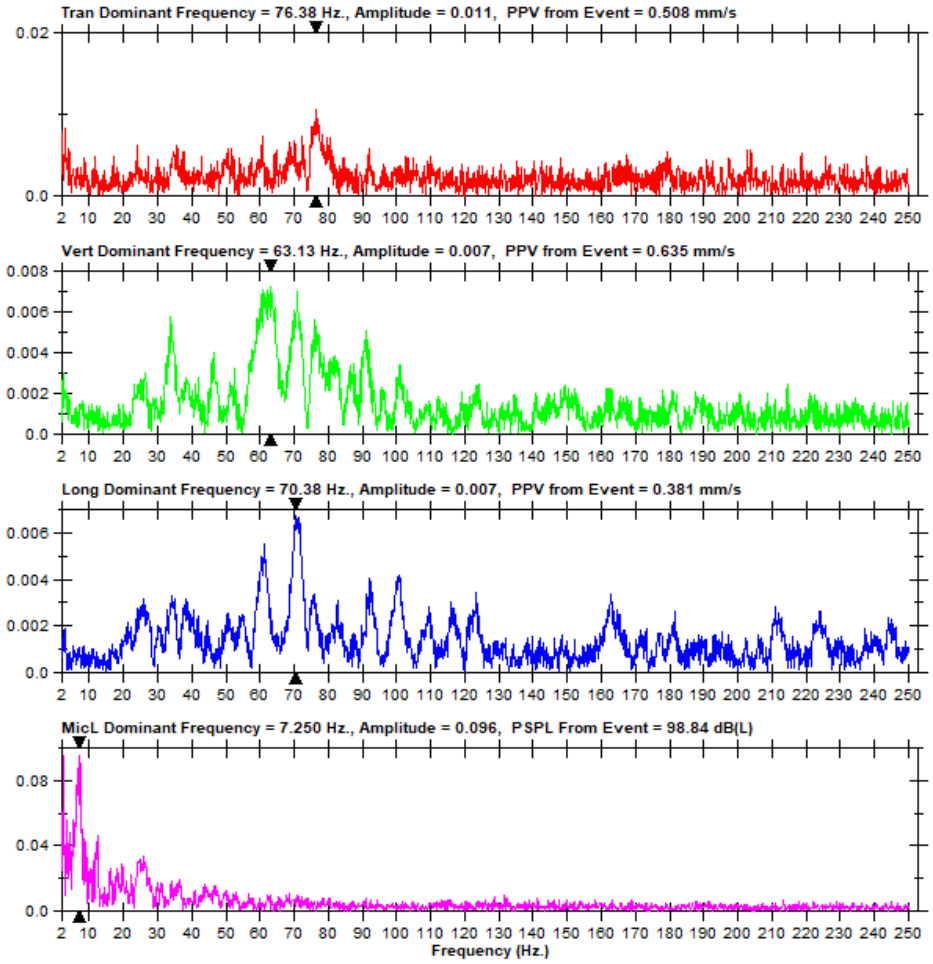
FFT Report

Date/Time	Tran at 13:02:41 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.8H0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg, MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 144 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 13:02:40 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2K.8G0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

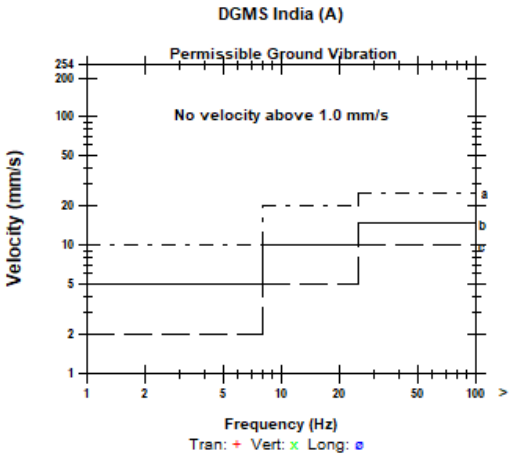
Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg, MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 256 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

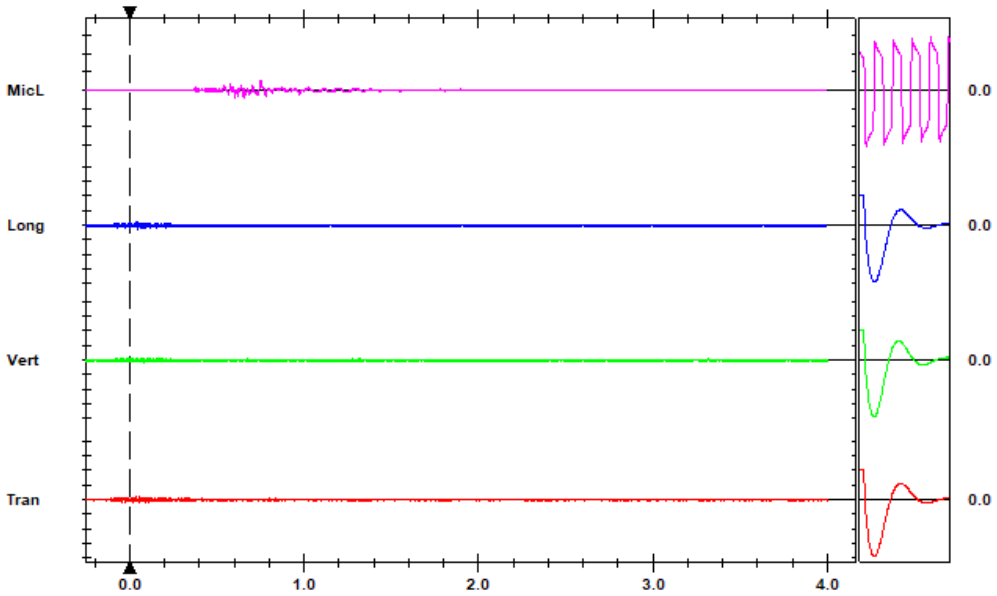
Microphone	Linear Weighting
PSPL	108.0 dB(L) at 0.750 sec
ZC Freq	17 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 520 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	0.635	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.106	0.083	0.049	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.6	7.0	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 0.648 mm/s at 0.049 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

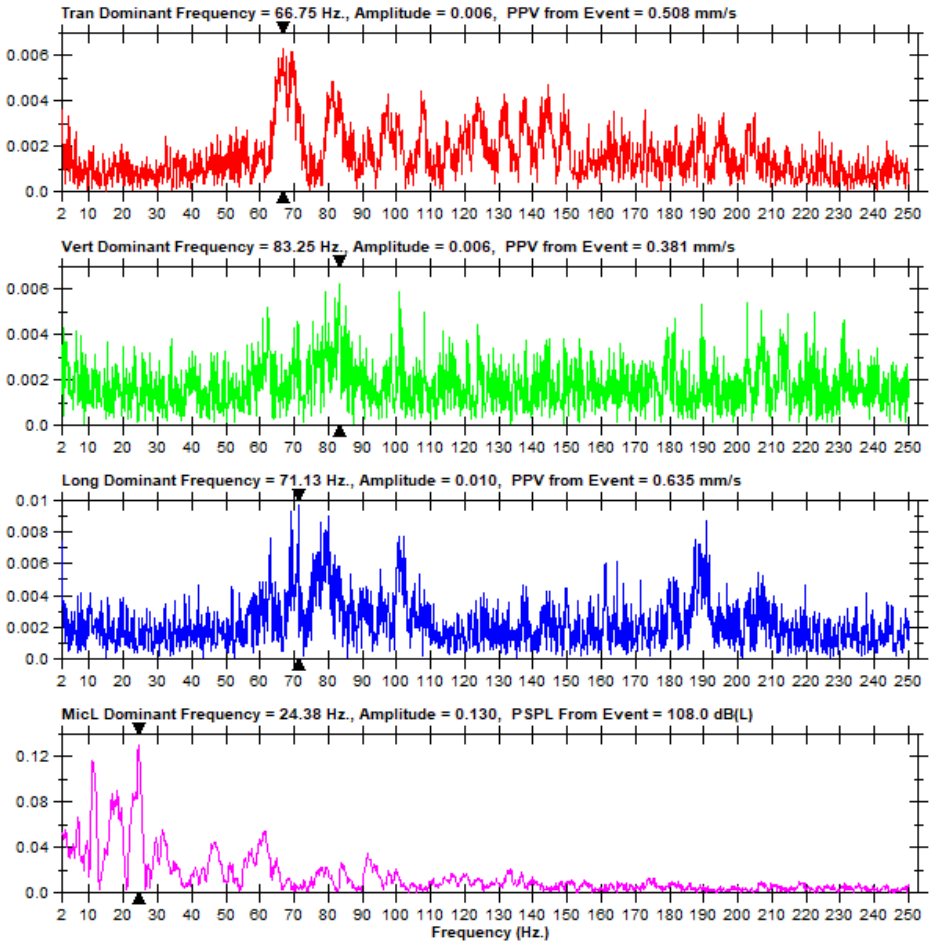
FFT Report

Date/Time	Long at 13:02:40 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2K.8G0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 21, Hole Depth - 1.8 m, Charge/hole - 0.472Kg, MCPD - 0.475 Kg, Total Charge - 9.925 Kg, Distance - 256 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 13:07:44 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2K.GW0
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 75 m

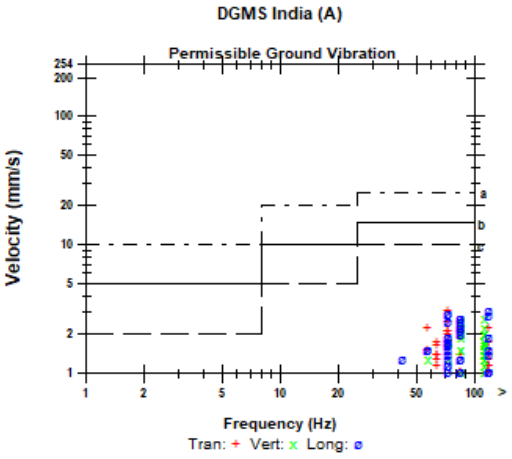
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

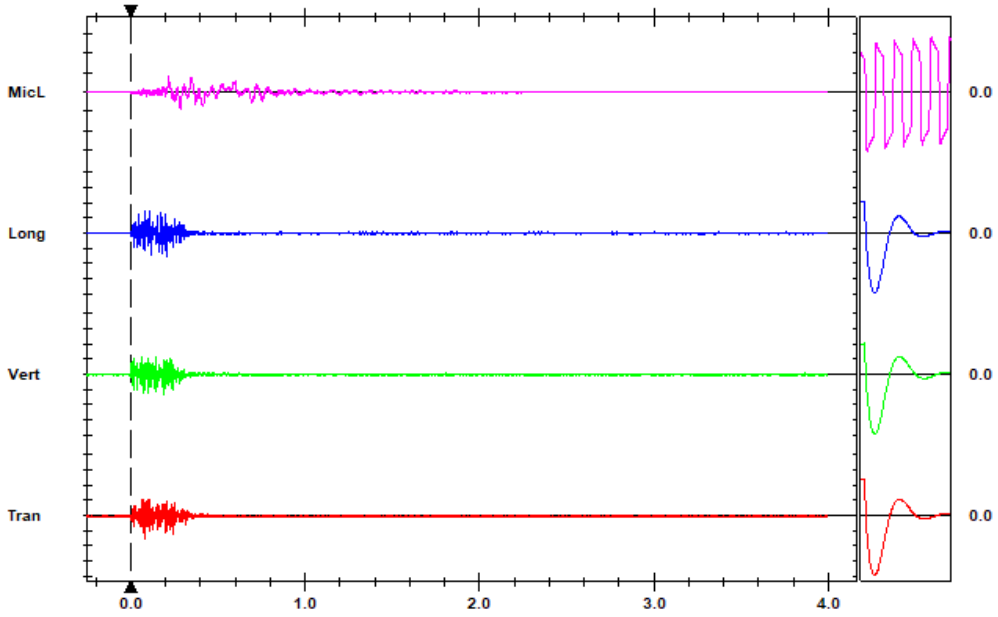
Microphone Linear Weighting
PSPL 112.8 dB(L) at 0.289 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	3.048	2.667	3.048	mm/s
ZC Freq	73	>100	>100	Hz
Time (Rel. to Trig)	0.083	0.194	0.204	sec
Peak Acceleration	0.172	0.225	0.212	g
Peak Displacement	0.006	0.004	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 4.229 mm/s at 0.084 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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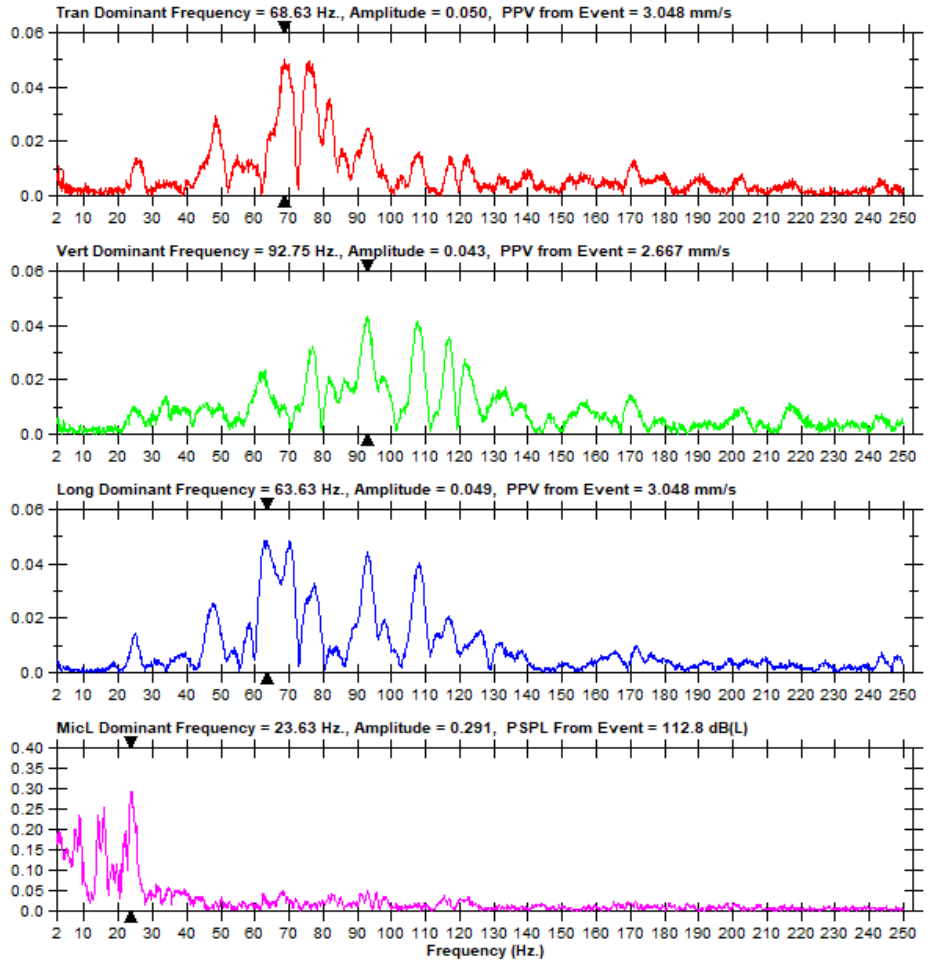
FFT Report

Date/Time	Vert at 13:07:44 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2K.GW0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg,
MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 75 m



Printed: February 20, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 13:07:47 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.GZ0
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 136 m

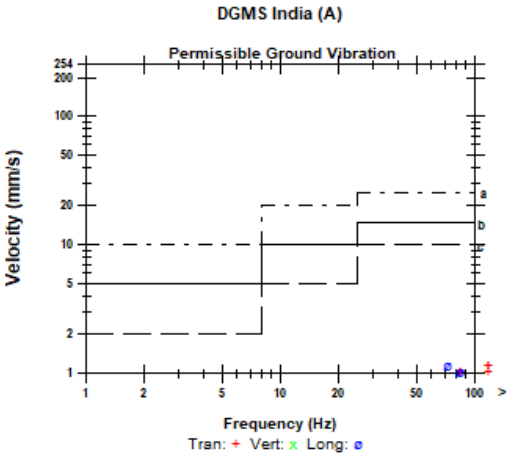
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

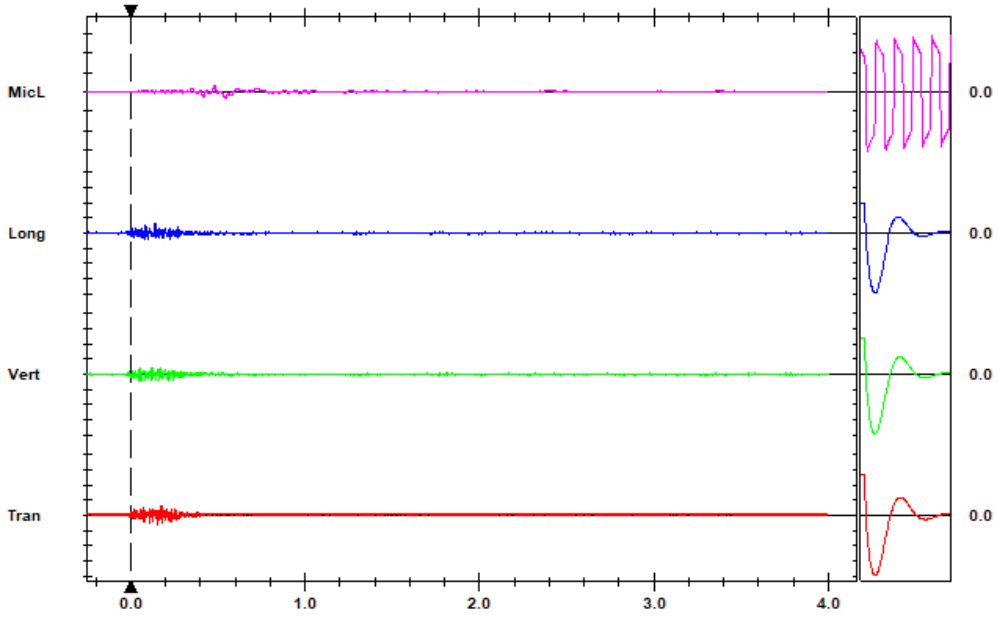
Microphone Linear Weighting
PSPL 103.5 dB(L) at 0.479 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 523 mv)

	Tran	Vert	Long	
PPV	1.143	0.889	1.143	mm/s
ZC Freq	>100	85	73	Hz
Time (Rel. to Trig)	0.155	0.052	0.140	sec
Peak Acceleration	0.093	0.053	0.093	g
Peak Displacement	0.002	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 1.205 mm/s at 0.064 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

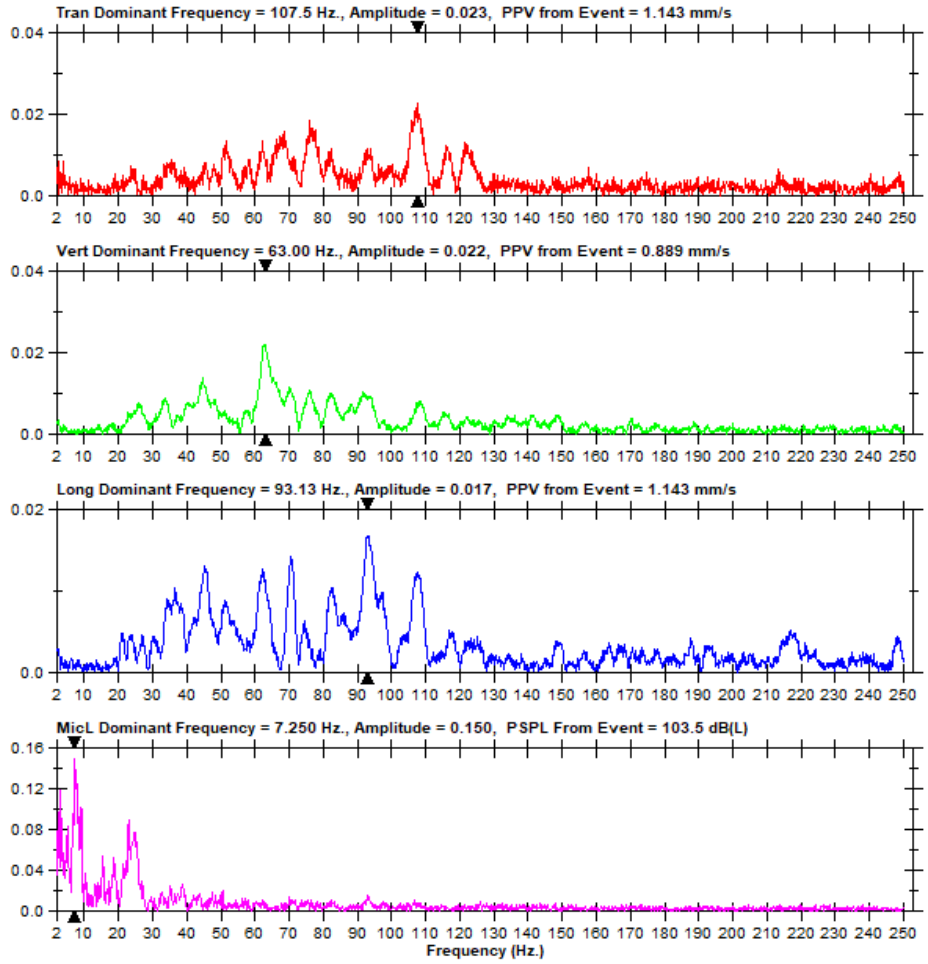
FFT Report

Date/Time	Vert at 13:07:47 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.GZ0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 136 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 13:08:07 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103130807.IDFW

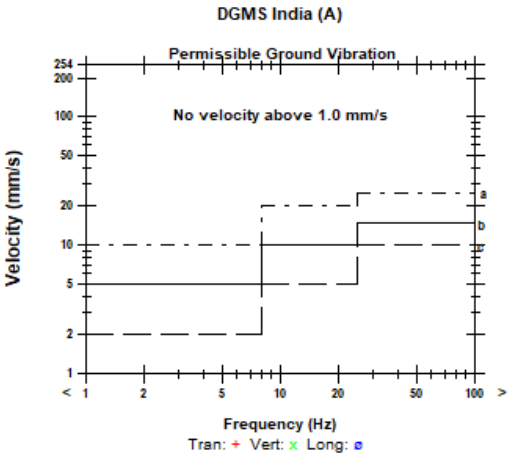
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 186 m

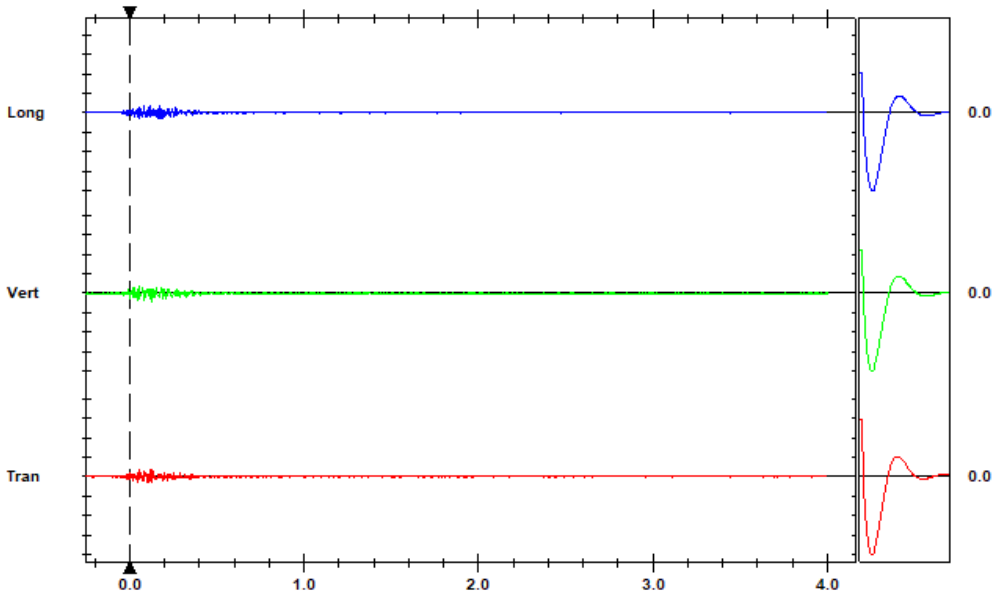
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.796	0.796	0.670	mm/s
ZC Freq	85	85	43	Hz
Time (Rel. to Trig)	0.122	0.130	0.084	sec
Peak Acceleration	0.046	0.064	0.050	g
Peak Displacement	0.002	0.002	0.016	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 1.045 mm/s at 0.085 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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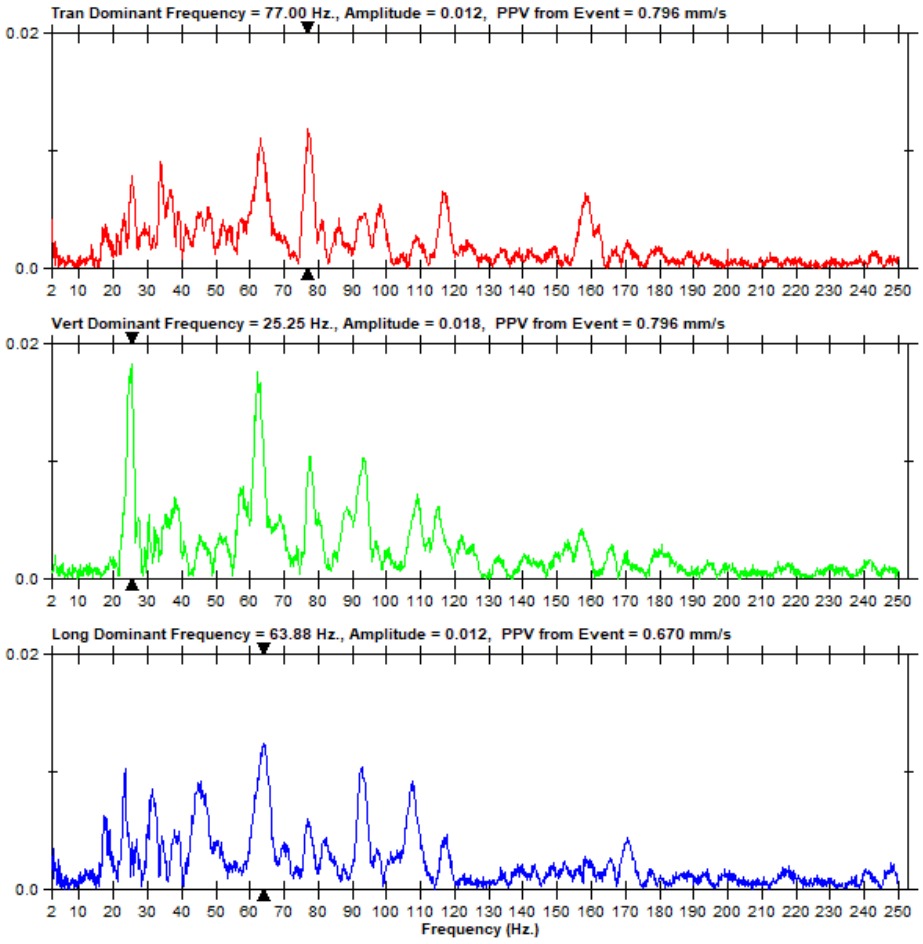
FFT Report

Date/Time	Vert at 13:08:07 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103130807.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 186 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 13:07:46 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2K.GY0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

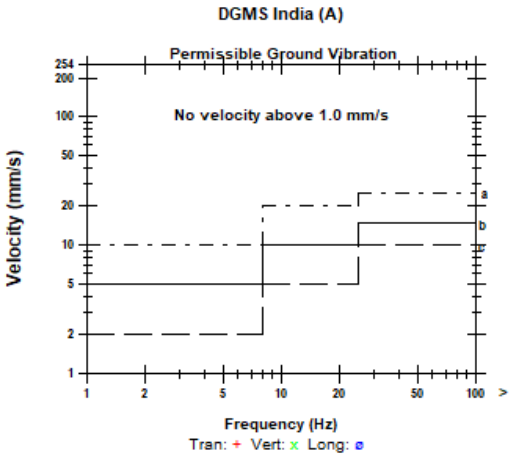
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 265 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

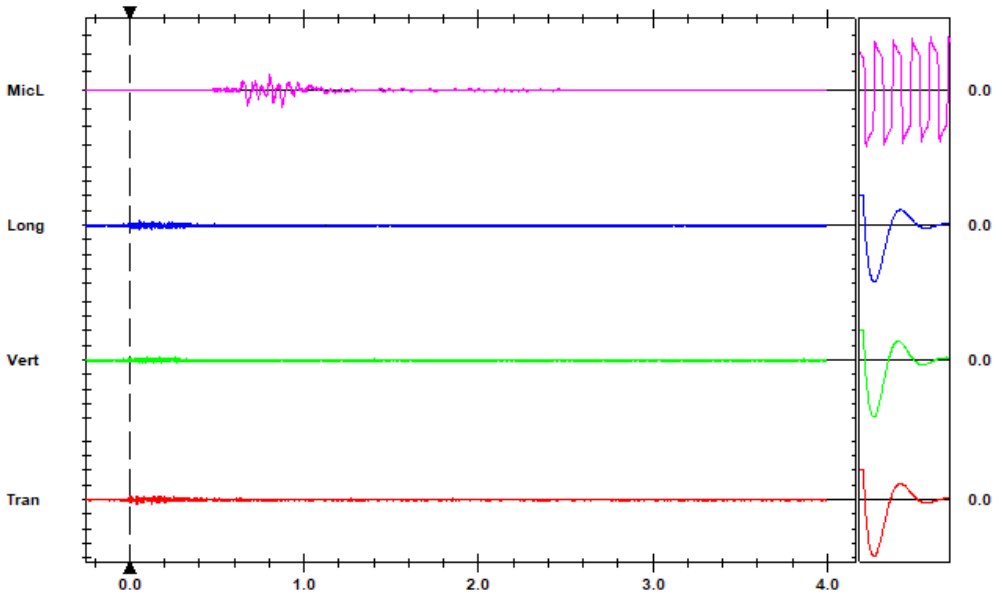
Microphone	Linear Weighting
PSPL	113.3 dB(L) at 0.876 sec
ZC Freq	16 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 532 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	0.635	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.041	0.059	0.054	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.9	3.2	4.0	

Peak Vector Sum 0.823 mm/s at 0.128 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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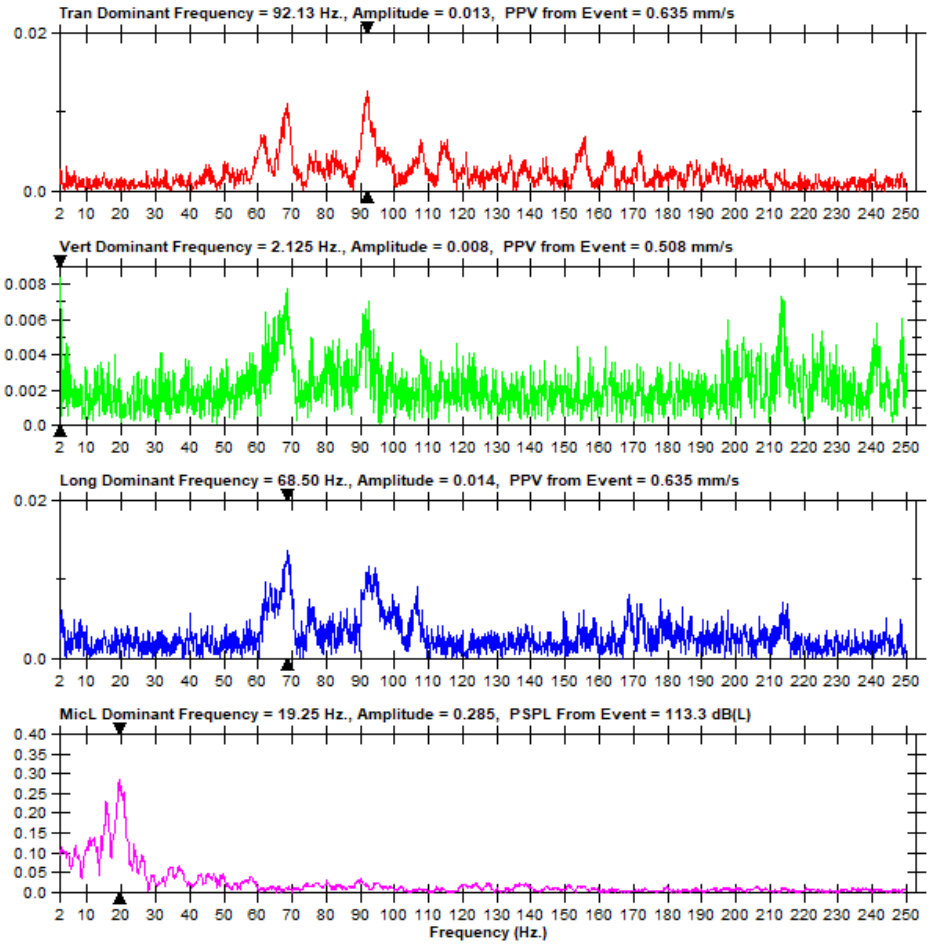
FFT Report

Date/Time	Long at 13:07:46 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2K.GY0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg,
MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 265 m



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Event Report

Date/Time Tran at 13:07:35 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JU2K.GN0
Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 320 m

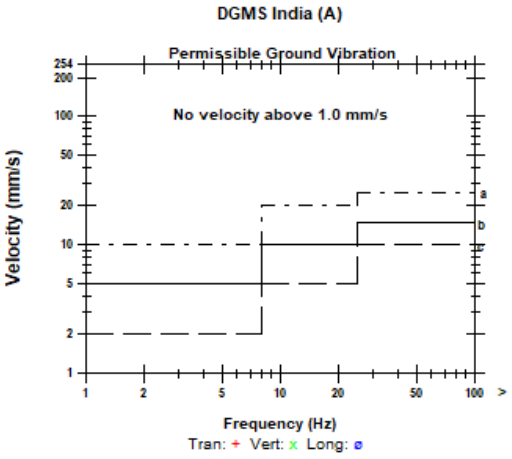
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

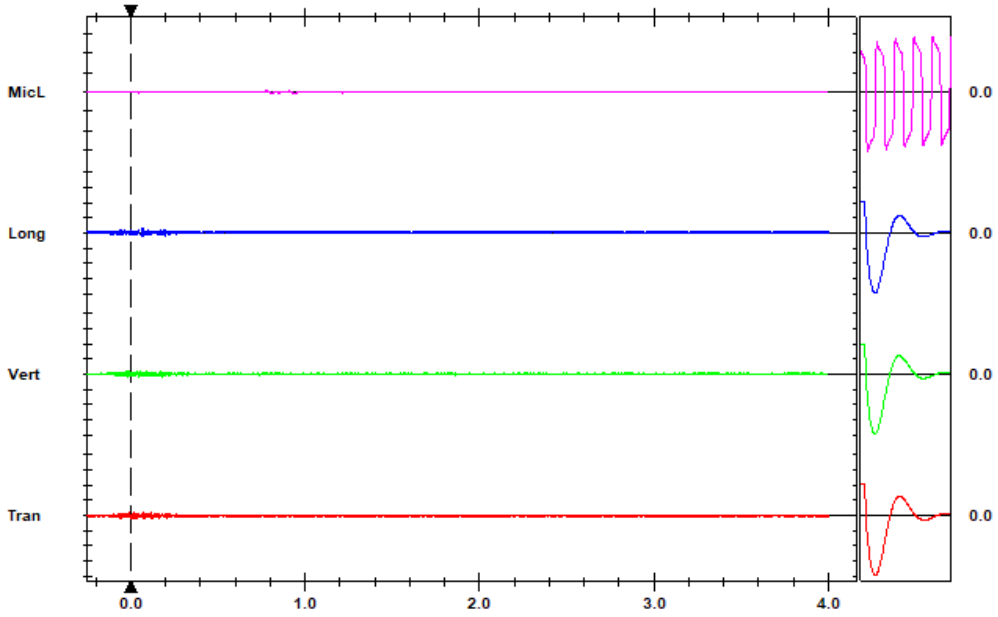
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.801 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 479 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.635	mm/s
ZC Freq	73	>100	>100	Hz
Time (Rel. to Trig)	0.000	0.050	0.064	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.696 mm/s at 0.064 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

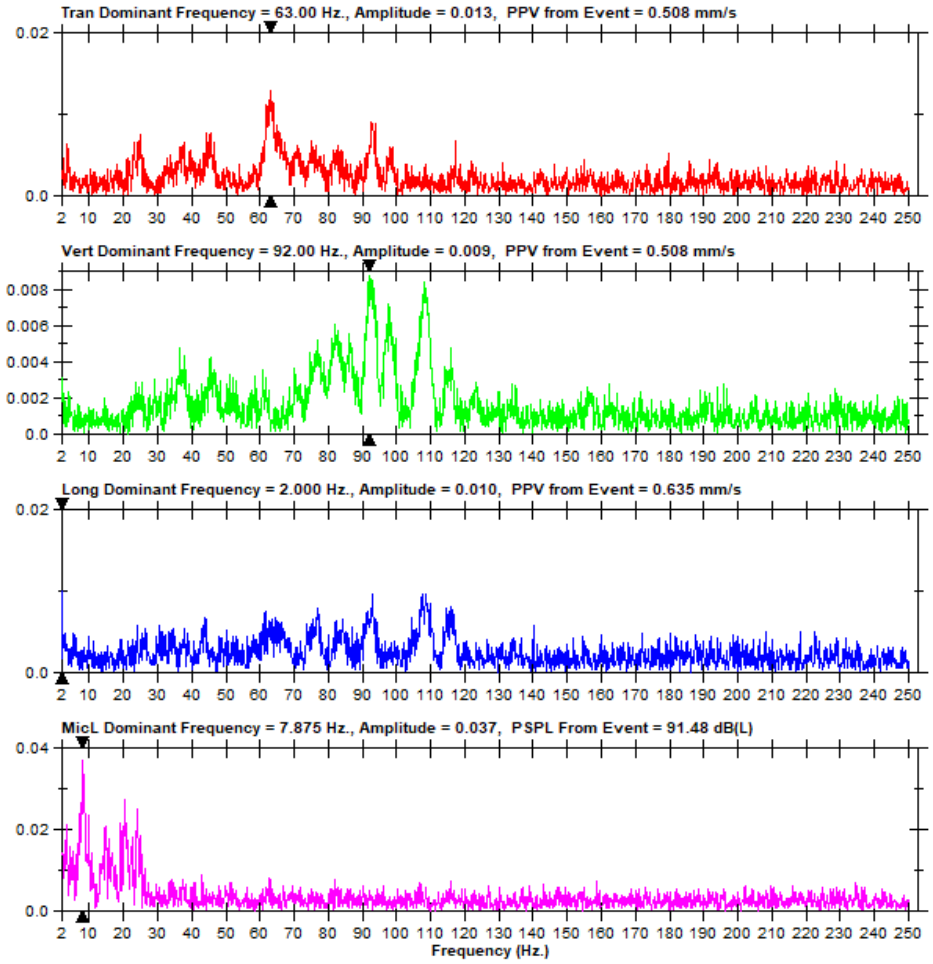
FFT Report

Date/Time	Tran at 13:07:35 January 3, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JU2K.GN0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 2.4 m, Charge/hole - 0.790Kg, MCPD - 0.85 Kg, Total Charge - 23.725 Kg, Distance - 320 m



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Event Report

Date/Time Vert at 13:12:21 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2K.OL0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 62 m

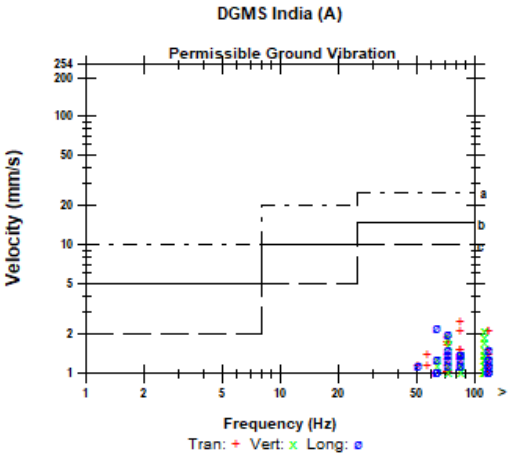
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

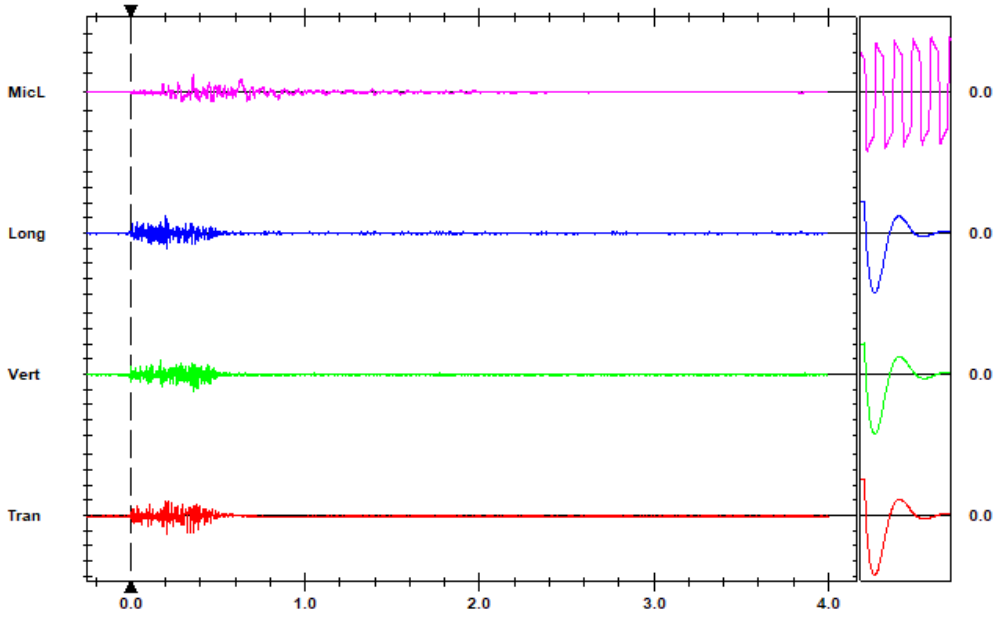
Microphone Linear Weighting
PSPL 112.8 dB(L) at 0.358 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	2.540	2.159	2.286	mm/s
ZC Freq	85	>100	64	Hz
Time (Rel. to Trig)	0.207	0.365	0.203	sec
Peak Acceleration	0.146	0.159	0.106	g
Peak Displacement	0.005	0.004	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 2.808 mm/s at 0.365 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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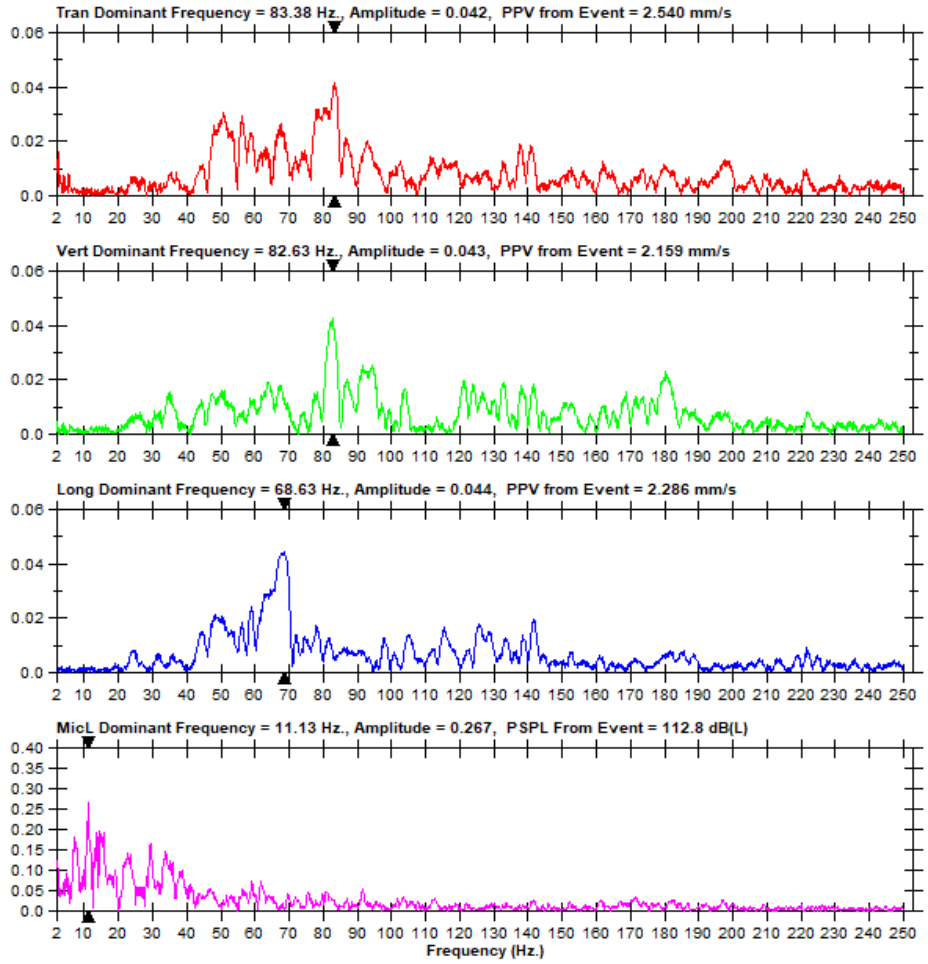
FFT Report

Date/Time	Vert at 13:12:21 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2K.OL0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 62 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 13:12:24 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.OO0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 124 m

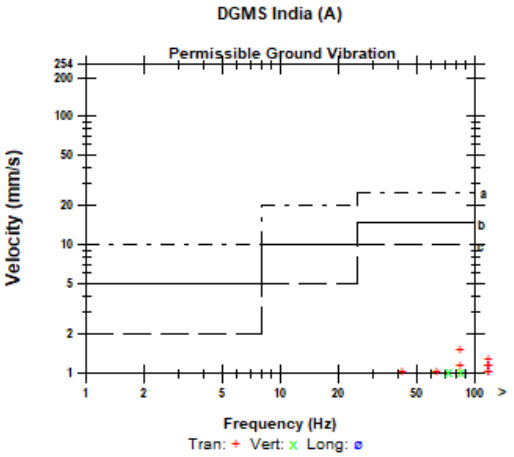
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

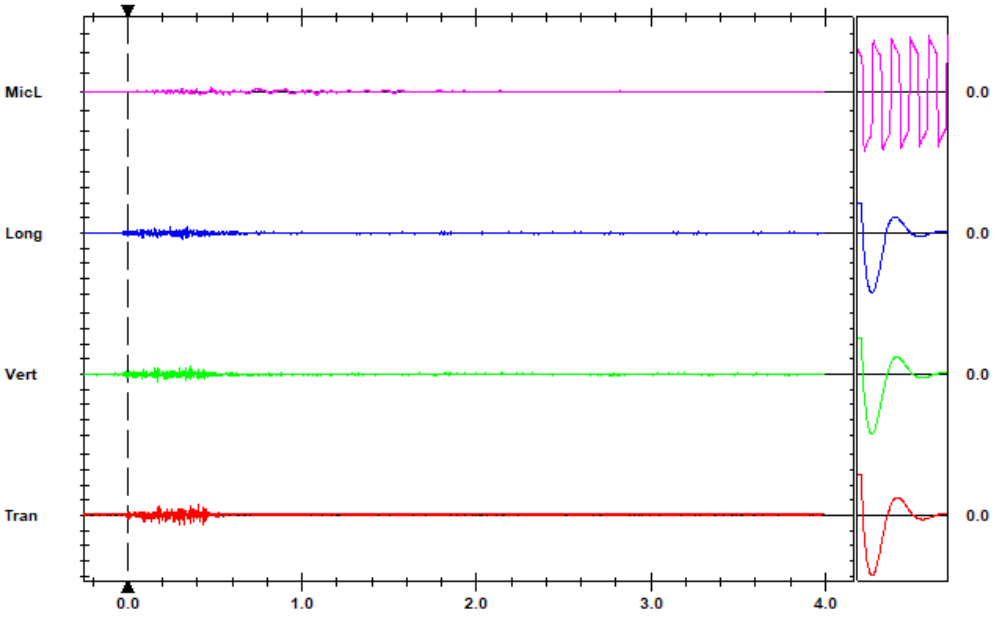
Microphone Linear Weighting
PSPL 101.0 dB(L) at 0.479 sec
ZC Freq 23 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 529 mv)

	Tran	Vert	Long	
PPV	1.524	1.016	0.762	mm/s
ZC Freq	85	73	>100	Hz
Time (Rel. to Trig)	0.408	0.171	0.243	sec
Peak Acceleration	0.133	0.066	0.080	g
Peak Displacement	0.003	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 1.670 mm/s at 0.408 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

Printed: February 20, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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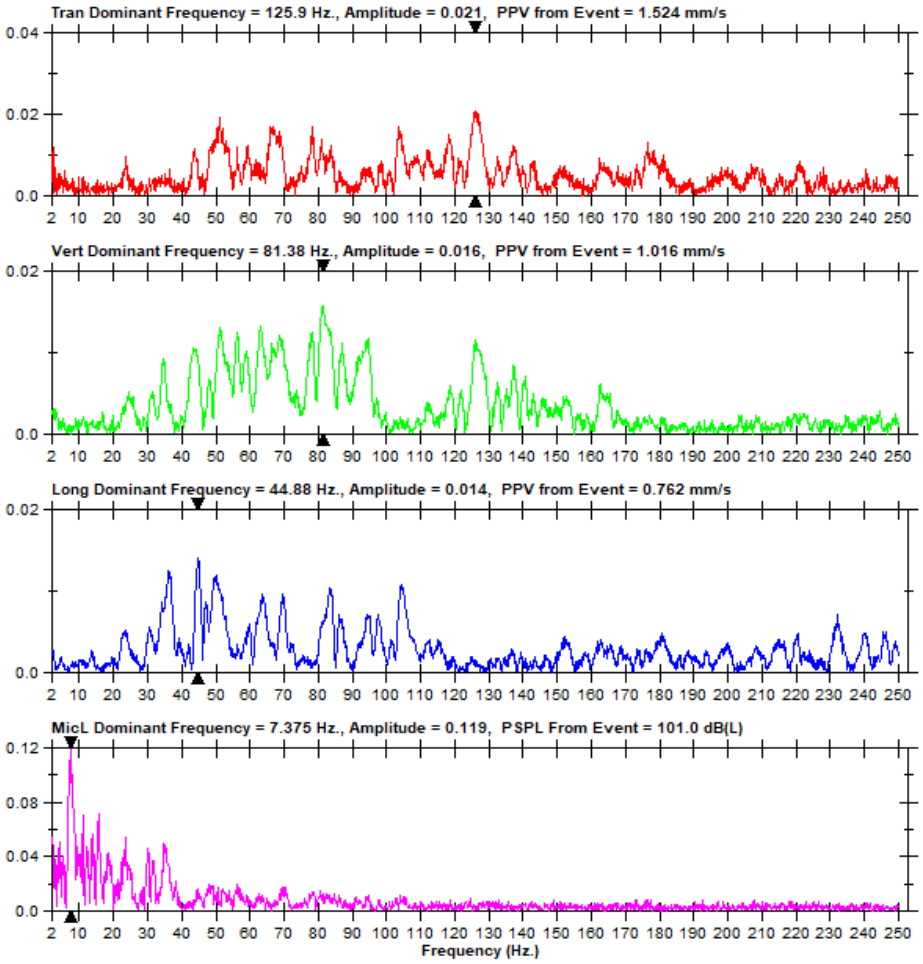
FFT Report

Date/Time	Tran at 13:12:24 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.OO0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 124 m



Printed: February 20, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 13:12:45 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103131245.IDFW

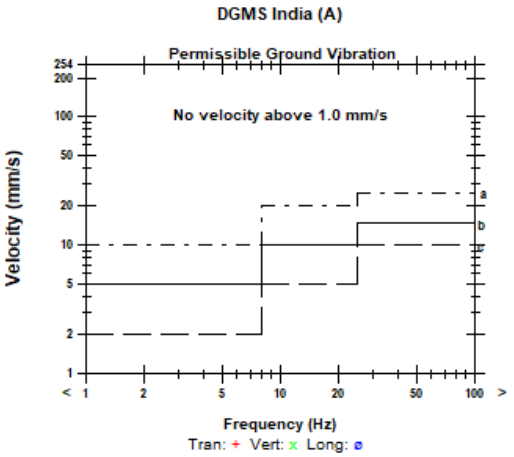
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 159 m

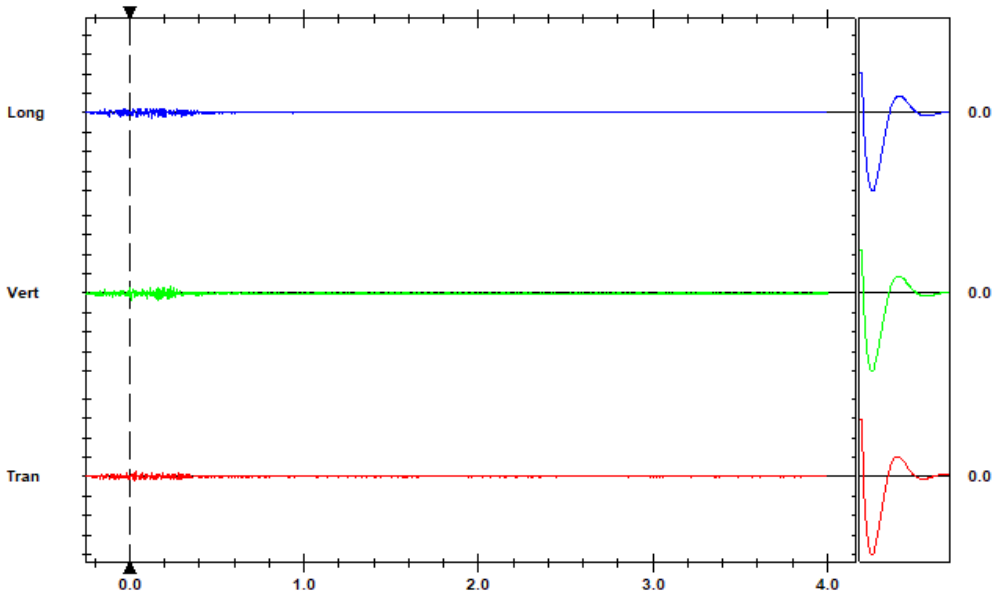
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.497	0.733	0.560	mm/s
ZC Freq	57	64	57	Hz
Time (Rel. to Trig)	0.033	0.167	0.130	sec
Peak Acceleration	0.025	0.039	0.056	g
Peak Displacement	0.002	0.002	0.017	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 0.795 mm/s at 0.167 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

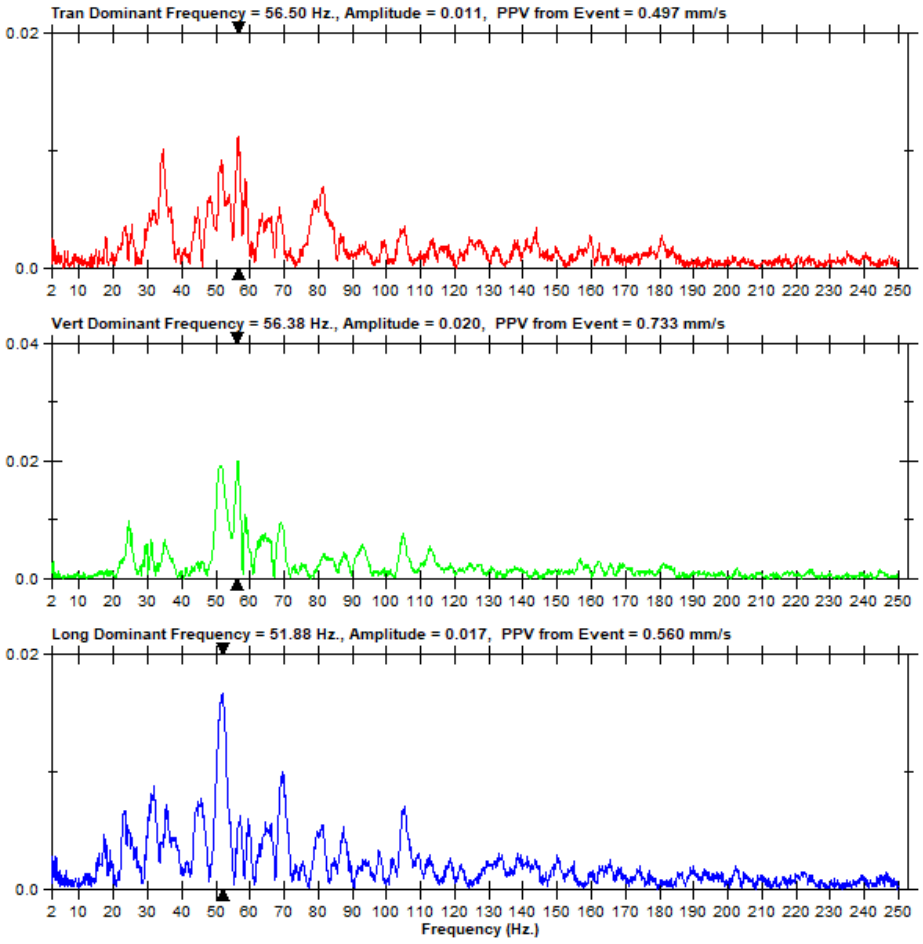
FFT Report

Date/Time	Vert at 13:12:45 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103131245.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 159 m



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Event Report

Date/Time Long at 13:12:27 January 3, 2023
Trigger Source Geo: 0.492 mm/s
Range Geo: 127.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR Dhanbad
Converted: January 3, 2023 19:38:12 (V10.72.1)

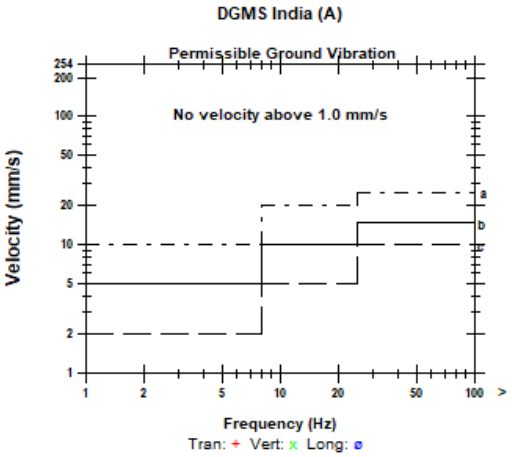
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

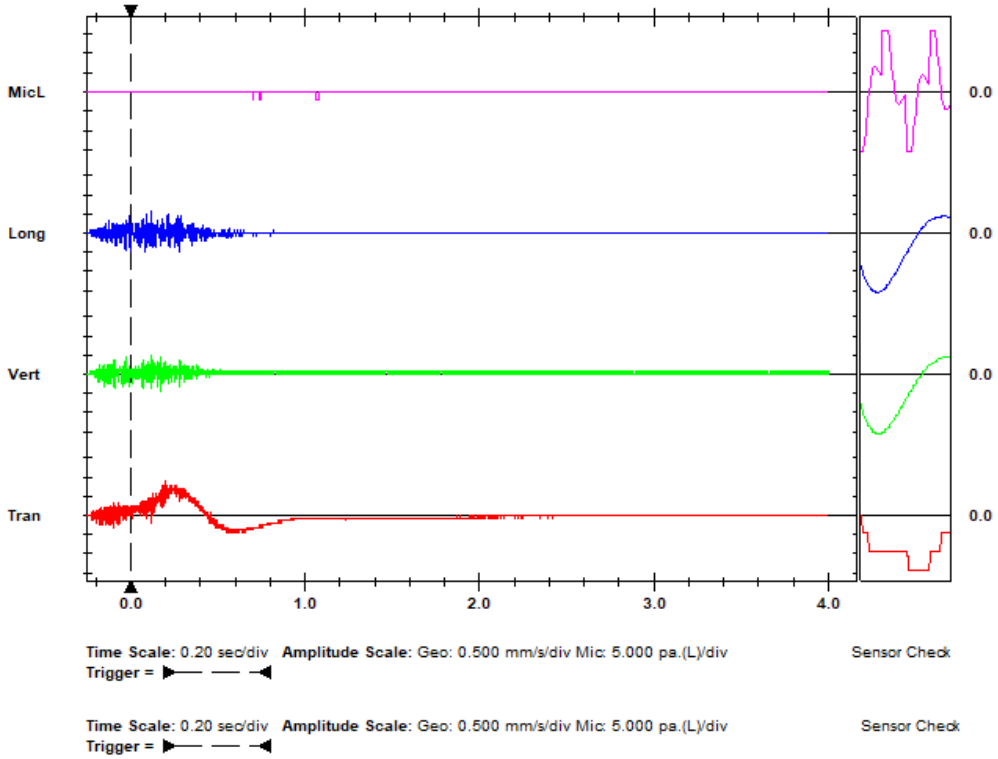
Microphone Linear Weighting
PSPL 100.00 dB(L) at 0.700 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 301 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	0.572	mm/s
ZC Freq	2.0	N/A	85	Hz
Time (Rel. to Trig)	0.197	0.118	0.116	sec
Peak Acceleration	0.040	0.046	0.046	g
Peak Displacement	0.065	0.001	0.001	mm
Sensor Check	Check	Passed	Passed	
Frequency	2.5	7.5	7.8	Hz
Overswing Ratio	0.0	3.7	3.7	

Peak Vector Sum 0.921 mm/s at 0.197 sec
N/A: Not Applicable

Serial Number 5363 V 2.61 MiniMate
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name G363JU4F.CR0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 218 m





Instantel

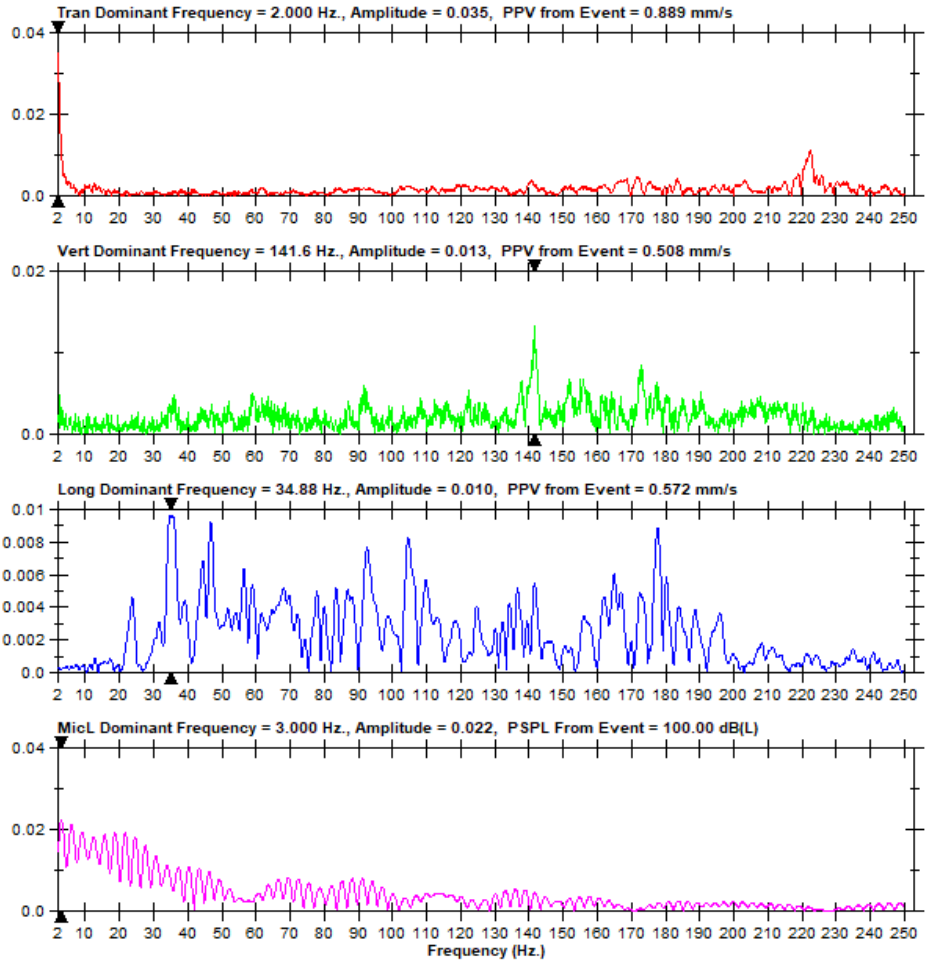
FFT Report

Date/Time	Long at 13:12:27 January 3, 2023	**Serial Number**	5363 V 2.61 MiniMate
Trigger Source	Geo: 0.492 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 127.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	G363JU4F.CR0

Notes
Location: On ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR Dhanbad
Converted: January 3, 2023 19:38:12 (V10.72.1)

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 218 m



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Event Report

Date/Time	Tran at 13:12:24 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2K.OO0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

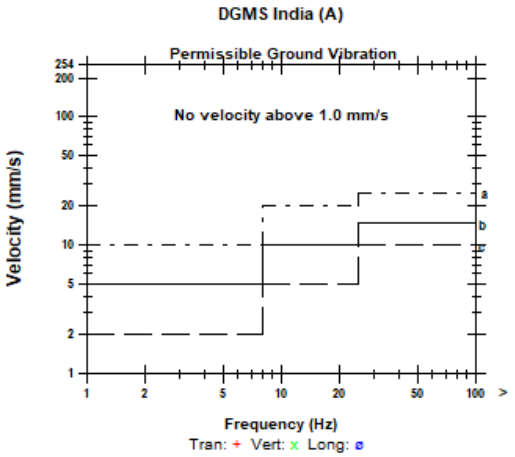
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 279 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

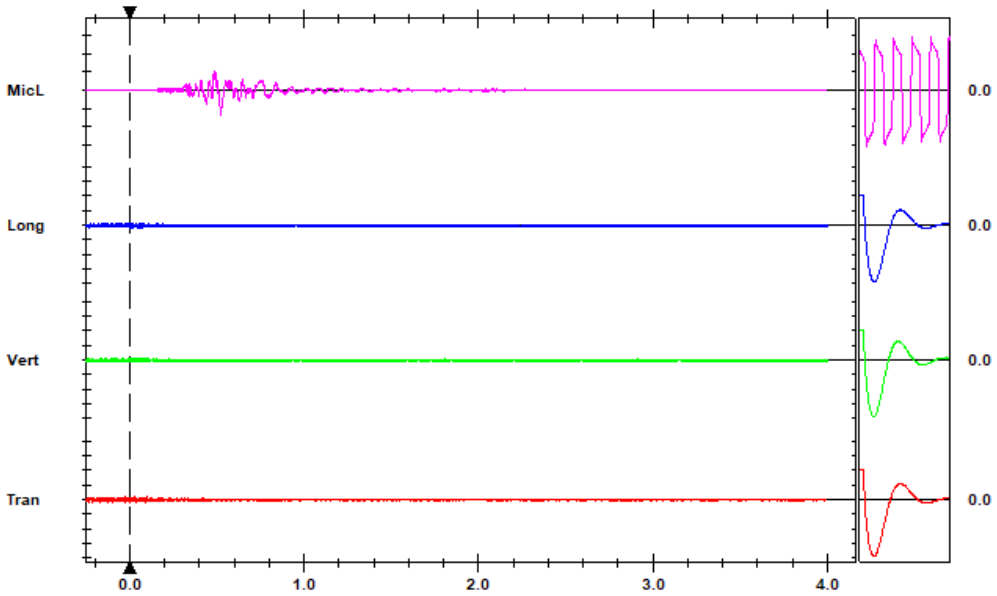
Microphone	Linear Weighting
PSPL	116.6 dB(L) at 0.523 sec
ZC Freq	14 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	-0.234	-0.229	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.648 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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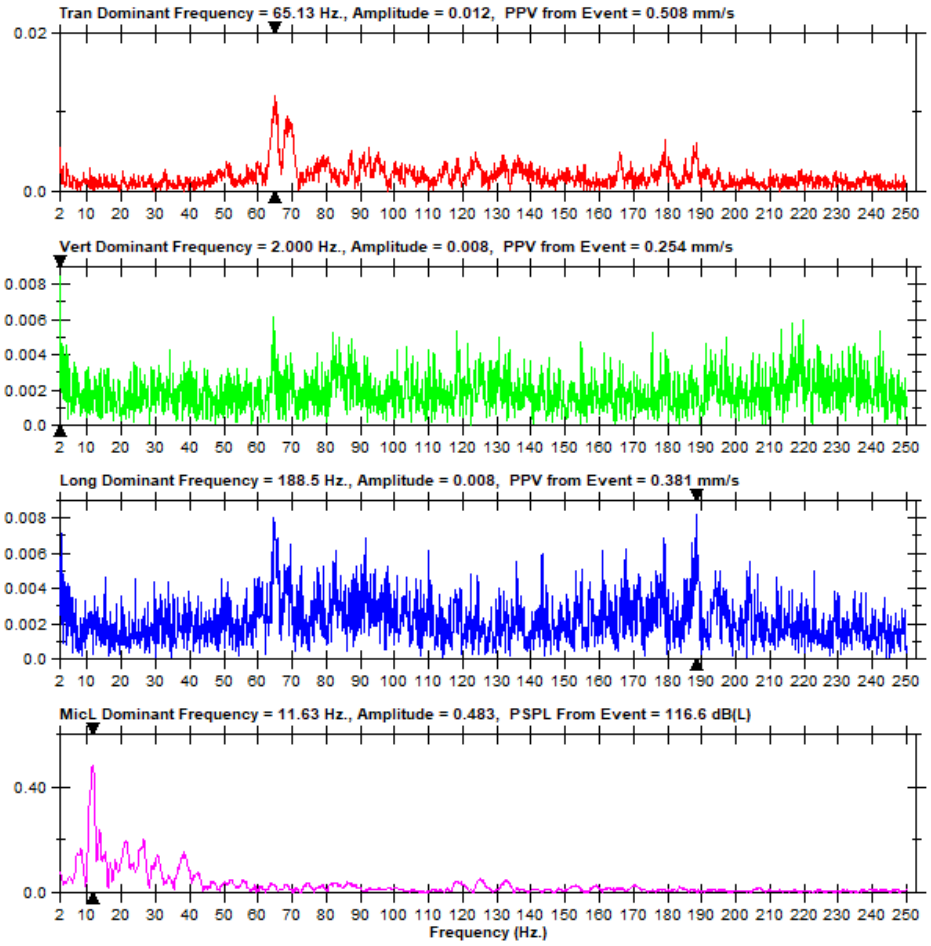
FFT Report

Date/Time	Tran at 13:12:24 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2K.OO0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 279 m



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Event Report

Date/Time Tran at 13:12:12 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JU2K.OC0
Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 291 m

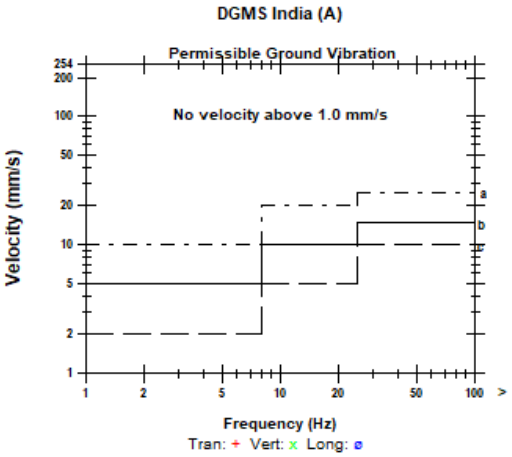
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

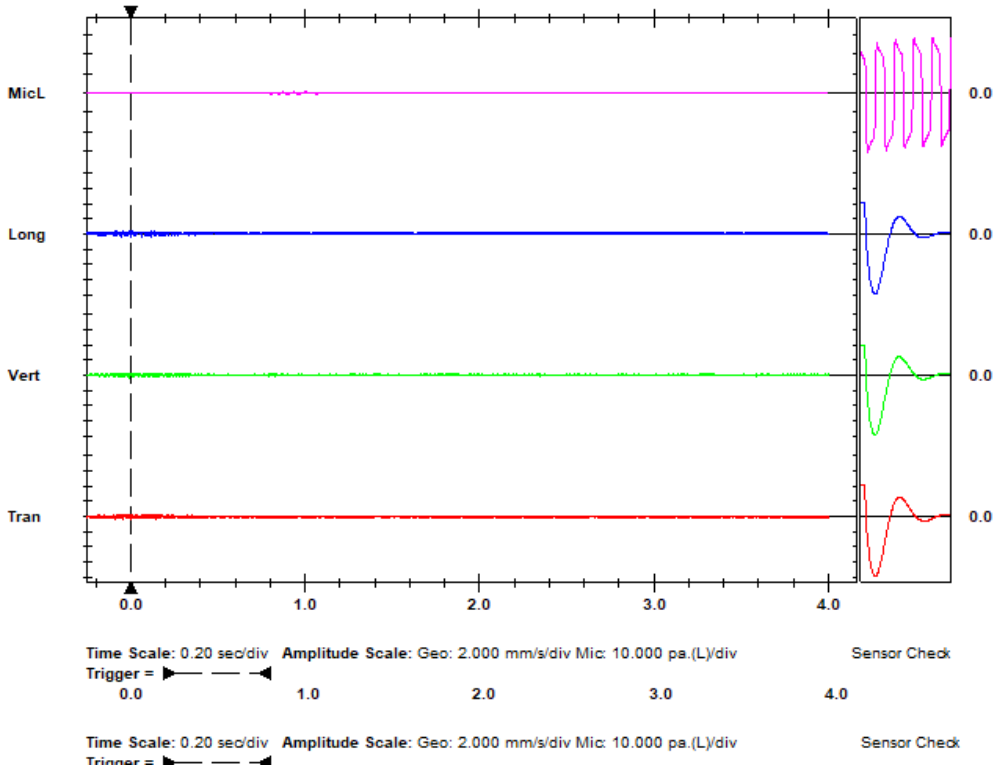
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.853 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 479 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	0.508	mm/s
ZC Freq	73	>100	>100	Hz
Time (Rel. to Trig)	0.000	-0.007	0.120	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.596 mm/s at -0.002 sec





Instantel

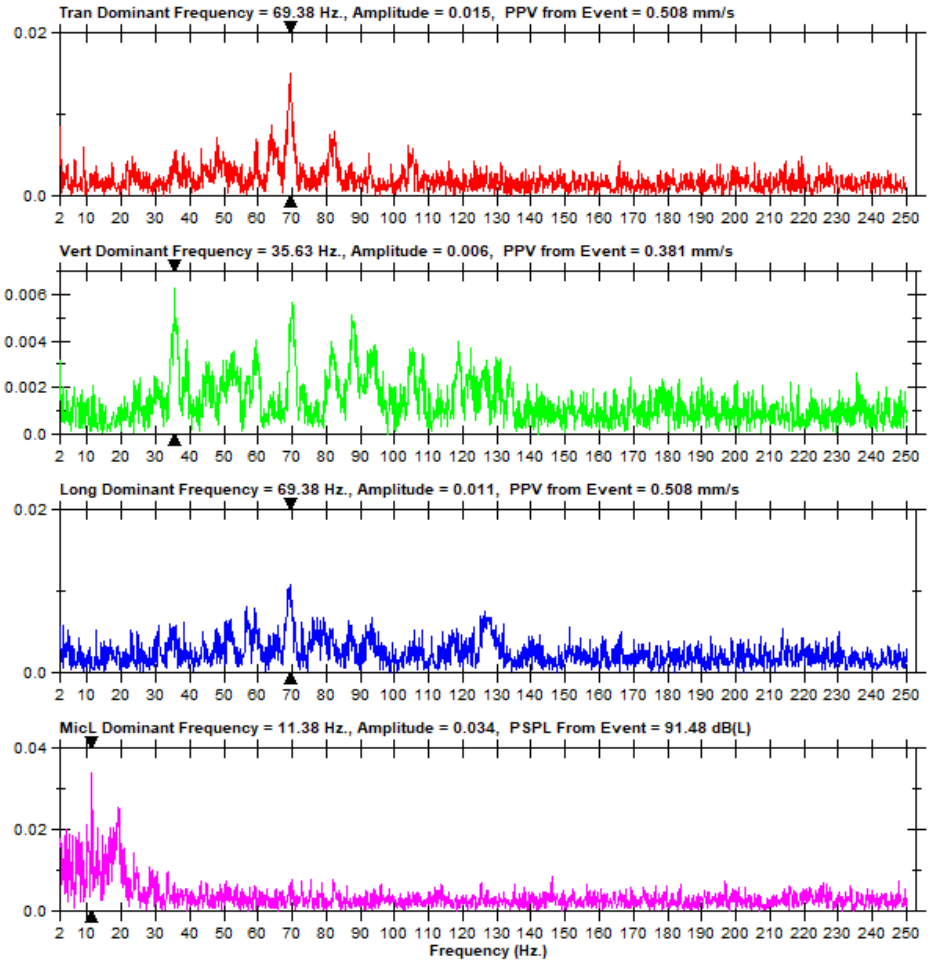
FFT Report

Date/Time	Tran at 13:12:12 January 3, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JU2K.OC0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 60, Hole Depth - 1.8 m, Charge/hole - 0.422Kg, MCPD - 0.425 Kg, Total Charge - 25.375 Kg, Distance - 291 m



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Event Report

Date/Time Vert at 13:17:15 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2K.WR0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 76 m

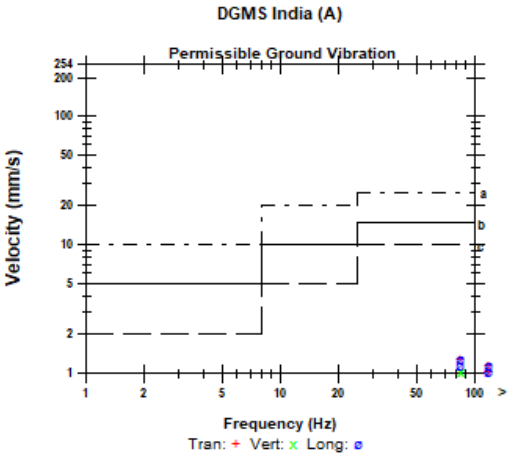
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

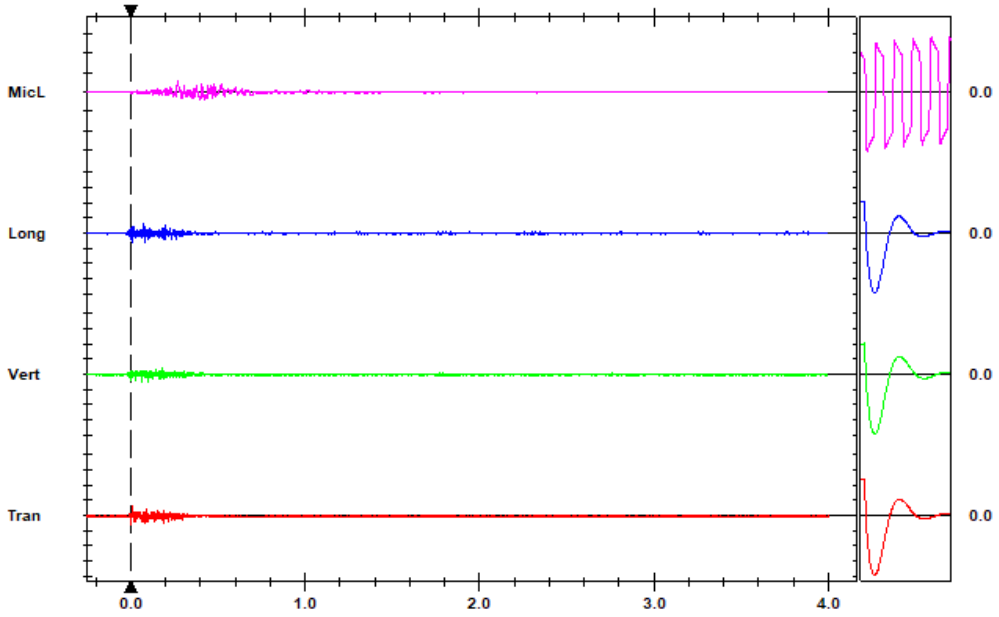
Microphone Linear Weighting
PSPL 109.2 dB(L) at 0.272 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	1.270	1.016	1.270	mm/s
ZC Freq	85	85	85	Hz
Time (Rel. to Trig)	0.011	0.064	0.008	sec
Peak Acceleration	0.080	0.080	0.093	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 1.611 mm/s at 0.079 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

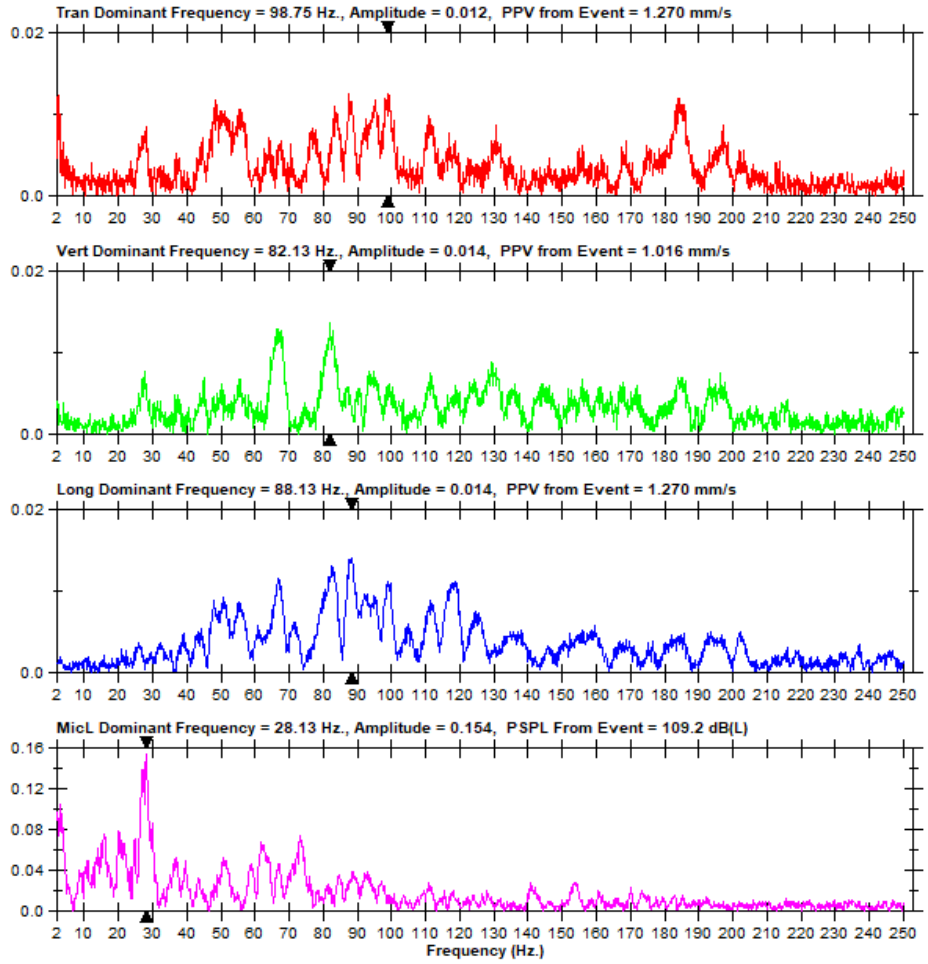
FFT Report

Date/Time	Vert at 13:17:15 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2K.WR0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 76 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 13:17:18 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2K.WU0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 131 m

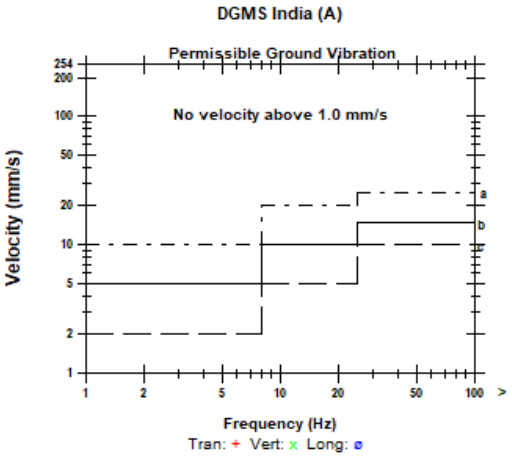
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

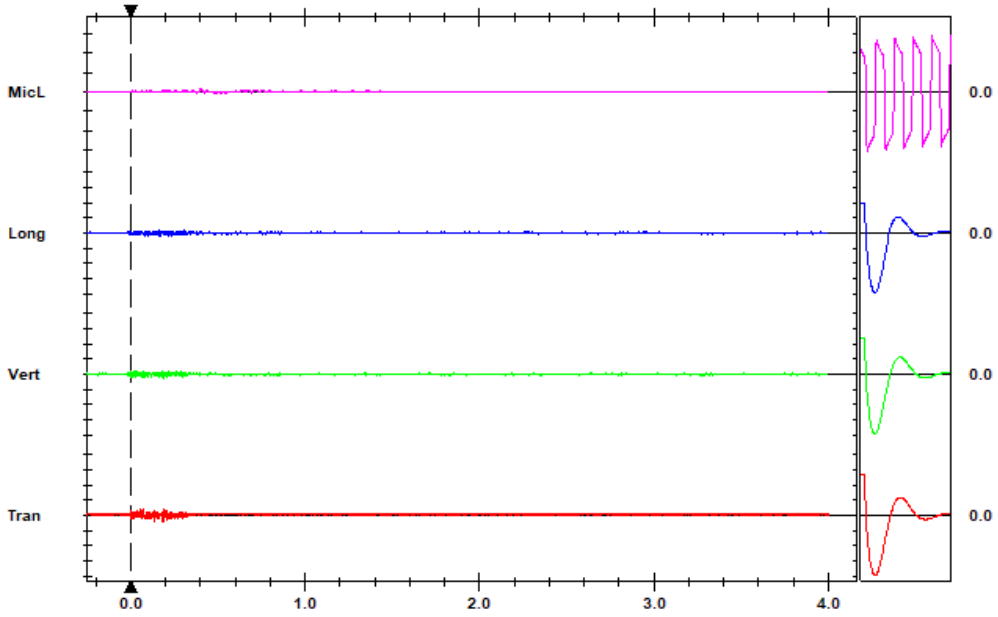
Microphone Linear Weighting
PSPL 95.92 dB(L) at 0.400 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 539 mv)

	Tran	Vert	Long	
PPV	0.889	0.635	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.074	0.187	0.305	sec
Peak Acceleration	0.066	0.066	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 1.000 mm/s at 0.187 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

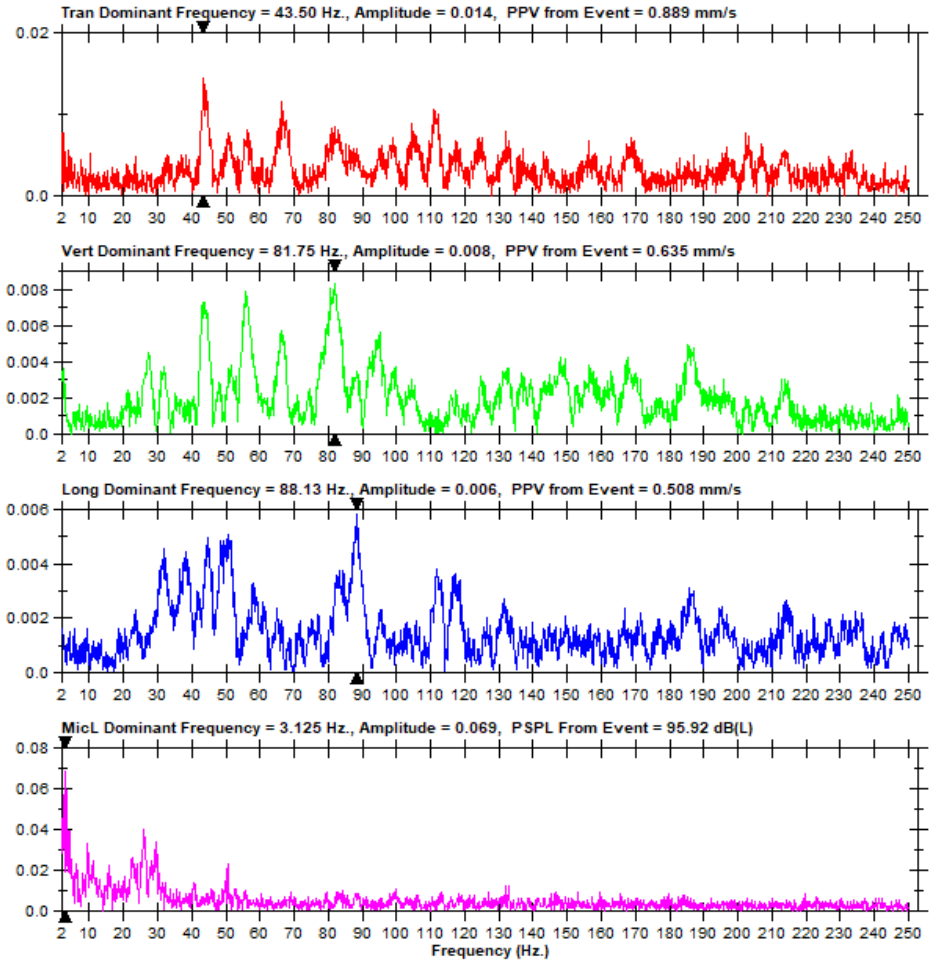
FFT Report

Date/Time	Tran at 13:17:18 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2K.WU0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 131 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Vert at 13:17:39 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103131739.IDFW

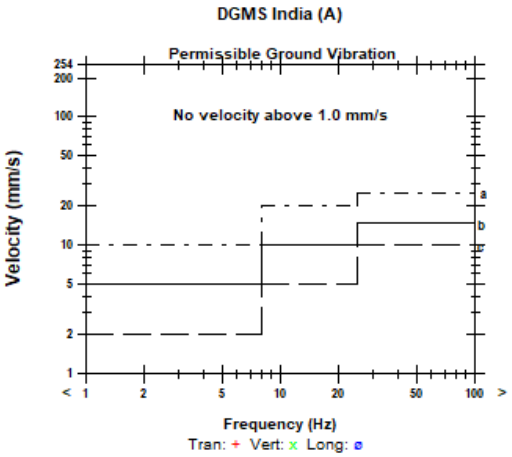
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

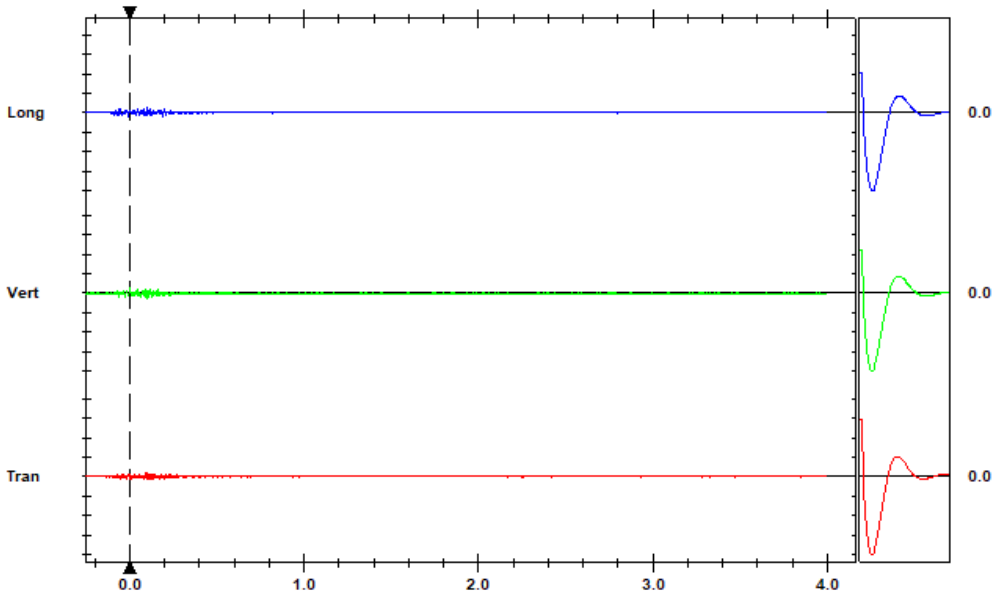
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 148 m

	Tran	Vert	Long	
PPV	0.449	0.552	0.489	mm/s
ZC Freq	>100	51	47	Hz
Time (Rel. to Trig)	0.091	0.000	0.101	sec
Peak Acceleration	0.032	0.033	0.030	g
Peak Displacement	0.002	0.001	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 0.682 mm/s at 0.097 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

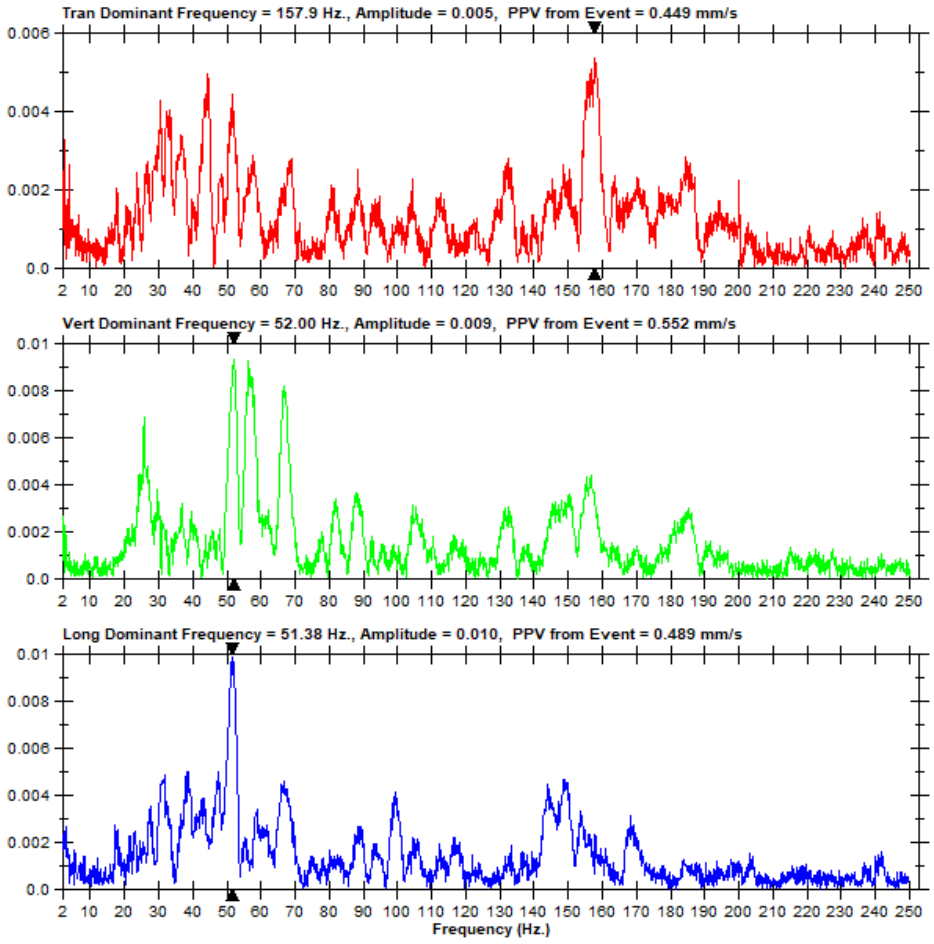
FFT Report

Date/Time	Vert at 13:17:39 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103131739.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 11.25 Kg, Distance - 148 m



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Event Report

Date/Time Tran at 13:20:52 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2L.2S0
Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg, MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 63 m

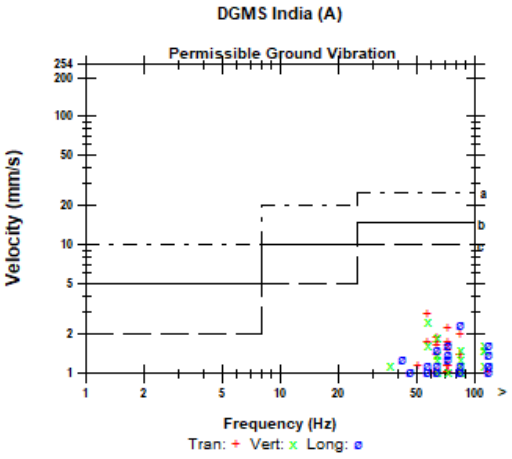
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

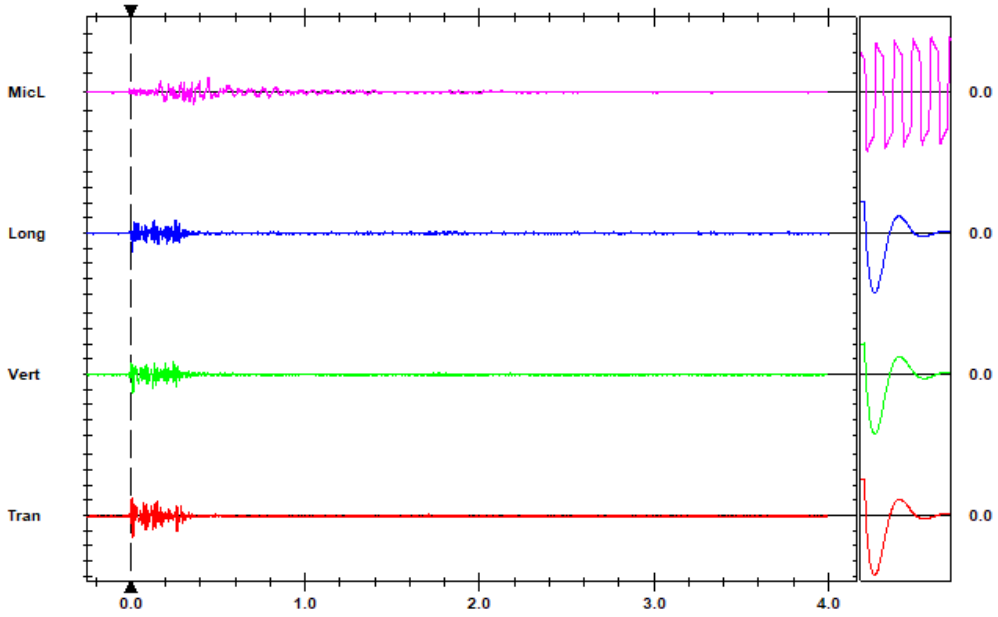
Microphone Linear Weighting
PSPL 111.5 dB(L) at 0.444 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	2.921	2.540	2.413	mm/s
ZC Freq	57	57	85	Hz
Time (Rel. to Trig)	0.015	0.015	0.014	sec
Peak Acceleration	0.119	0.119	0.106	g
Peak Displacement	0.008	0.006	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 4.214 mm/s at 0.014 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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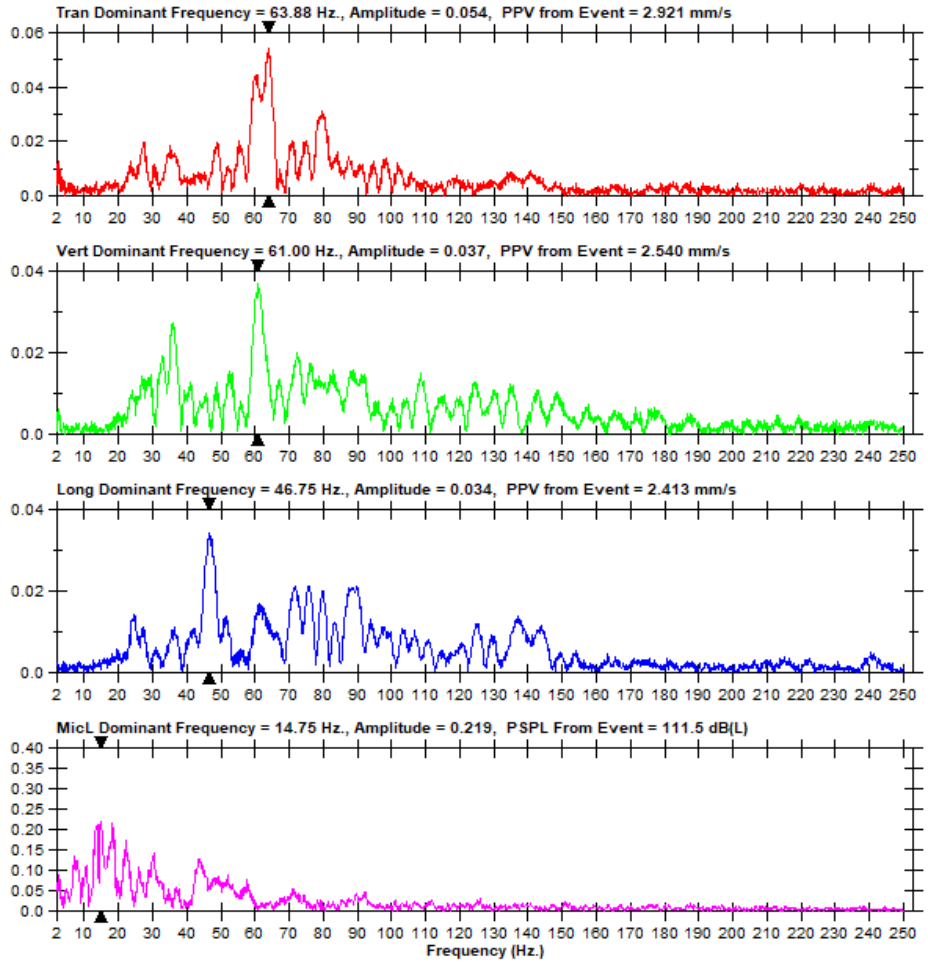
FFT Report

Date/Time	Tran at 13:20:52 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2L.2S0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg,
MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 63 m



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Event Report

Date/Time Vert at 13:20:55 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2L.2V0
Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg, MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 119 m

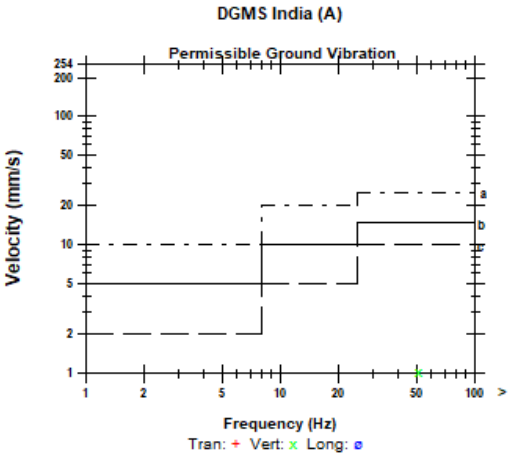
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

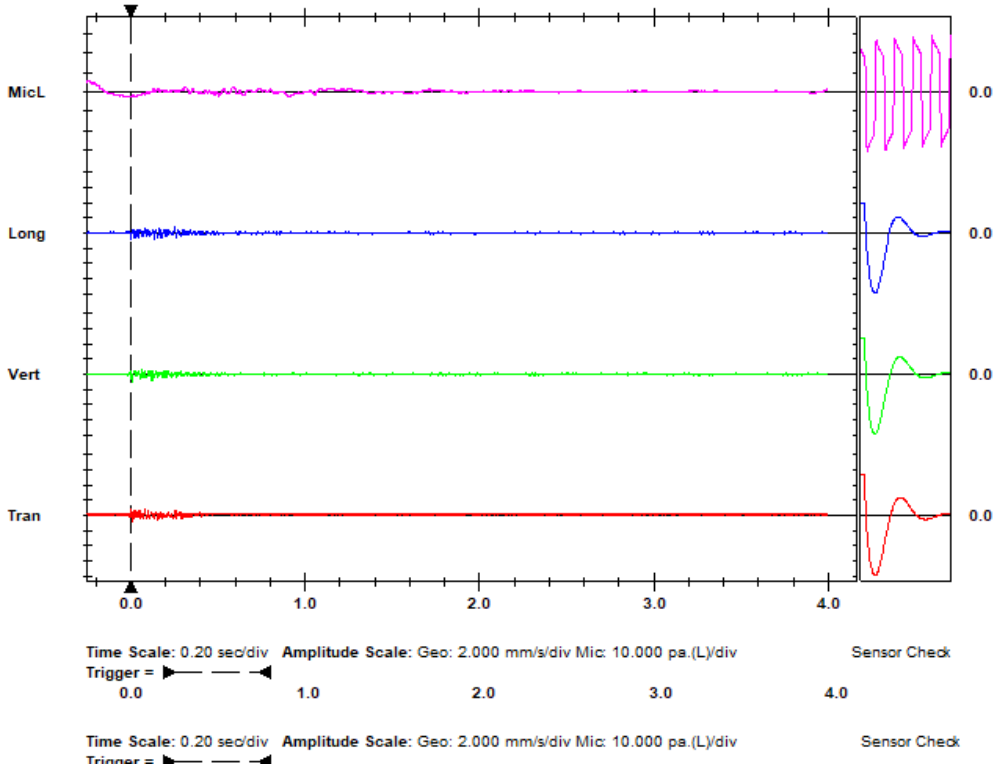
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 109.2 dB(L) at -0.245 sec
ZC Freq N/A
Channel Test Passed (Freq = 19.7 Hz Amp = 568 mv)

	Tran	Vert	Long	
PPV	0.889	1.016	0.762	mm/s
ZC Freq	57	51	64	Hz
Time (Rel. to Trig)	0.084	0.008	0.002	sec
Peak Acceleration	0.053	0.040	0.053	g
Peak Displacement	0.002	0.003	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	3.9	

Peak Vector Sum 1.114 mm/s at 0.002 sec
N/A: Not Applicable





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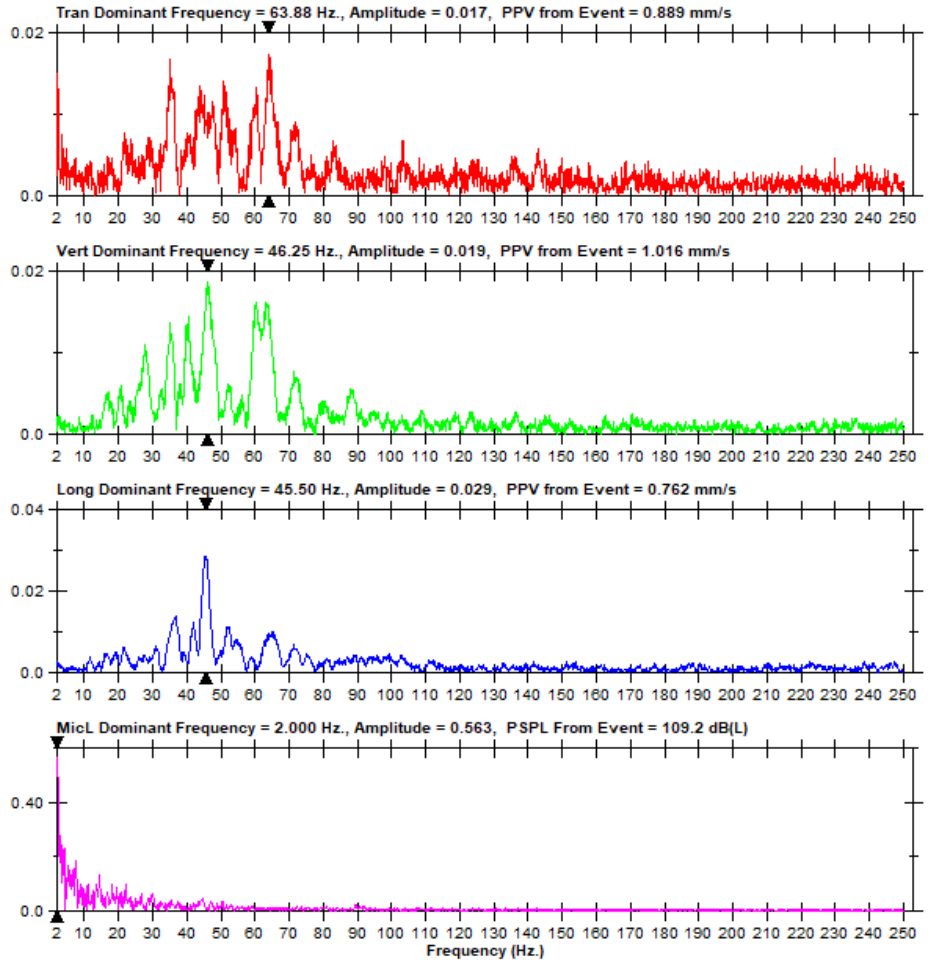
FFT Report

Date/Time	Vert at 13:20:55 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2L.2V0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg,
MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 119 m



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Event Report

Date/Time	Vert at 13:21:16 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103132116.IDFW

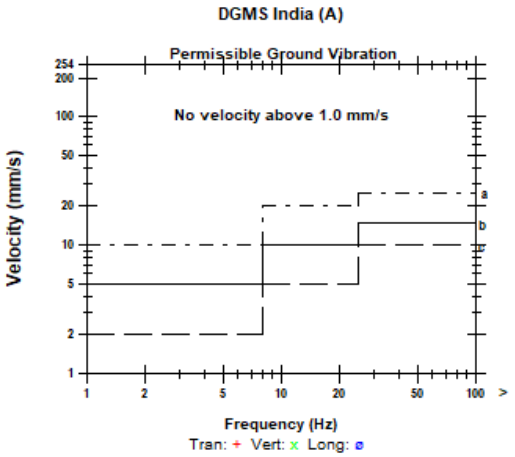
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

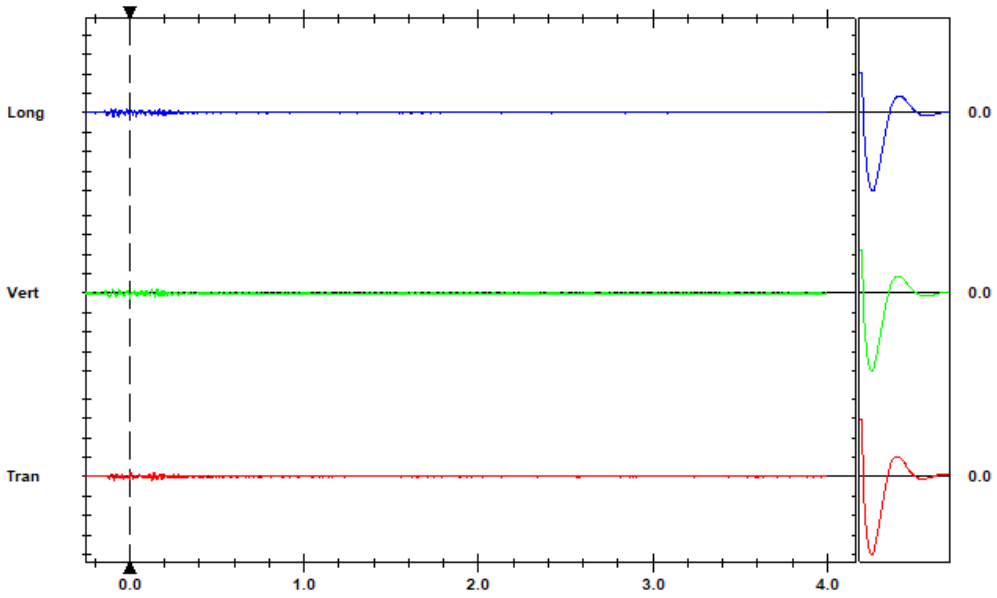
Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg, MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 183 m

	Tran	Vert	Long	
PPV	0.457	0.567	0.473	mm/s
ZC Freq	47	47	37	Hz
Time (Rel. to Trig)	0.142	0.001	-0.079	sec
Peak Acceleration	0.017	0.018	0.022	g
Peak Displacement	0.002	0.002	0.008	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 0.668 mm/s at -0.078 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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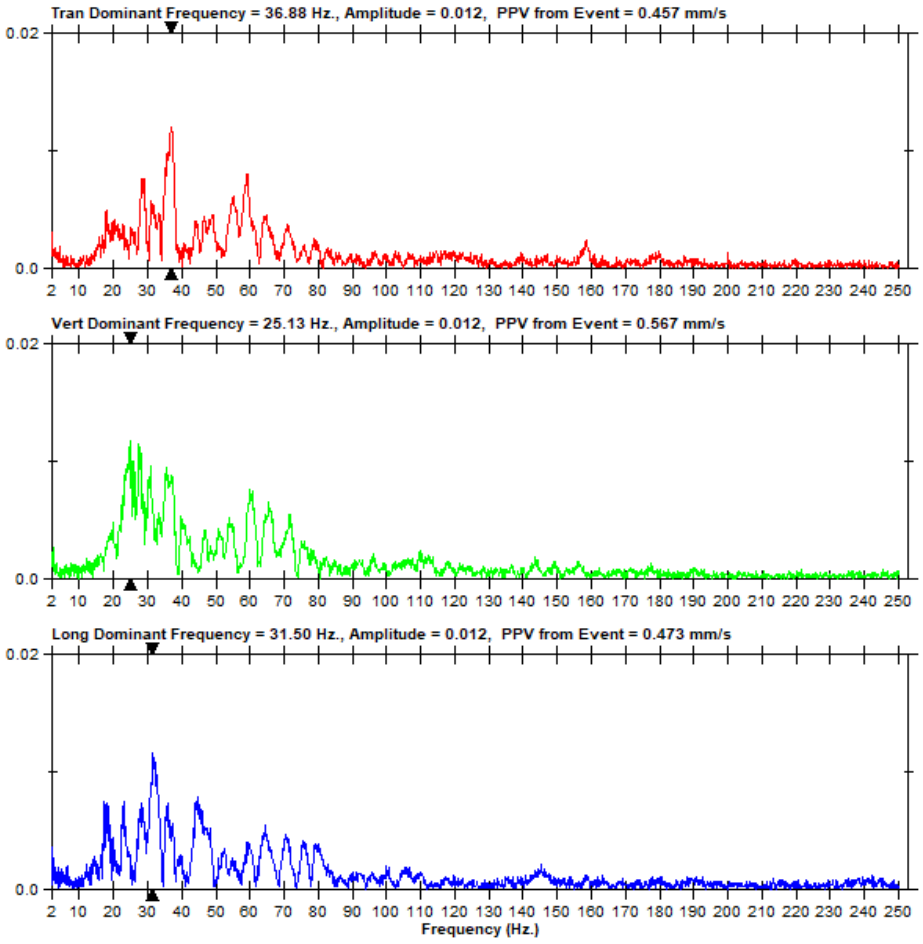
FFT Report

Date/Time	Vert at 13:21:16 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103132116.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg, MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 183 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 13:20:54 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2L.2U0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

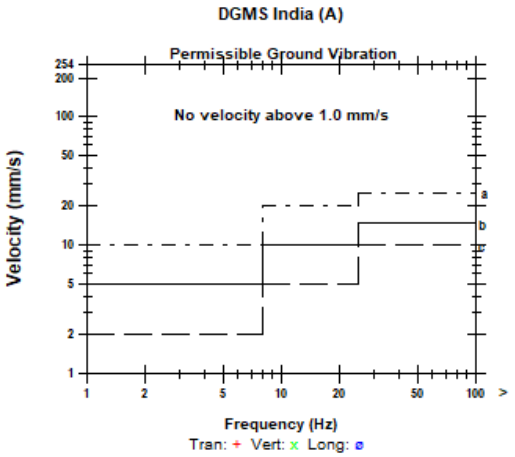
Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg, MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 280 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

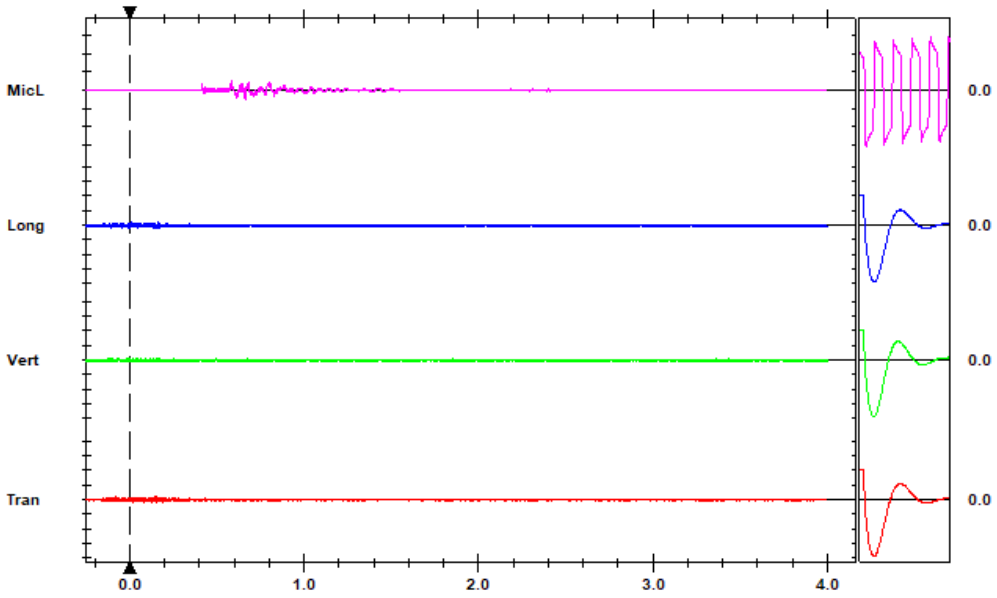
Microphone	Linear Weighting
PSPL	108.4 dB(L) at 0.584 sec
ZC Freq	22 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 511 mv)

	Tran	Vert	Long	
PPV	0.381	0.254	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	-0.083	-0.144	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.582 mm/s at 0.134 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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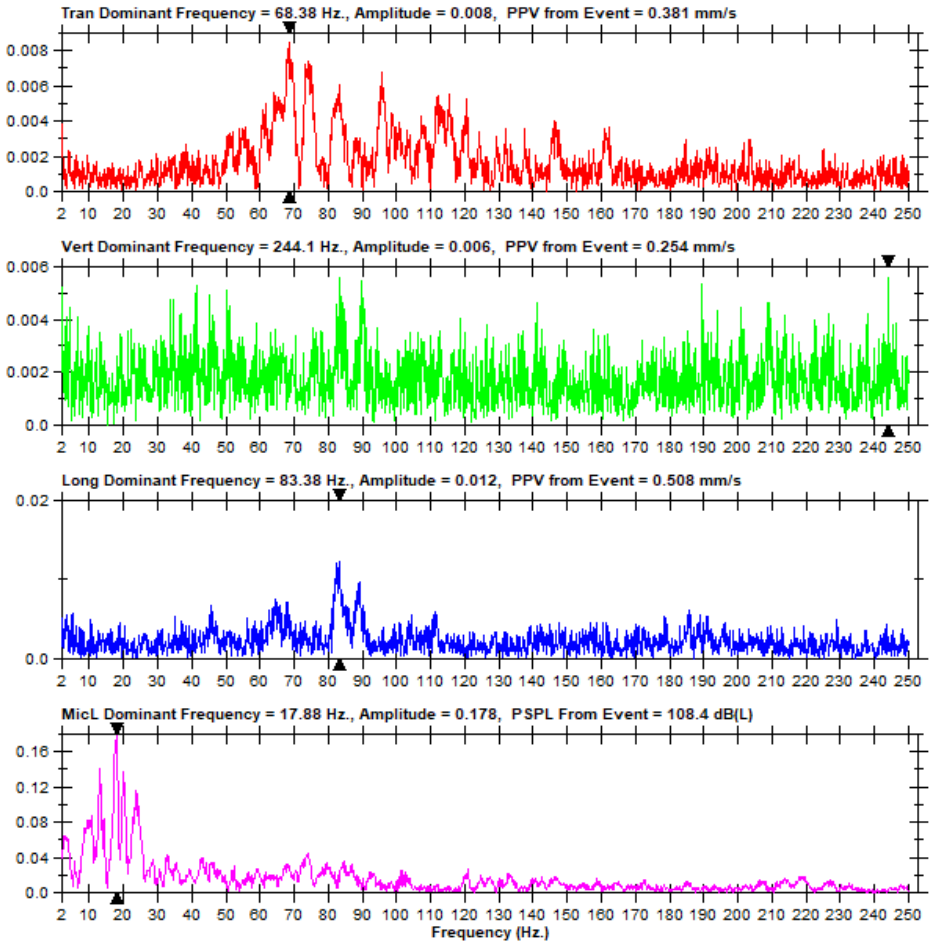
FFT Report

Date/Time	Long at 13:20:54 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2L.2U0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 2.4 m, Charge/hole - 0.650 Kg,
MCPD - 0.650 Kg, Total Charge - 9.750 Kg, Distance - 280 m



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Event Report

Date/Time Vert at 13:24:11 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

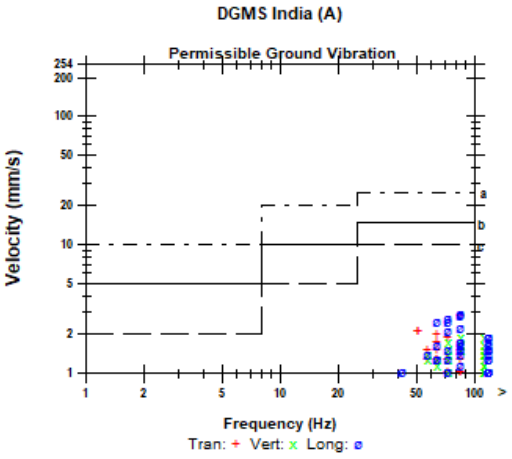
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

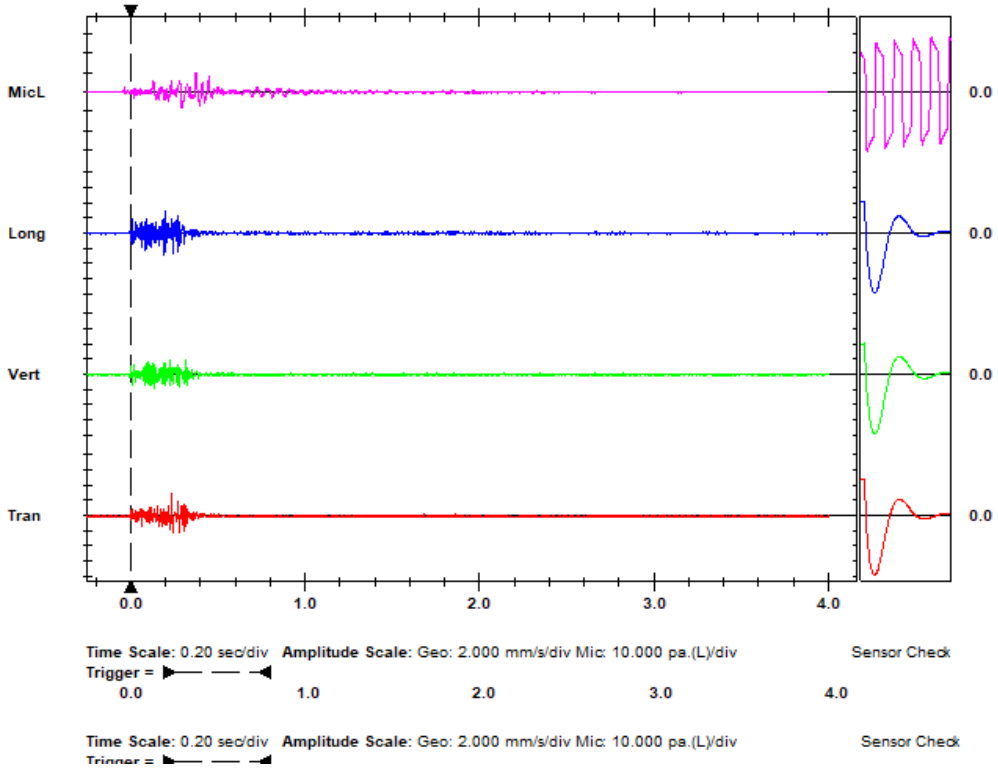
Microphone Linear Weighting
PSPL 113.8 dB(L) at 0.374 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	2.794	1.905	2.921	mm/s
ZC Freq	85	85	85	Hz
Time (Rel. to Trig)	0.235	0.134	0.196	sec
Peak Acceleration	0.133	0.133	0.172	g
Peak Displacement	0.006	0.004	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 3.448 mm/s at 0.196 sec

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2L.8B0
Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 50 m





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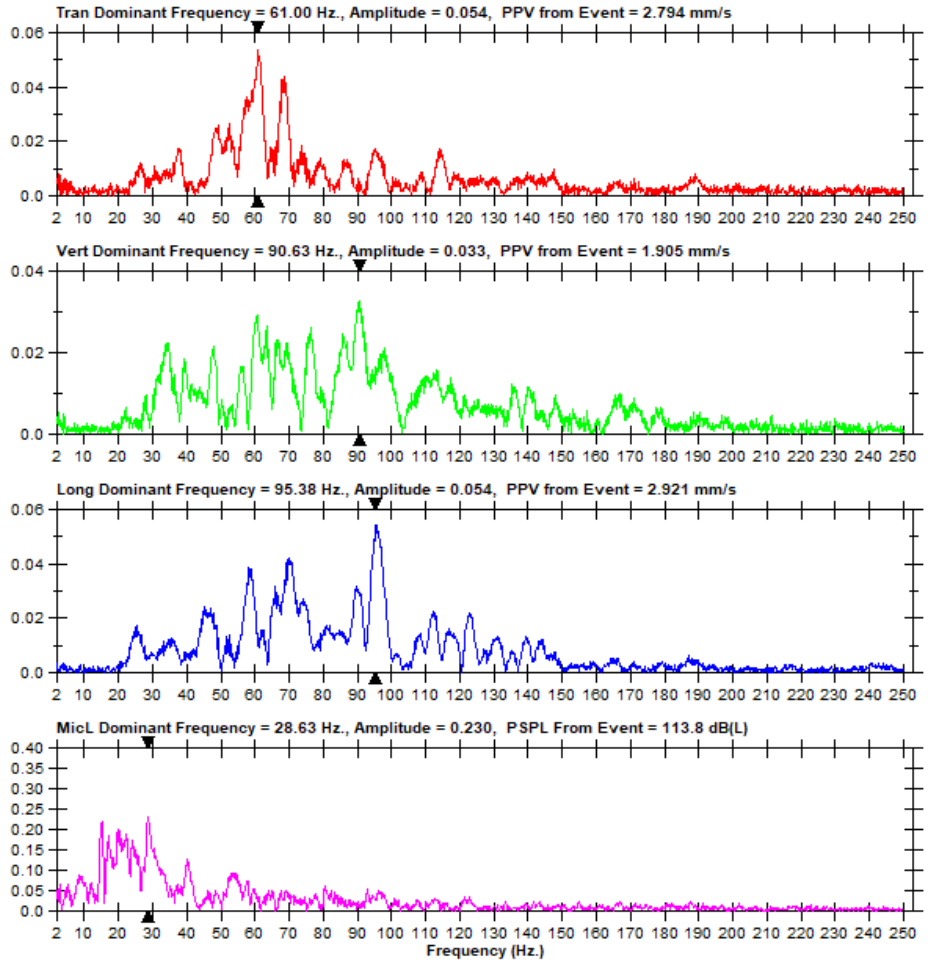
FFT Report

Date/Time	Vert at 13:24:11 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2L.8B0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 50 m



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Event Report

Date/Time Tran at 13:24:15 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2L.8F0
Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 108 m

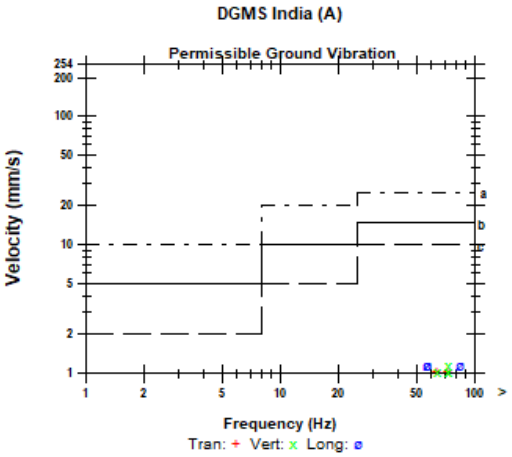
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

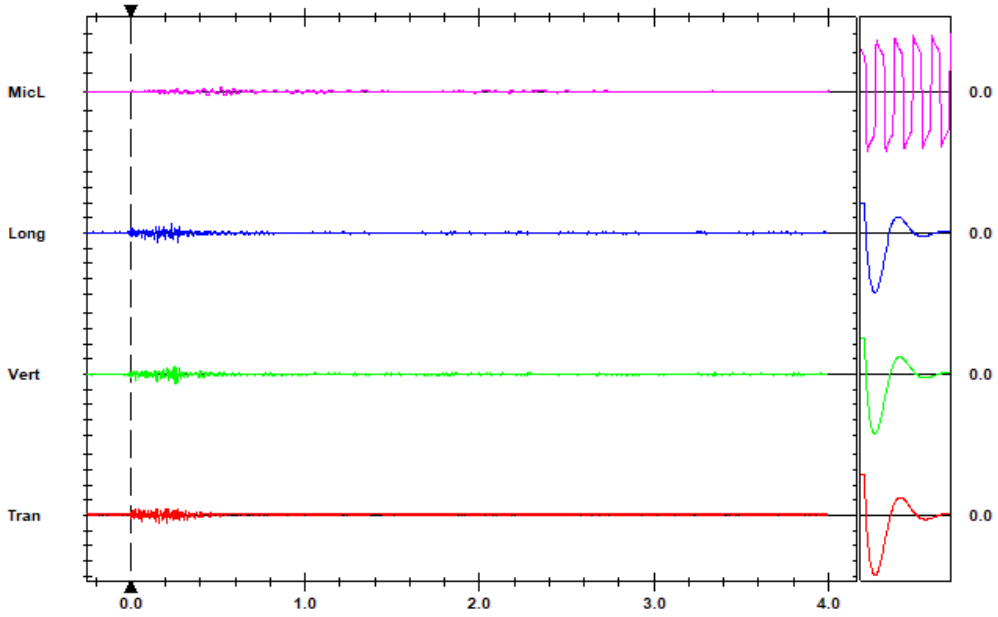
Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.518 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 559 mv)

	Tran	Vert	Long	
PPV	1.016	1.143	1.143	mm/s
ZC Freq	64	73	57	Hz
Time (Rel. to Trig)	0.162	0.257	0.156	sec
Peak Acceleration	0.066	0.053	0.066	g
Peak Displacement	0.002	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	4.0	

Peak Vector Sum 1.448 mm/s at 0.272 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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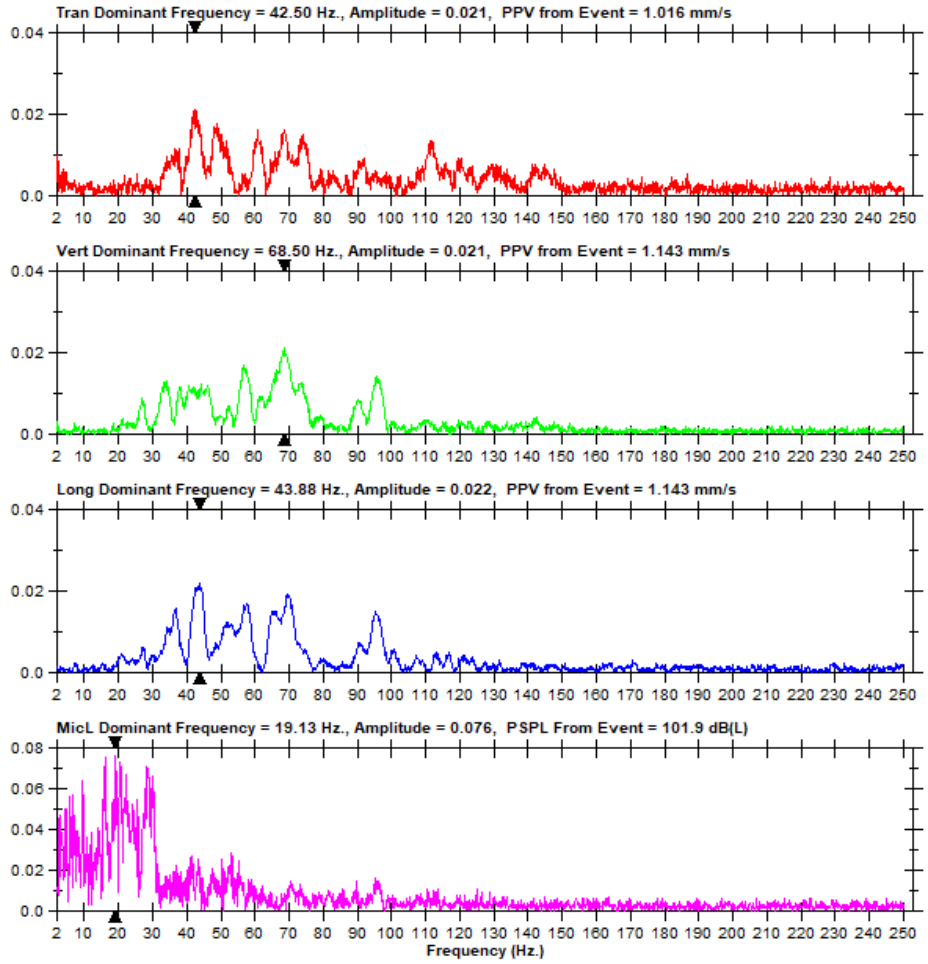
FFT Report

Date/Time	Tran at 13:24:15 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2L.8F0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 108 m



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Event Report

Date/Time	Vert at 13:24:35 January 3, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230103132435.IDFW

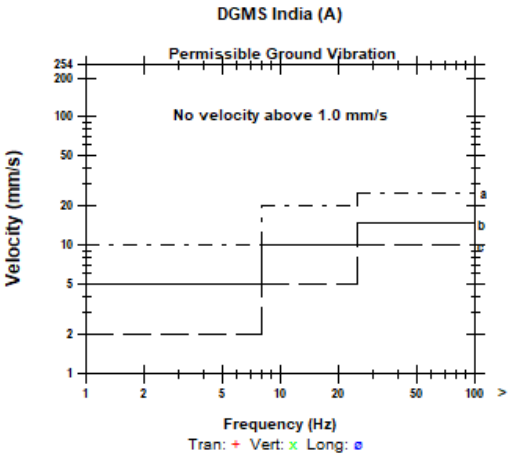
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

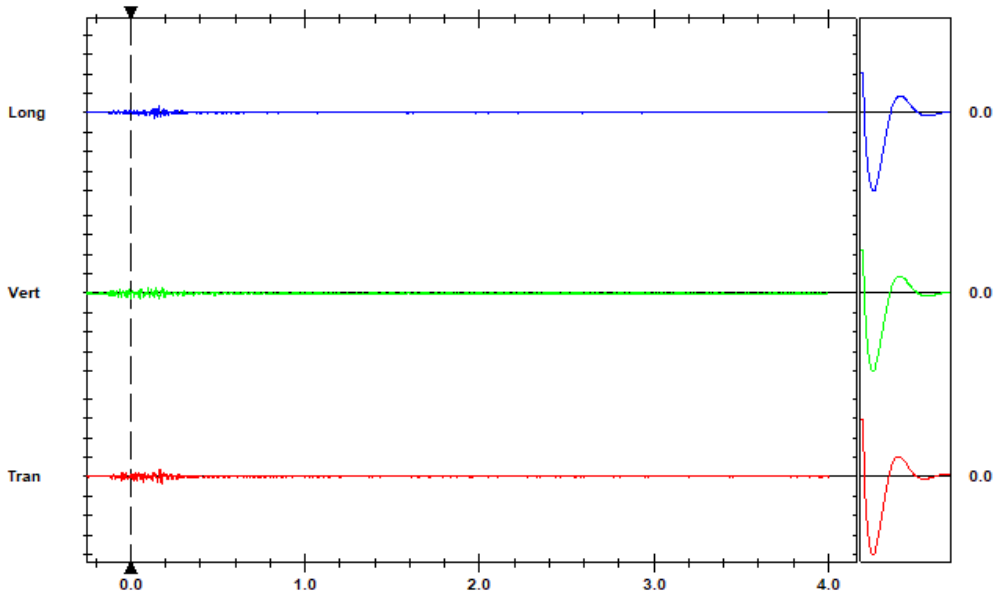
Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 165 m

	Tran	Vert	Long	
PPV	0.772	0.575	0.662	mm/s
ZC Freq	47	57	47	Hz
Time (Rel. to Trig)	0.179	0.001	0.161	sec
Peak Acceleration	0.034	0.034	0.027	g
Peak Displacement	0.003	0.002	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.2	5.1	5.2	

Peak Vector Sum 0.857 mm/s at 0.163 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

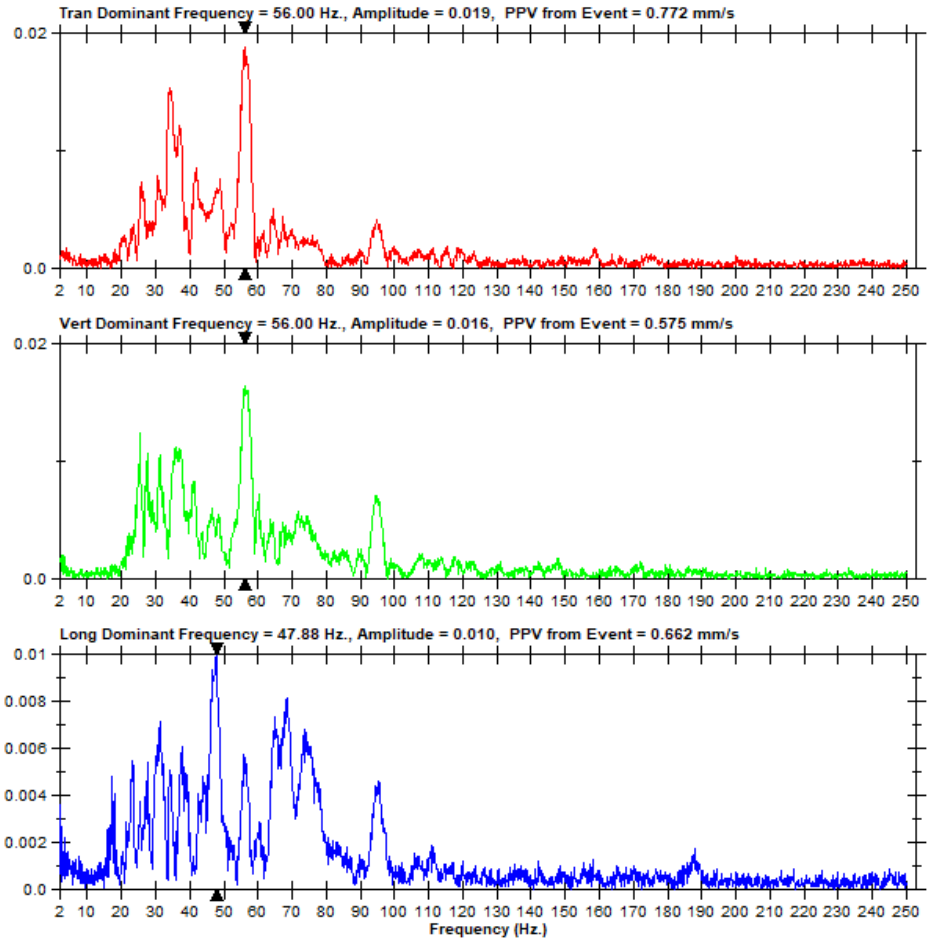
FFT Report

Date/Time	Vert at 13:24:35 January 3, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230103132435.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 165 m



Printed: February 21, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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Event Report

Date/Time	Tran at 13:24:14 January 3, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU2L.8E0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

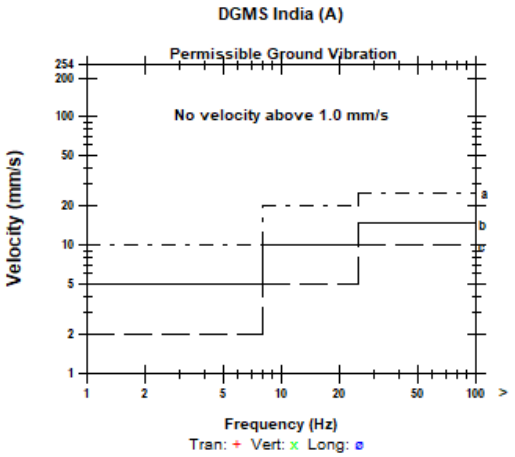
Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 290 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

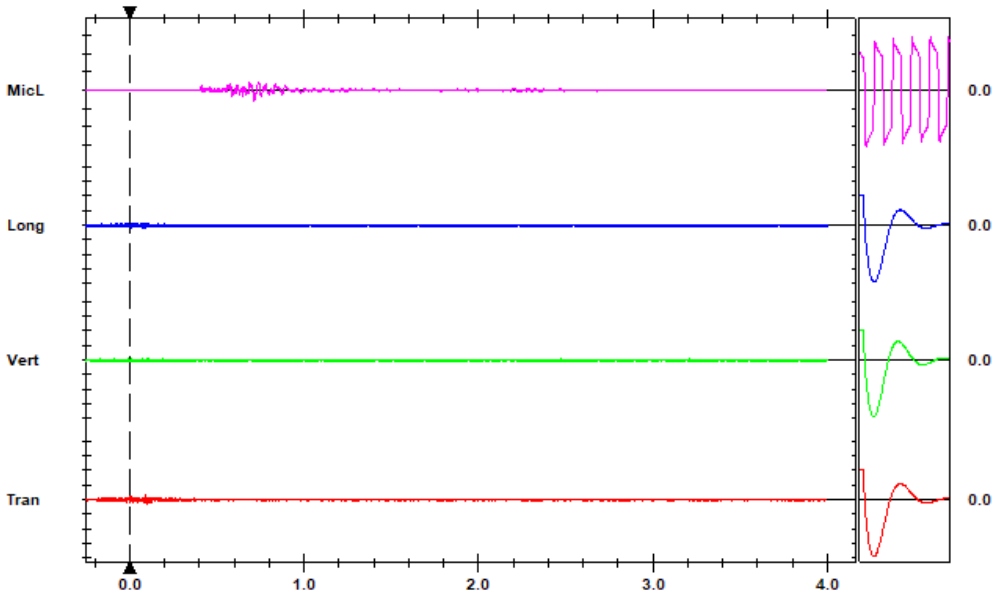
Microphone	Linear Weighting
PSPL	109.2 dB(L) at 0.716 sec
ZC Freq	20 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 498 mv)

	Tran	Vert	Long	
PPV	0.635	0.254	0.508	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.091	0.078	0.073	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.696 mm/s at 0.091 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

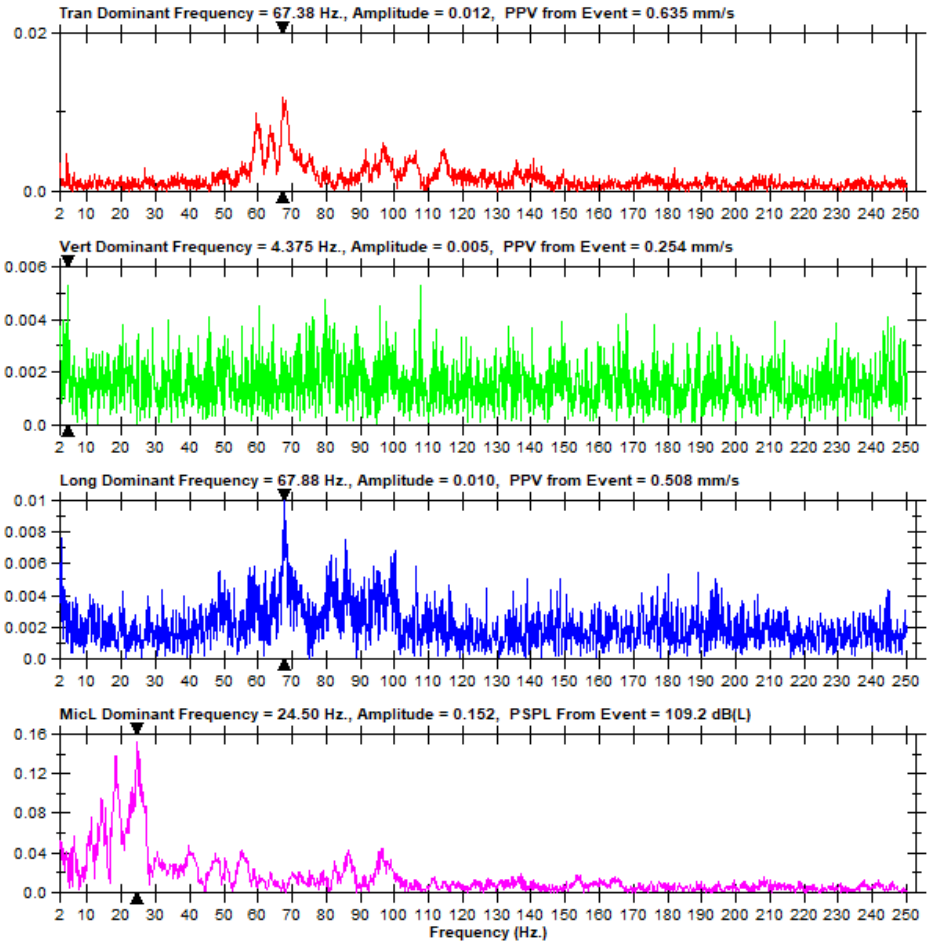
FFT Report

Date/Time	Tran at 13:24:14 January 3, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU2L.8E0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 17, Hole Depth - 1.8 m, Charge/hole - 0.422 Kg, MCPD - 0.425 Kg, Total Charge - 7.175 Kg, Distance - 290 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 13:27:27 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JU2L.DR0
Post Event Notes
Total No. of holes - 14, Hole Depth - 1.8 m, Charge/hole - 0.378 Kg, MCPD - 0.425 Kg, Total Charge - 5.30 Kg, Distance - 42 m

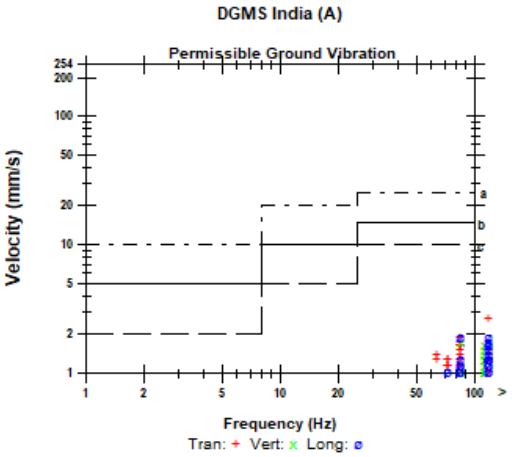
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

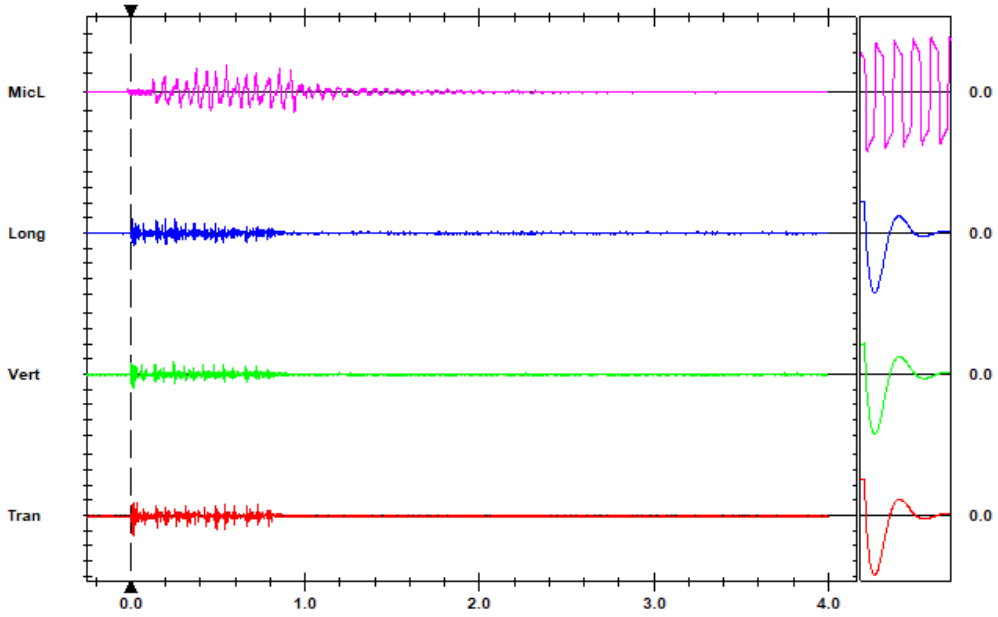
Microphone Linear Weighting
PSPL 116.6 dB(L) at 0.551 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 470 mv)

	Tran	Vert	Long	
PPV	2.667	1.778	1.905	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.016	0.016	0.012	sec
Peak Acceleration	0.159	0.146	0.133	g
Peak Displacement	0.004	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.7	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 3.497 mm/s at 0.016 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

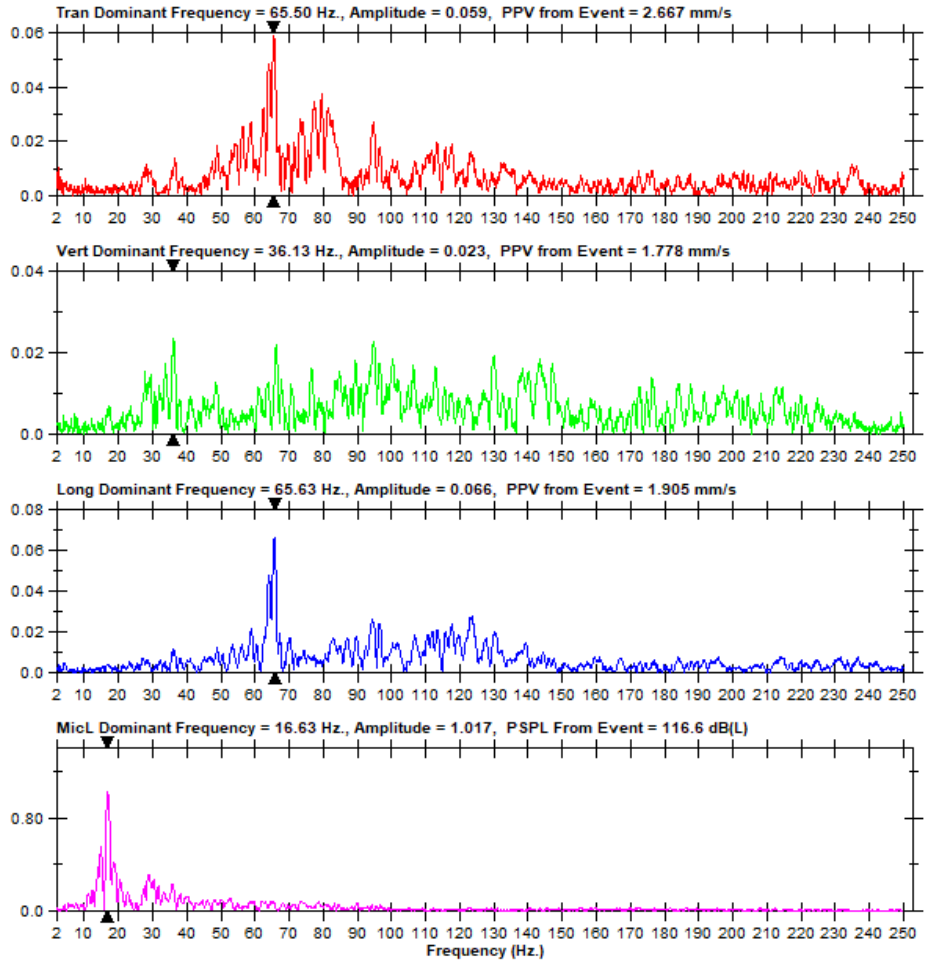
FFT Report

Date/Time	Vert at 13:27:27 January 3, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JU2L.DR0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg, CSIR-CIMFR,
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 14, Hole Depth - 1.8 m, Charge/hole - 0.378 Kg, MCPD - 0.425 Kg, Total Charge - 5.30 Kg, Distance - 42 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 13:27:30 January 3, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU2L.DU0
Post Event Notes
Total No. of holes - 14, Hole Depth - 1.8 m, Charge/hole - 0.378 Kg, MCPD - 0.425 Kg, Total Charge - 5.30 Kg, Distance - 99 m

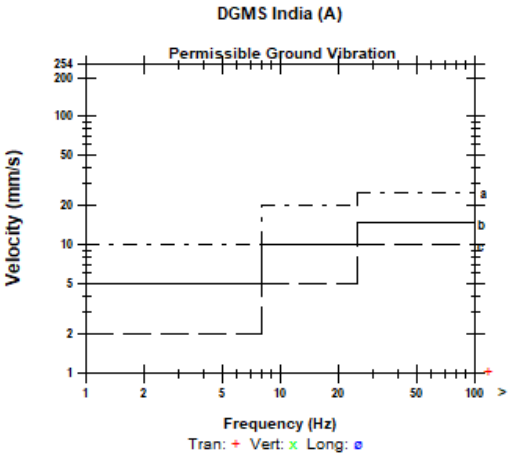
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

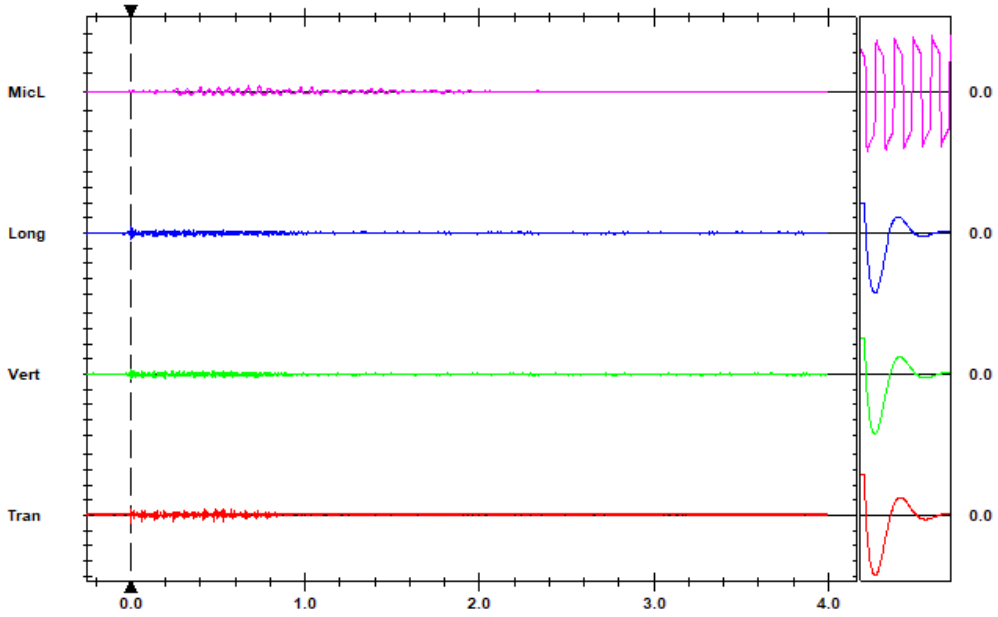
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 104.2 dB(L) at 0.736 sec
ZC Freq 22 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 577 mv)

	Tran	Vert	Long	
PPV	1.016	0.635	0.762	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.004	0.001	0.001	sec
Peak Acceleration	0.080	0.040	0.066	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.8	Hz
Overswing Ratio	3.5	3.8	3.9	

Peak Vector Sum 1.332 mm/s at 0.001 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

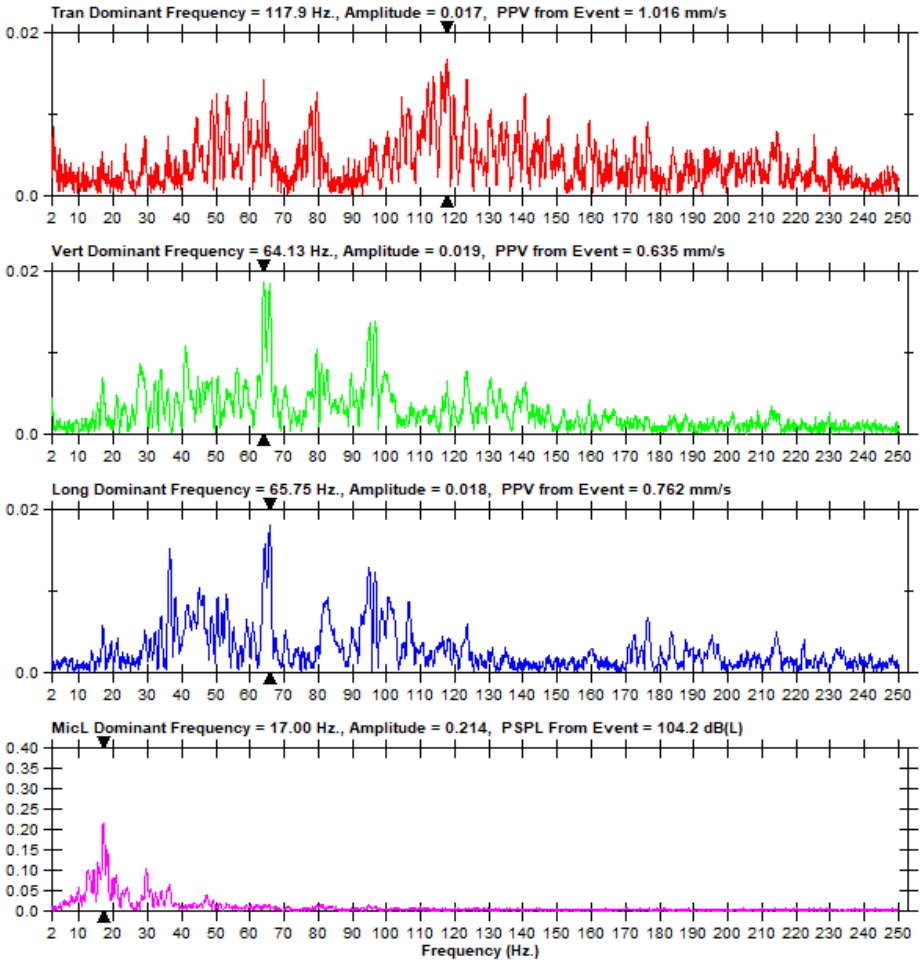
FFT Report

Date/Time	Tran at 13:27:30 January 3, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU2L.DU0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 14, Hole Depth - 1.8 m, Charge/hole - 0.378 Kg, MCPD - 0.425 Kg, Total Charge - 5.30 Kg, Distance - 99 m



Printed: February 21, 2023 (V 10.72 - 10.72)

ANNEXURE-6

Event and FFT Reports of Ground Vibration Recorded at Granite Stone Quarry of M/s Blue Metal Industries Limited, Kottayam District

Instantel

Event Report

Date/Time Vert at 17:03:38 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

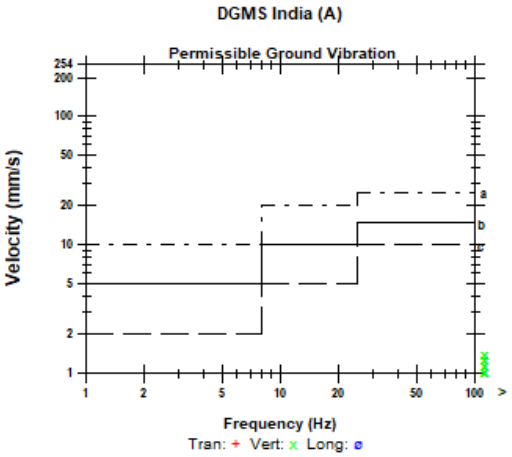
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 116.1 dB(L) at 0.938 sec
ZC Freq 12 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 459 mv)

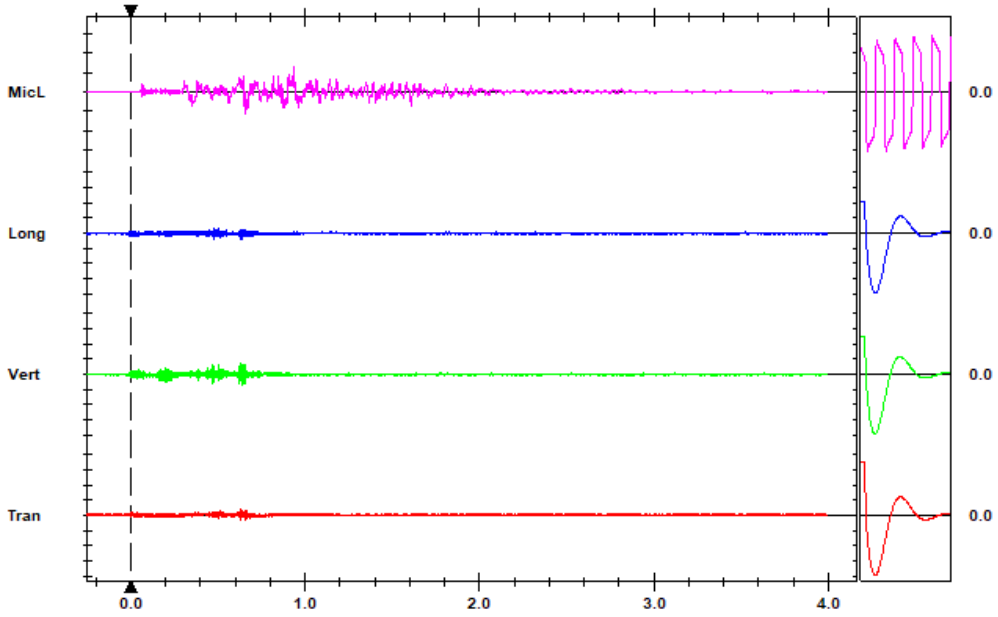
	Tran	Vert	Long	
PPV	0.762	1.397	0.889	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.632	0.628	0.630	sec
Peak Acceleration	0.080	0.172	0.080	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.3	Hz
Overswing Ratio	3.4	3.6	3.8	

Peak Vector Sum 1.636 mm/s at 0.643 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8F.E20
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 126 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

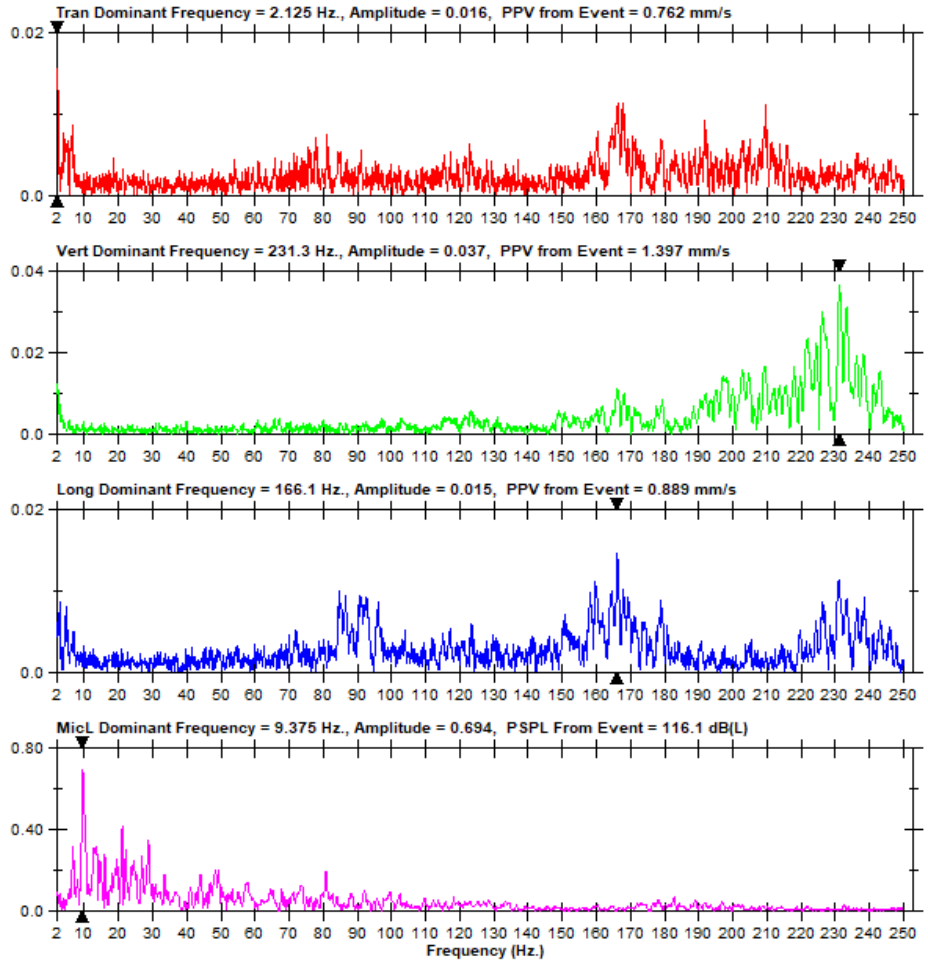
FFT Report

Date/Time	Vert at 17:03:38 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8F.E20

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 126 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 17:03:34 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8F.DY0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 159 m

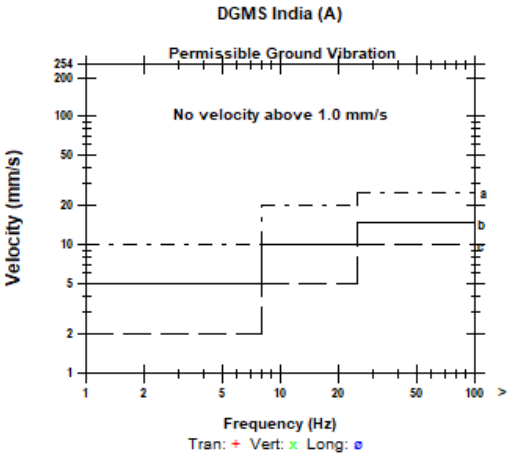
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

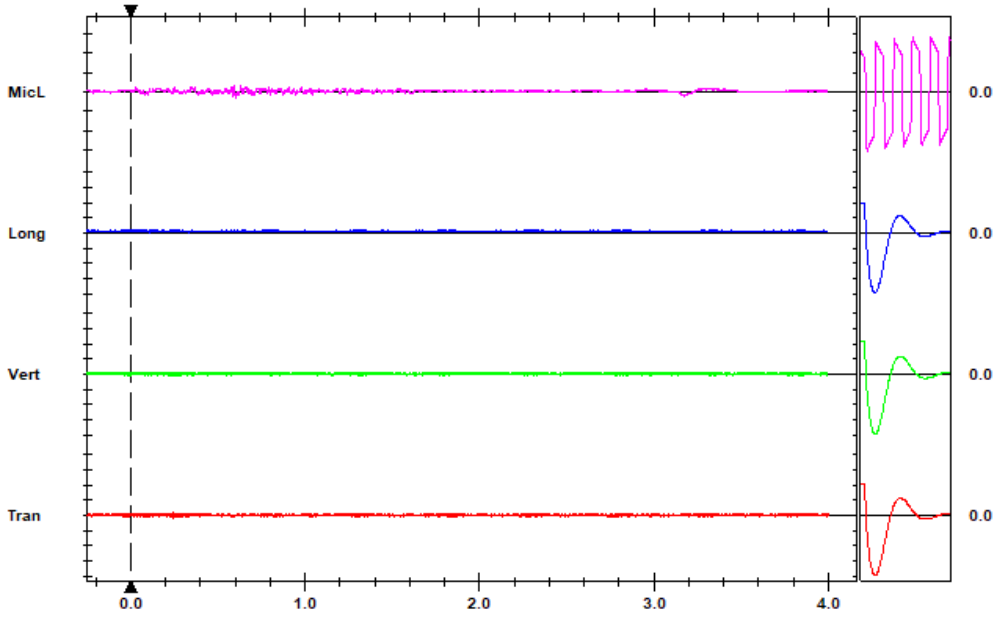
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.604 sec
ZC Freq 43 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.508	mm/s
ZC Freq	>100	>100	73	Hz
Time (Rel. to Trig)	0.247	0.054	0.000	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.000	0.000	0.012	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.648 mm/s at 0.247 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

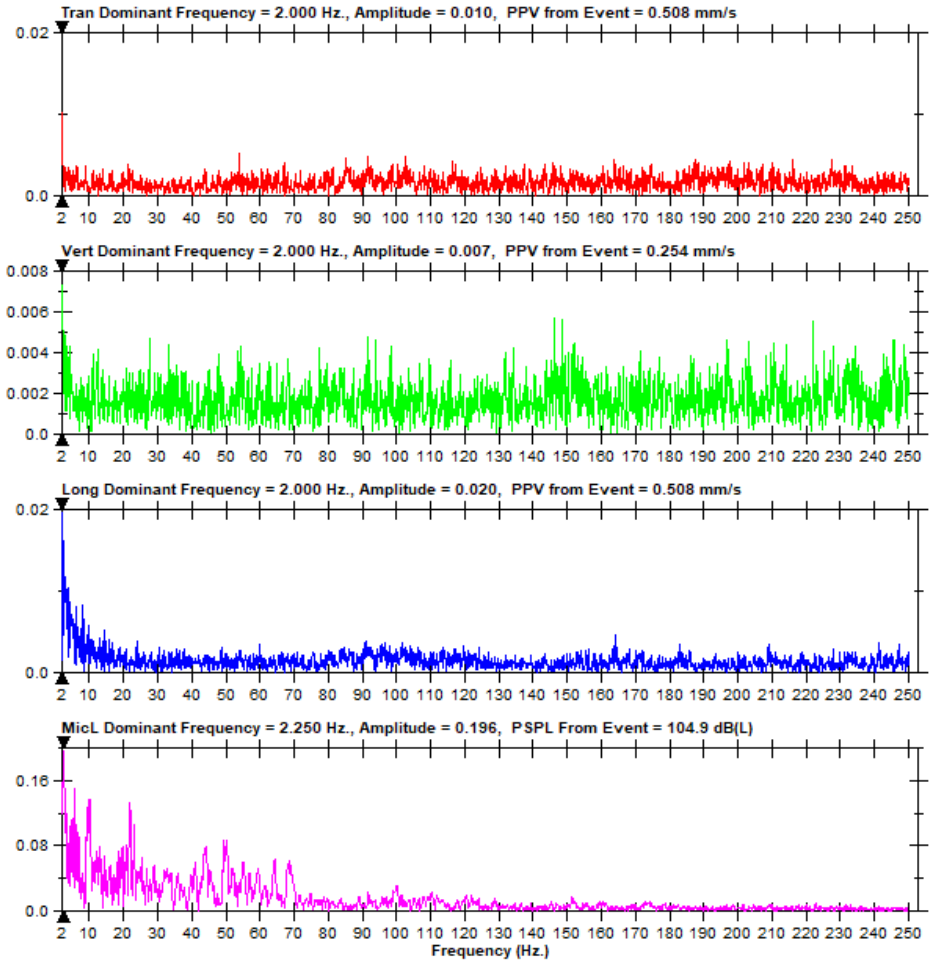
FFT Report

Date/Time	Long at 17:03:34 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8F.DY0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 159 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 17:03:19 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

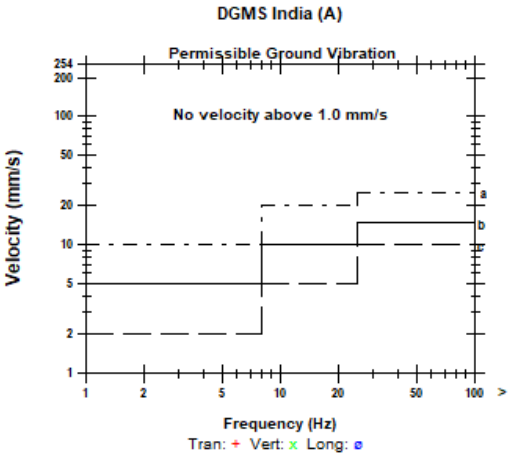
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

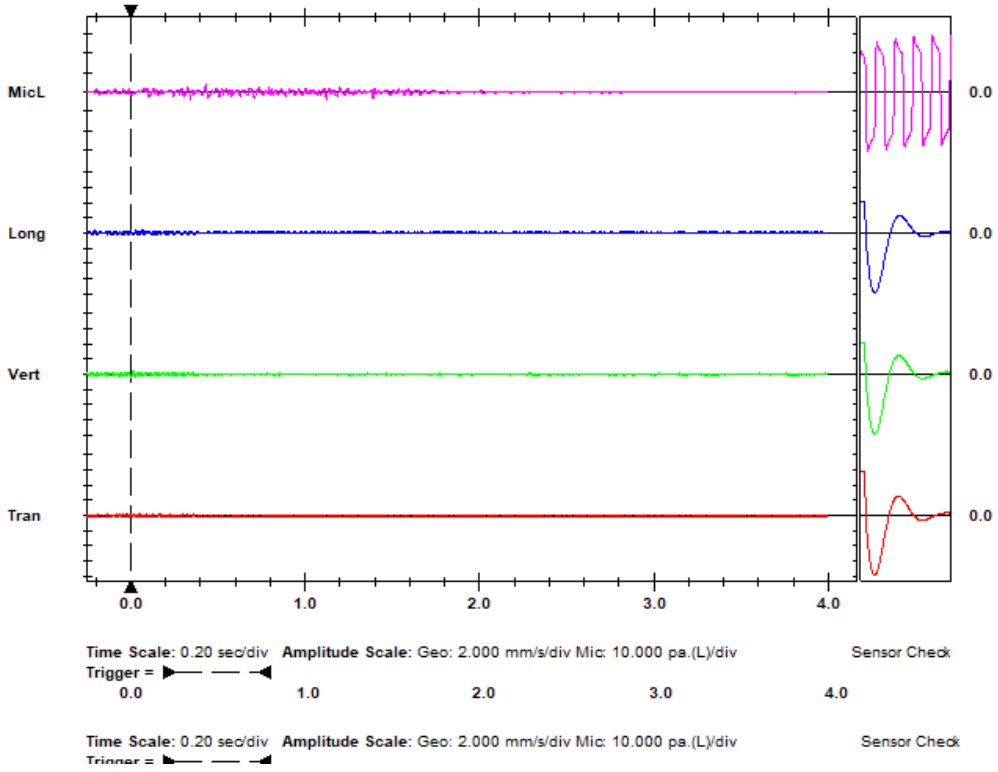
Microphone Linear Weighting
PSPL 106.5 dB(L) at 1.123 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 451 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.381	mm/s
ZC Freq	>100	51	51	Hz
Time (Rel. to Trig)	-0.240	0.000	-0.209	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.9	7.7	7.5	Hz
Overswing Ratio	3.3	3.5	3.7	

Peak Vector Sum 0.582 mm/s at 0.001 sec

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JU8F.DJ0
Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 164 m





Instantel

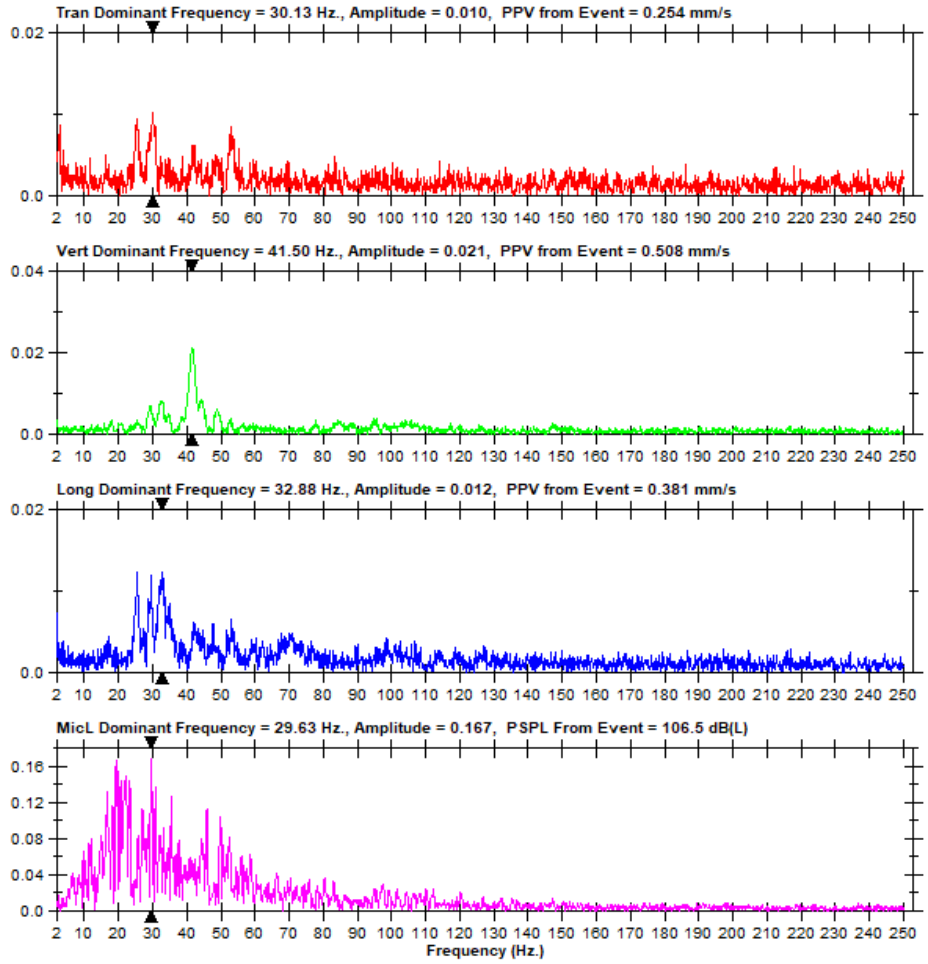
FFT Report

Date/Time	Vert at 17:03:19 January 6, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JU8F.DJ0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Rock Excavation Engineering
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 30, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 7.50 Kg, Distance - 164 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 17:11:17 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8F.QT0
Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 34 m

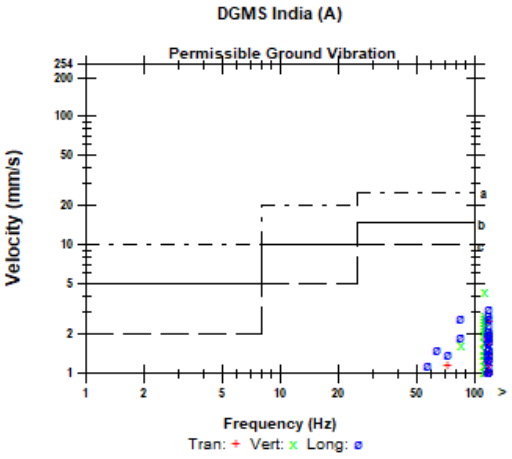
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

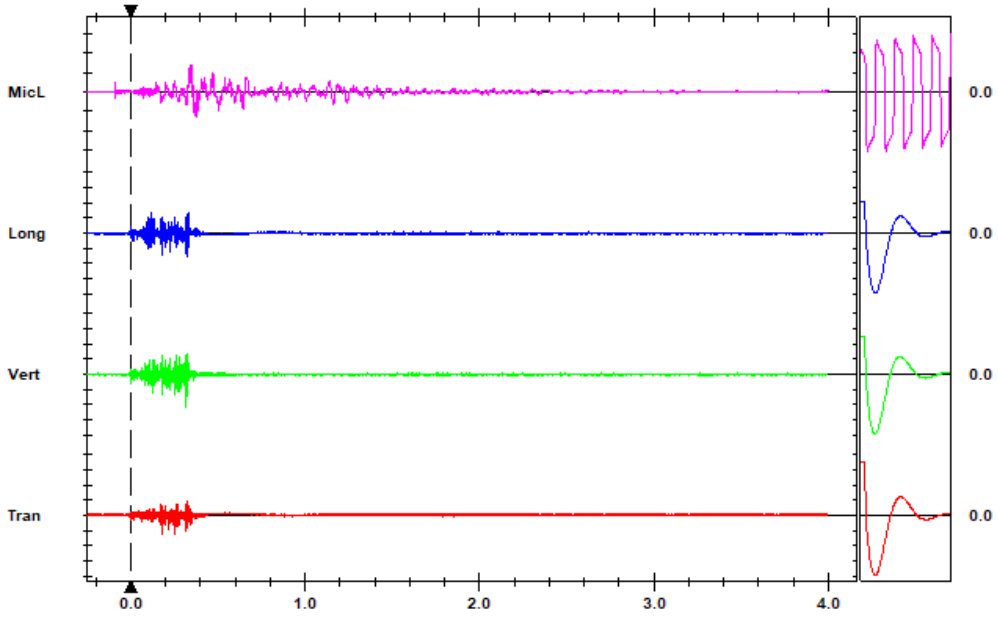
Microphone Linear Weighting
PSPL 116.9 dB(L) at 0.347 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 501 mv)

	Tran	Vert	Long	
PPV	2.540	4.318	3.175	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.181	0.316	0.321	sec
Peak Acceleration	0.212	0.398	0.239	g
Peak Displacement	0.007	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.3	Hz
Overswing Ratio	3.5	3.7	3.8	

Peak Vector Sum 5.145 mm/s at 0.316 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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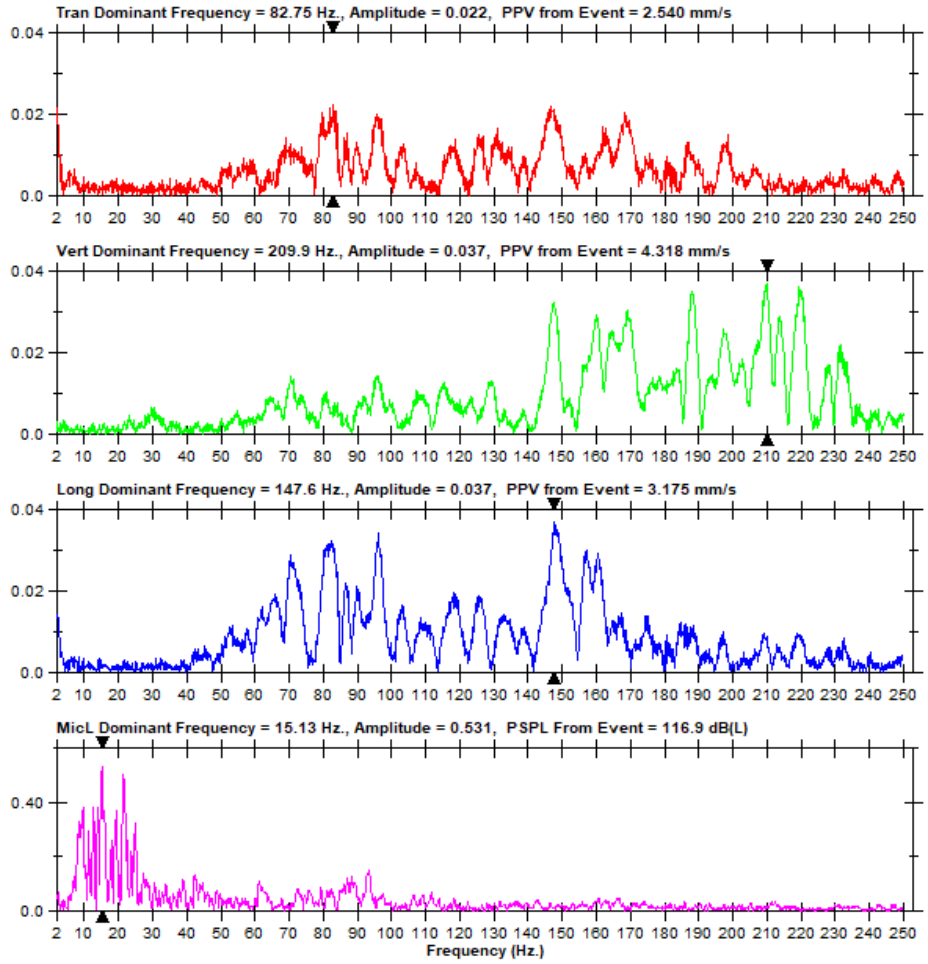
FFT Report

Date/Time	Vert at 17:11:17 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8F.QT0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 34 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 17:11:13 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8F.QP0
Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 69 m

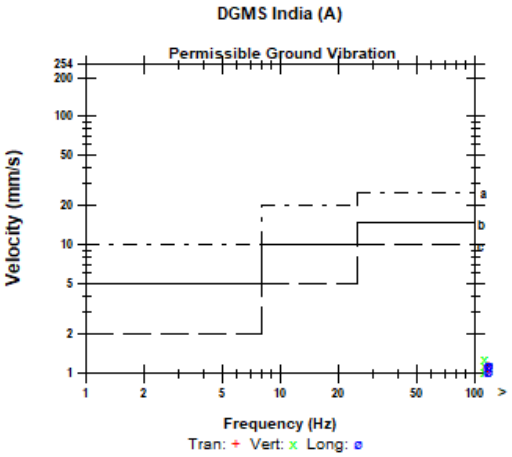
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

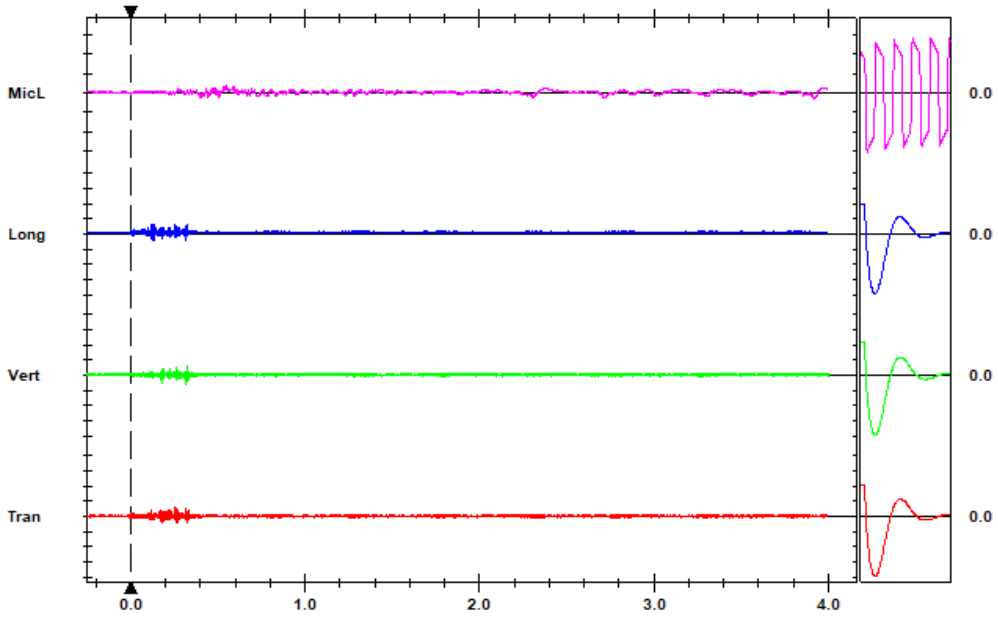
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.550 sec
ZC Freq 6.9 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.143	1.270	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.257	0.325	0.117	sec
Peak Acceleration	0.080	0.080	0.093	g
Peak Displacement	0.002	0.002	0.031	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.374 mm/s at 0.317 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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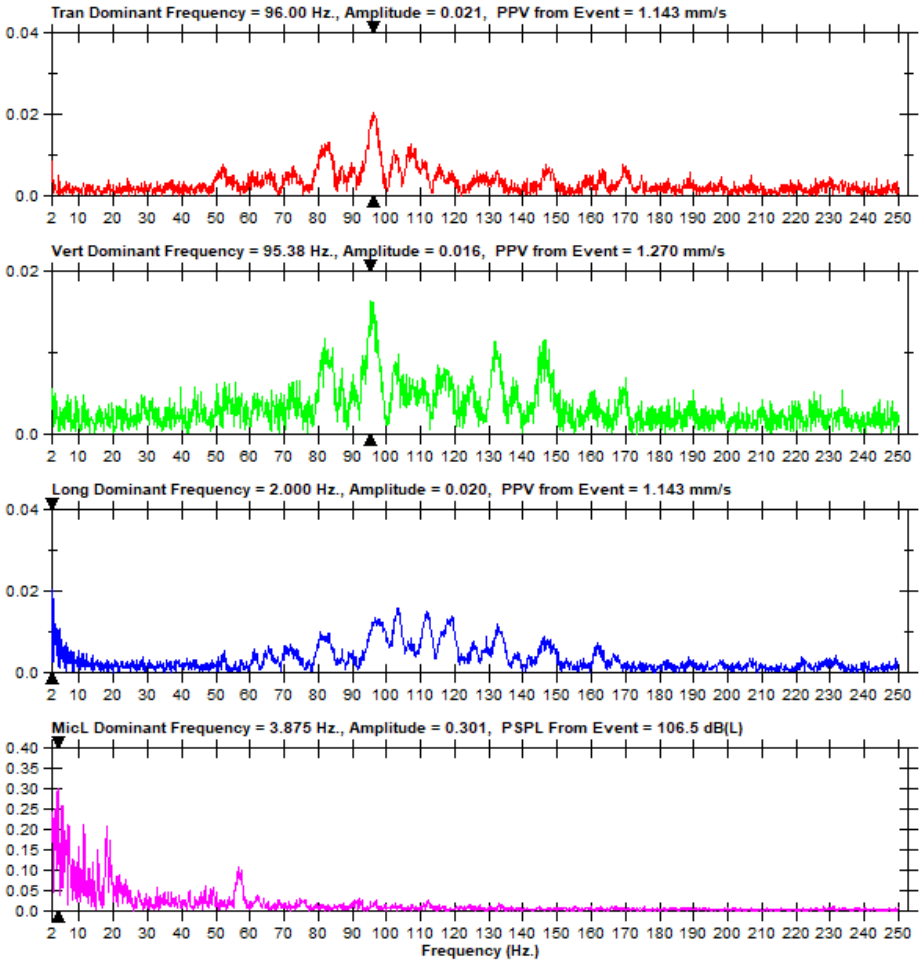
FFT Report

Date/Time	Long at 17:11:13 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8F.QP0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 69 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 17:11:49 January 6, 2023
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20230106171149.IDFW

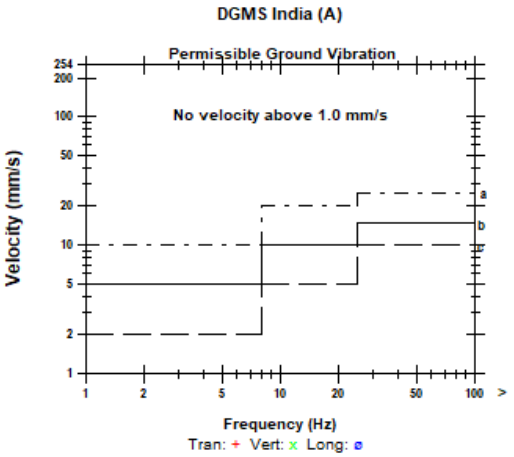
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 93 m

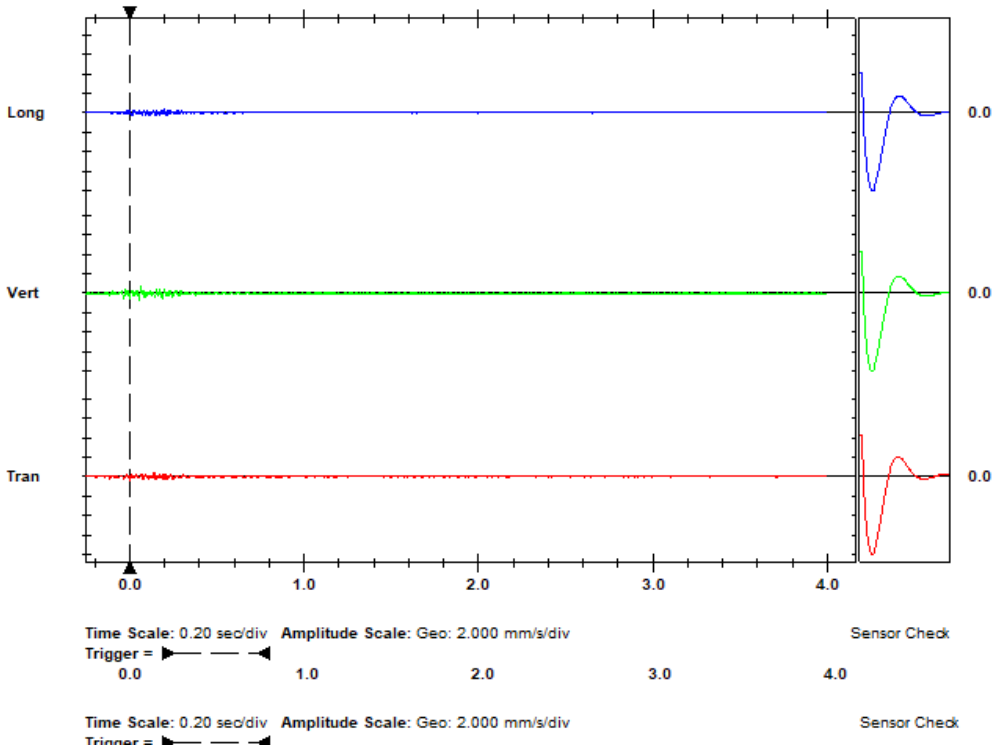
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.363	0.670	0.363	mm/s
ZC Freq	43	51	64	Hz
Time (Rel. to Trig)	0.142	0.065	0.200	sec
Peak Acceleration	0.016	0.022	0.021	g
Peak Displacement	0.002	0.003	0.010	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.700 mm/s at 0.055 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



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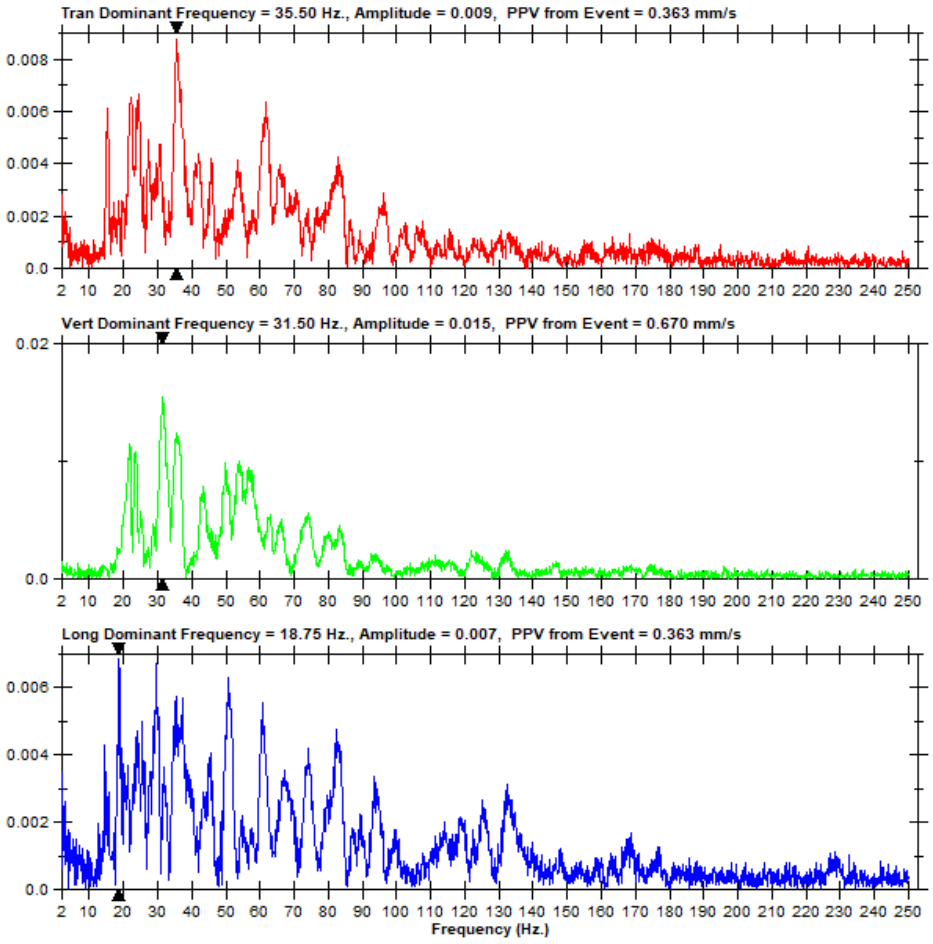
FFT Report

Date/Time	Vert at 17:11:49 January 6, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230106171149.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 4.00 Kg, Distance - 93 m



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Event Report

Date/Time Vert at 17:13:41 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8F.UT0
Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 55 m

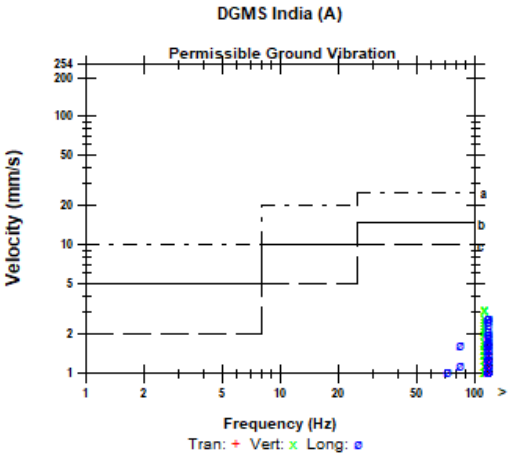
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

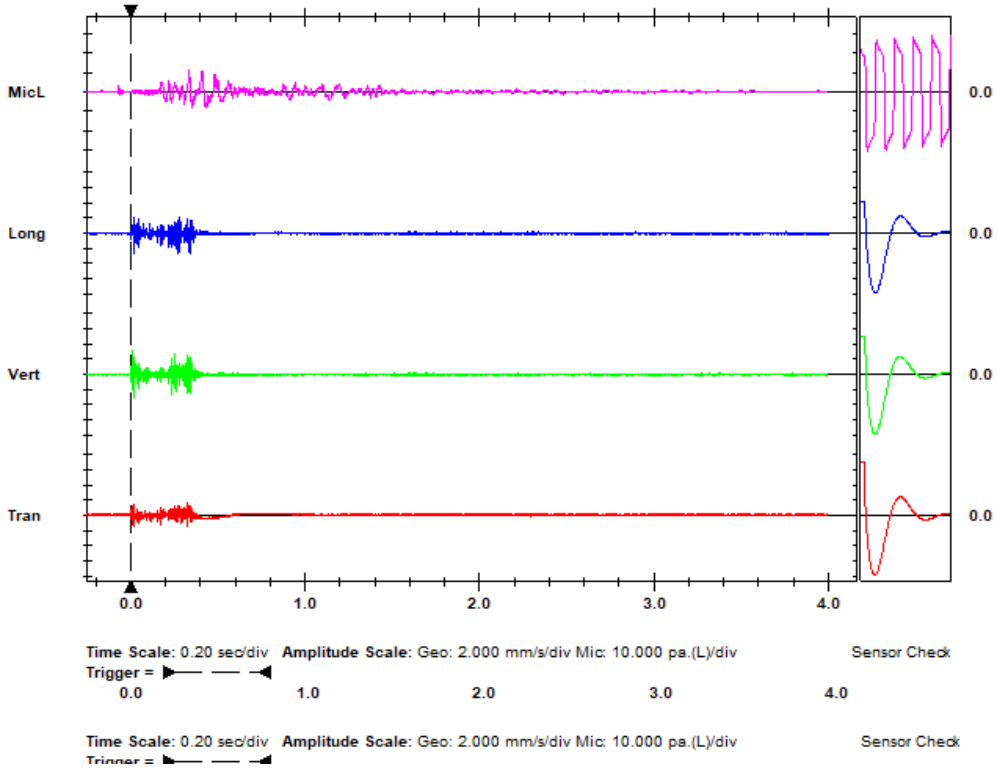
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 115.0 dB(L) at 0.333 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	1.651	3.175	2.667	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.324	0.017	0.017	sec
Peak Acceleration	0.159	0.345	0.252	g
Peak Displacement	0.021	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.3	Hz
Overswing Ratio	3.5	3.7	3.8	

Peak Vector Sum 4.376 mm/s at 0.017 sec





Instantel

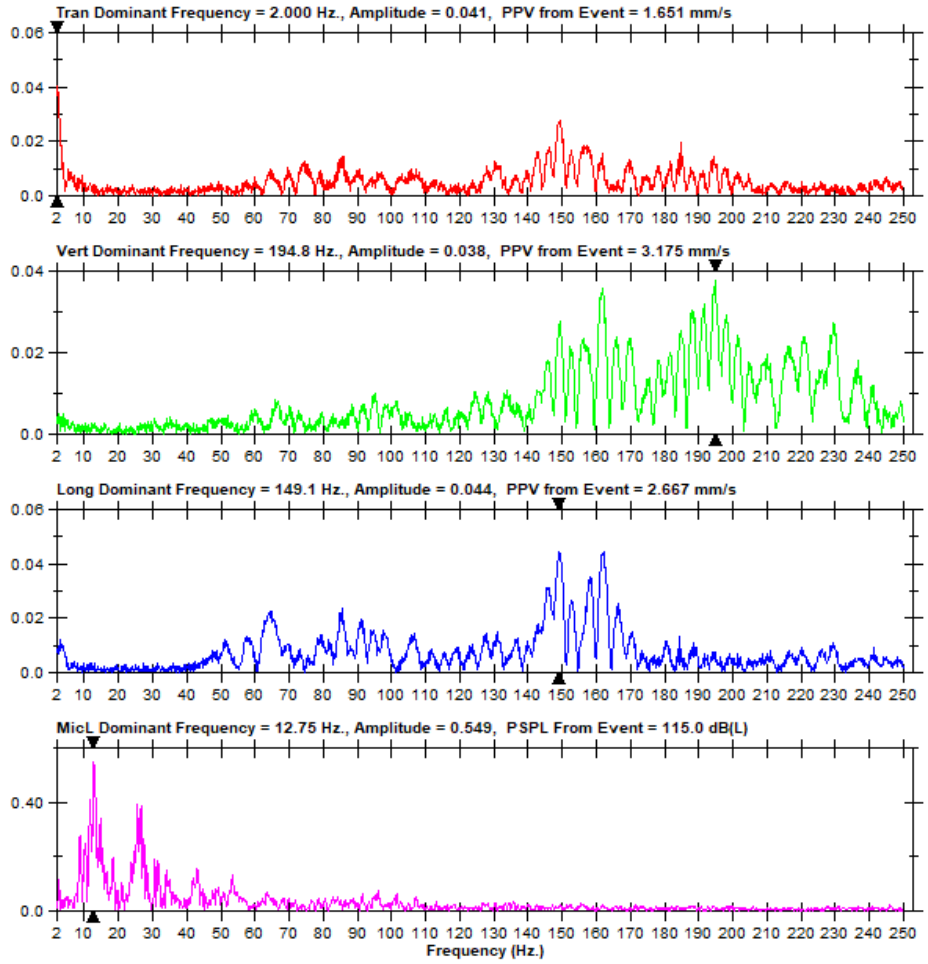
FFT Report

Date/Time	Vert at 17:13:41 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8F.UT0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 55 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 17:13:37 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

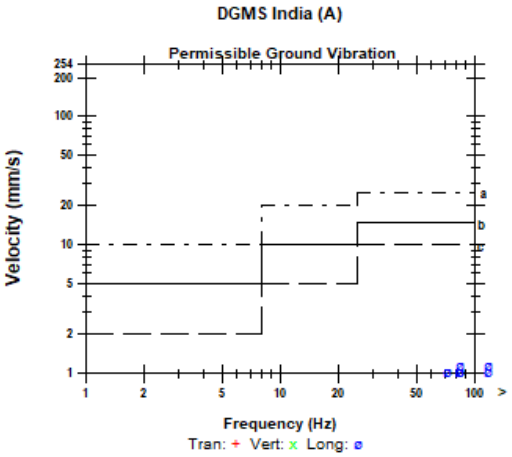
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

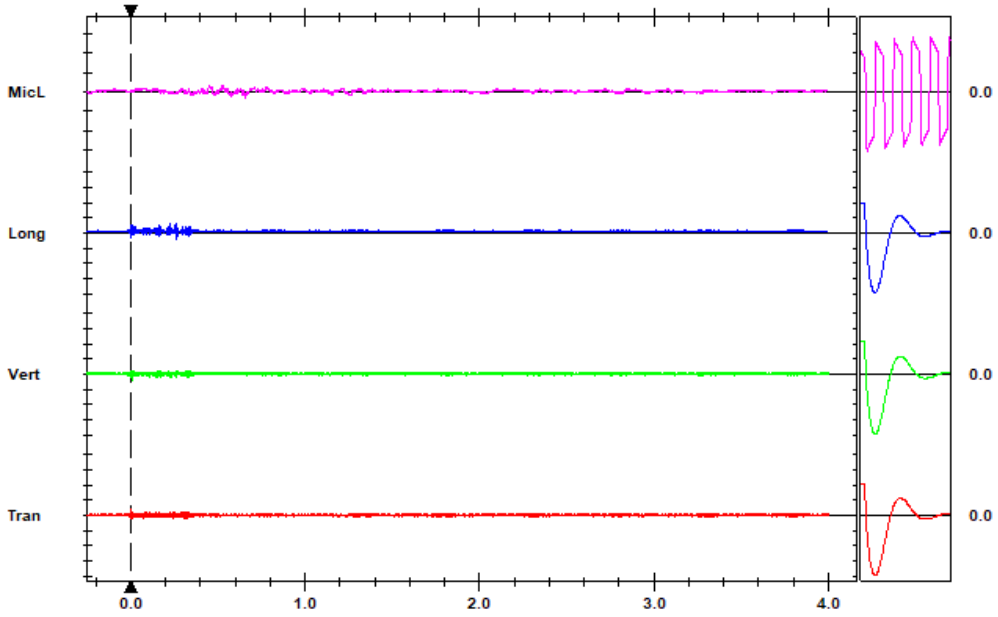
Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.449 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.006	0.008	0.224	sec
Peak Acceleration	0.066	0.066	0.093	g
Peak Displacement	0.001	0.001	0.021	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.178 mm/s at 0.264 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8F.UP0
Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 94 m





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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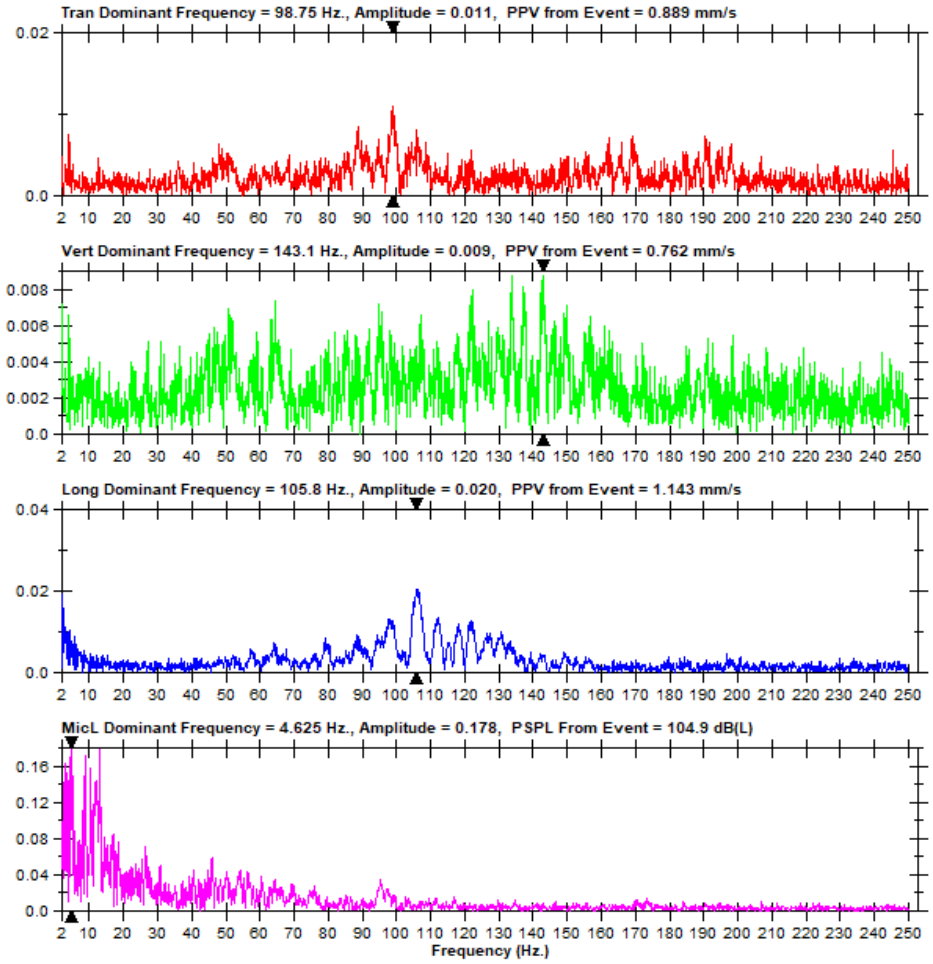
FFT Report

Date/Time	Long at 17:13:37 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8F.UP0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 94 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 17:14:13 January 6, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230106171413.IDFW

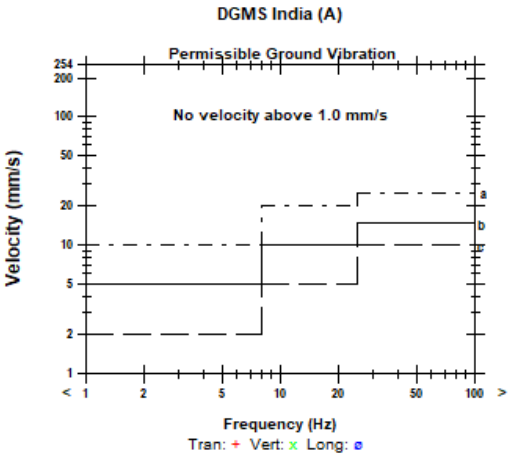
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 115 m

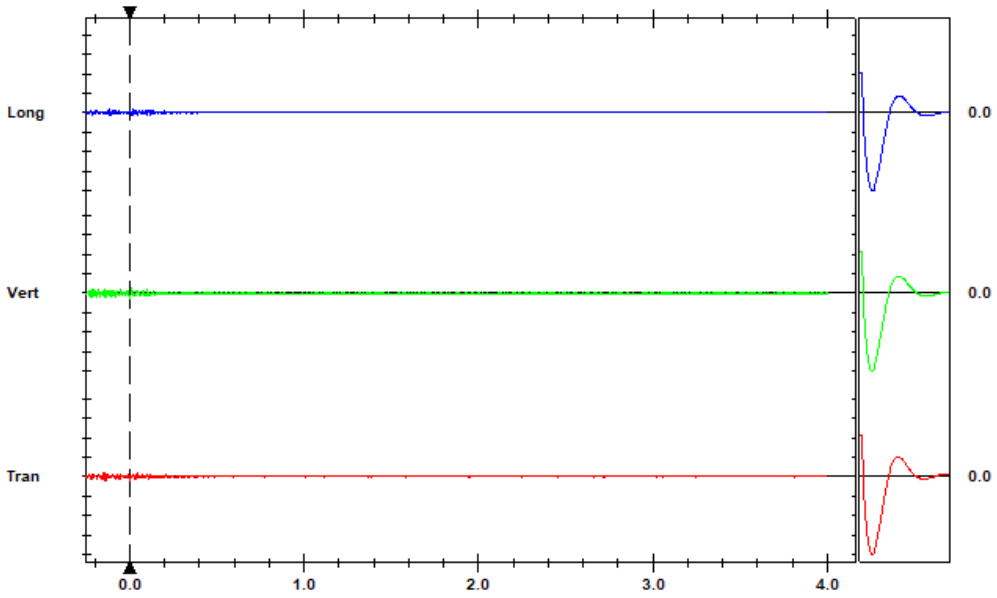
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.347	0.567	0.441	mm/s
ZC Freq	51	47	57	Hz
Time (Rel. to Trig)	-0.146	0.001	0.021	sec
Peak Acceleration	0.017	0.022	0.019	g
Peak Displacement	0.003	0.002	0.057	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.675 mm/s at 0.002 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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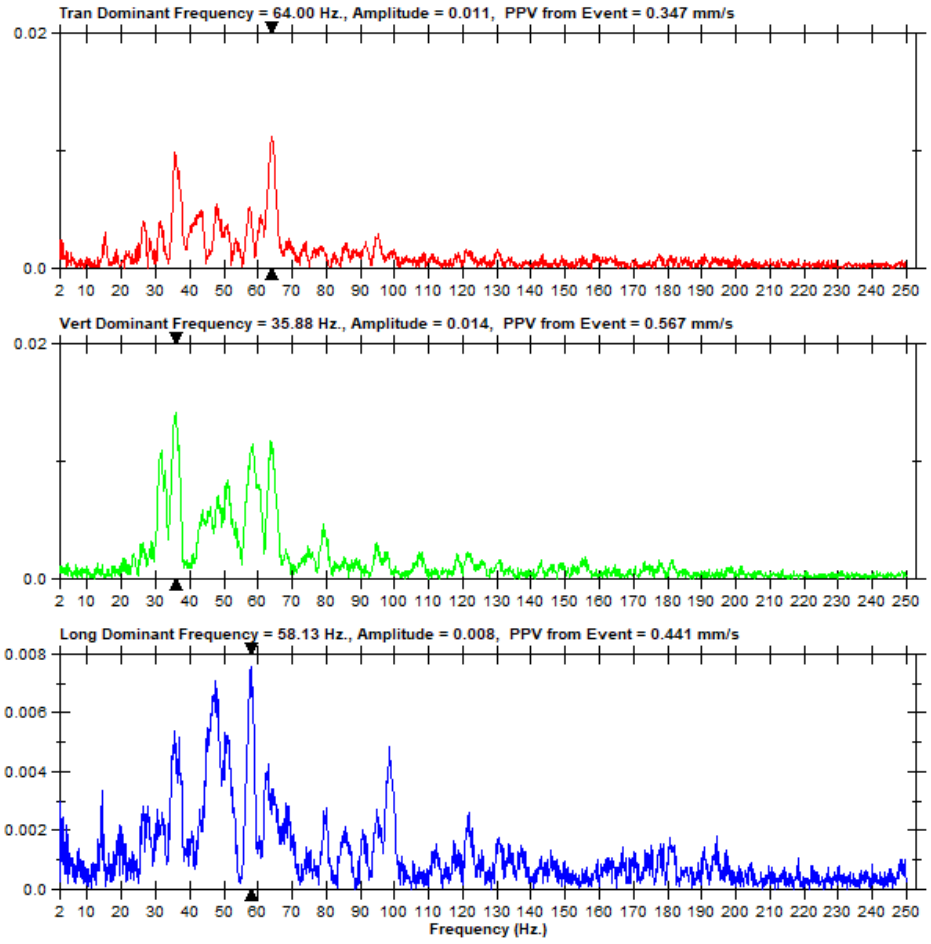
FFT Report

Date/Time	Vert at 17:14:13 January 6, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230106171413.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 115 m



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Event Report

Date/Time	Long at 17:13:39 January 6, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU8F.UR0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

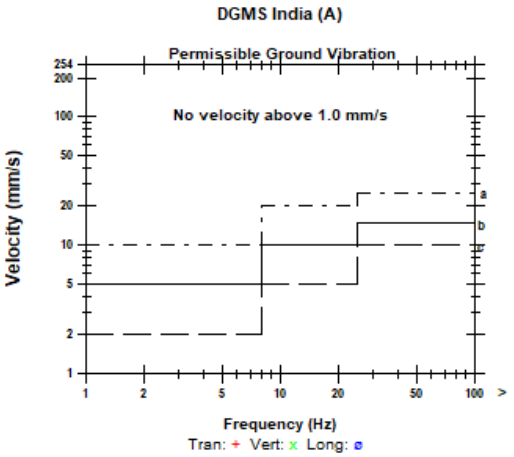
Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 241 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

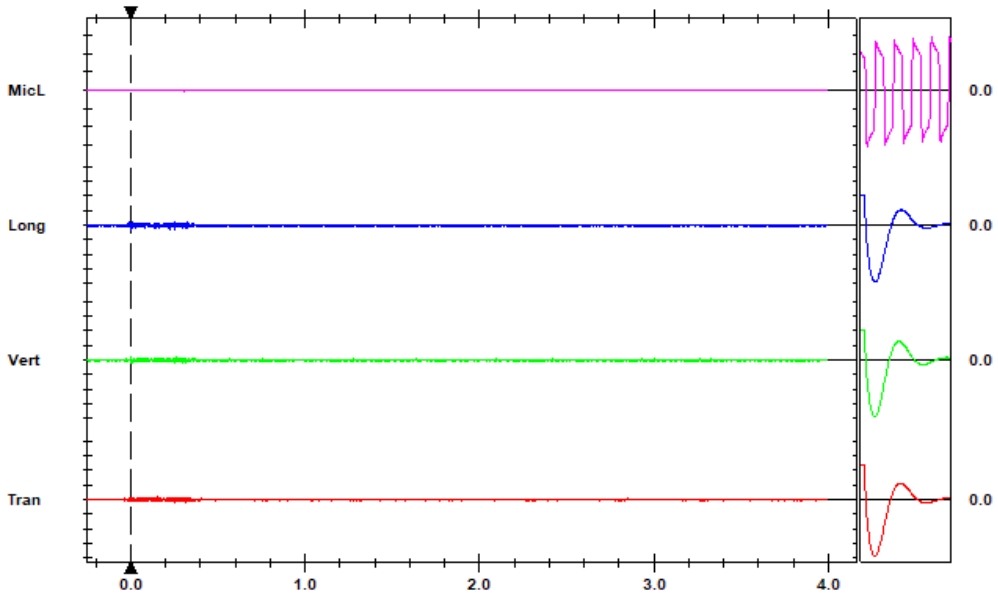
Microphone	Linear Weighting
PSPL	<88 dB(L)
ZC Freq	>100 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 537 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.635	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.154	0.254	0.000	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.000	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.8	7.2	Hz
Overswing Ratio	3.8	3.3	4.1	

Peak Vector Sum 0.813 mm/s at 0.254 sec
N/A: Not Applicable



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

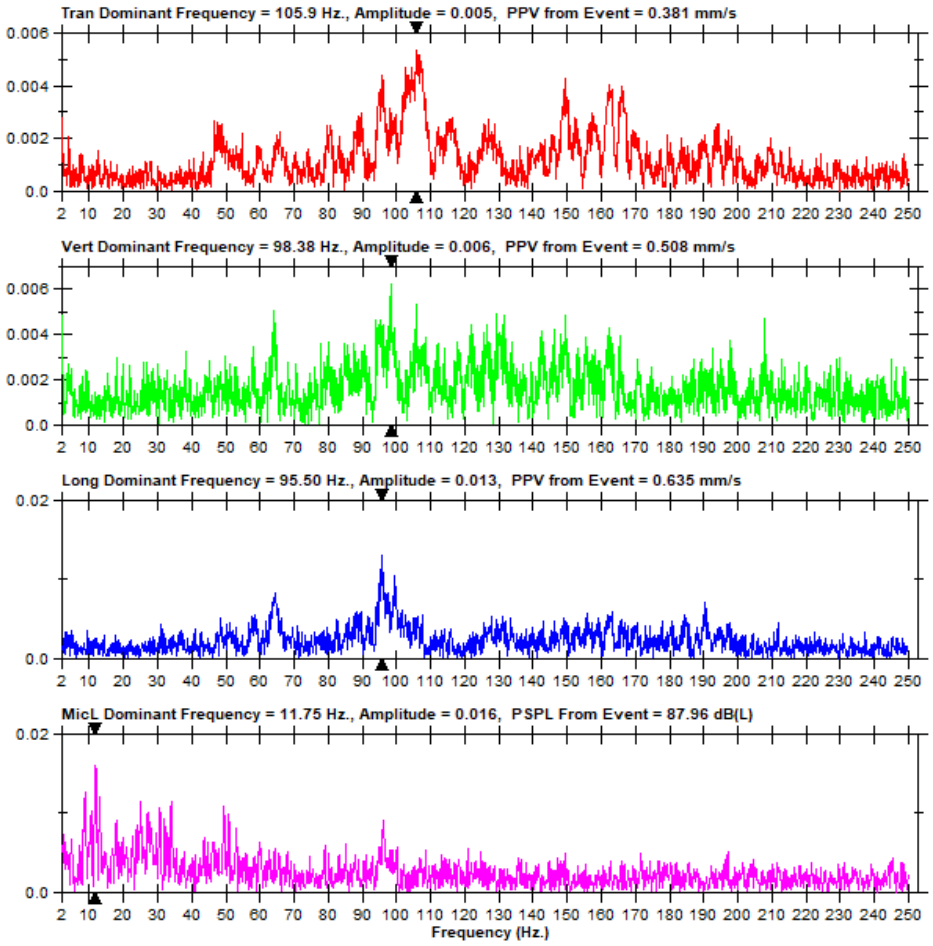
FFT Report

Date/Time	Long at 17:13:39 January 6, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU8F.UR0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.3125 Kg, Total Charge - 3.75 Kg, Distance - 241 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 17:15:48 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8F.YC0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 2.50 Kg, Distance - 60 m

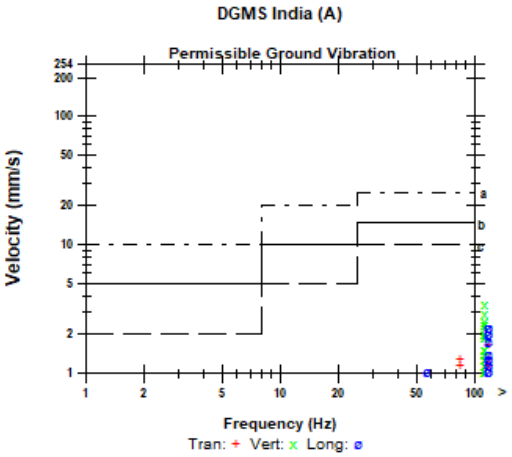
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

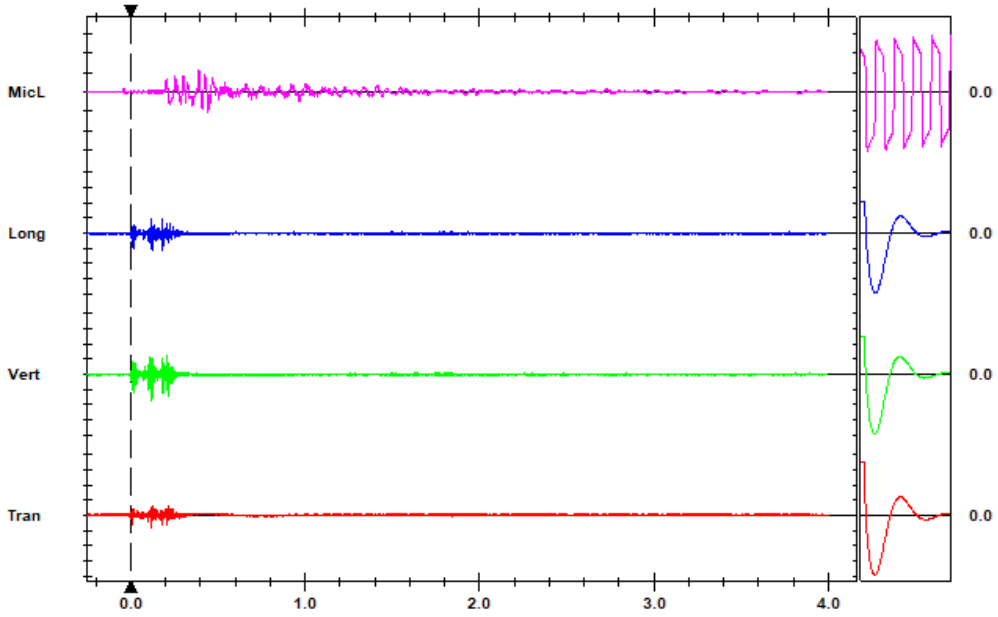
Microphone Linear Weighting
PSPL 115.4 dB(L) at 0.391 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	1.651	3.429	2.286	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.119	0.122	0.123	sec
Peak Acceleration	0.133	0.331	0.239	g
Peak Displacement	0.002	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 4.058 mm/s at 0.122 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

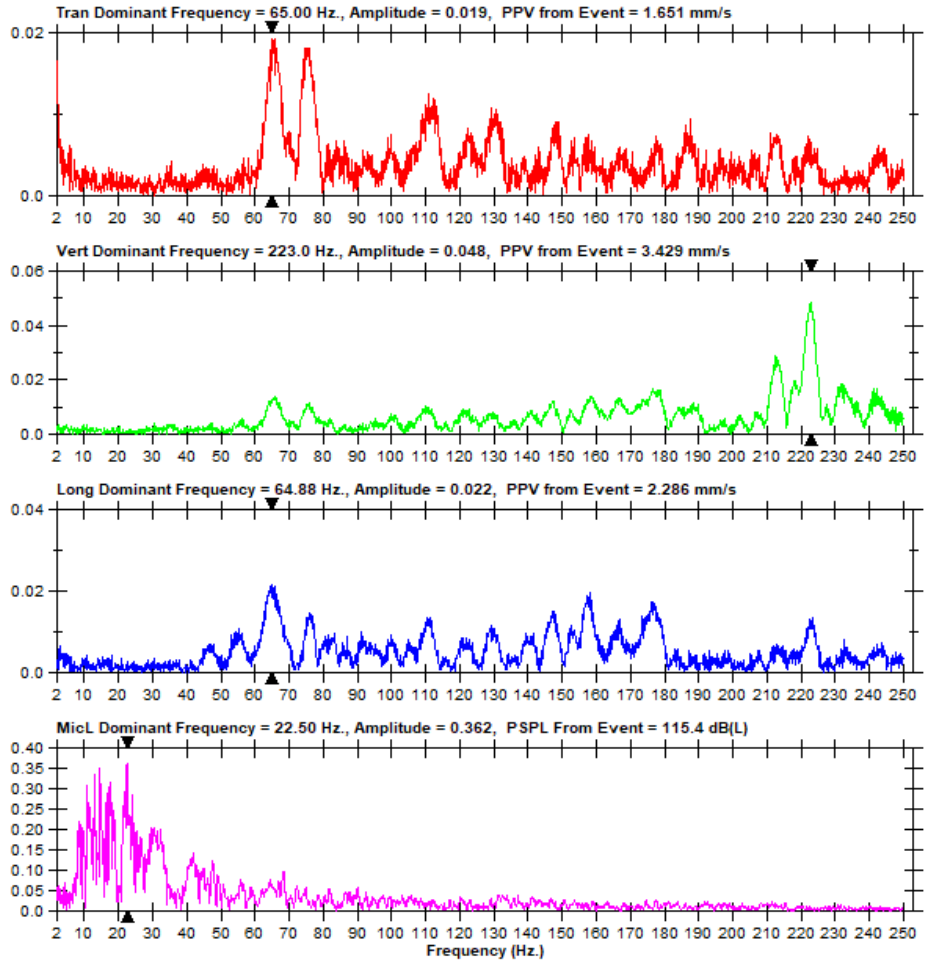
FFT Report

Date/Time	Tran at 17:15:48 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8F.YC0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 2.50 Kg, Distance - 60 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 17:16:20 January 6, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230106171620.IDFW

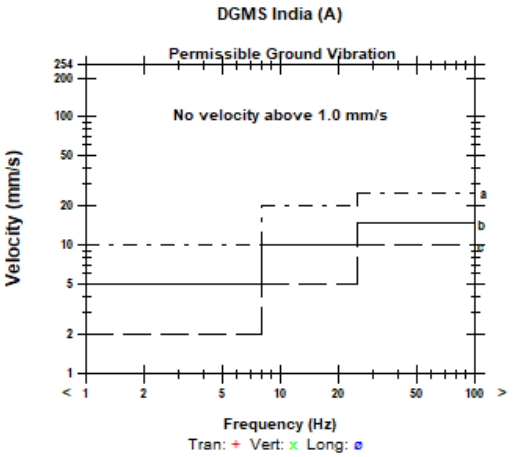
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 2.50 Kg, Distance - 112 m

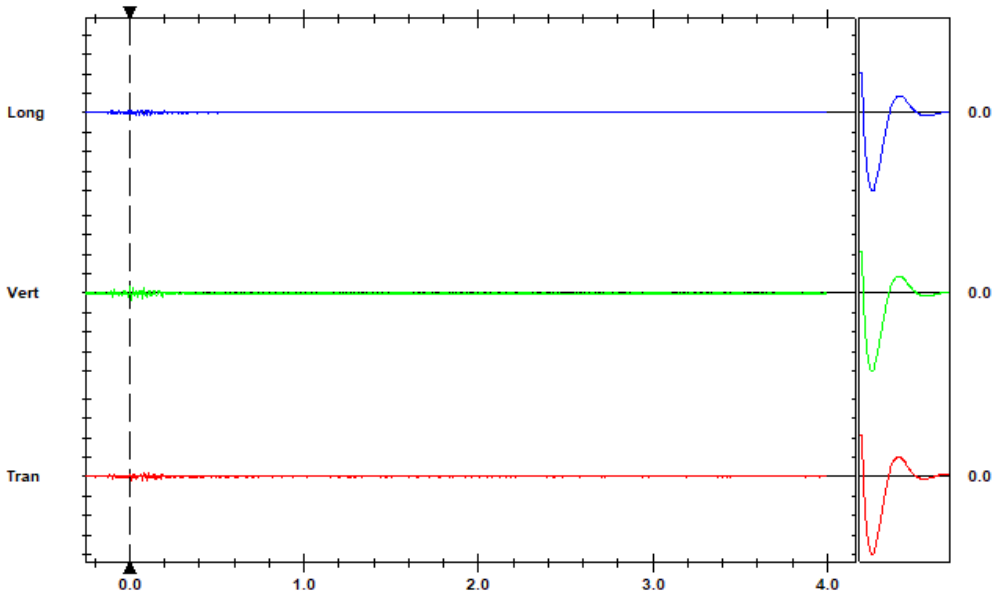
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.402	0.717	0.323	mm/s
ZC Freq	51	64	57	Hz
Time (Rel. to Trig)	0.102	0.002	0.109	sec
Peak Acceleration	0.017	0.028	0.023	g
Peak Displacement	0.002	0.002	0.011	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.781 mm/s at 0.002 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

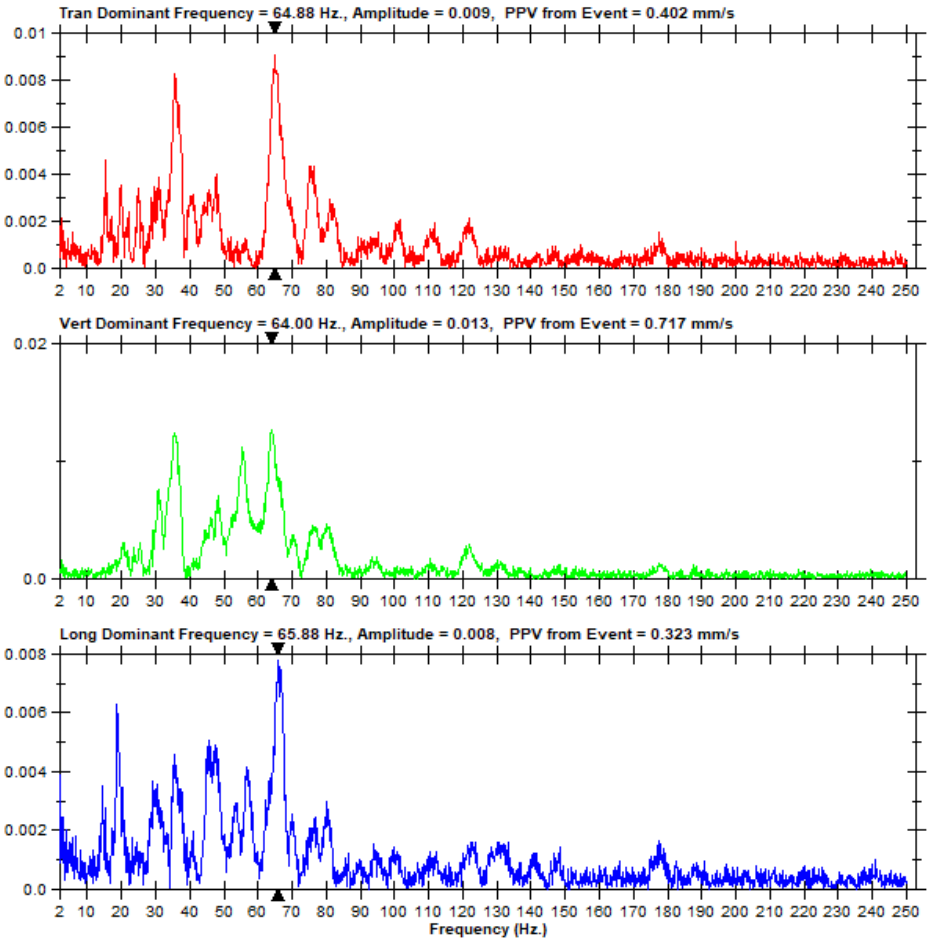
FFT Report

Date/Time	Vert at 17:16:20 January 6, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230106171620.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 2.50 Kg, Distance - 112 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 17:20:08 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8G.5K0
Post Event Notes
Total No. of holes - 24, Hole Depth - 1.5 m, Charge/hole - 0.288 Kg, MCPD - 0.3125 Kg, Total Charge - 6.875 Kg, Distance - 37 m

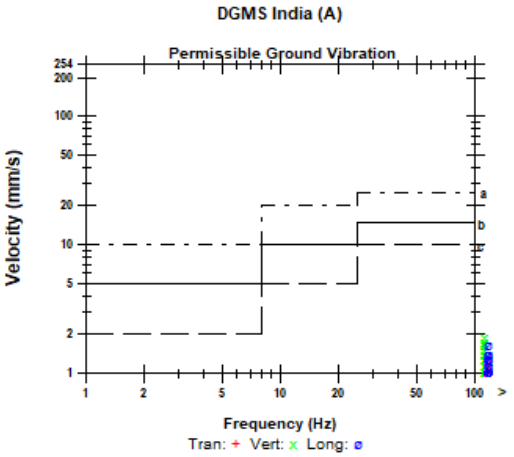
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

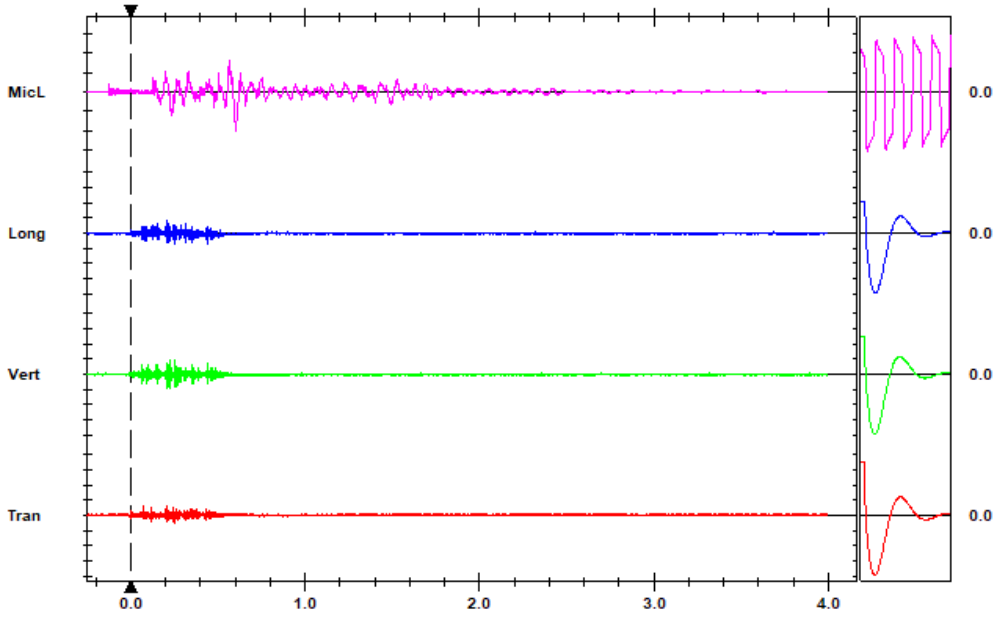
Microphone Linear Weighting
PSPL 120.3 dB(L) at 0.604 sec
ZC Freq 17 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 461 mv)

	Tran	Vert	Long	
PPV	1.143	1.905	1.651	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.076	0.225	0.211	sec
Peak Acceleration	0.133	0.239	0.225	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 2.261 mm/s at 0.211 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

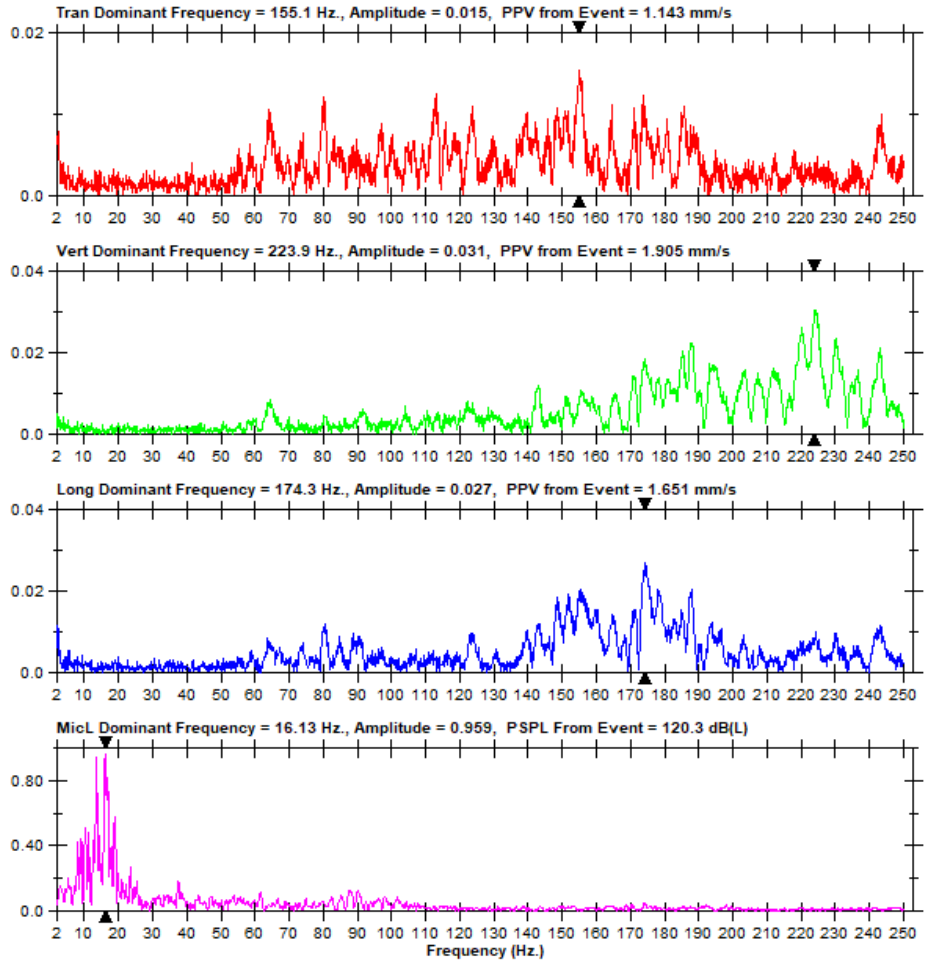
FFT Report

Date/Time	Tran at 17:20:08 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8G.5K0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 24, Hole Depth - 1.5 m, Charge/hole - 0.286 Kg, MCPD - 0.3125 Kg, Total Charge - 6.875 Kg, Distance - 37 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 17:20:04 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

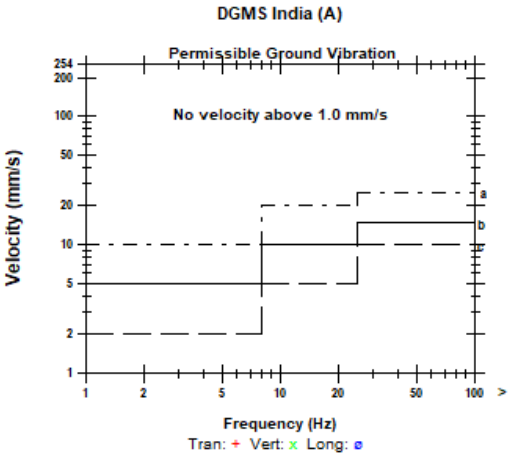
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

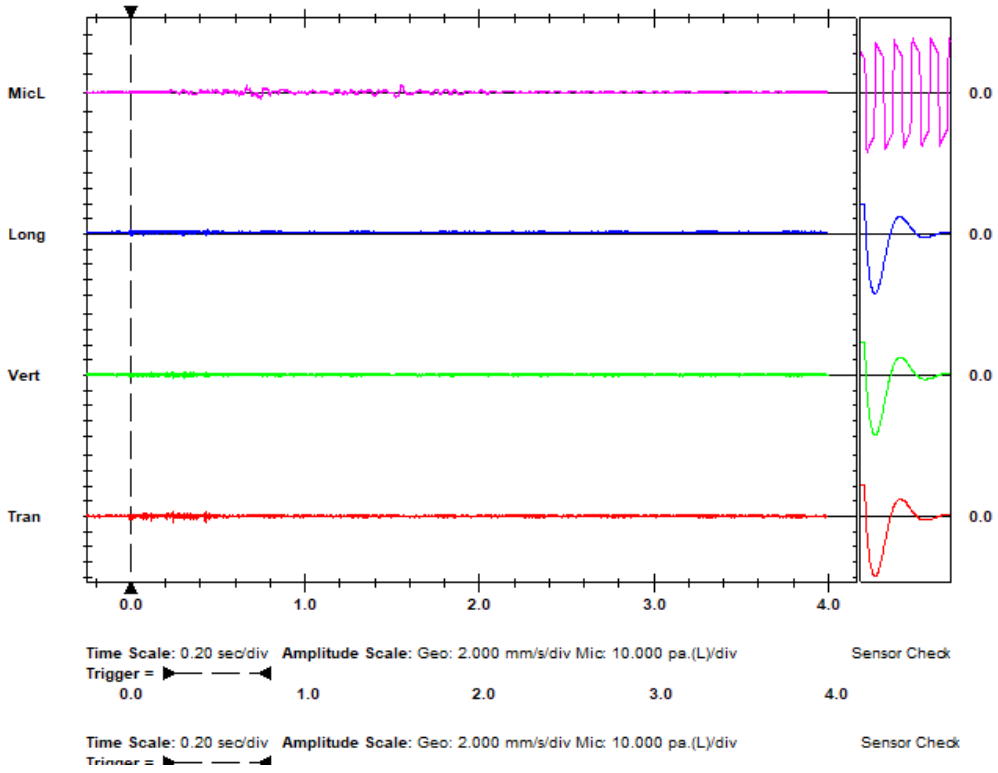
Microphone Linear Weighting
PSPL 106.0 dB(L) at 1.553 sec
ZC Freq 14 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.889	0.381	0.635	mm/s
ZC Freq	>100	>100	73	Hz
Time (Rel. to Trig)	0.429	0.116	0.001	sec
Peak Acceleration	0.080	0.053	0.040	g
Peak Displacement	0.001	0.000	0.028	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 0.933 mm/s at 0.429 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8G.5G0
Post Event Notes
Total No. of holes - 24, Hole Depth - 1.5 m, Charge/hole - 0.288 Kg, MCPD - 0.3125 Kg, Total Charge - 6.875 Kg, Distance - 73 m





Instantel

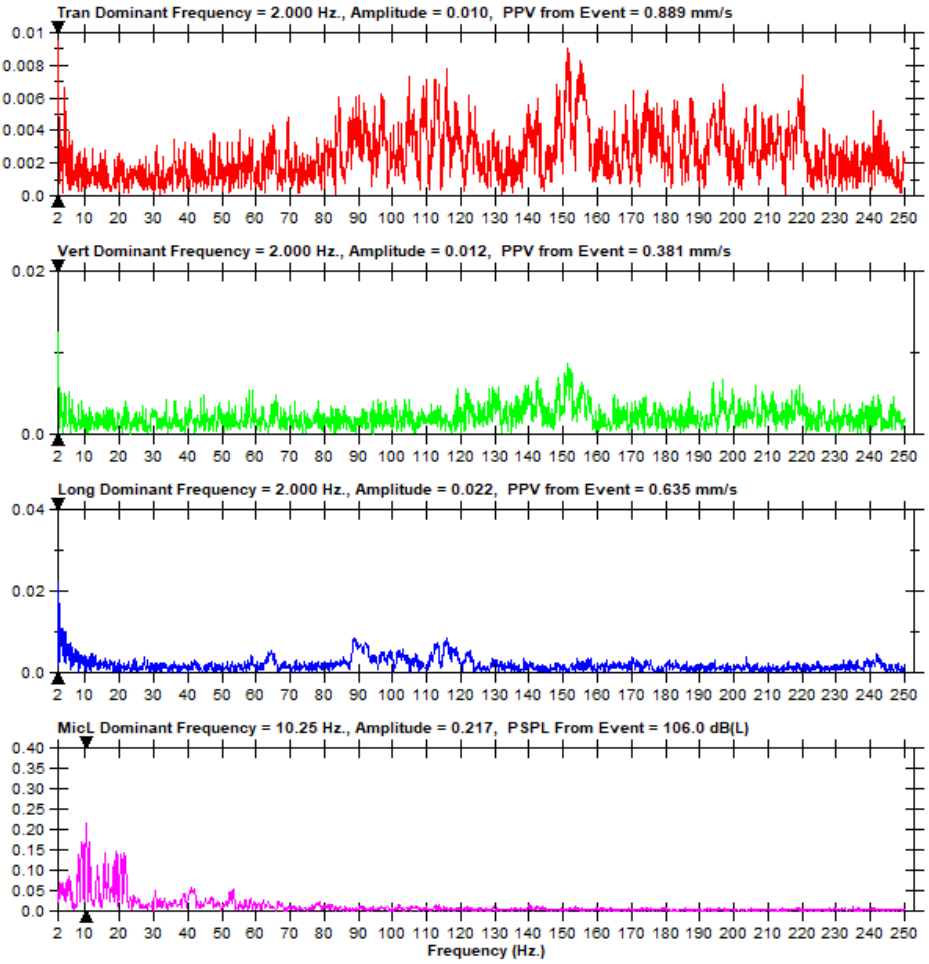
FFT Report

Date/Time	Long at 17:20:04 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8G.5G0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 24, Hole Depth - 1.5 m, Charge/hole - 0.286 Kg, MCPD - 0.3125 Kg, Total Charge - 6.875 Kg, Distance - 73 m



Printed: February 21, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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Event Report

Date/Time Tran at 17:24:57 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

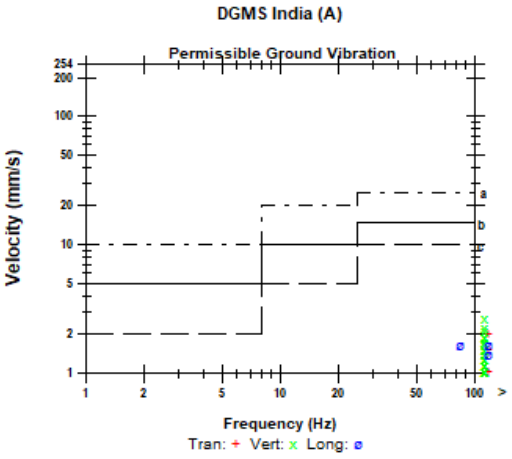
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

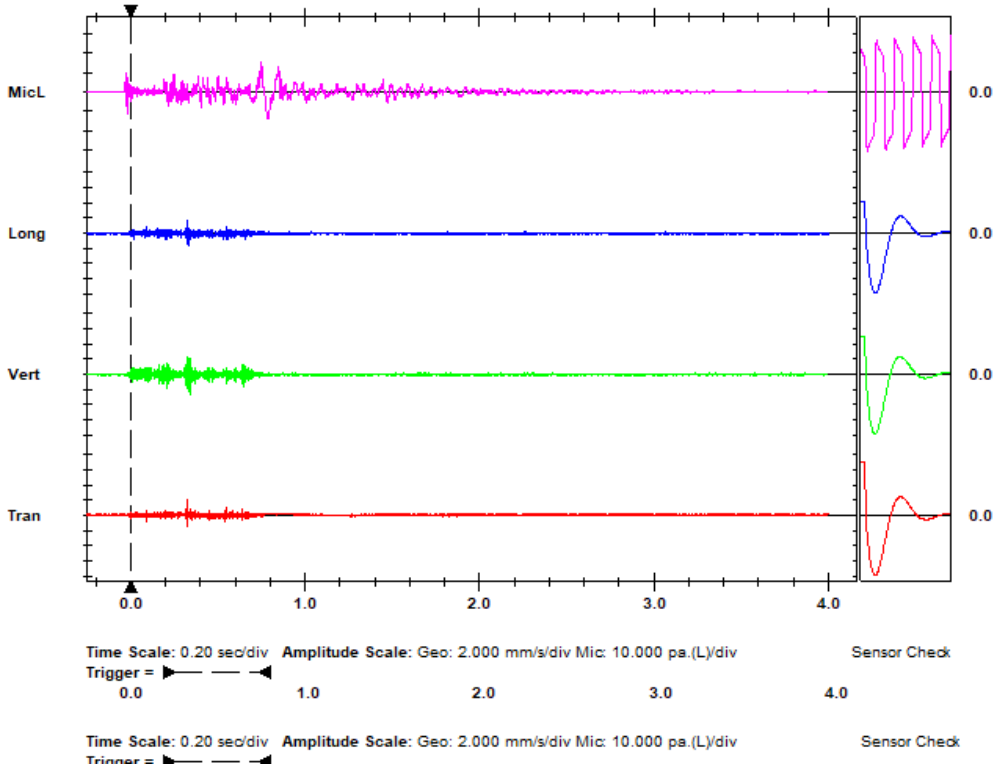
Microphone Linear Weighting
PSPL 117.8 dB(L) at 0.750 sec
ZC Freq 12 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 474 mv)

	Tran	Vert	Long	
PPV	2.032	2.667	1.651	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.324	0.340	0.329	sec
Peak Acceleration	0.225	0.318	0.199	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 2.762 mm/s at 0.340 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8G.DL0
Post Event Notes
Total No. of holes - 31, Hole Depth - 1.5 m, Charge/hole - 0.254 Kg, MCPD - 0.3125 Kg, Total Charge - 7.875 Kg, Distance - 104 m





Instantel

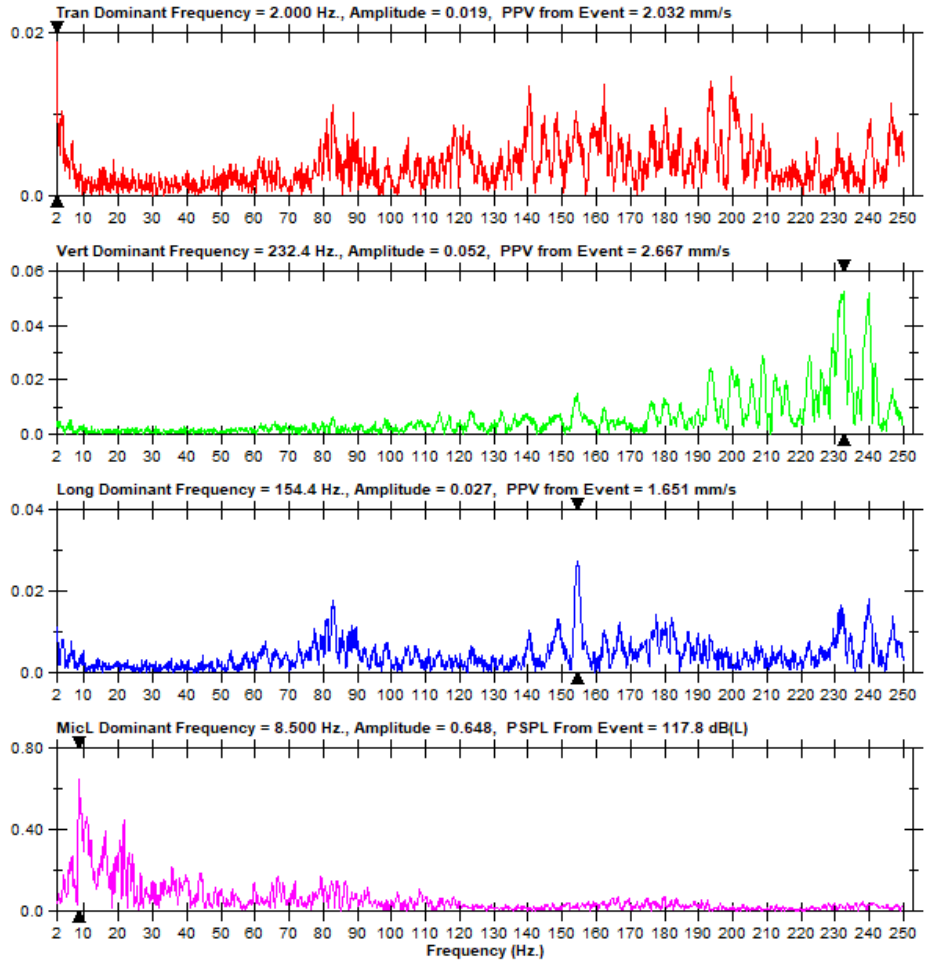
FFT Report

Date/Time	Tran at 17:24:57 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8G.DL0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 31, Hole Depth - 1.5 m, Charge/hole - 0.254 Kg, MCPD - 0.3125 Kg, Total Charge - 7.875 Kg, Distance - 104 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 17:24:53 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8G.DH0
Post Event Notes
Total No. of holes - 31, Hole Depth - 1.5 m, Charge/hole - 0.254 Kg, MCPD - 0.3125 Kg, Total Charge - 7.875 Kg, Distance - 145 m

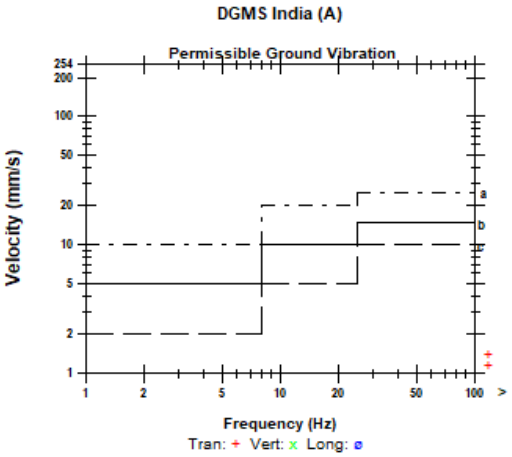
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

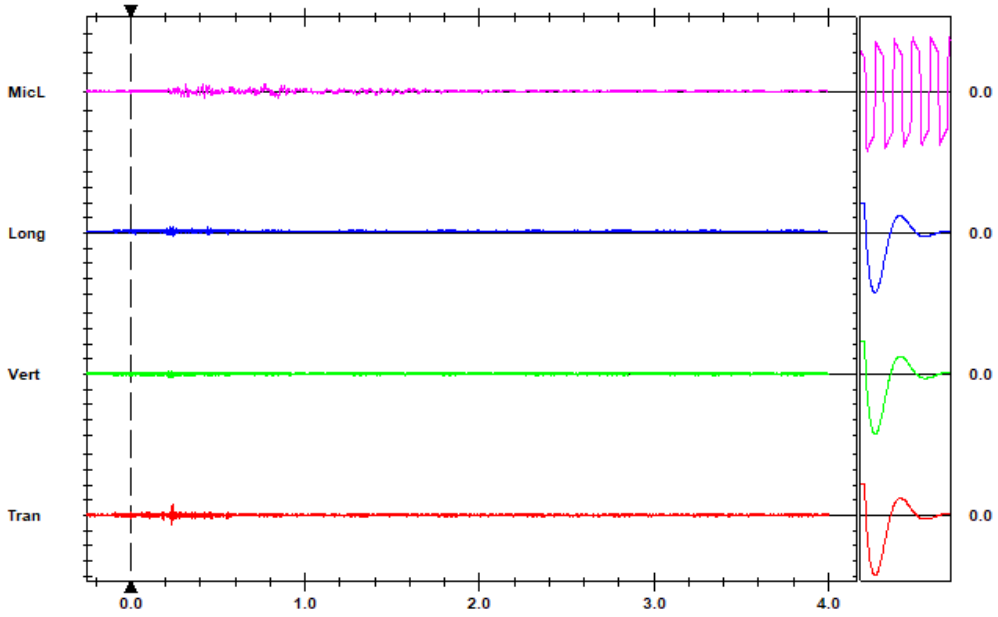
Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.770 sec
ZC Freq 13 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	1.397	0.508	0.762	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.240	0.229	0.225	sec
Peak Acceleration	0.119	0.053	0.080	g
Peak Displacement	0.001	0.001	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.492 mm/s at 0.240 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

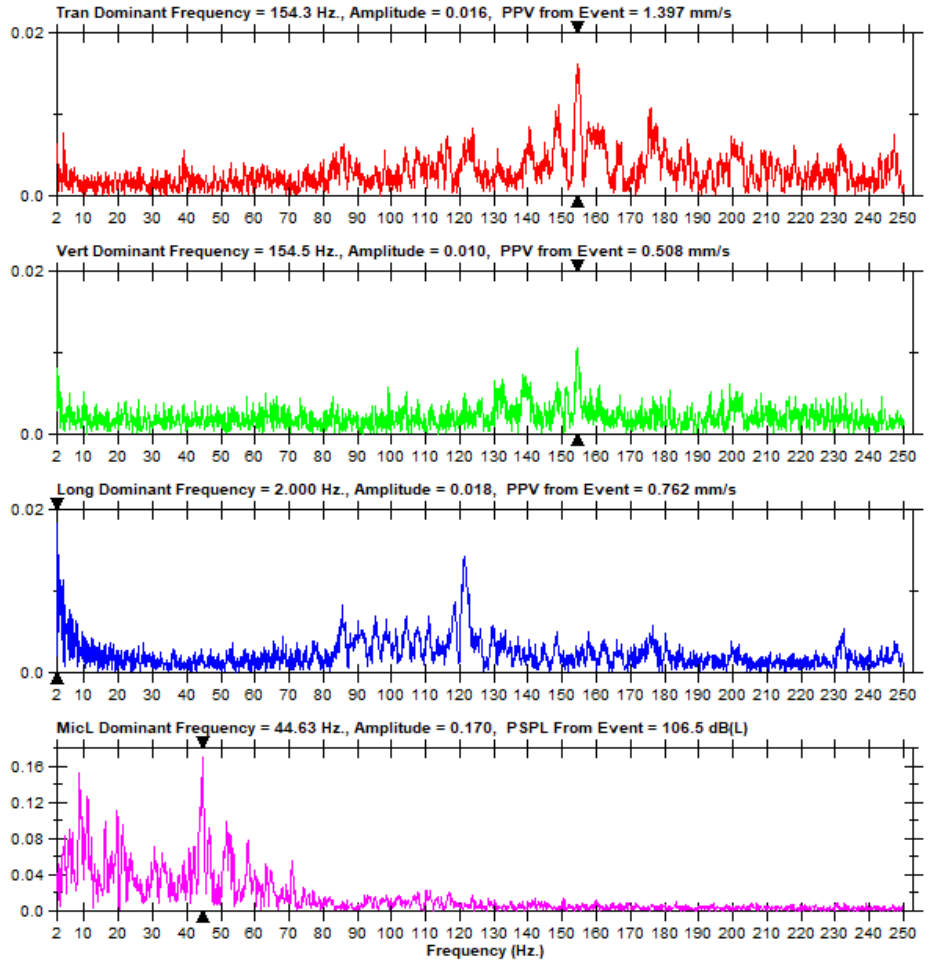
FFT Report

Date/Time	Tran at 17:24:53 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8G.DH0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 31, Hole Depth - 1.5 m, Charge/hole - 0.254 Kg, MCPD - 0.3125 Kg, Total Charge - 7.875 Kg, Distance - 145 m



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Event Report

Date/Time Vert at 17:27:28 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

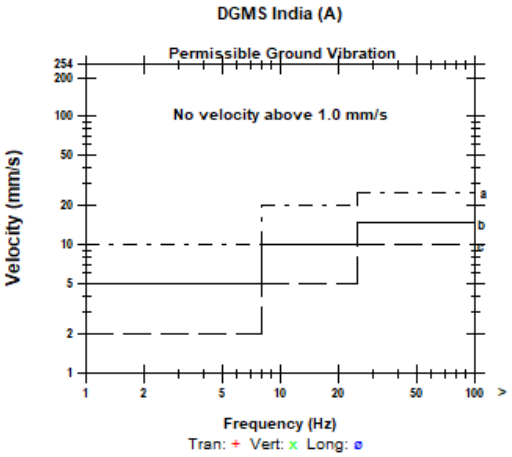
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 117.9 dB(L) at 0.211 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 510 mv)

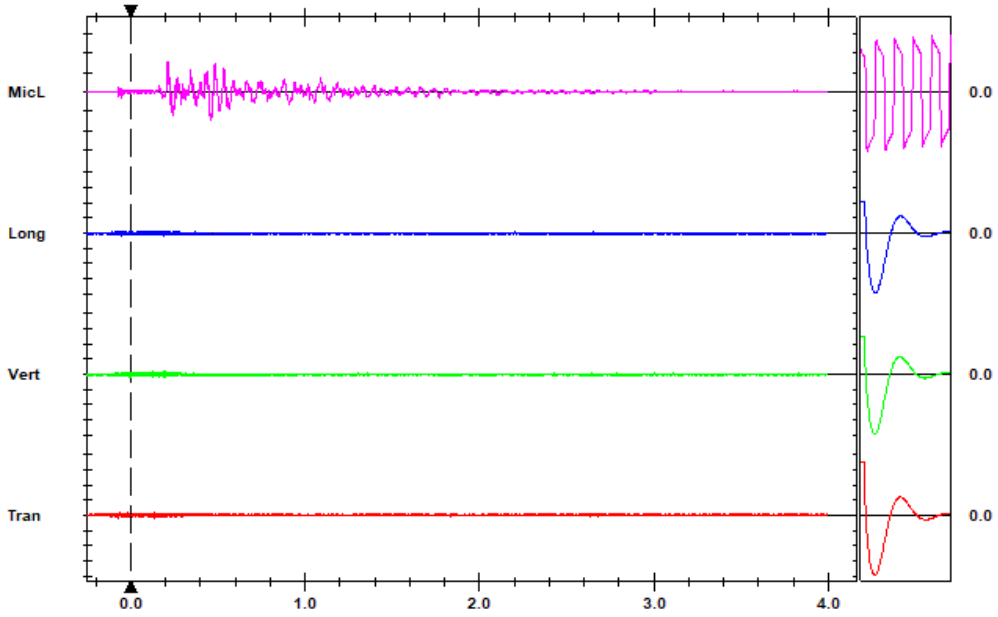
	Tran	Vert	Long	
PPV	0.381	0.508	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	-0.067	0.000	-0.055	sec
Peak Acceleration	0.053	0.066	0.040	g
Peak Displacement	0.000	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 0.539 mm/s at 0.188 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8G.HS0
Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 5.00 Kg, Distance - 82 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

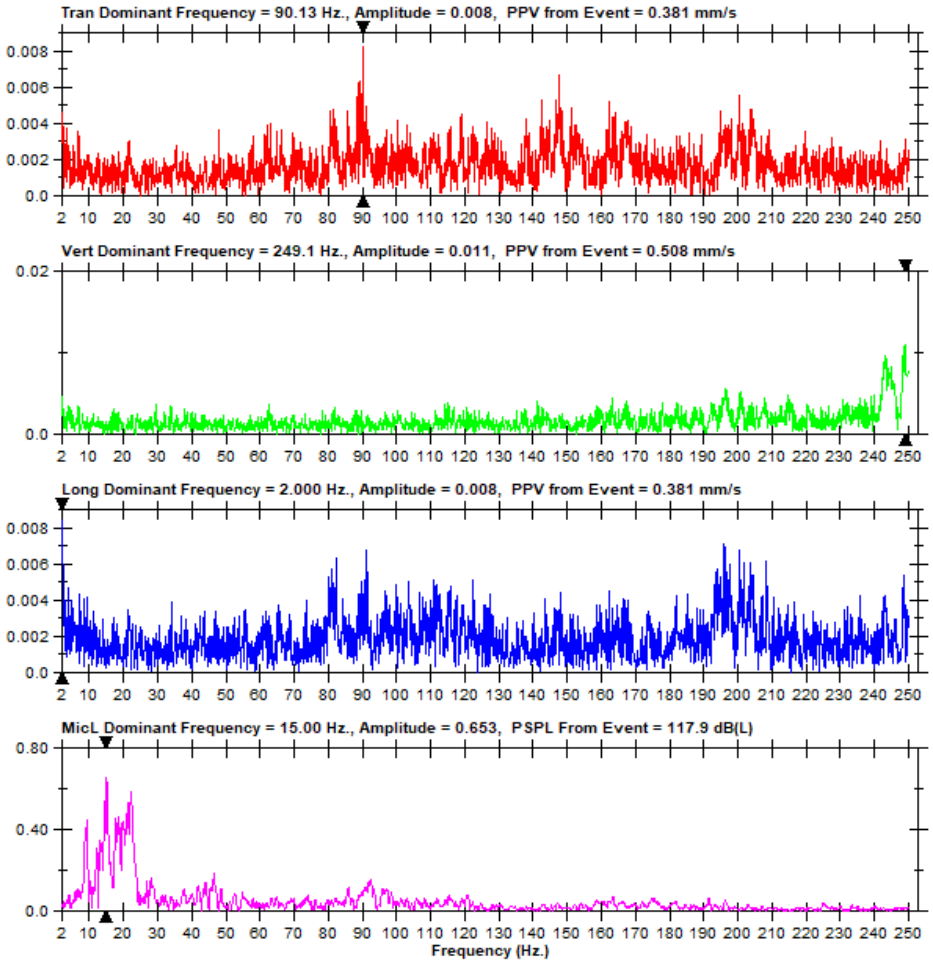
FFT Report

Date/Time	Vert at 17:27:28 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8G.HS0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 20, Hole Depth - 1.5 m, Charge/hole - 0.25 Kg, MCPD - 0.25 Kg, Total Charge - 5.00 Kg, Distance - 82 m



Printed: February 21, 2023 (V 10.72 - 10.72) Format © 1995-2014 Xmark Corporation

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Event Report

Date/Time Tran at 17:39:55 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8H.2J0
Post Event Notes
Total No. of holes - 46, Hole Depth - 1.5 m, Charge/hole - 0.375 Kg, MCPD - 0.6875 Kg, Total Charge - 17.25 Kg, Distance - 69 m

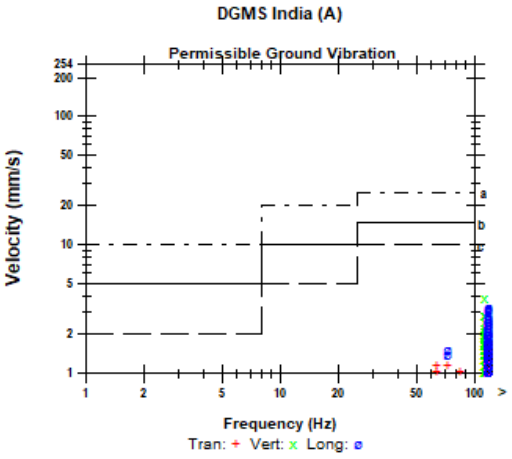
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

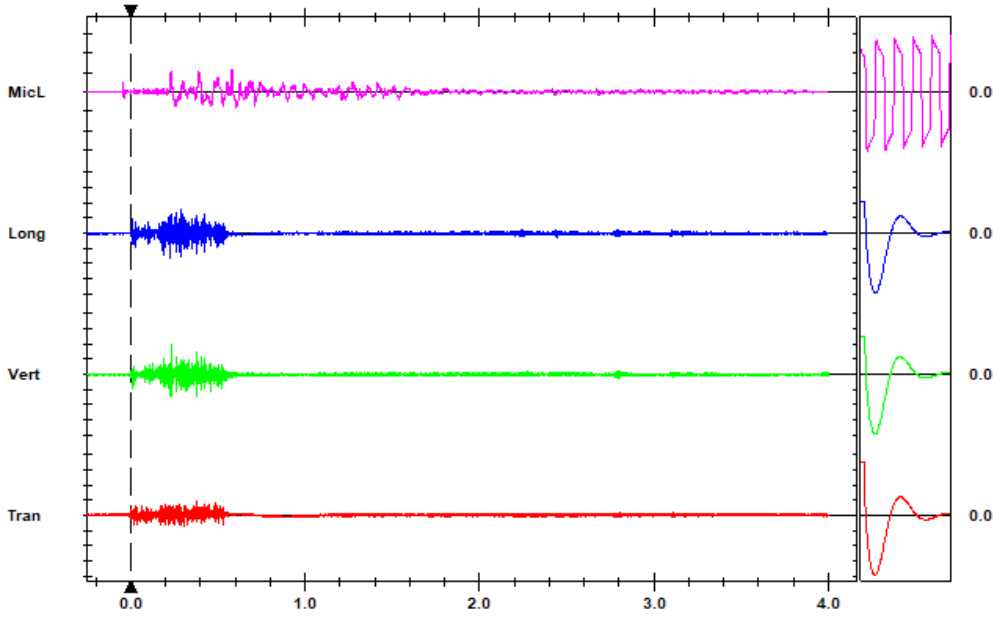
Microphone Linear Weighting
PSPL 115.2 dB(L) at 0.582 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 520 mv)

	Tran	Vert	Long	
PPV	1.778	3.810	3.302	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.375	0.232	0.229	sec
Peak Acceleration	0.172	0.398	0.331	g
Peak Displacement	0.002	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.3	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 4.623 mm/s at 0.232 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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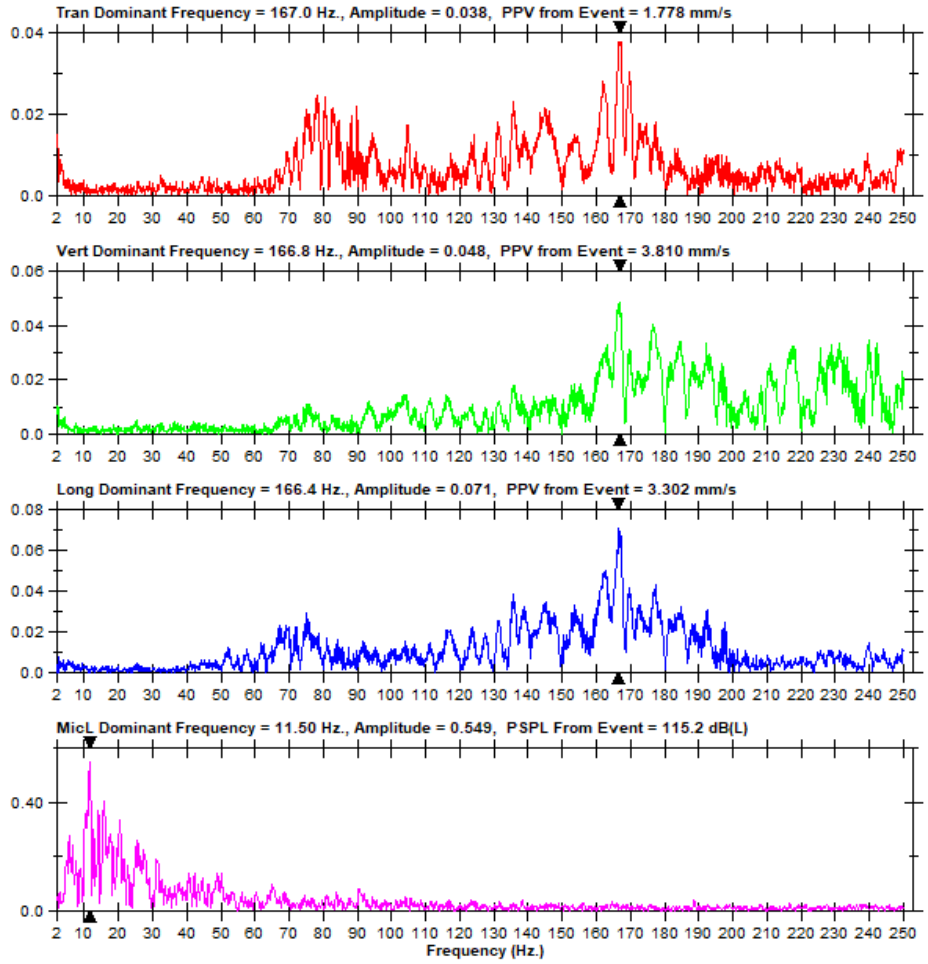
FFT Report

Date/Time	Tran at 17:39:55 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8H.2J0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 46, Hole Depth - 1.5 m, Charge/hole - 0.375 Kg, MCPD - 0.6875 Kg, Total Charge - 17.25 Kg, Distance - 69 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 17:39:51 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8H.2F0
Post Event Notes
Total No. of holes - 46, Hole Depth - 1.5 m, Charge/hole - 0.375 Kg, MCPD - 0.6875 Kg, Total Charge - 17.25 Kg, Distance - 94 m

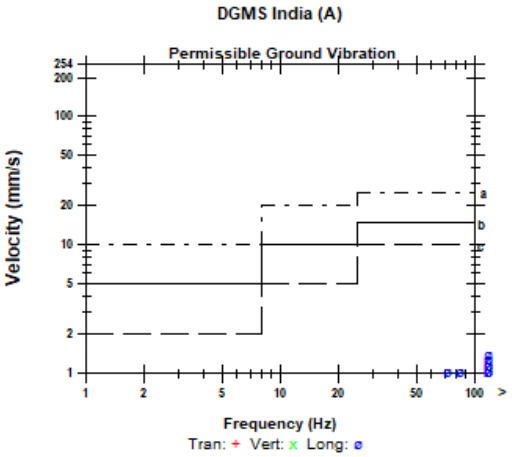
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

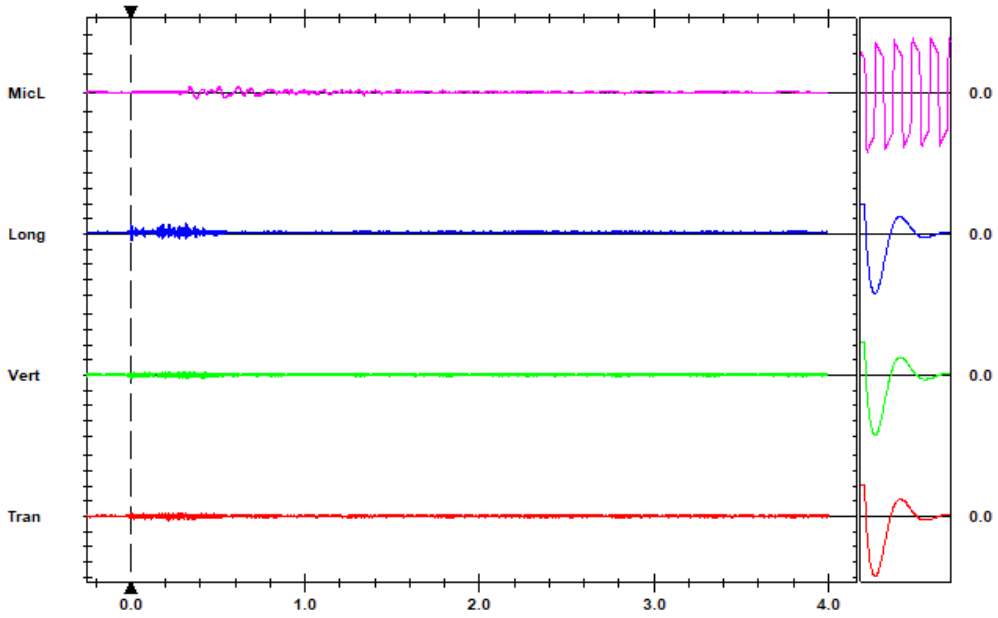
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 104.2 dB(L) at 0.338 sec
ZC Freq 14 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	1.397	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.213	0.015	0.320	sec
Peak Acceleration	0.053	0.066	0.106	g
Peak Displacement	0.001	0.001	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.497 mm/s at 0.320 sec





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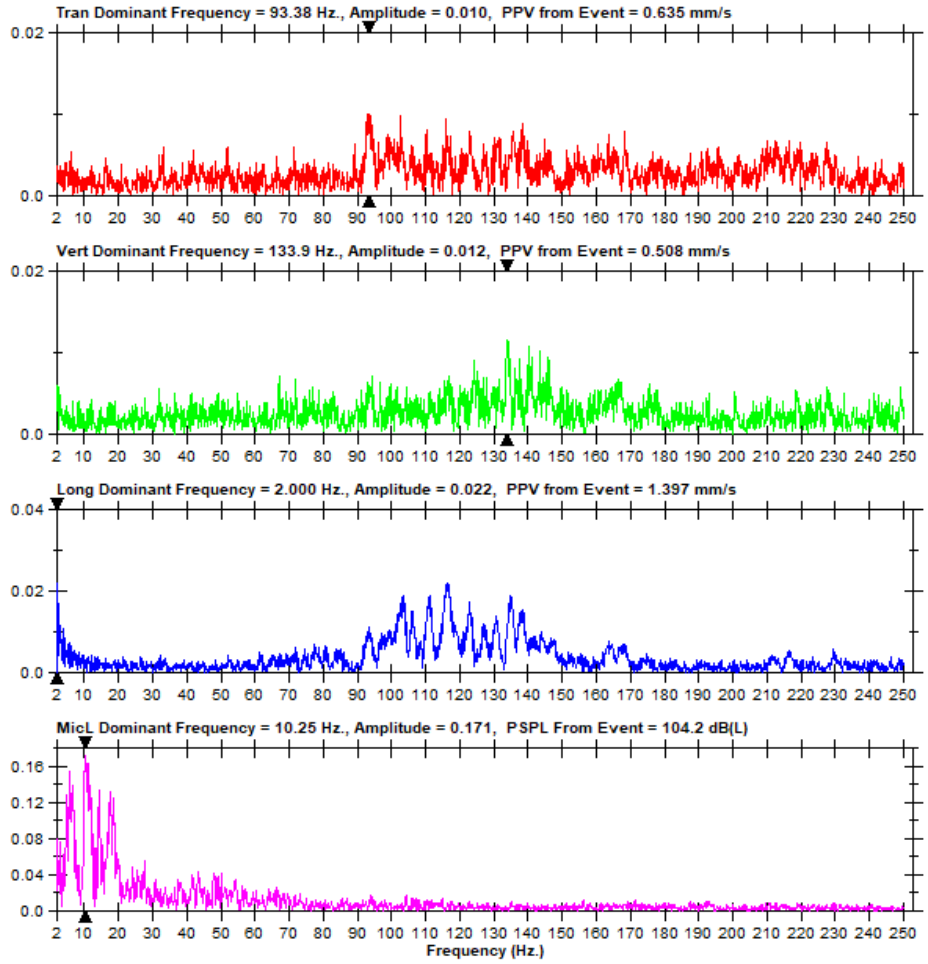
FFT Report

Date/Time	Long at 17:39:51 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8H.2F0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 46, Hole Depth - 1.5 m, Charge/hole - 0.375 Kg, MCPD - 0.6875 Kg, Total Charge - 17.25 Kg, Distance - 94 m



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Event Report

Date/Time Vert at 17:47:25 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

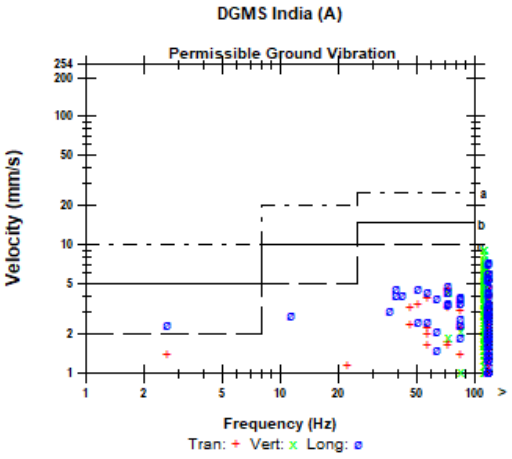
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 126.8 dB(L) at 0.553 sec
ZC Freq 14 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 517 mv)

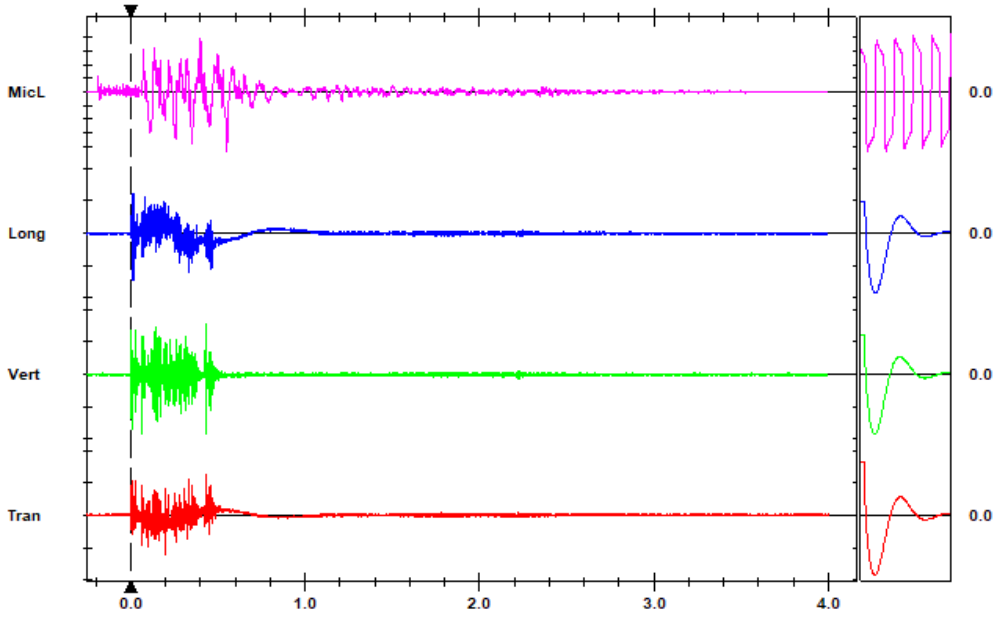
	Tran	Vert	Long	
PPV	6.223	9.271	7.366	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.430	0.066	0.008	sec
Peak Acceleration	0.716	0.848	0.769	g
Peak Displacement	0.063	0.008	0.095	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.7	3.8	

Peak Vector Sum 10.42 mm/s at 0.066 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8H.F10
Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 28 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

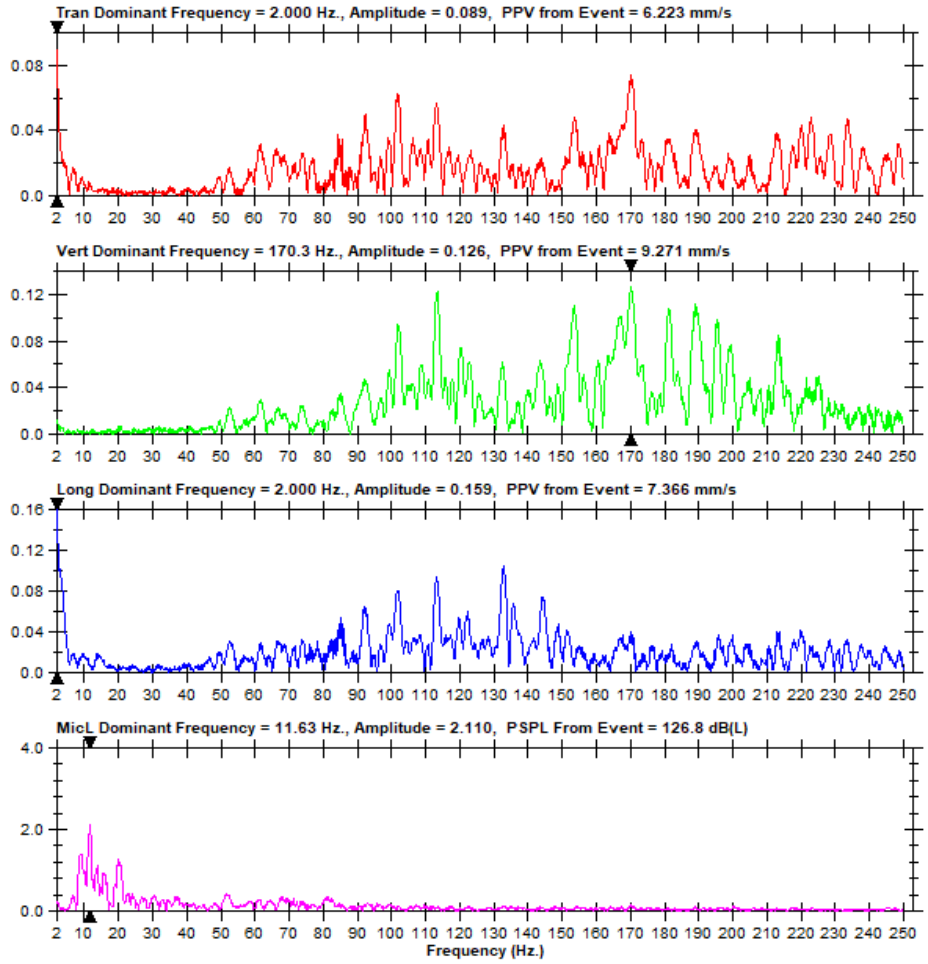
FFT Report

Date/Time	Vert at 17:47:25 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8H.F10

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 28 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 17:47:20 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

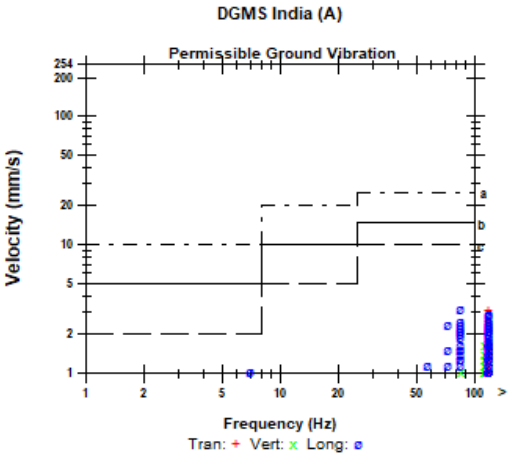
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

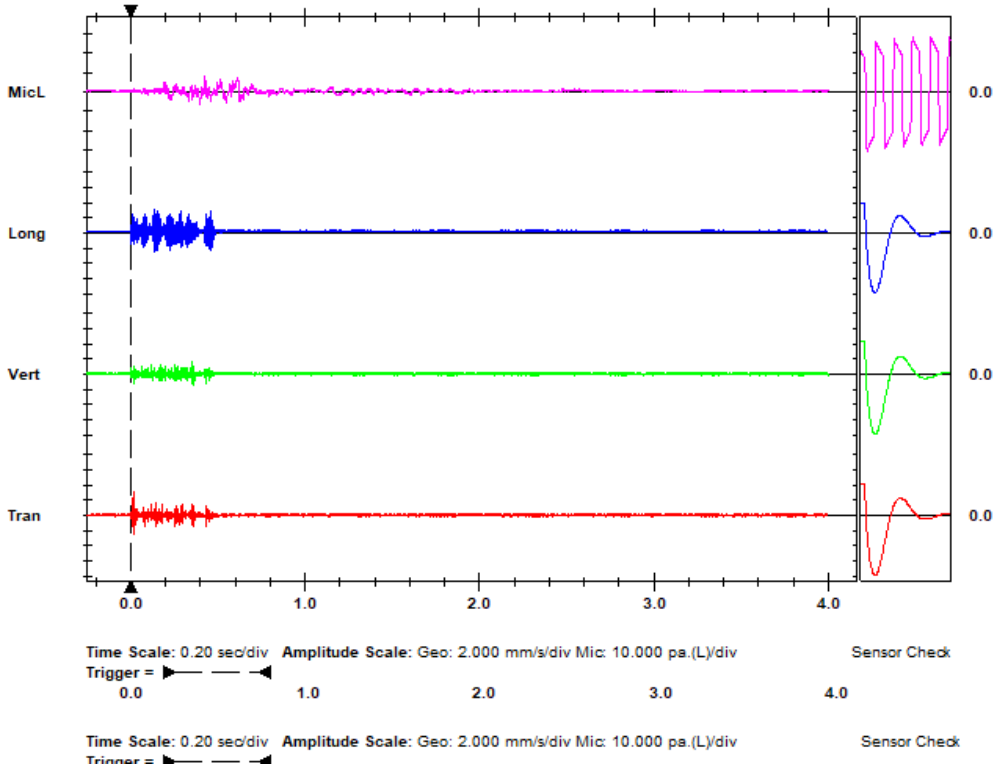
Microphone Linear Weighting
PSPL 112.0 dB(L) at 0.425 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	3.048	1.651	3.175	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.016	0.354	0.141	sec
Peak Acceleration	0.225	0.133	0.199	g
Peak Displacement	0.004	0.002	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 3.215 mm/s at 0.016 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8H.EW0
Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 67 m





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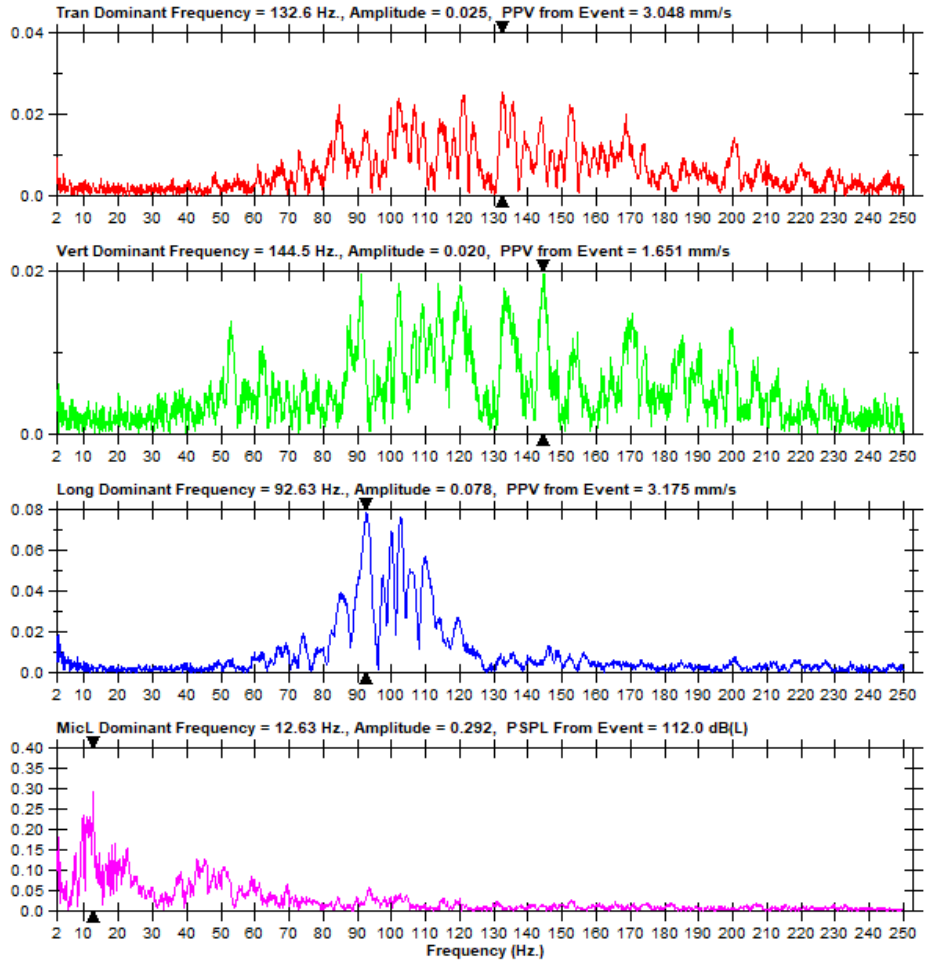
FFT Report

Date/Time	Long at 17:47:20 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8H.EW0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 67 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 17:47:57 January 6, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230106174757.IDFW

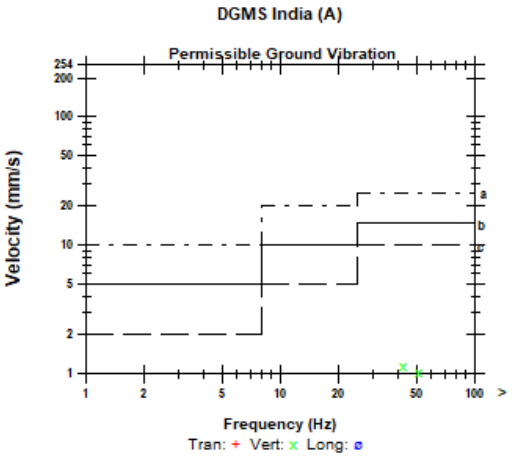
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 86 m

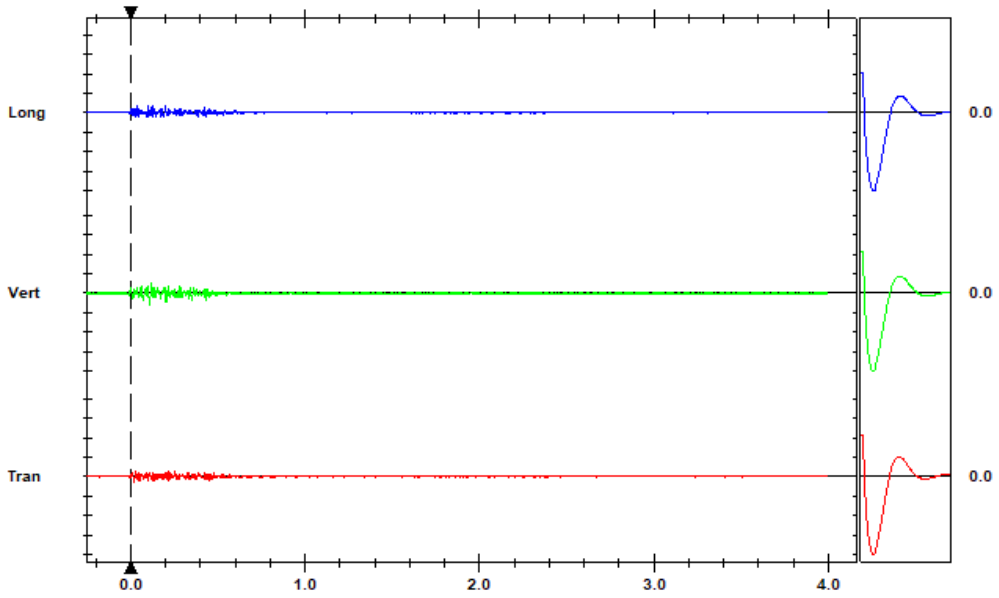
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.607	1.167	0.717	mm/s
ZC Freq	51	43	57	Hz
Time (Rel. to Trig)	0.021	0.109	0.199	sec
Peak Acceleration	0.034	0.039	0.039	g
Peak Displacement	0.004	0.004	0.008	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 1.188 mm/s at 0.109 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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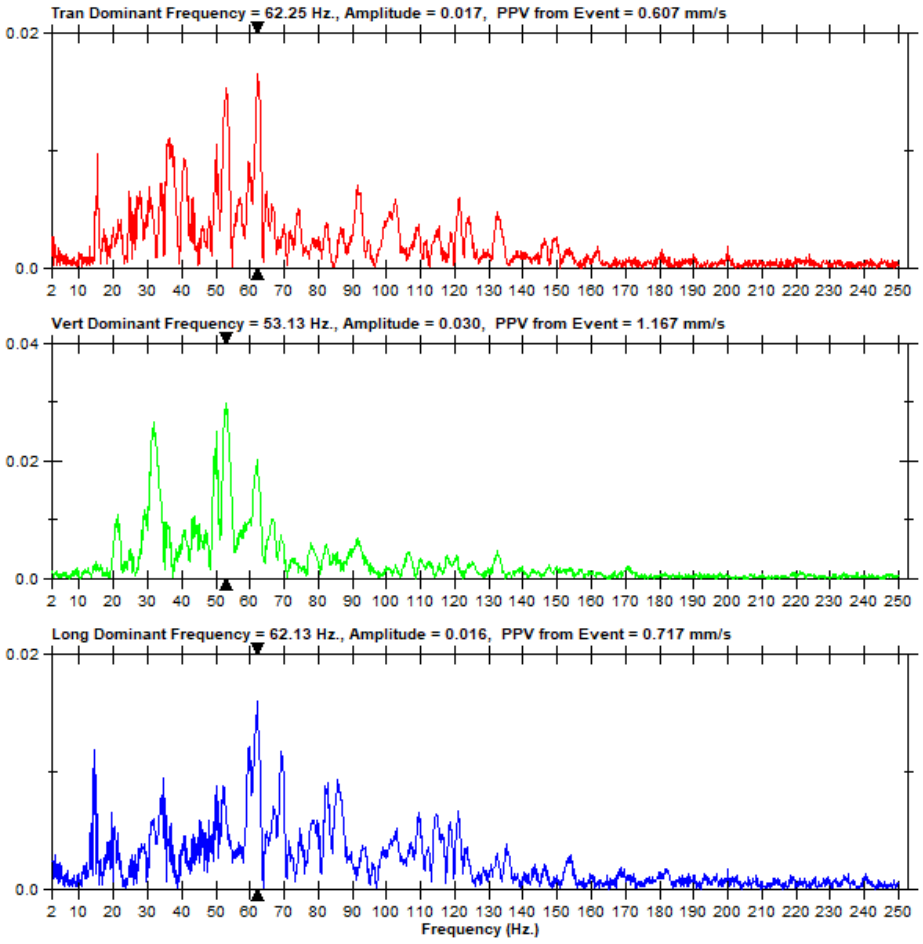
FFT Report

Date/Time	Vert at 17:47:57 January 6, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230106174757.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: REE Research Group, CSIR-CIMFR, DHANBAD
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 86 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 17:47:23 January 6, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JU8H.EZ0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

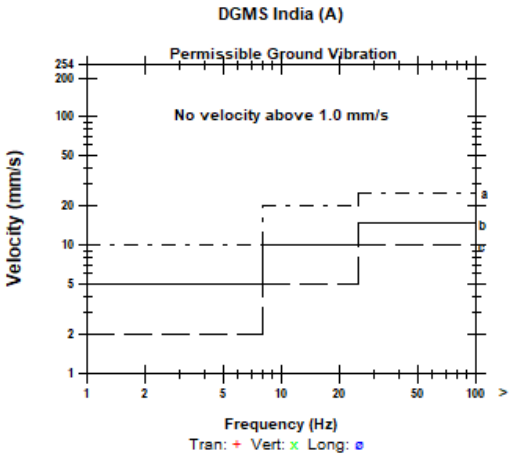
Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 200 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

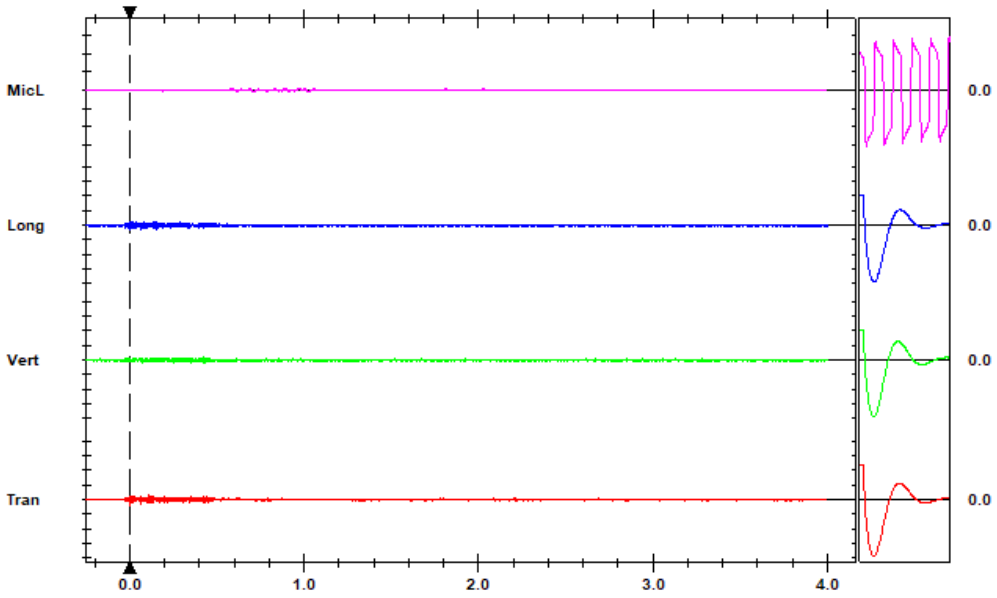
Microphone	Linear Weighting
PSPL	93.98 dB(L) at 0.709 sec
ZC Freq	26 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 576 mv)

	Tran	Vert	Long	
PPV	0.762	0.381	0.635	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.004	0.071	0.004	sec
Peak Acceleration	0.053	0.040	0.053	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.8	7.2	Hz
Overswing Ratio	3.8	3.3	4.0	

Peak Vector Sum 1.024 mm/s at 0.004 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

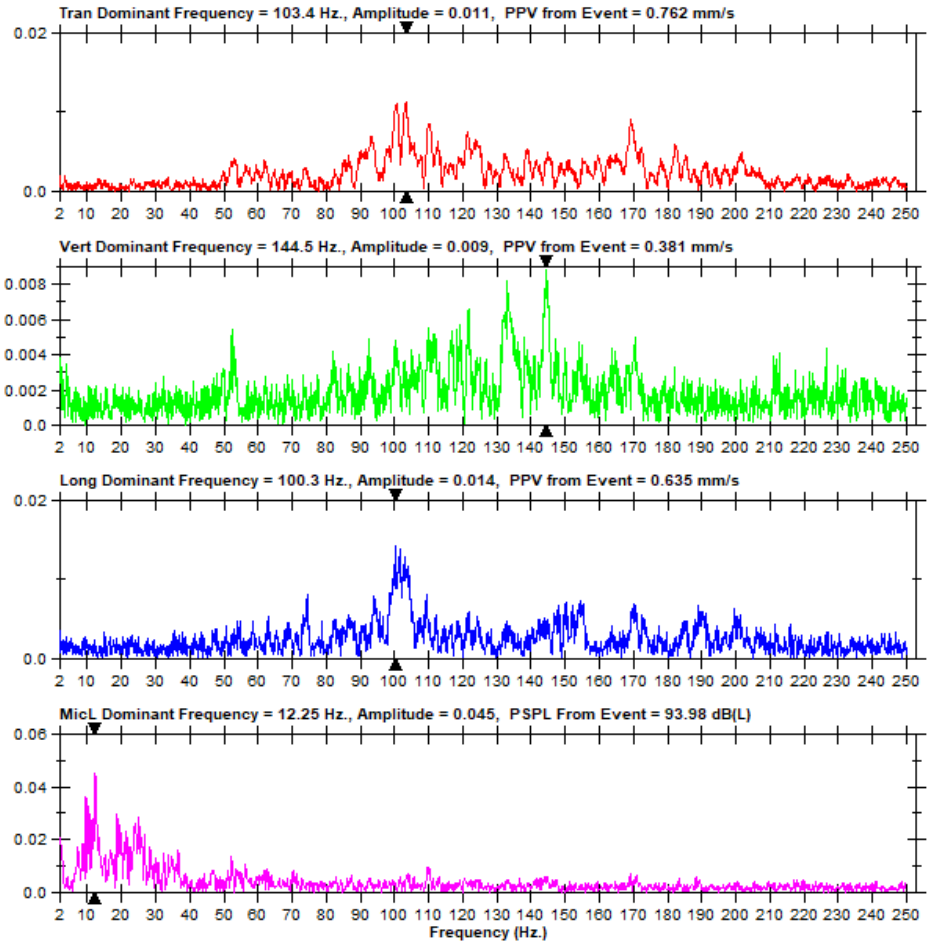
FFT Report

Date/Time	Long at 17:47:23 January 6, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JU8H.EZ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 33, Hole Depth - 1.5 m, Charge/hole - 0.4356 Kg, MCPD - 0.50 Kg, Total Charge - 14.375 Kg, Distance - 200 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Vert at 17:50:17 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

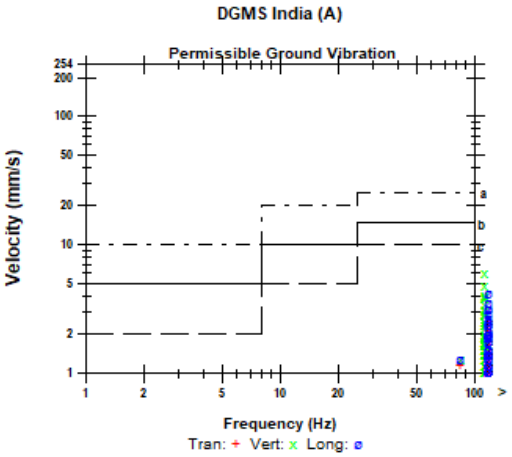
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

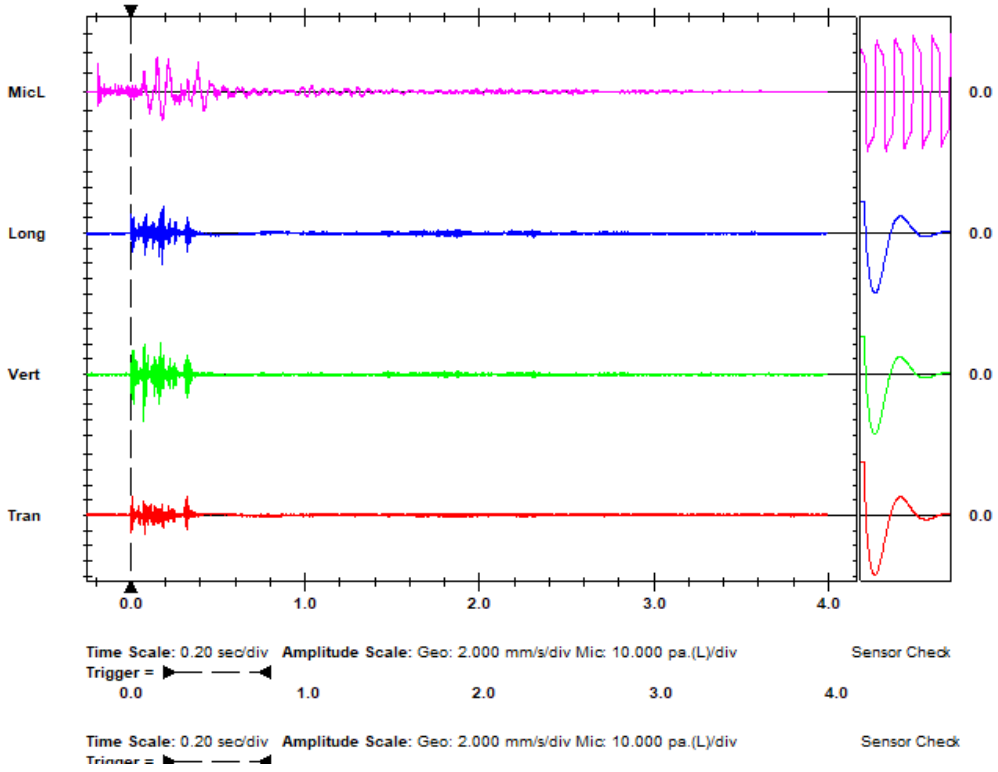
Microphone Linear Weighting
PSPL 119.0 dB(L) at 0.150 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 518 mv)

	Tran	Vert	Long	
PPV	2.540	6.096	4.191	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.009	0.077	0.183	sec
Peak Acceleration	0.252	0.504	0.345	g
Peak Displacement	0.003	0.004	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.5	7.4	Hz
Overswing Ratio	3.5	3.6	3.8	

Peak Vector Sum 6.185 mm/s at 0.077 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JU8H.JT0
Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.367 Kg, MCPD - 0.25 Kg, Total Charge - 5.875 Kg, Distance - 26 m





Instantel

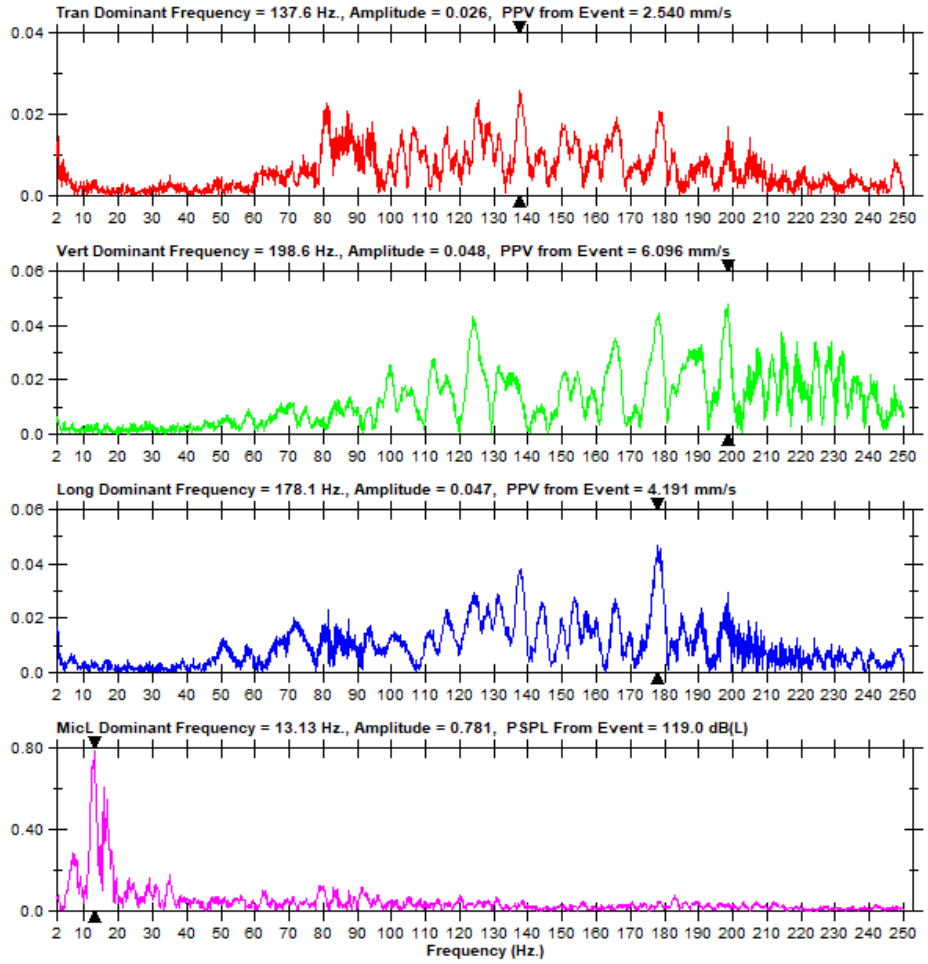
FFT Report

Date/Time	Vert at 17:50:17 January 6, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JU8H.JT0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: Rock Excavation Engg.CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.367 Kg, MCPD - 0.25 Kg, Total Charge - 5.875 Kg, Distance - 26 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 17:50:13 January 6, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JU8H.JP0
Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.367 Kg, MCPD - 0.25 Kg, Total Charge - 5.875 Kg, Distance - 67 m

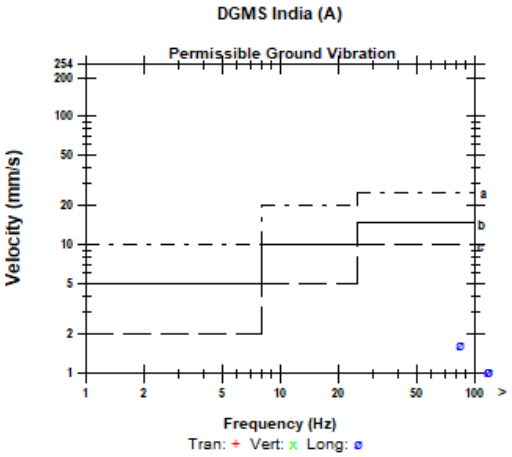
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

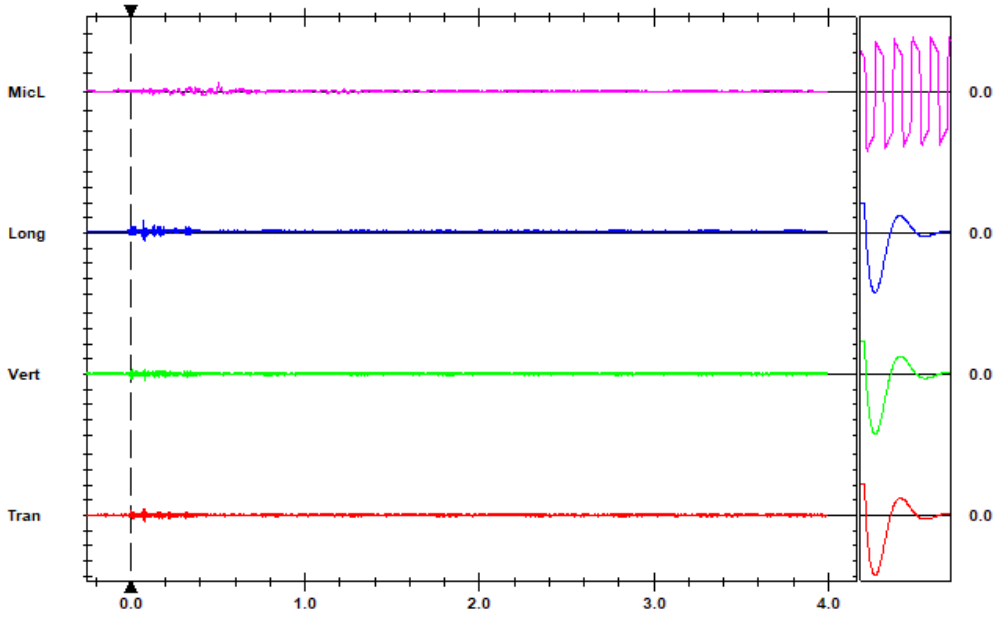
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.505 sec
ZC Freq 17 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 490 mv)

	Tran	Vert	Long	
PPV	0.889	0.889	1.651	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.078	0.080	0.073	sec
Peak Acceleration	0.080	0.066	0.080	g
Peak Displacement	0.001	0.001	0.027	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.7	

Peak Vector Sum 1.773 mm/s at 0.073 sec





Instantel

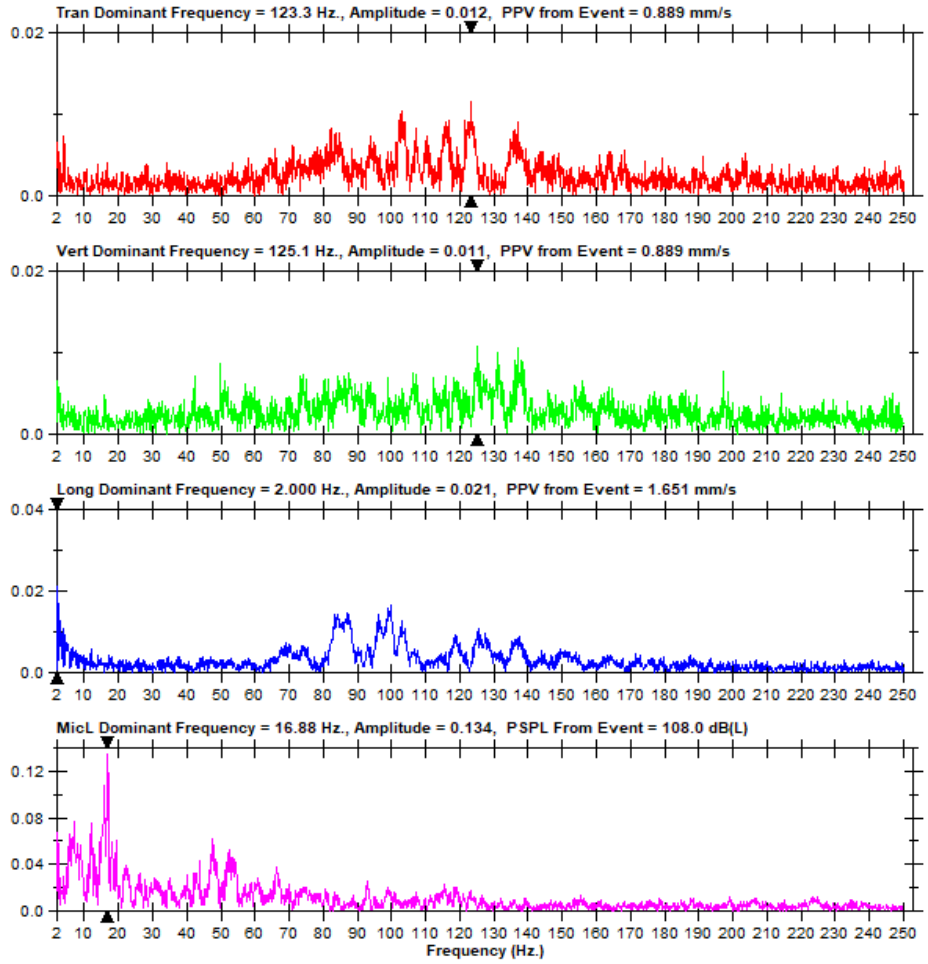
FFT Report

Date/Time	Long at 17:50:13 January 6, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JU8H.JP0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: REED, CSIR-CIMFR, Dhanbad
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 16, Hole Depth - 1.5 m, Charge/hole - 0.367 Kg, MCPD - 0.25 Kg, Total Charge - 5.875 Kg, Distance - 67 m



Printed: February 21, 2023 (V 10.72 - 10.72)

ANNEXURE-7

Event and FFT Reports of Ground Vibration Recorded at Granite (Building Stone) Quarry of M/s Penta Granites, Palakkad District

Instantel

Event Report

Date/Time	Tran at 15:14:38 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111151438.IDFW

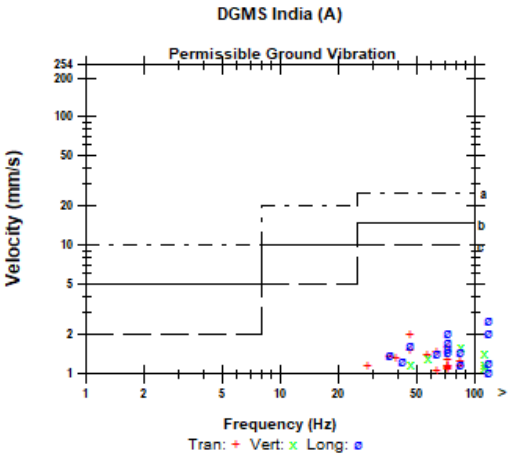
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 40 m

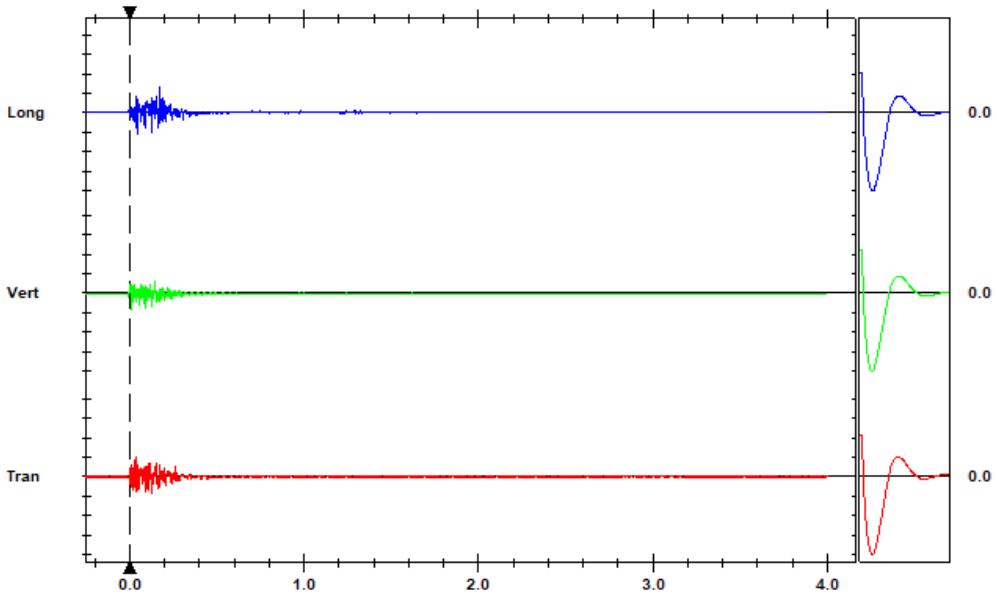
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.994	1.616	2.577	mm/s
ZC Freq	47	85	>100	Hz
Time (Rel. to Trig)	0.034	0.010	0.176	sec
Peak Acceleration	0.118	0.086	0.131	g
Peak Displacement	0.005	0.008	0.011	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 2.657 mm/s at 0.176 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

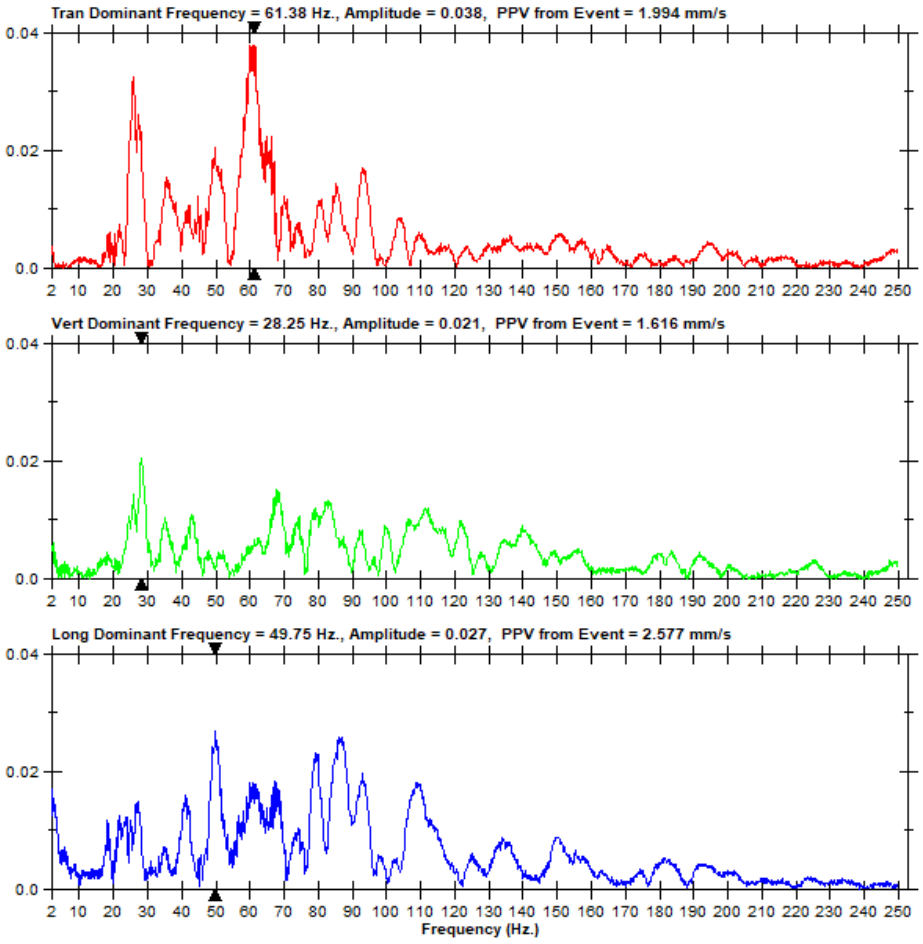
FFT Report

Date/Time	Tran at 15:14:38 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111151438.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 40 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:14:36 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHJ.OC0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 102 m

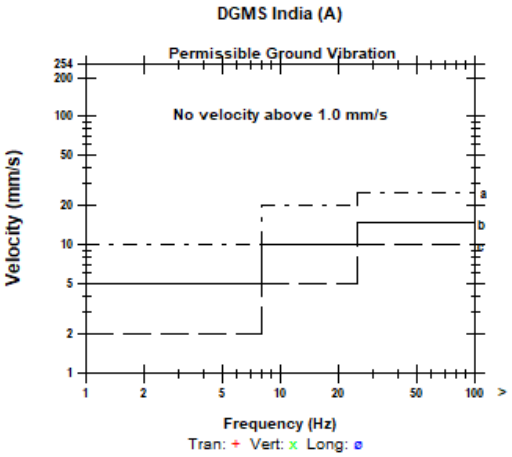
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

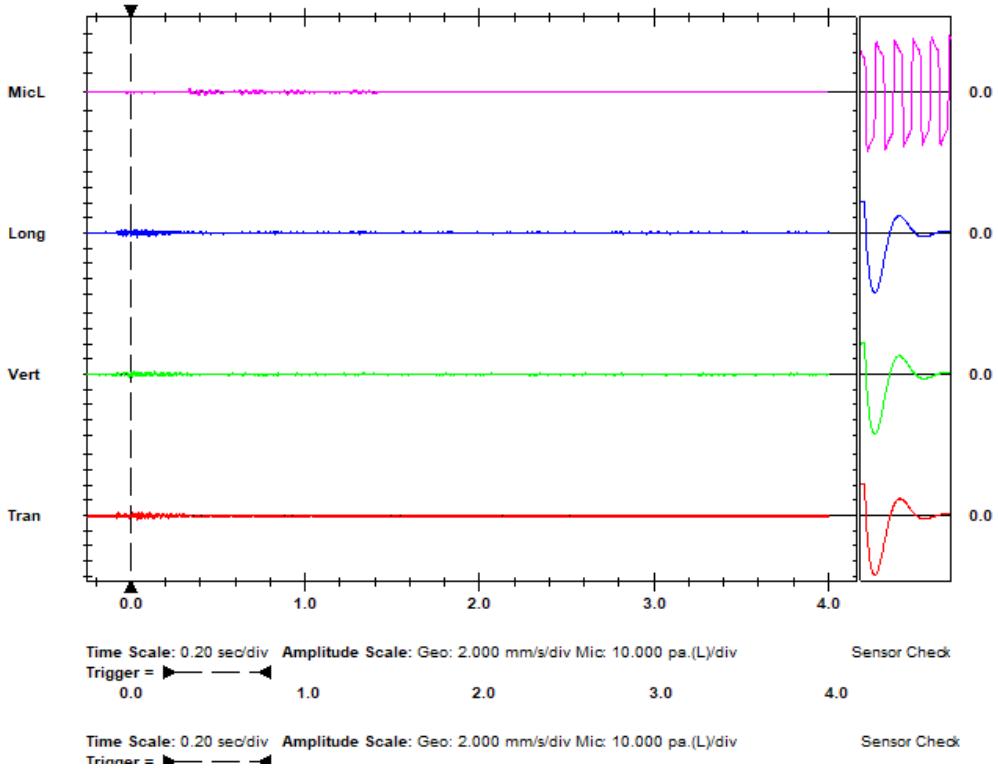
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.336 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.635	mm/s
ZC Freq	73	85	>100	Hz
Time (Rel. to Trig)	0.036	-0.008	0.036	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.898 mm/s at 0.036 sec





Instantel

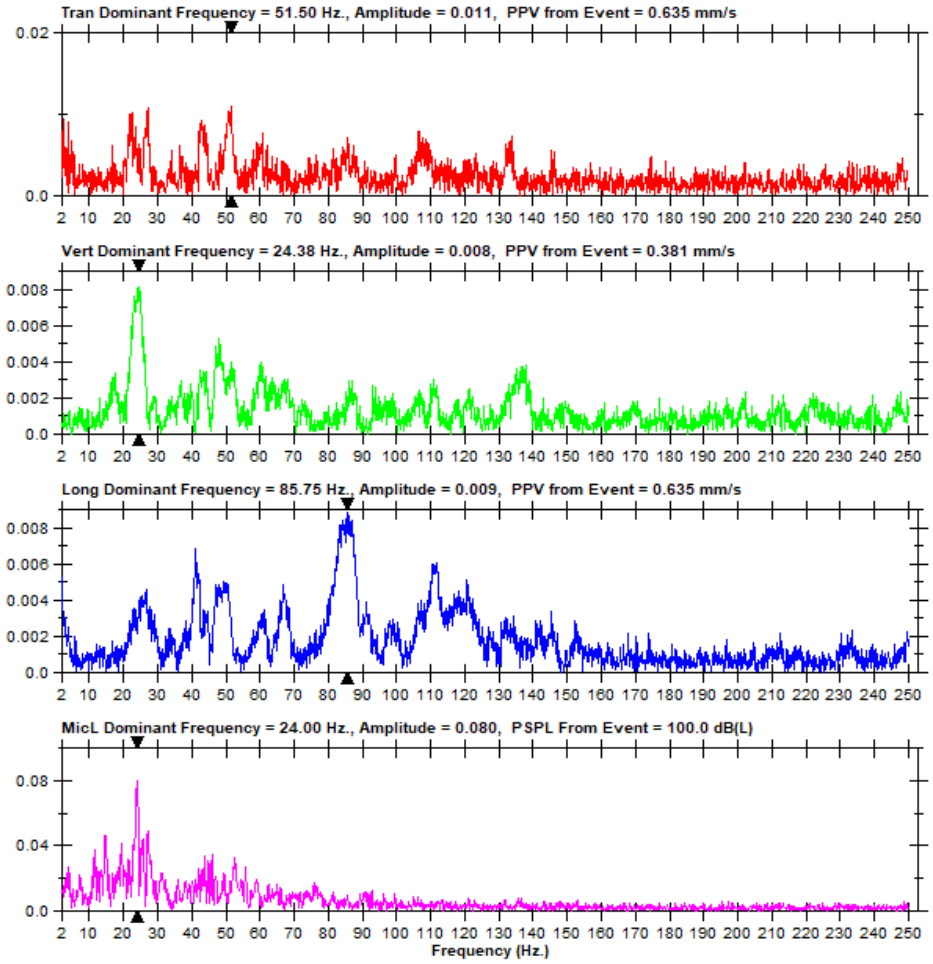
FFT Report

Date/Time	Long at 15:14:36 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHJ.OC0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 102 m



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Event Report

Date/Time Long at 15:13:41 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHJ.MT0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 109 m

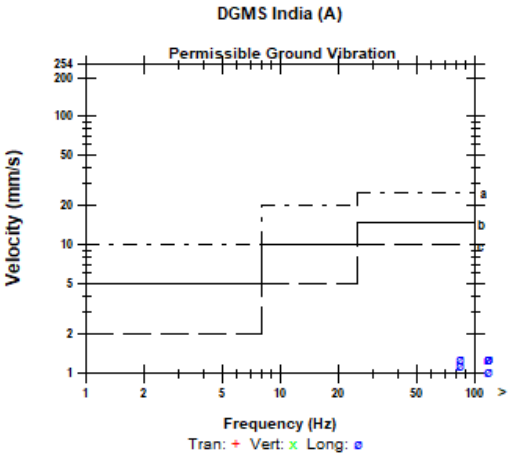
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

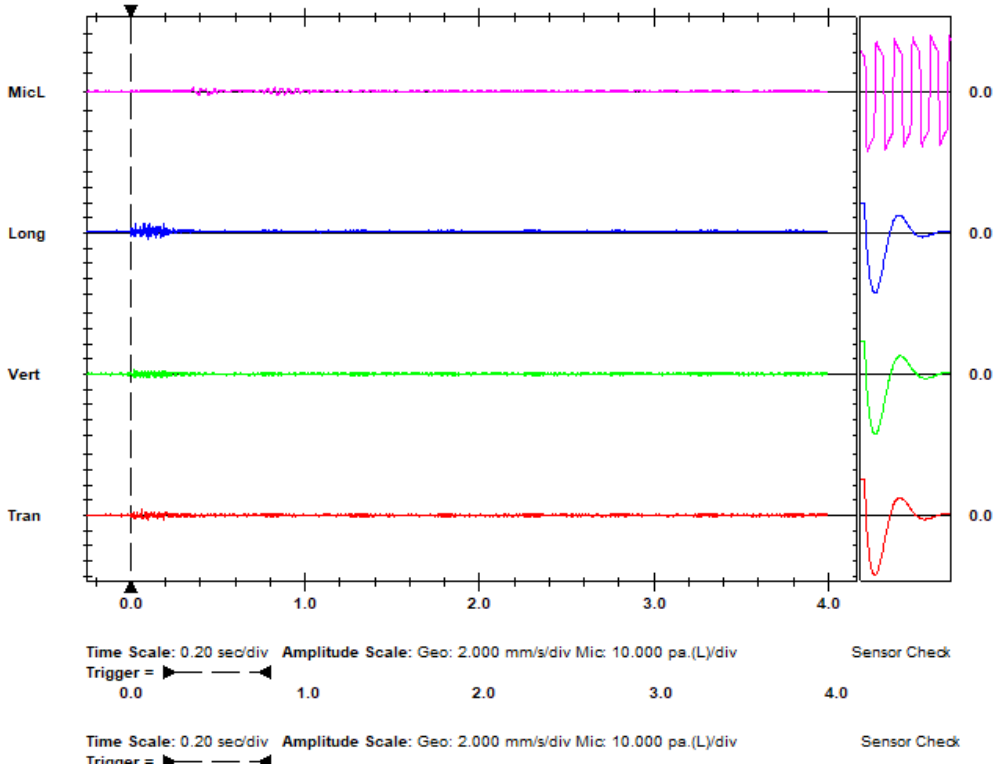
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.828 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	1.270	mm/s
ZC Freq	64	>100	85	Hz
Time (Rel. to Trig)	0.064	0.019	0.026	sec
Peak Acceleration	0.053	0.040	0.093	g
Peak Displacement	0.002	0.002	0.016	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.362 mm/s at 0.191 sec





Instantel

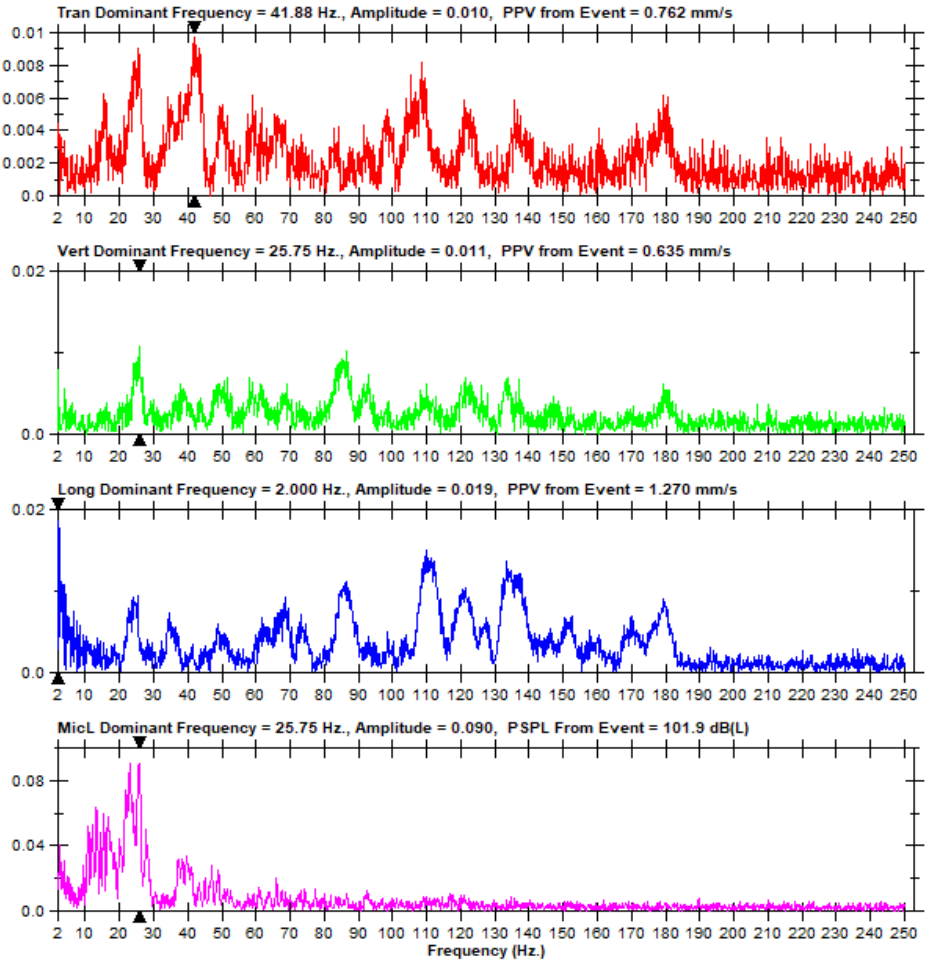
FFT Report

Date/Time	Long at 15:13:41 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHJ.MT0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 109 m



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Event Report

Date/Time	Vert at 15:13:45 January 11, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUHJ.MX0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

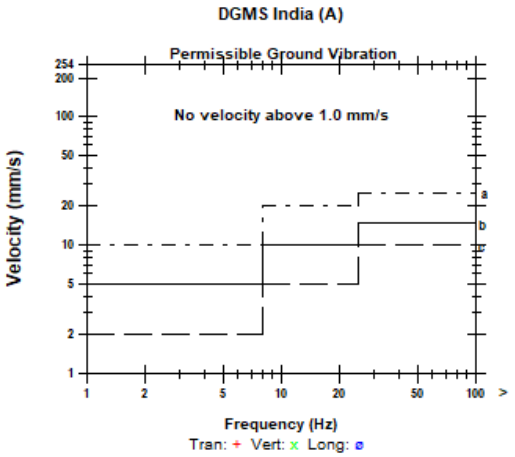
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 162 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

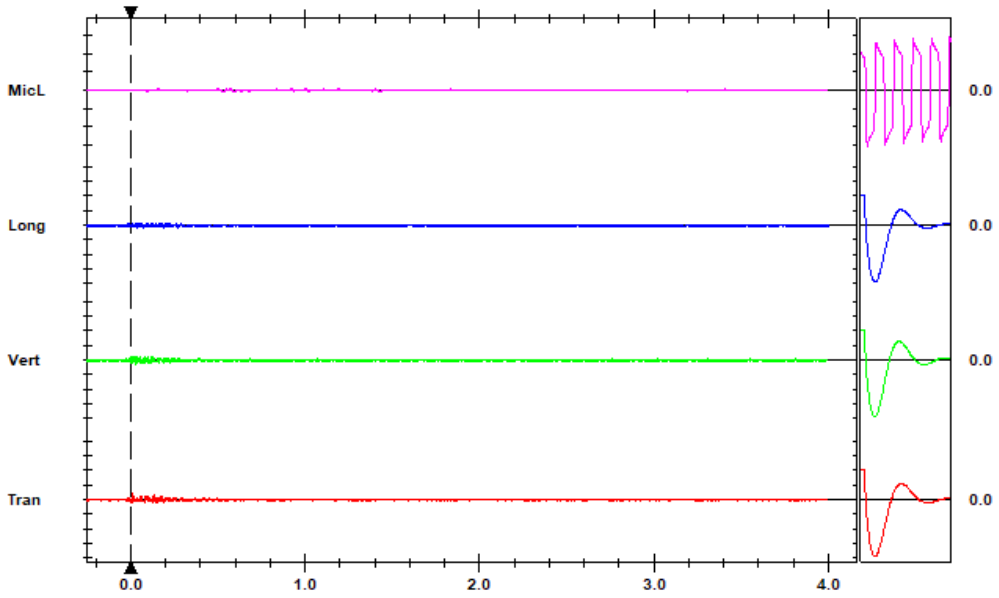
Microphone	Linear Weighting
PSPL	93.98 dB(L) at 0.499 sec
ZC Freq	28 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 542 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	0.381	mm/s
ZC Freq	73	85	>100	Hz
Time (Rel. to Trig)	0.013	0.028	0.038	sec
Peak Acceleration	0.040	0.040	0.027	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.803 mm/s at 0.013 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

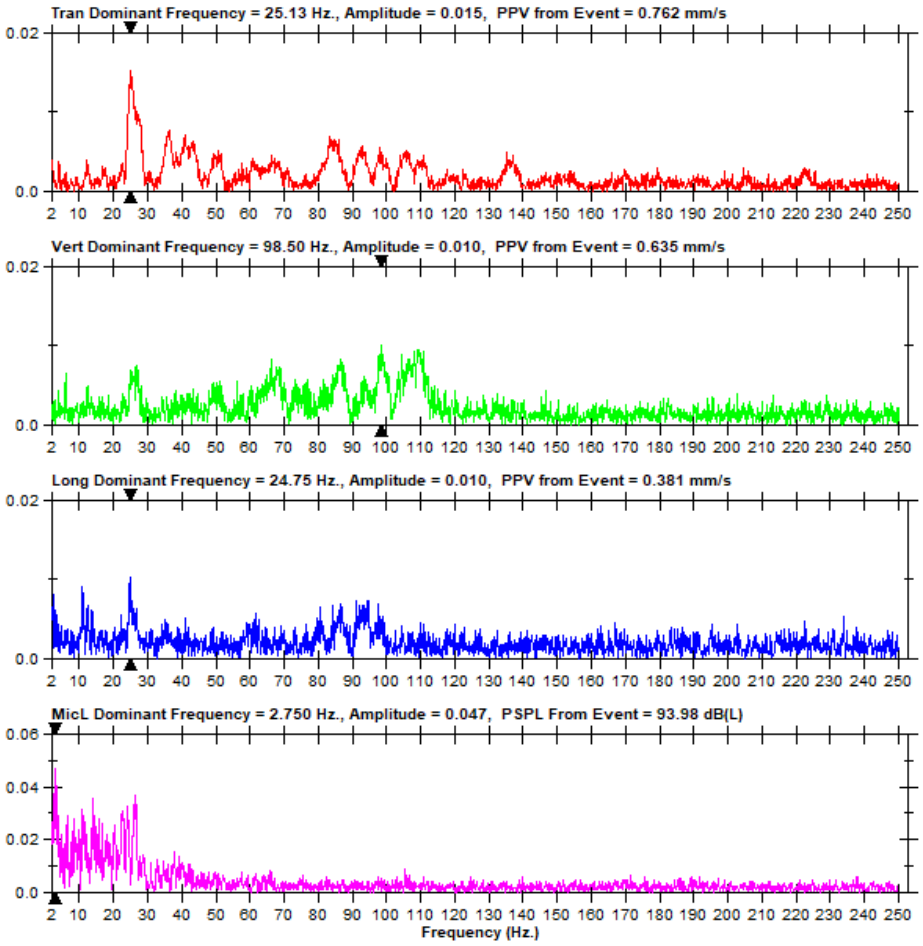
FFT Report

Date/Time	Vert at 15:13:45 January 11, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUHJ.MX0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 162 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 15:13:47 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUHJ.MZ0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 202 m

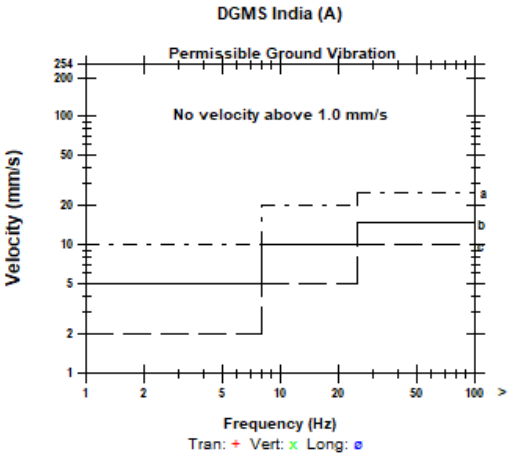
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

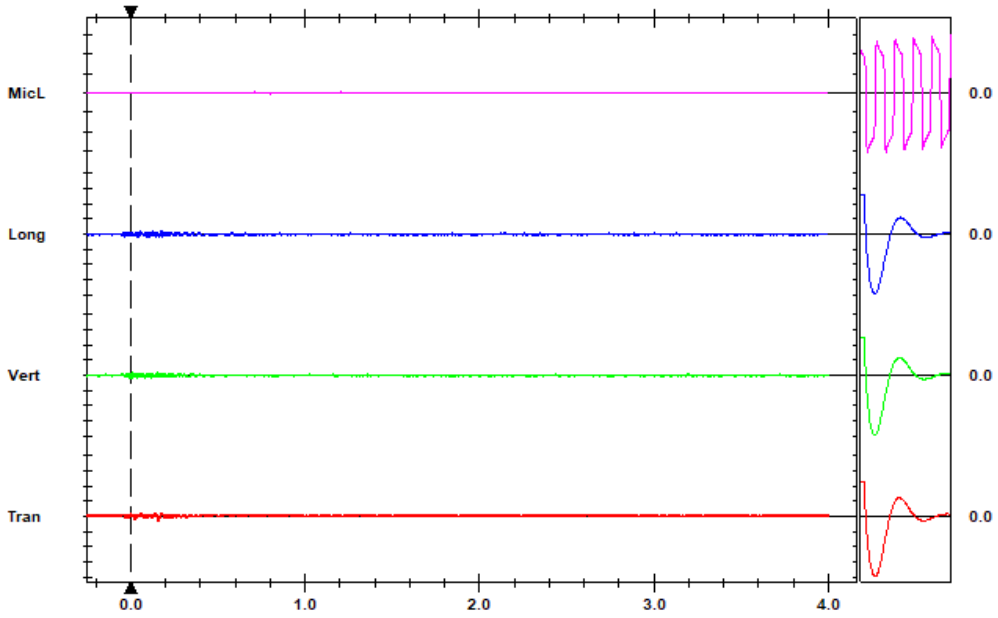
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL <88 dB(L)
ZC Freq 51 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 513 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.157	-0.006	0.041	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 0.730 mm/s at 0.158 sec
N/A: Not Applicable





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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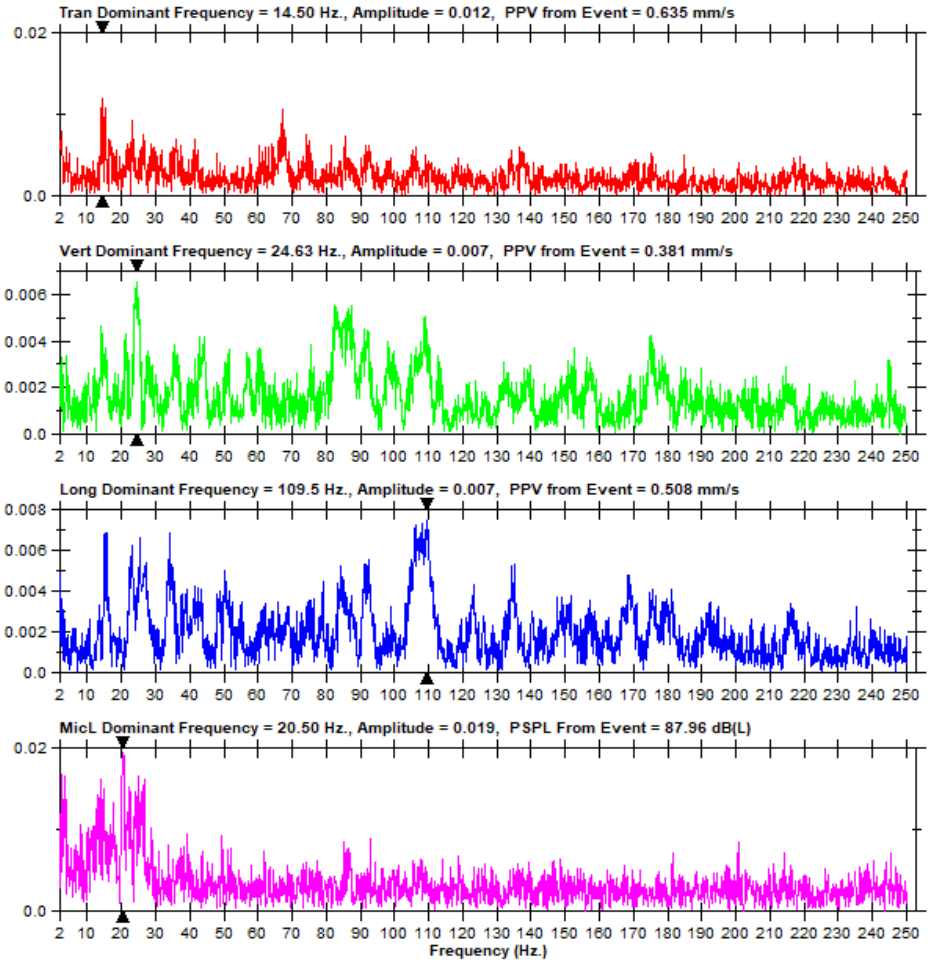
FFT Report

Date/Time	Tran at 15:13:47 January 11, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUHJ.MZ0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 202 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Vert at 15:37:22 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111153722.IDFW

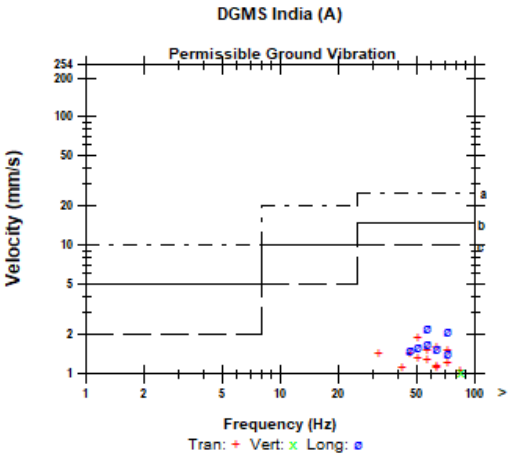
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 42 m

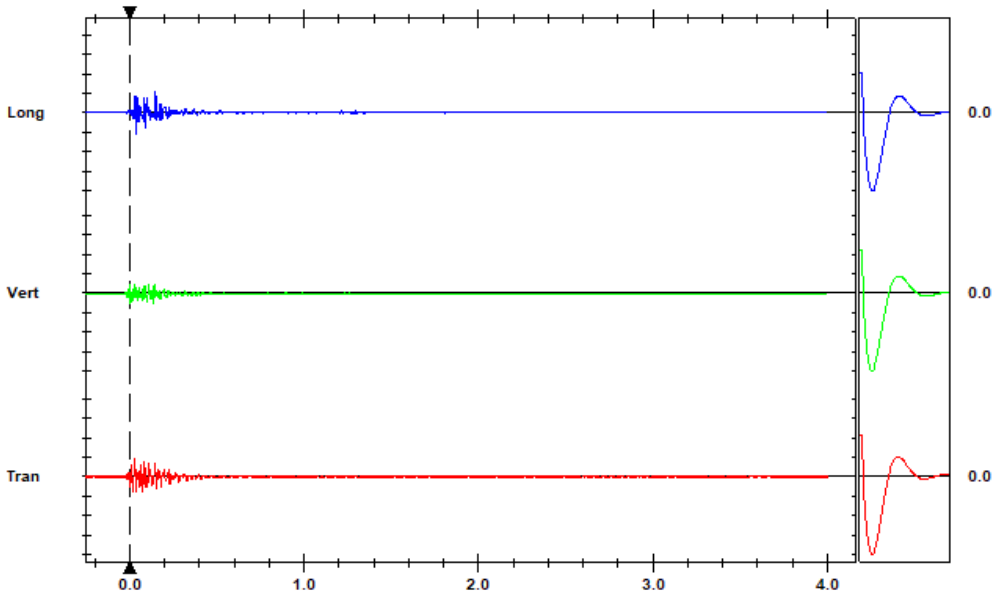
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.915	1.033	2.231	mm/s
ZC Freq	51	85	57	Hz
Time (Rel. to Trig)	0.028	0.006	0.148	sec
Peak Acceleration	0.082	0.058	0.092	g
Peak Displacement	0.006	0.007	0.016	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 2.474 mm/s at 0.148 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

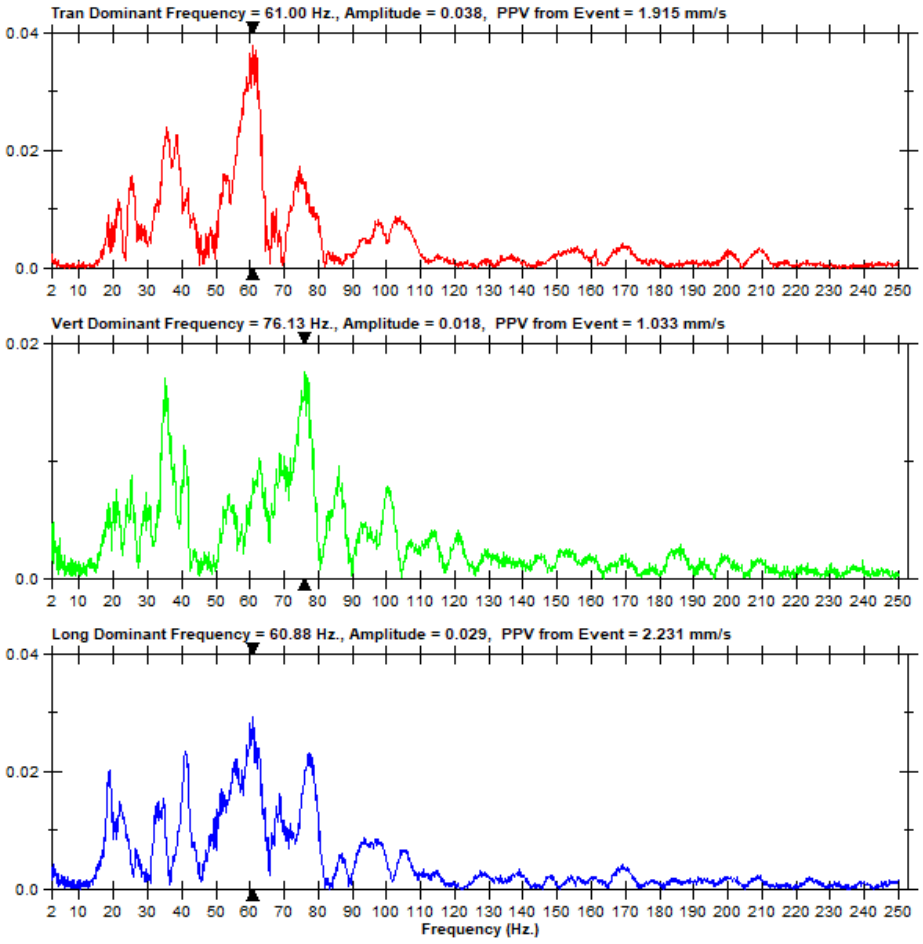
FFT Report

Date/Time	Vert at 15:37:22 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111153722.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 42 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:37:20 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHK.Q80
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 125 m

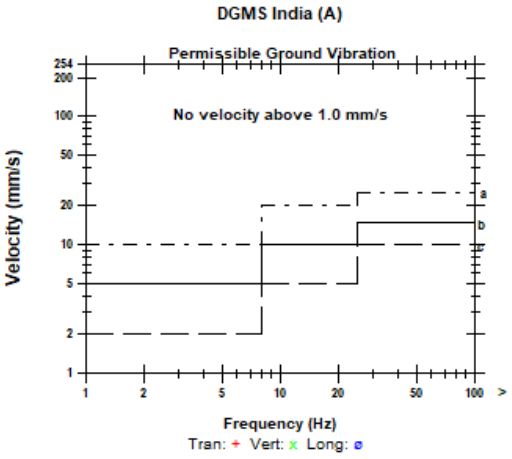
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

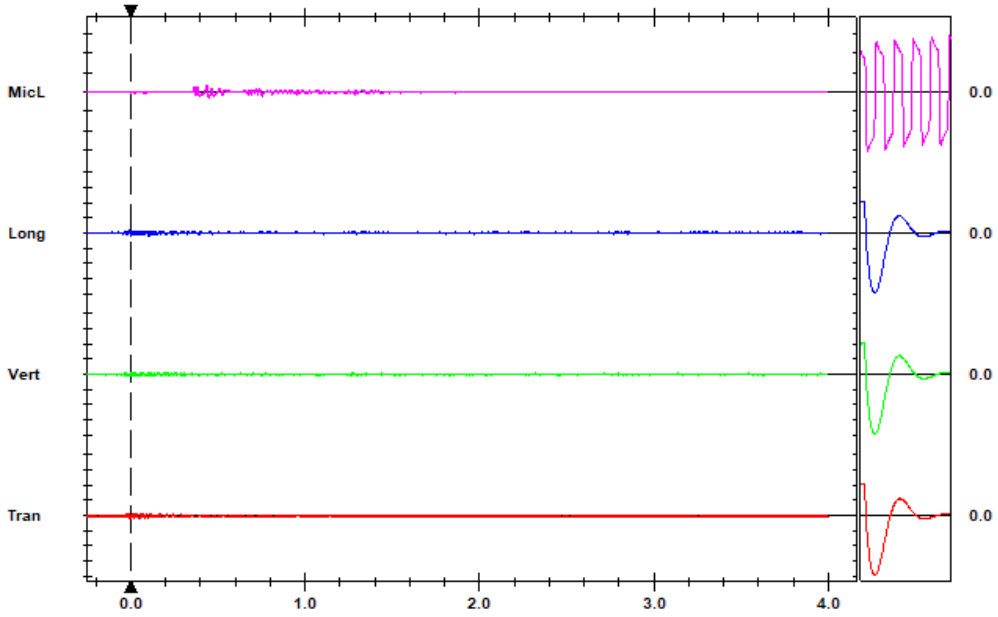
Microphone Linear Weighting
PSPL 104.2 dB(L) at 0.437 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.508	mm/s
ZC Freq	43	>100	>100	Hz
Time (Rel. to Trig)	0.049	-0.028	0.000	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.635 mm/s at 0.102 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

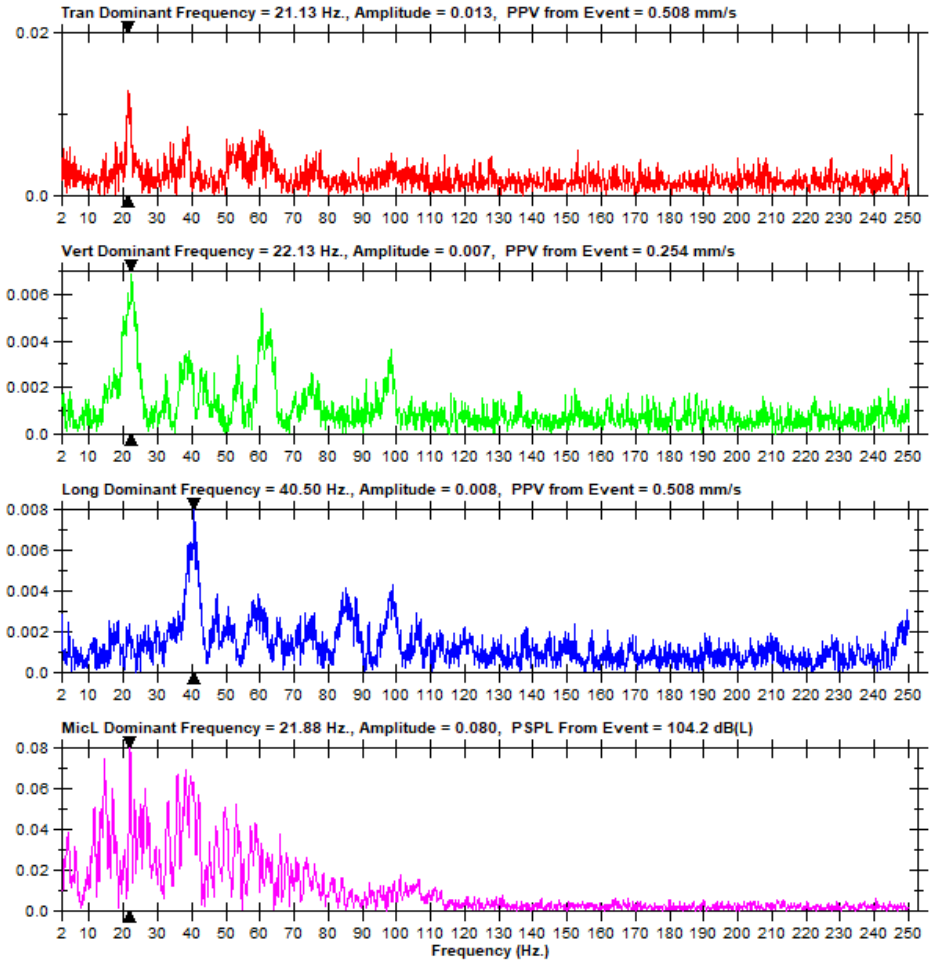
FFT Report

Date/Time	Long at 15:37:20 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHK.Q80

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 125 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:36:25 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHK.OP0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 105 m

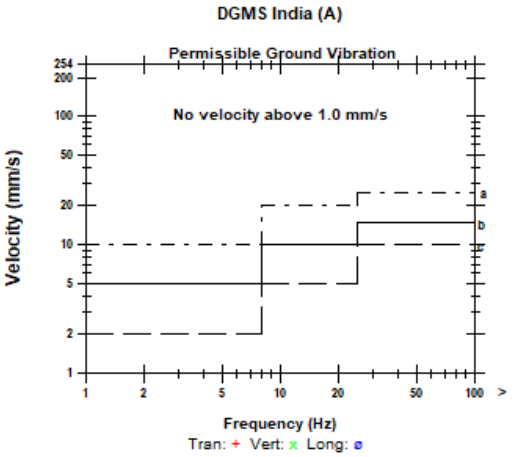
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

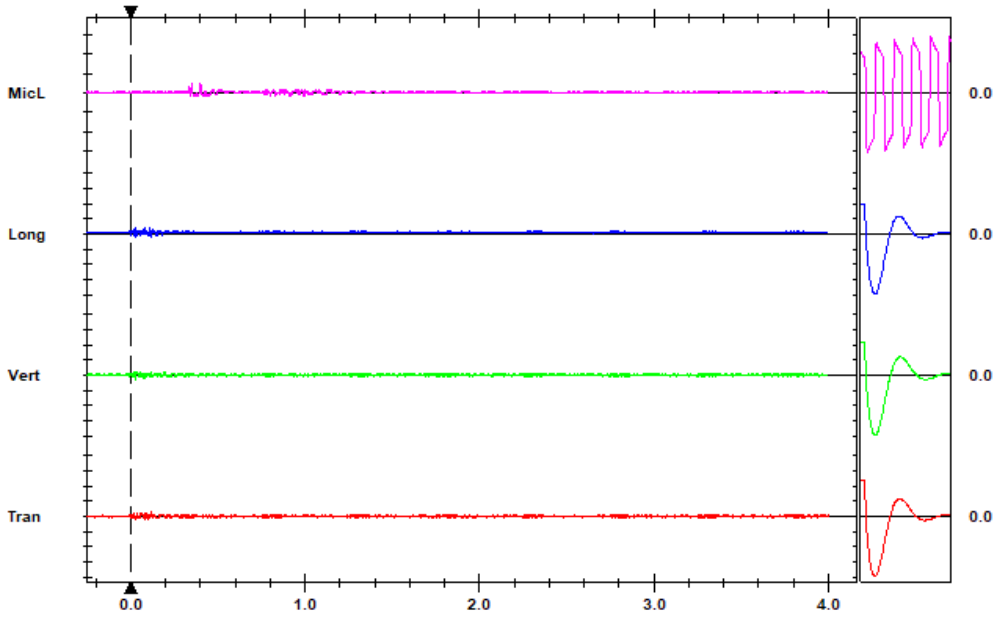
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.398 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.635	0.635	0.889	mm/s
ZC Freq	51	64	57	Hz
Time (Rel. to Trig)	0.115	0.026	0.024	sec
Peak Acceleration	0.027	0.040	0.040	g
Peak Displacement	0.002	0.001	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.122 mm/s at 0.026 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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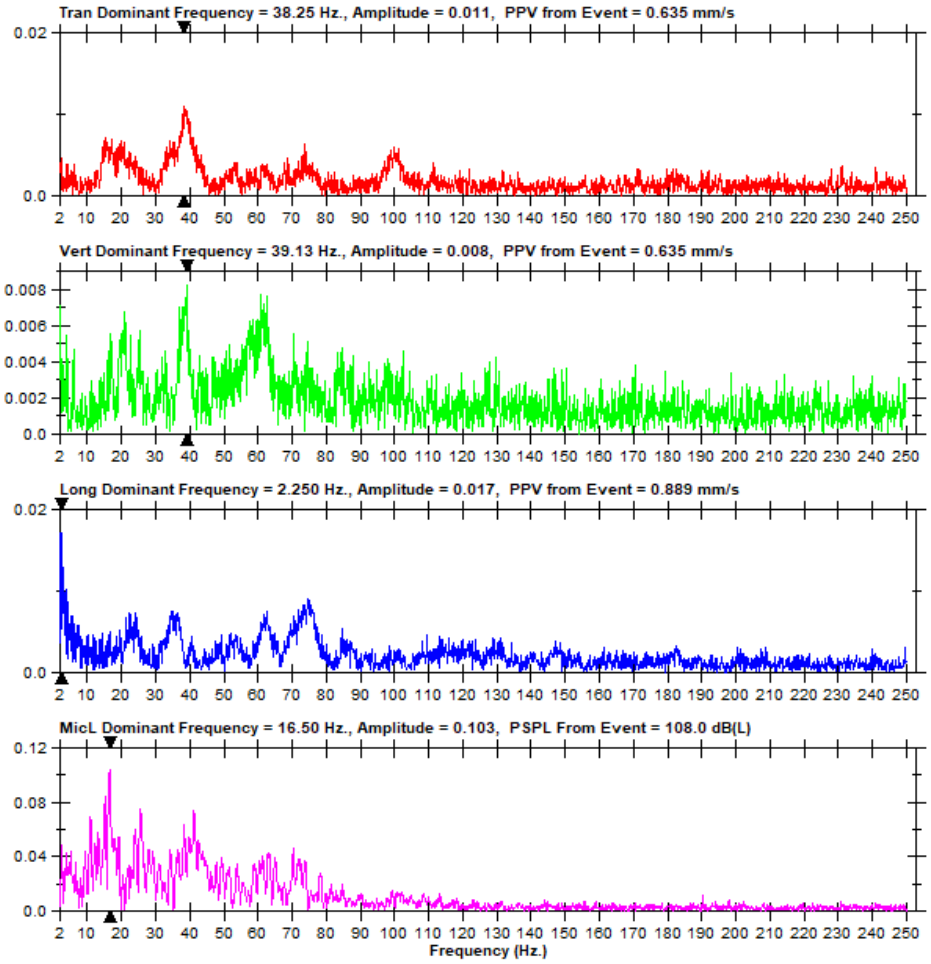
FFT Report

Date/Time	Long at 15:36:25 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHK.OP0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 105 m



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Event Report

Date/Time	Tran at 15:36:29 January 11, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUHK.OT0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

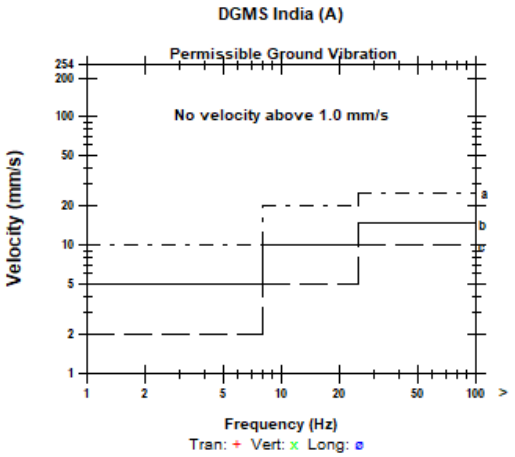
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 160 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

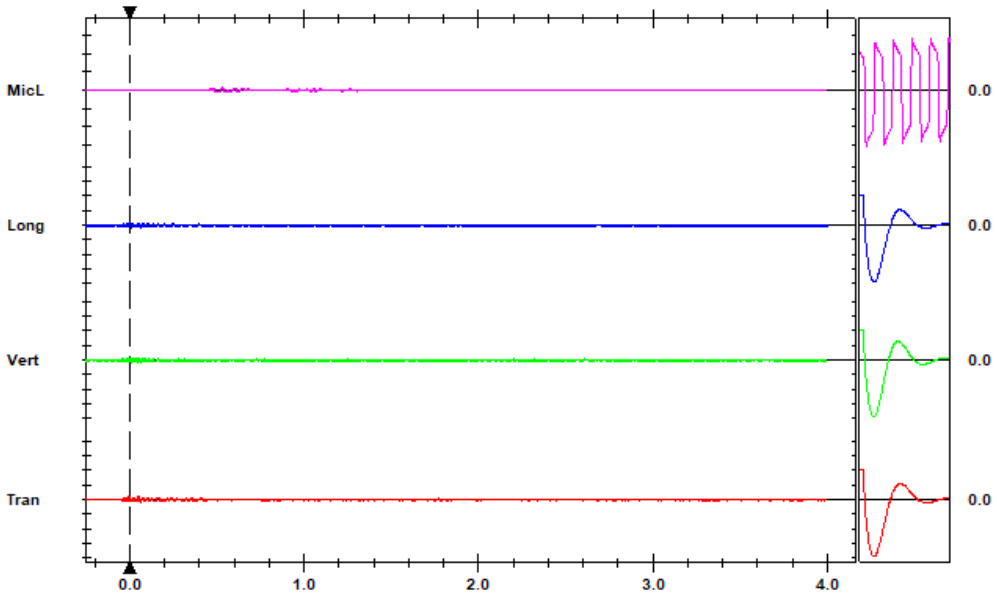
Microphone	Linear Weighting
PSPL	97.50 dB(L) at 0.530 sec
ZC Freq	34 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 551 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.508	mm/s
ZC Freq	73	85	73	Hz
Time (Rel. to Trig)	0.000	0.064	0.064	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.813 mm/s at 0.064 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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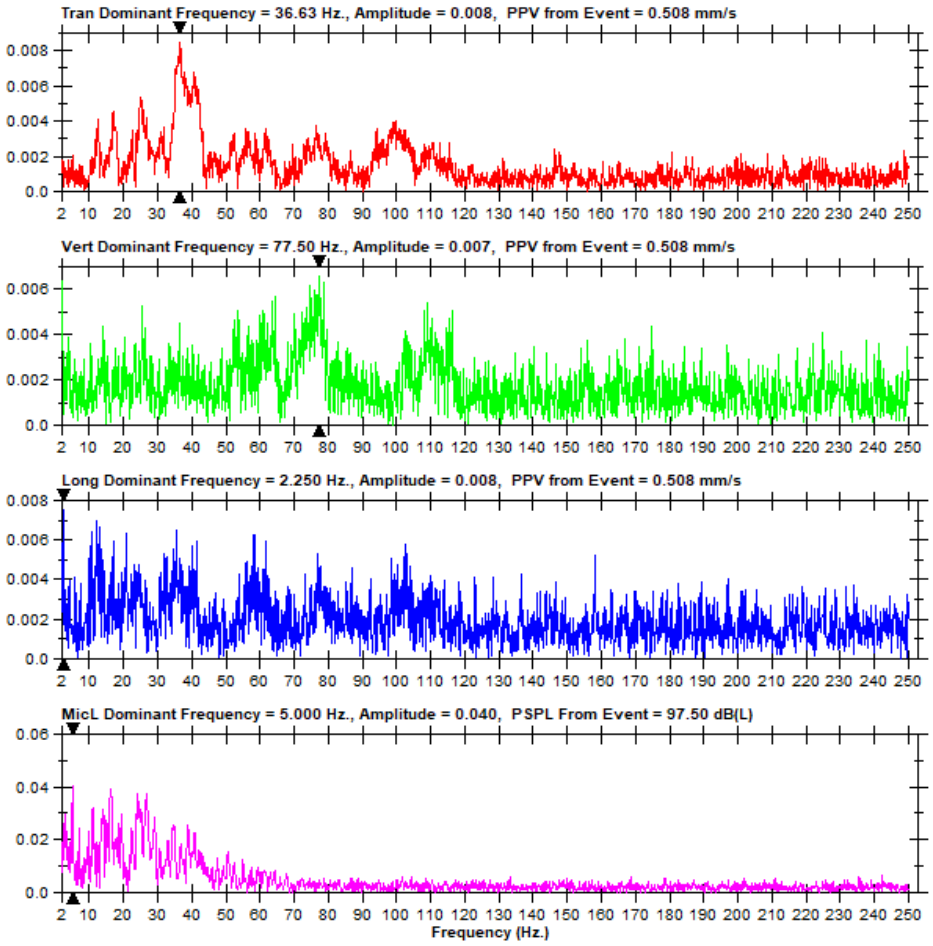
FFT Report

Date/Time	Tran at 15:36:29 January 11, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUHK.OT0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 160 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:36:32 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUHK.OW0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 200 m

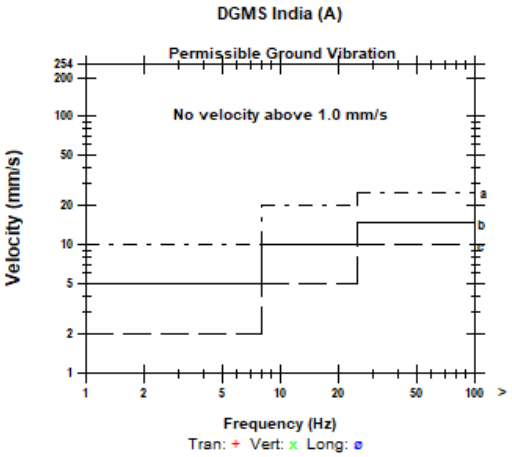
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

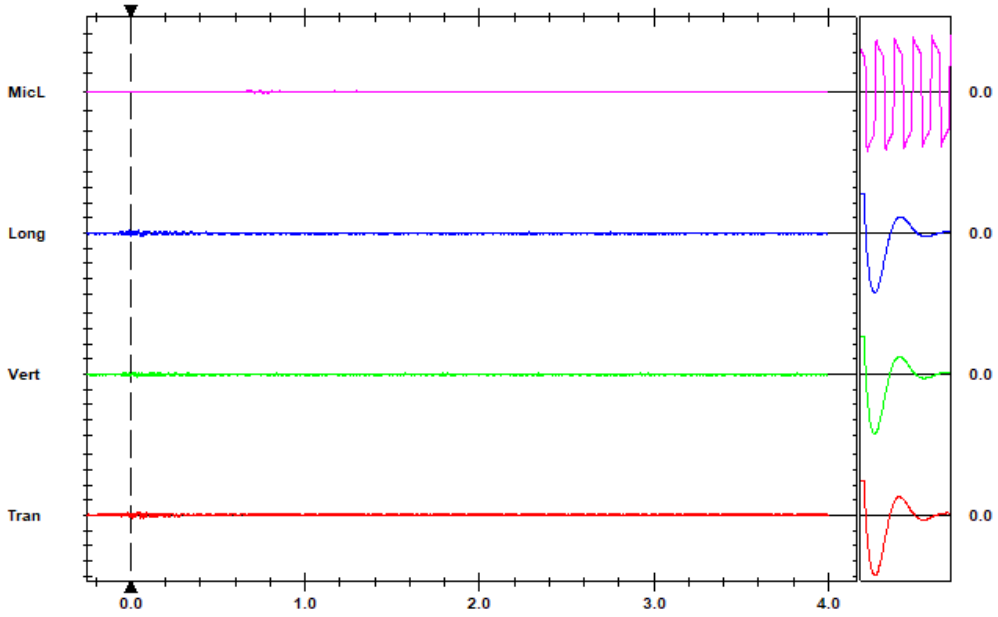
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.738 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 536 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.508	mm/s
ZC Freq	85	85	64	Hz
Time (Rel. to Trig)	0.039	0.040	0.000	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 0.730 mm/s at 0.046 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

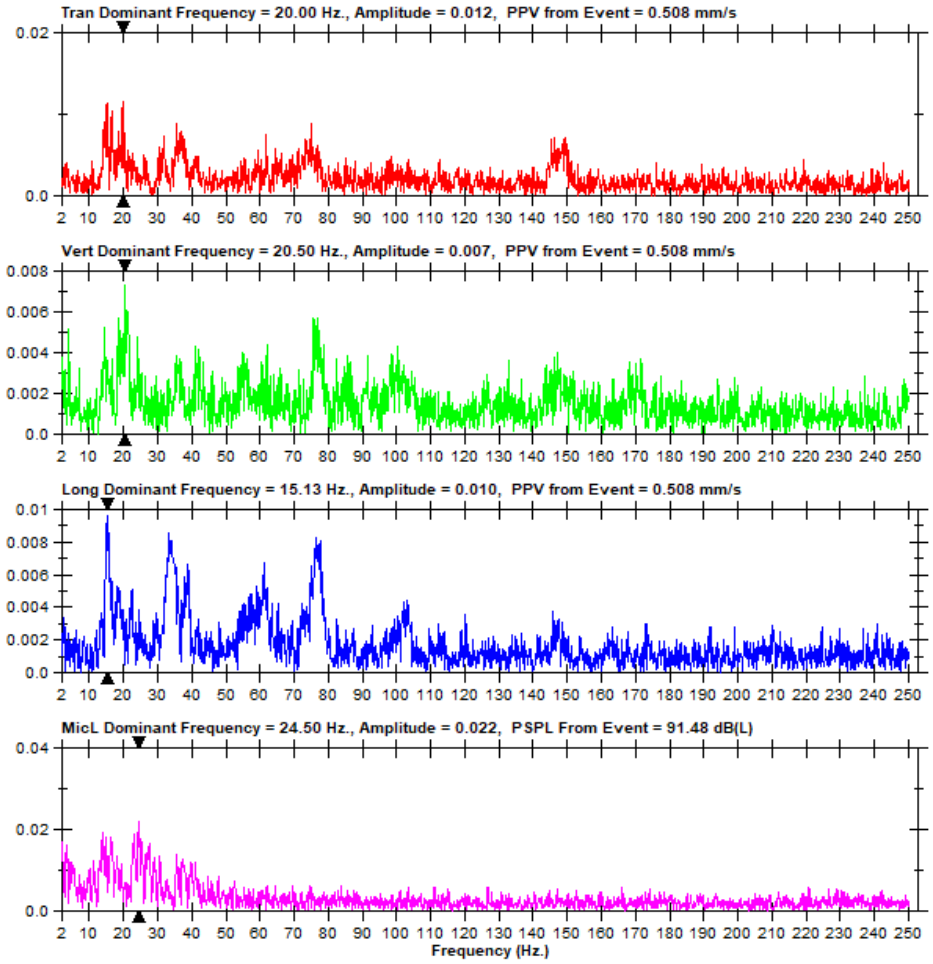
FFT Report

Date/Time	Long at 15:36:32 January 11, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUHK.OW0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 200 m



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Event Report

Date/Time	Vert at 15:42:40 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111154240.IDFW

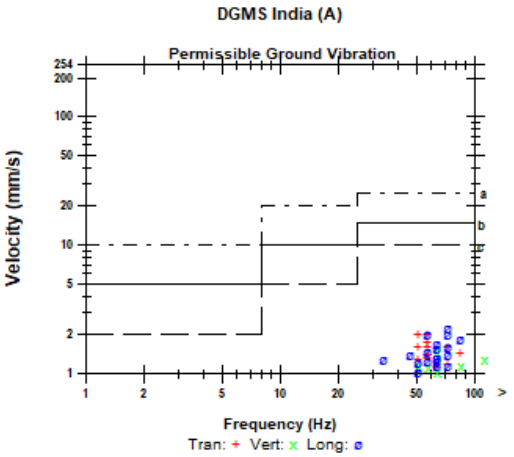
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 55 m

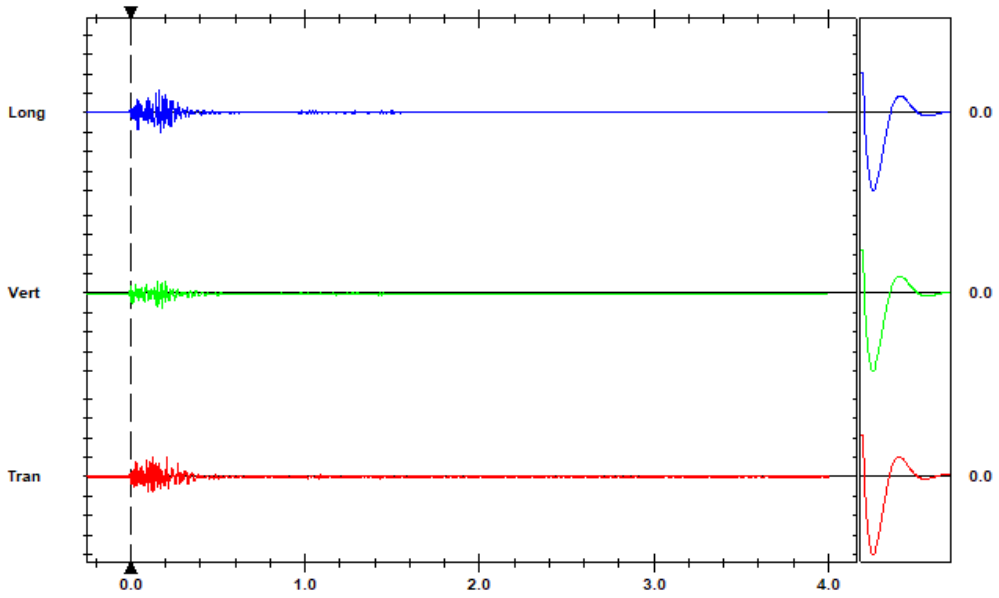
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	2.018	1.498	2.254	mm/s
ZC Freq	57	64	73	Hz
Time (Rel. to Trig)	0.124	0.184	0.161	sec
Peak Acceleration	0.105	0.115	0.138	g
Peak Displacement	0.006	0.008	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 2.514 mm/s at 0.161 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

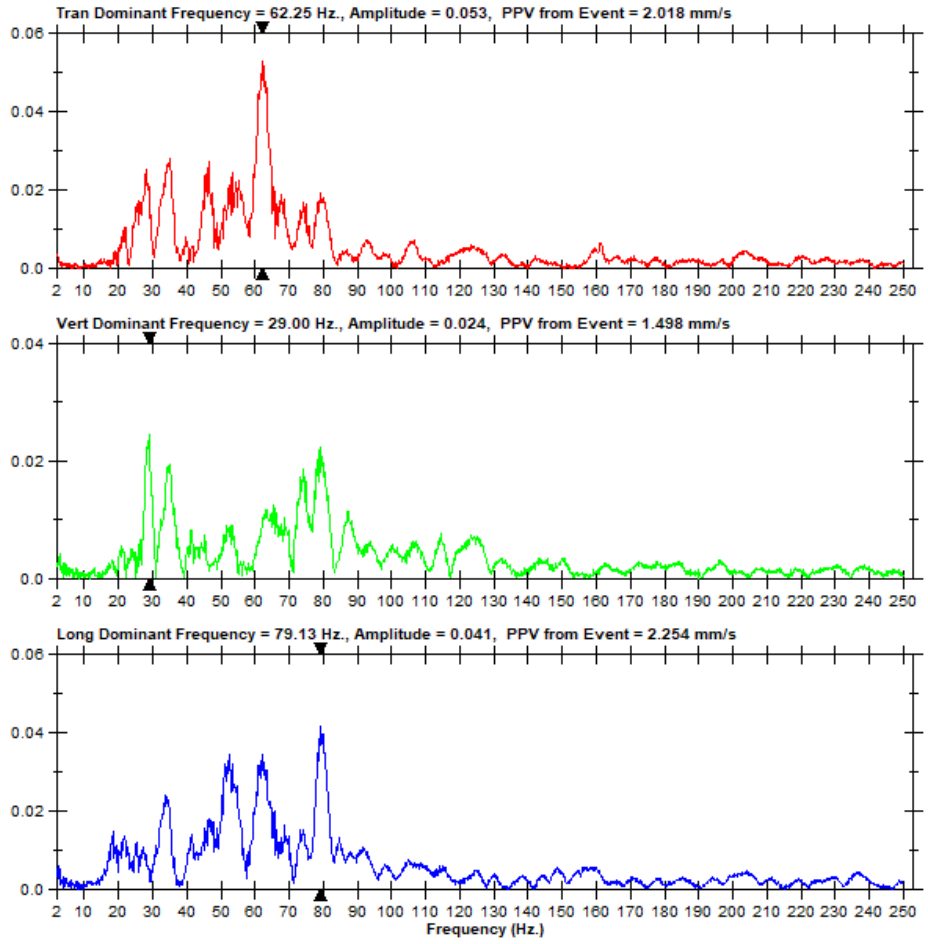
FFT Report

Date/Time	Vert at 15:42:40 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111154240.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 55 m



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Event Report

Date/Time Tran at 15:42:38 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHK.Z20
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 127 m

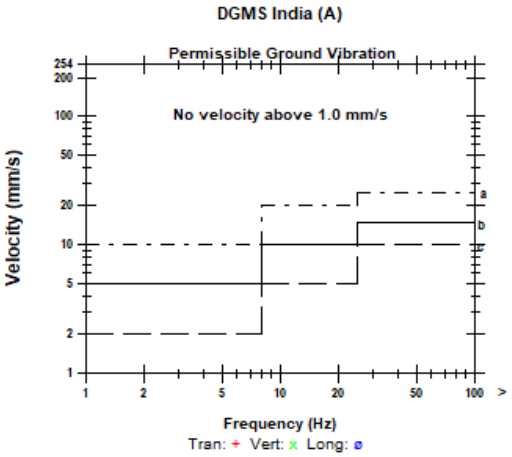
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

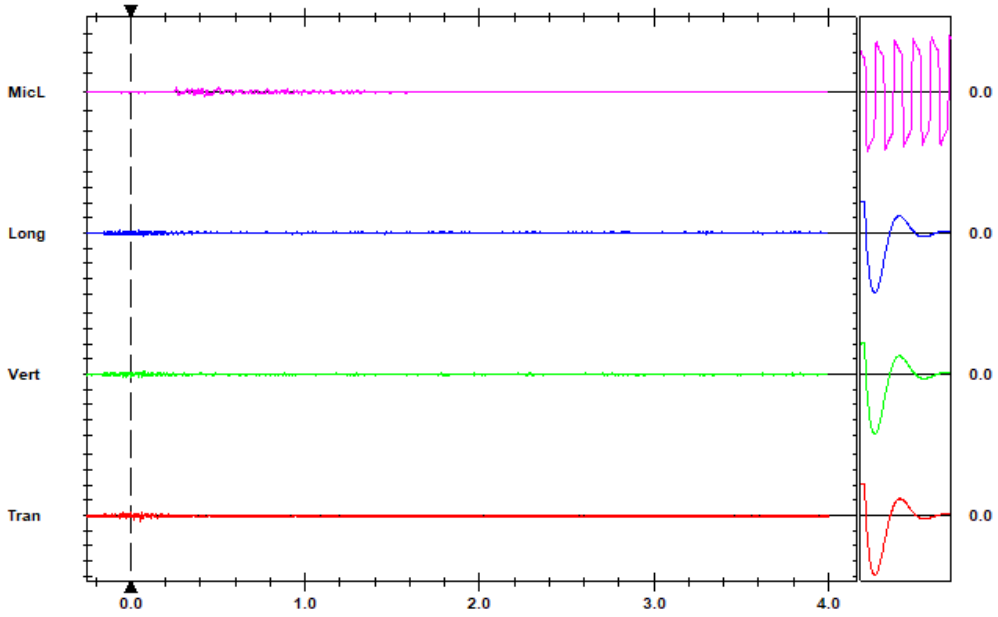
Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.503 sec
ZC Freq 15 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.762	0.508	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.060	0.049	0.077	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.773 mm/s at 0.060 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

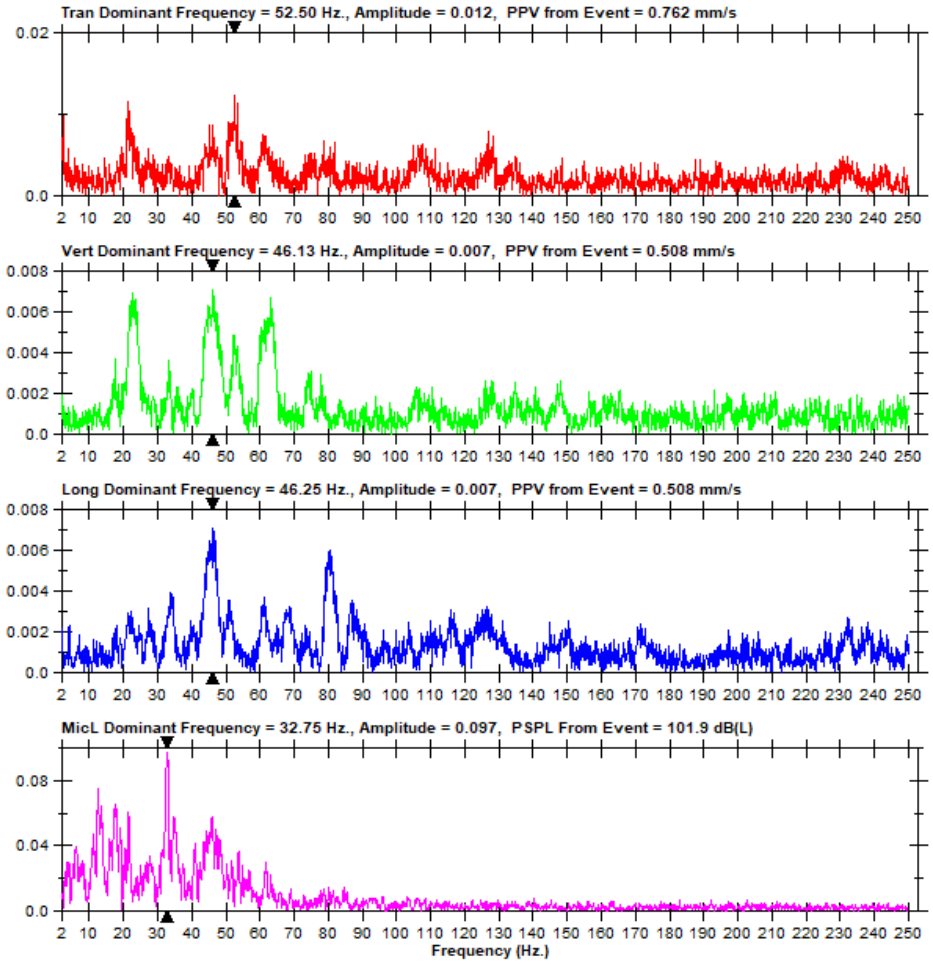
FFT Report

Date/Time	Tran at 15:42:38 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHK.Z20

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 127 m



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Event Report

Date/Time Long at 15:41:42 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHK.XI0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 103 m

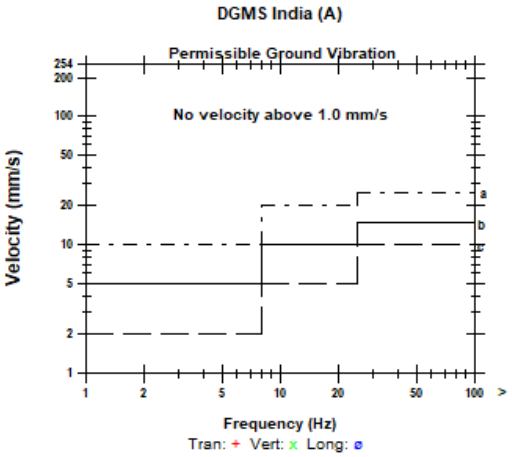
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

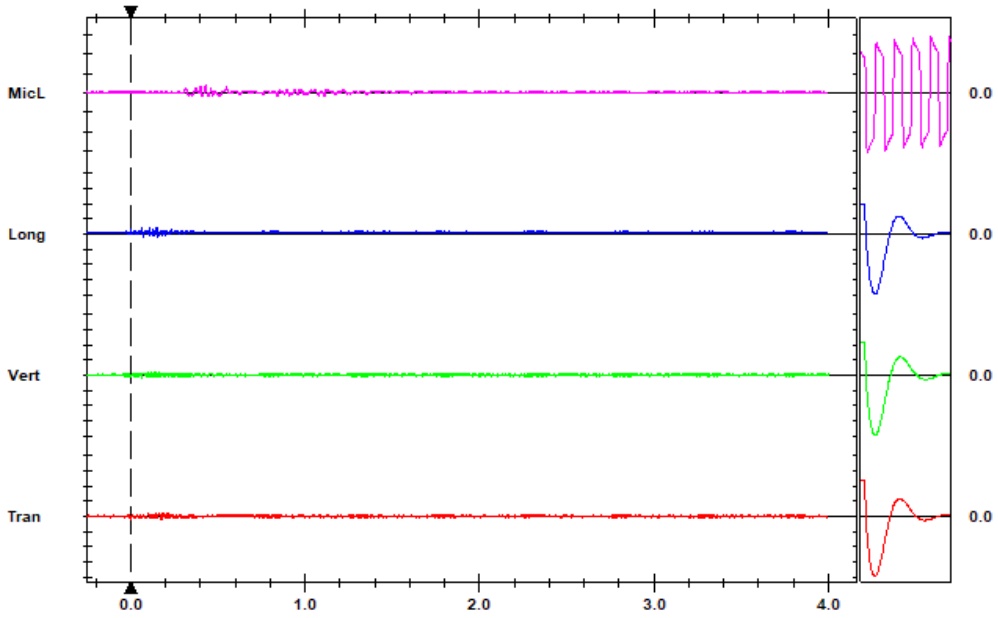
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 106.0 dB(L) at 0.431 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.889	mm/s
ZC Freq	57	85	64	Hz
Time (Rel. to Trig)	0.101	0.141	0.111	sec
Peak Acceleration	0.027	0.040	0.040	g
Peak Displacement	0.001	0.001	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 0.959 mm/s at 0.149 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

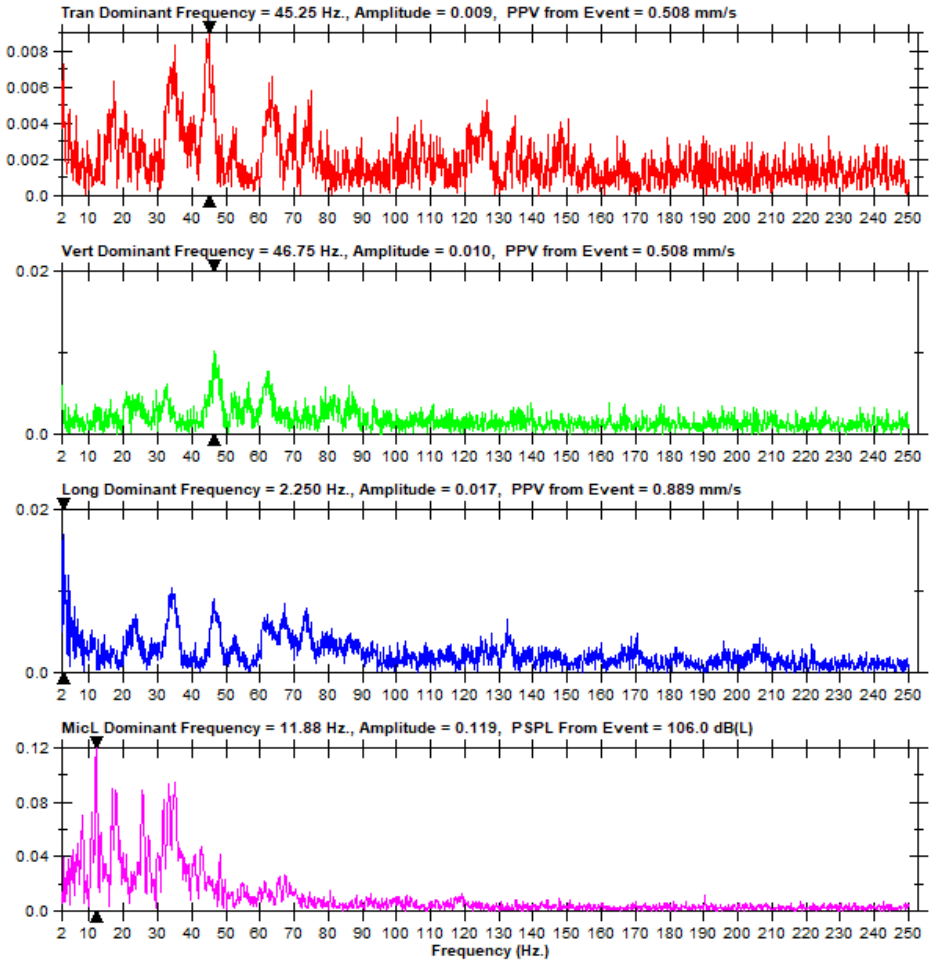
FFT Report

Date/Time	Long at 15:41:42 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHK.XI0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 103 m



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Event Report

Date/Time	Vert at 15:41:47 January 11, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUHK.XN0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

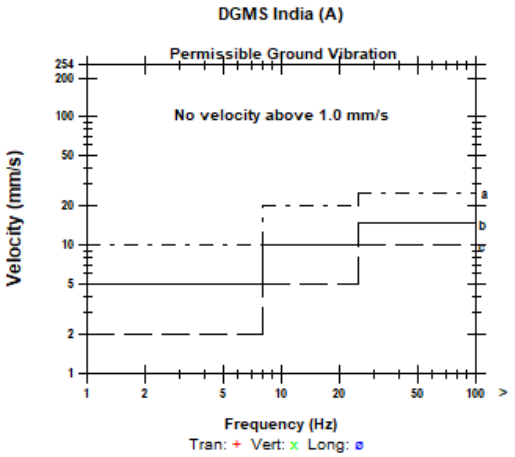
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 150 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

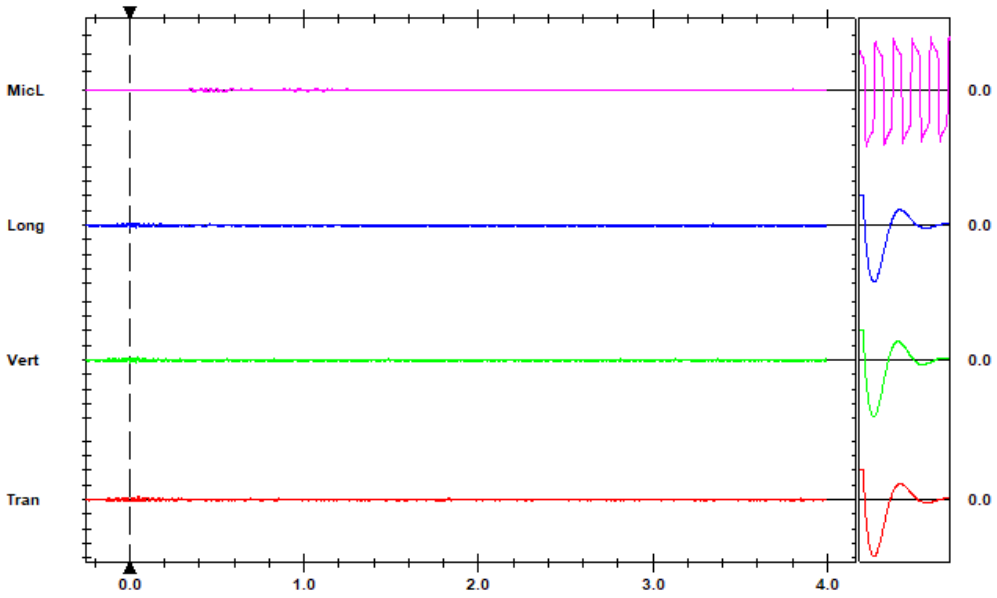
Microphone	Linear Weighting
PSPL	95.92 dB(L) at 0.464 sec
ZC Freq	37 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.381	mm/s
ZC Freq	64	>100	85	Hz
Time (Rel. to Trig)	0.049	0.000	0.002	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.622 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

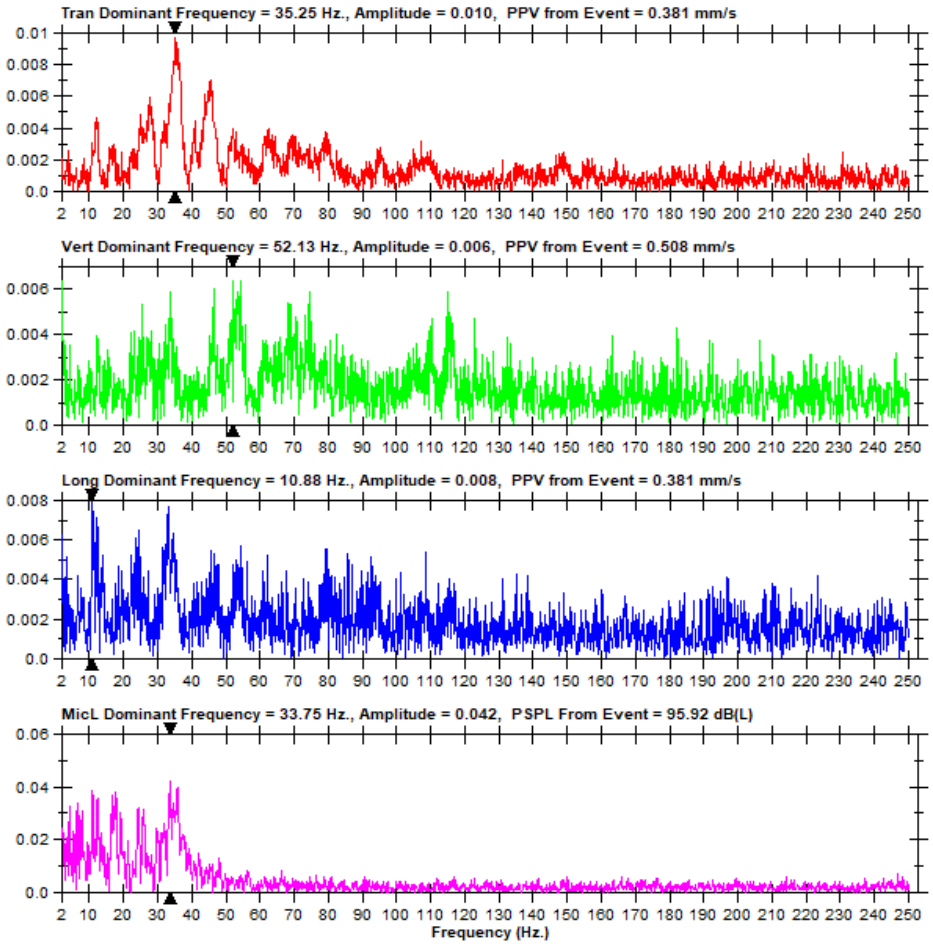
FFT Report

Date/Time	Vert at 15:41:47 January 11, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUHK.XN0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 150 m



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Event Report

Date/Time Tran at 15:41:49 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUHK.XP0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 205 m

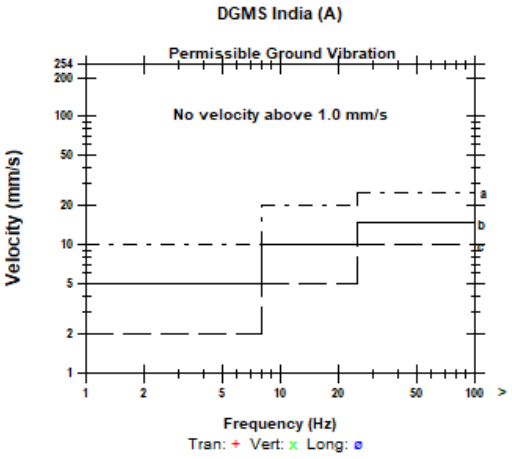
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

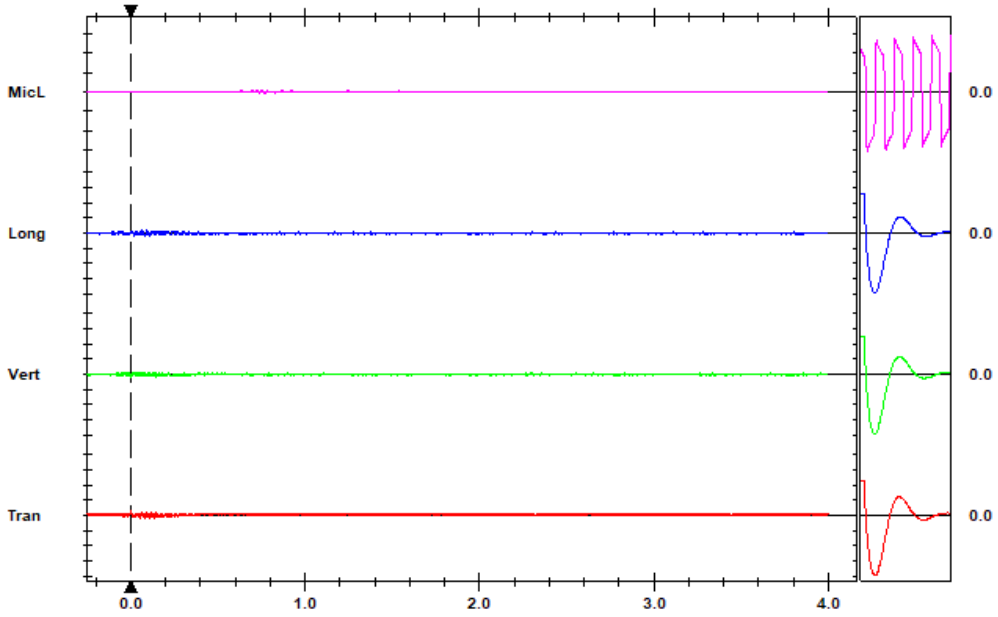
Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.752 sec
ZC Freq 47 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.508	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.001	0.001	0.080	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 0.751 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

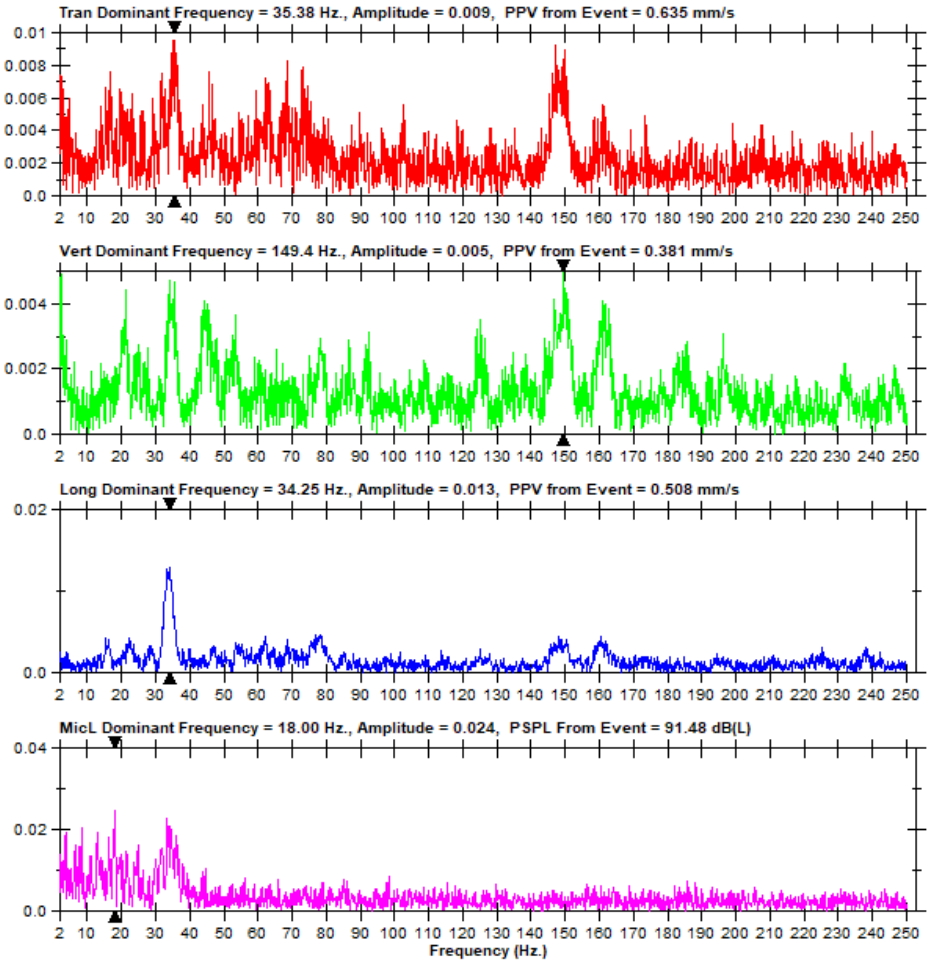
FFT Report

Date/Time	Tran at 15:41:49 January 11, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUHK.XP0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.5 Kg, Distance - 205 m



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Event Report

Date/Time	Long at 15:46:16 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111154616.IDFW

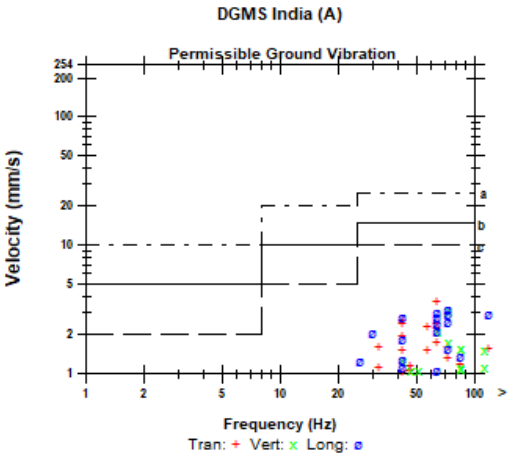
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 40 m

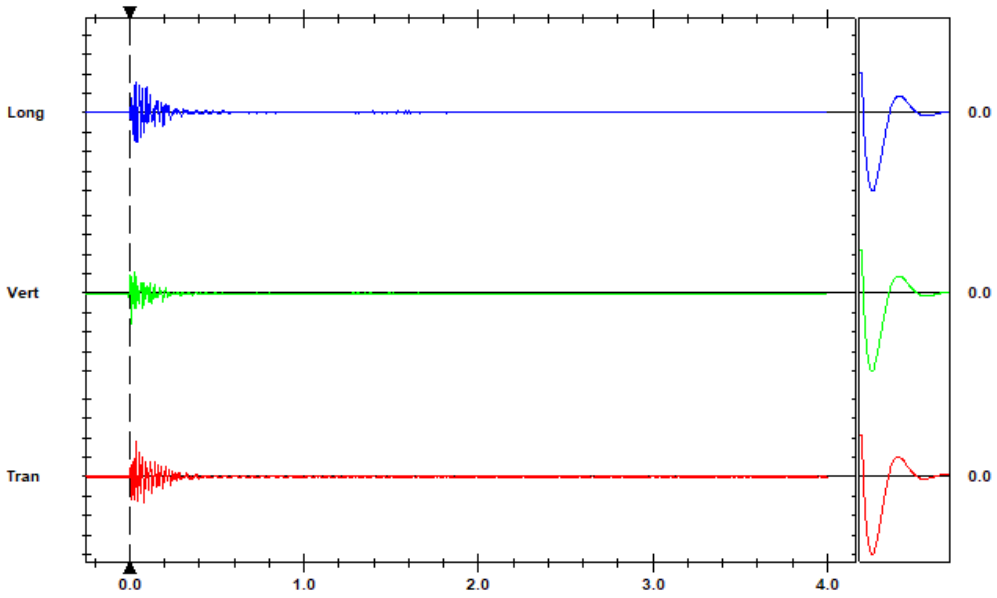
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	3.634	3.066	3.176	mm/s
ZC Freq	64	73	73	Hz
Time (Rel. to Trig)	0.035	0.013	0.039	sec
Peak Acceleration	0.149	0.160	0.174	g
Peak Displacement	0.009	0.011	0.010	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 4.213 mm/s at 0.034 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

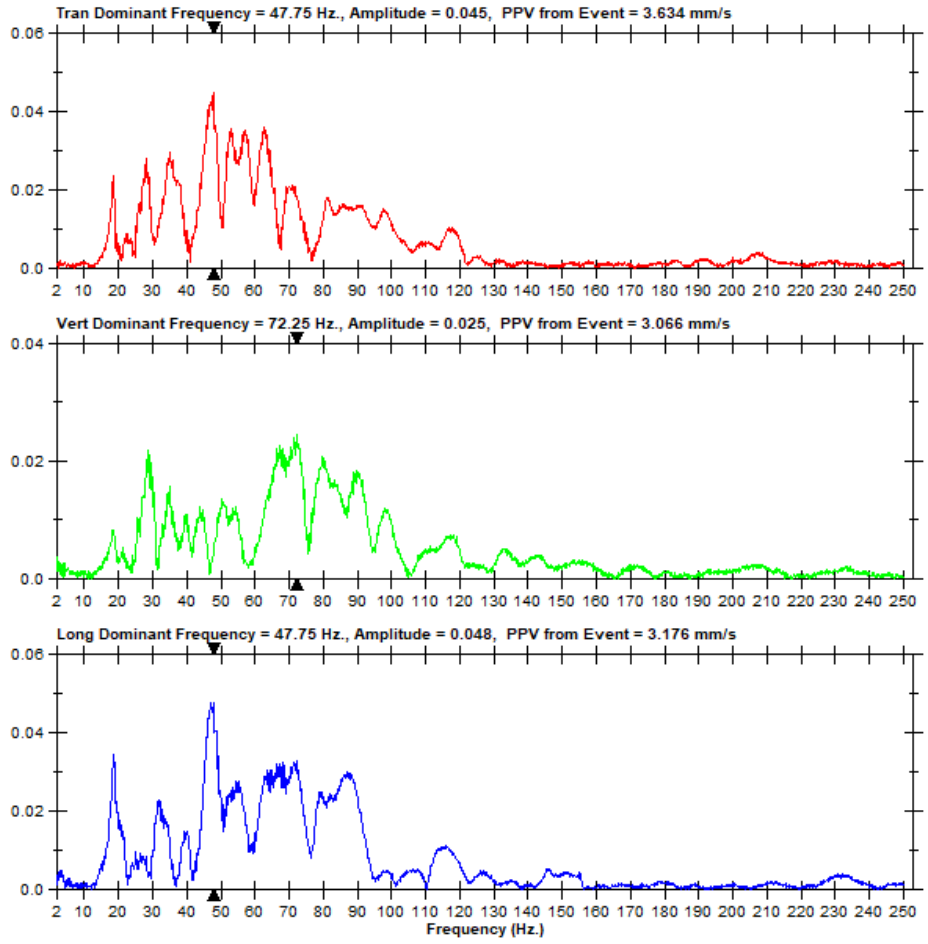
FFT Report

Date/Time	Long at 15:46:16 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111154616.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 40 m



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Event Report

Date/Time Long at 15:46:14 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHL.520
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 109 m

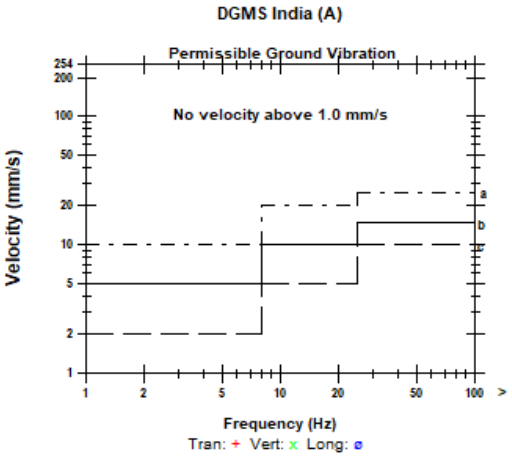
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

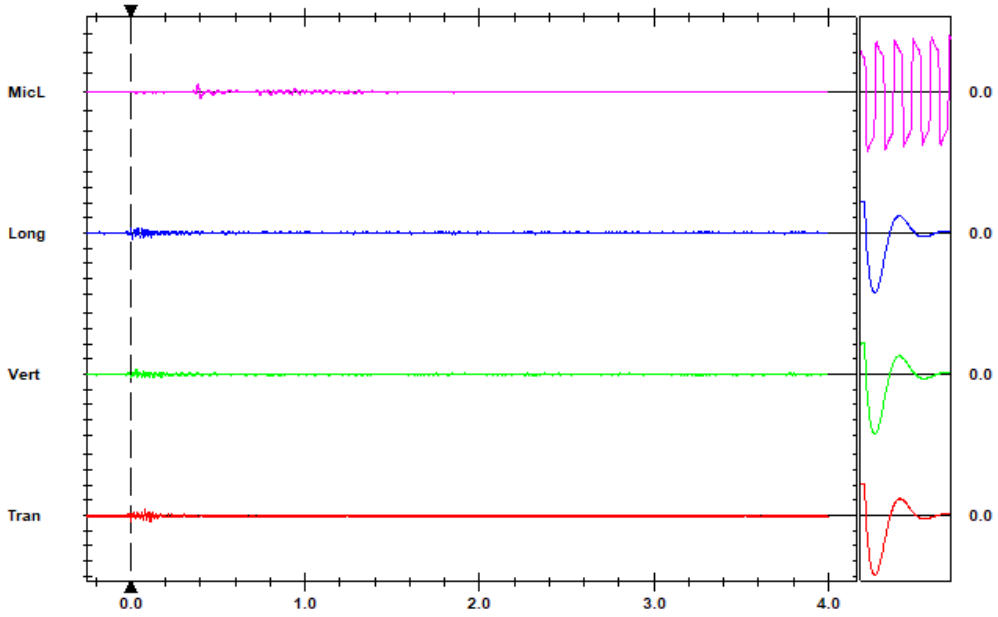
Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.386 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.762	0.635	0.762	mm/s
ZC Freq	73	73	64	Hz
Time (Rel. to Trig)	0.004	0.031	0.011	sec
Peak Acceleration	0.053	0.040	0.040	g
Peak Displacement	0.003	0.001	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.992 mm/s at 0.085 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

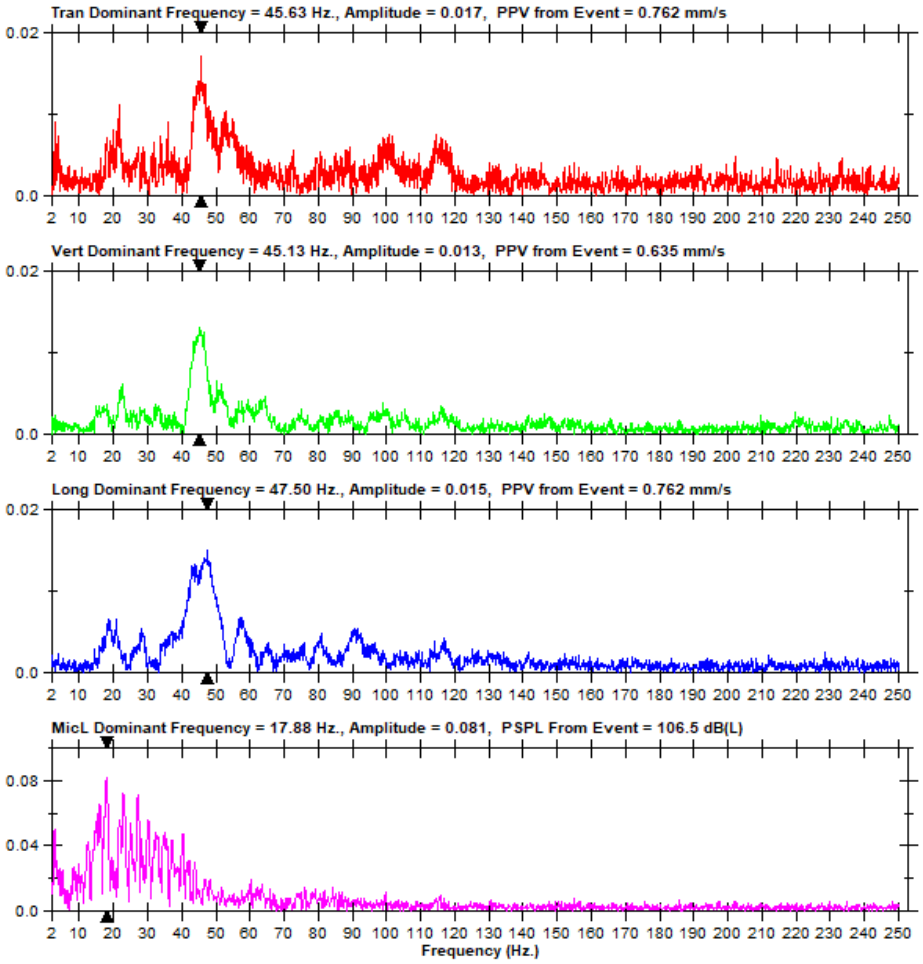
FFT Report

Date/Time	Long at 15:46:14 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHL.520

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 109 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 15:45:18 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHL.3I0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 101 m

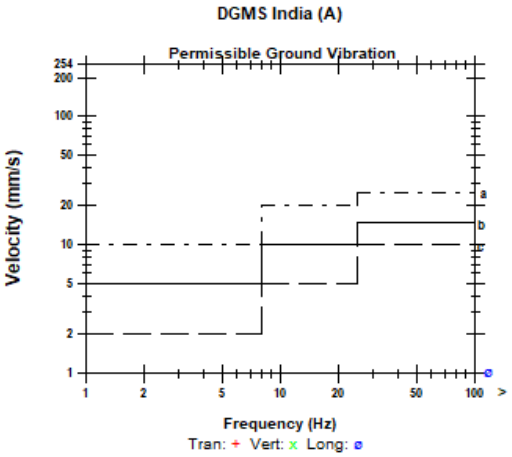
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

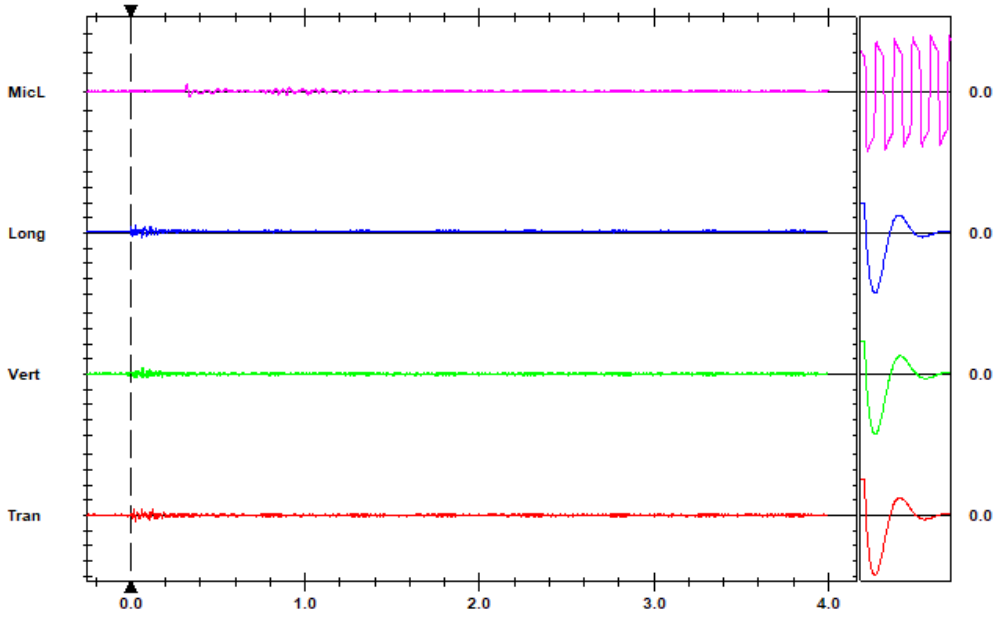
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.323 sec
ZC Freq 23 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	1.016	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.018	0.068	0.028	sec
Peak Acceleration	0.040	0.053	0.053	g
Peak Displacement	0.003	0.001	0.021	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.295 mm/s at 0.028 sec





Instantel

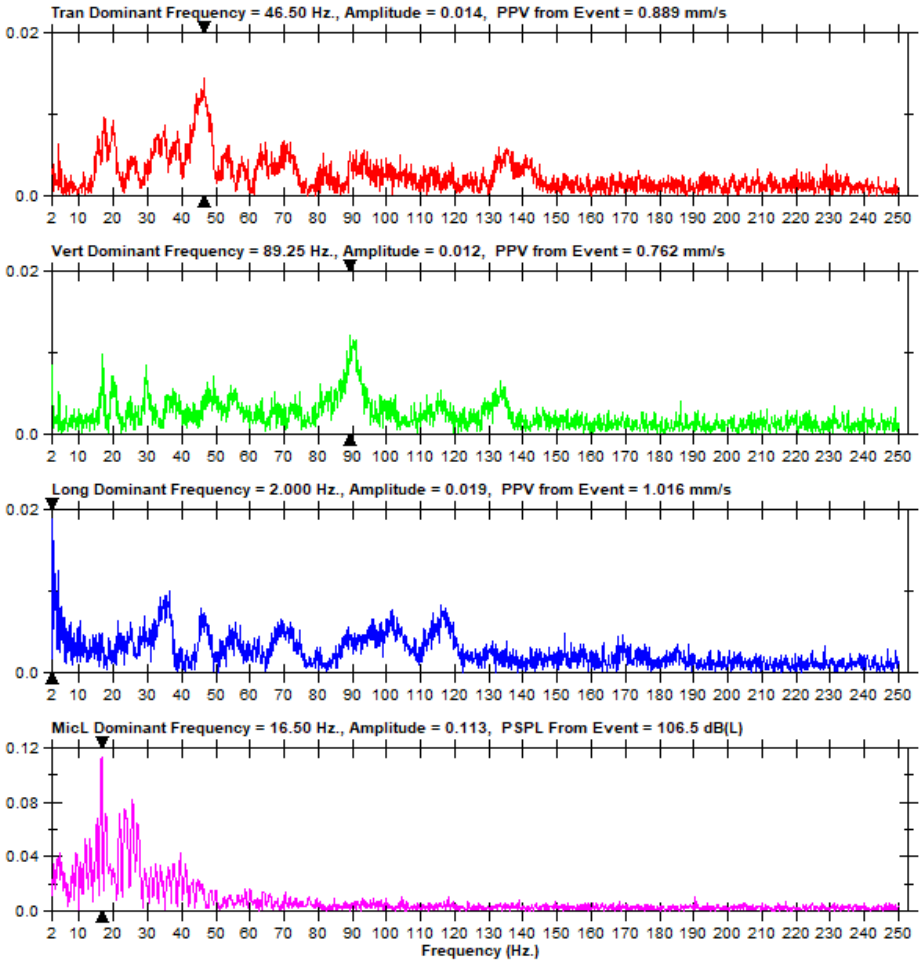
FFT Report

Date/Time	Long at 15:45:18 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHL.3I0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 101 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 15:45:23 January 11, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUHL.3N0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

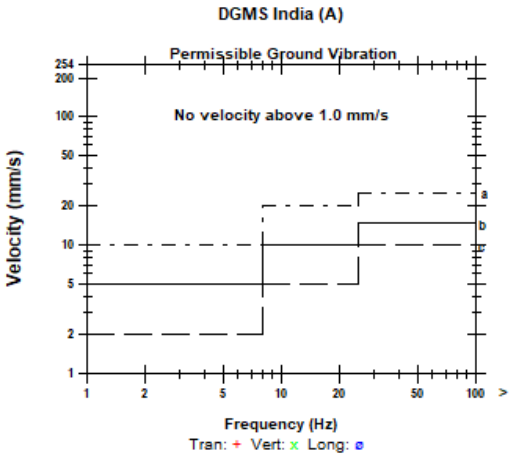
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 119 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

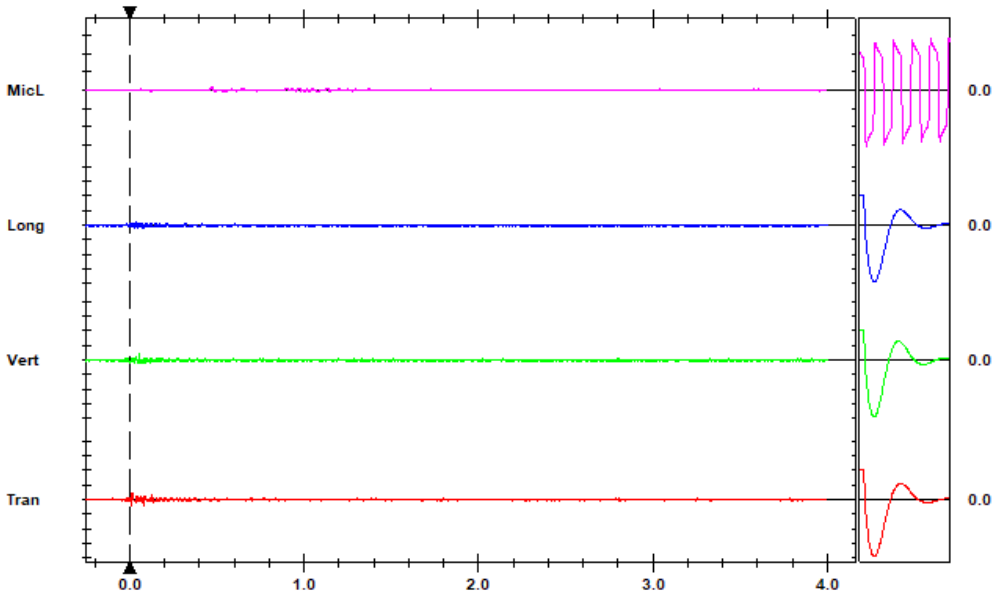
Microphone	Linear Weighting
PSPL	98.84 dB(L) at 0.472 sec
ZC Freq	27 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 548 mv)

	Tran	Vert	Long	
PPV	0.889	0.762	0.508	mm/s
ZC Freq	73	85	73	Hz
Time (Rel. to Trig)	0.009	0.055	0.077	sec
Peak Acceleration	0.053	0.040	0.027	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.925 mm/s at 0.010 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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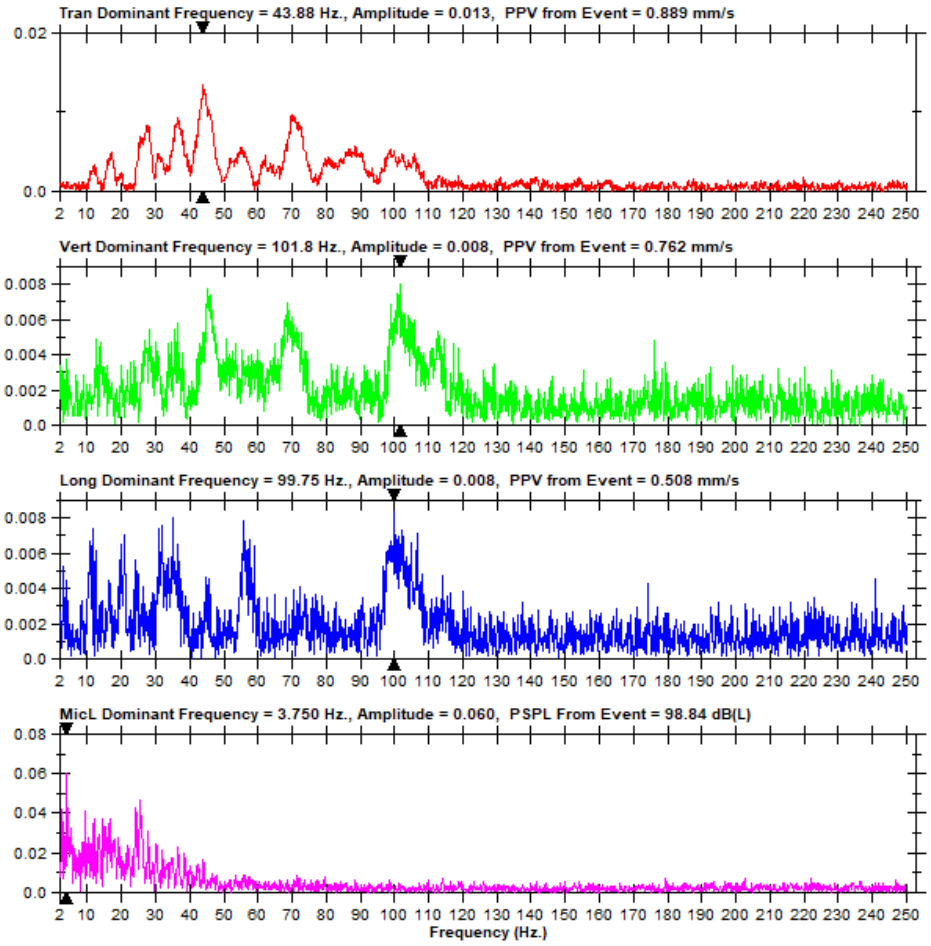
FFT Report

Date/Time	Vert at 15:45:23 January 11, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUHL.3N0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 119 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 15:45:25 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUHL.3P0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 203 m

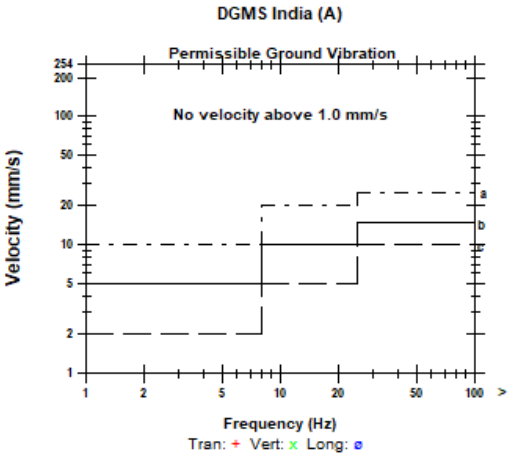
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

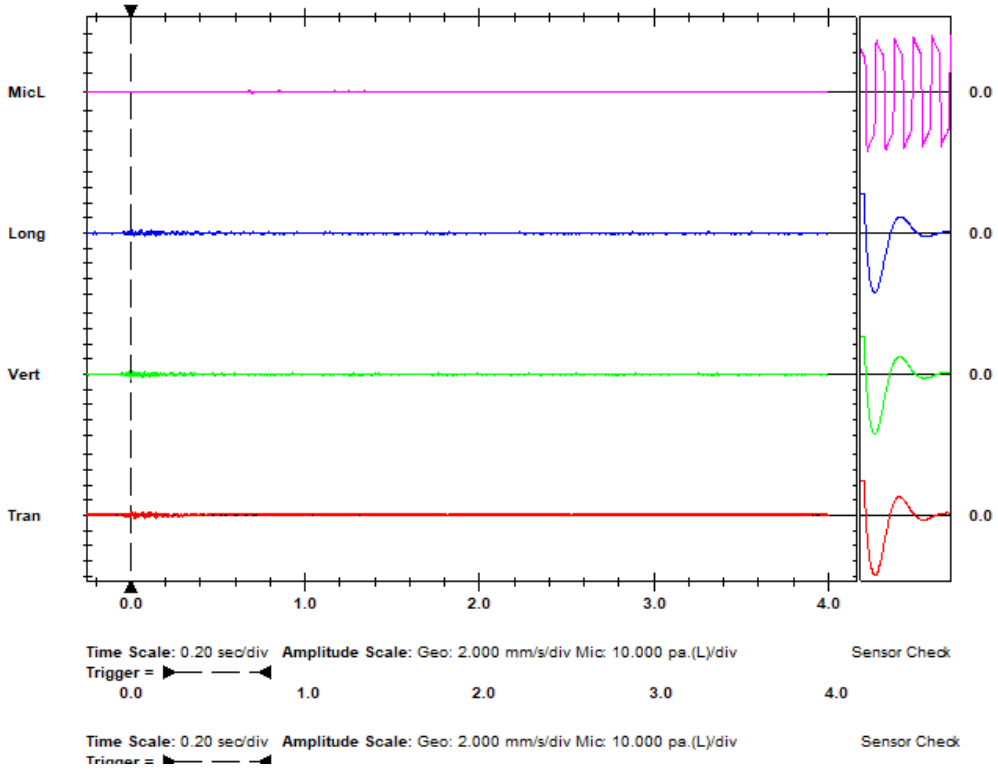
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 91.48 dB(L) at 0.677 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 500 mv)

	Tran	Vert	Long	
PPV	0.381	0.635	0.508	mm/s
ZC Freq	85	64	85	Hz
Time (Rel. to Trig)	0.001	0.001	0.007	sec
Peak Acceleration	0.040	0.040	0.027	g
Peak Displacement	0.002	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 0.751 mm/s at 0.001 sec





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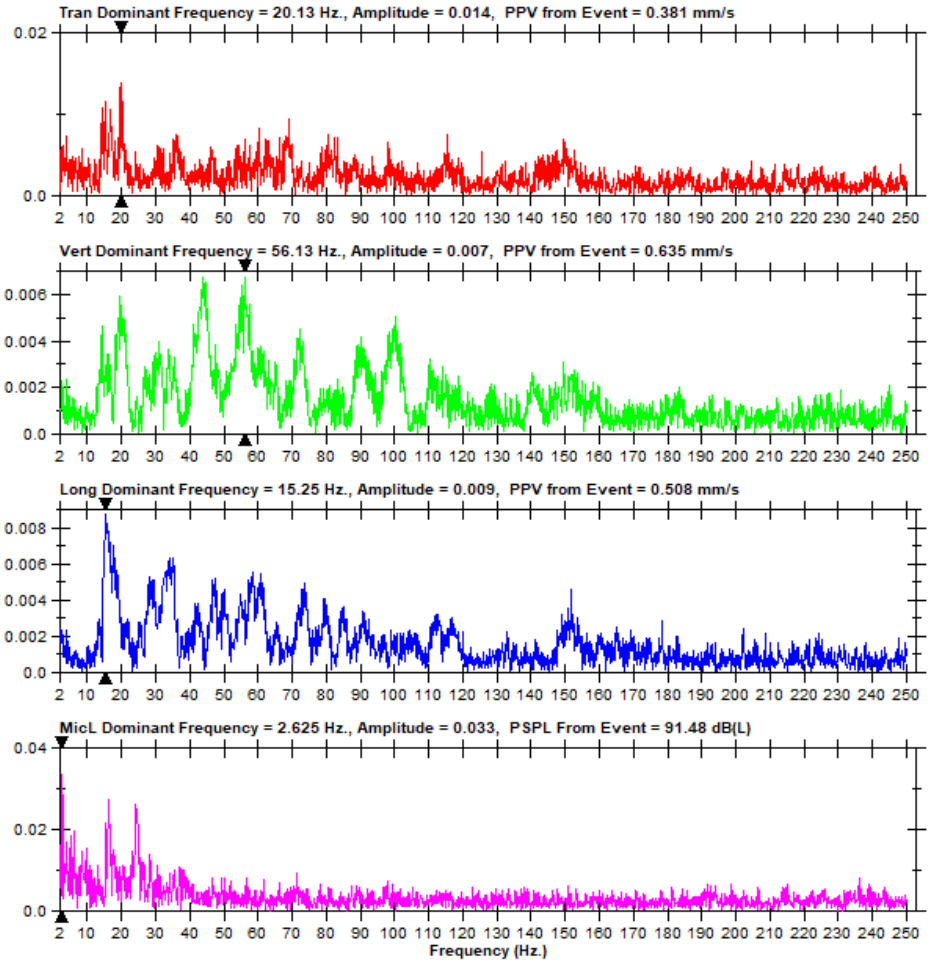
FFT Report

Date/Time	Vert at 15:45:25 January 11, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUHL.3P0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 3.75 Kg, Distance - 203 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 16:12:21 January 11, 2023
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20230111161221.IDFW

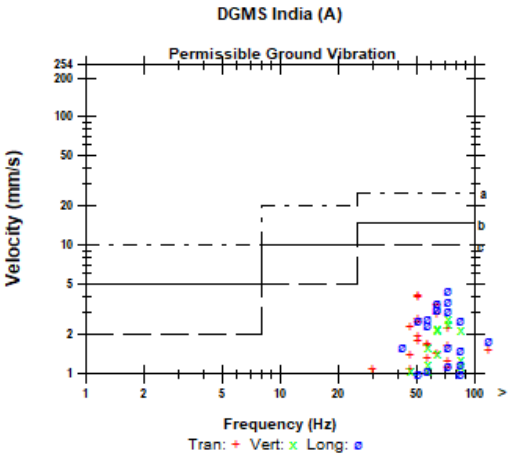
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 35 m

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

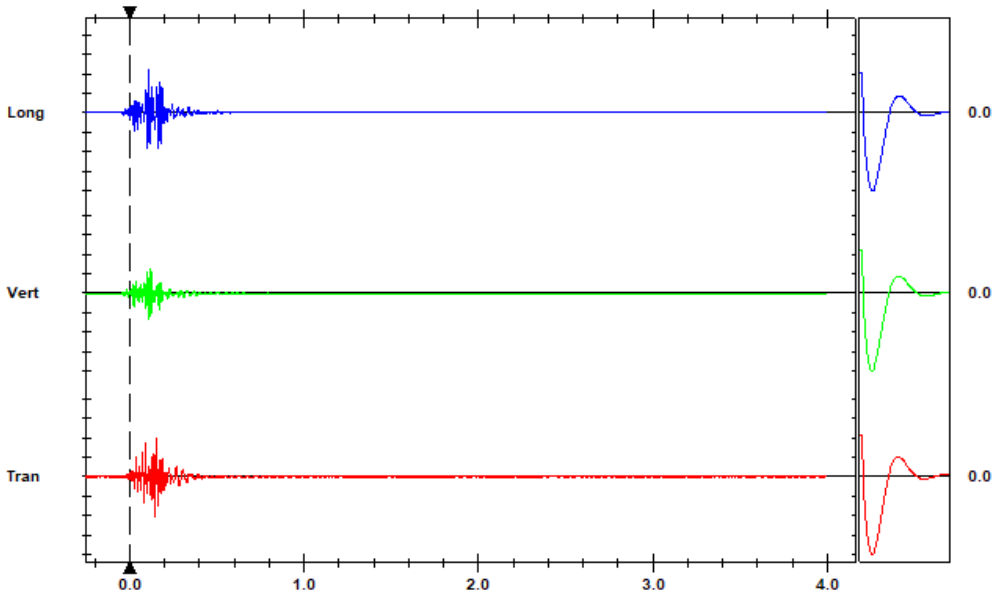
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	4.059	2.696	4.422	mm/s
ZC Freq	51	73	73	Hz
Time (Rel. to Trig)	0.144	0.106	0.110	sec
Peak Acceleration	0.159	0.213	0.288	g
Peak Displacement	0.013	0.005	0.011	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 4.474 mm/s at 0.111 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

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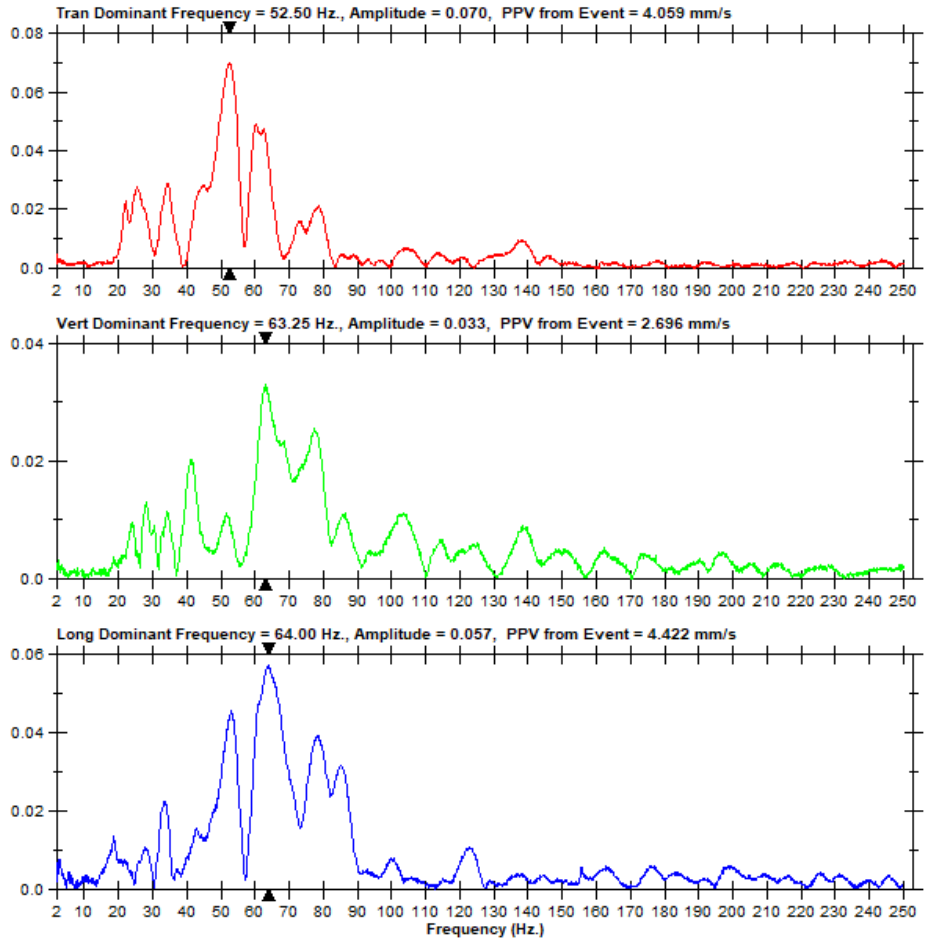
FFT Report

Date/Time	Long at 16:12:21 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111161221.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 35 m



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Event Report

Date/Time Tran at 16:12:19 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHM.CJ0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 131 m

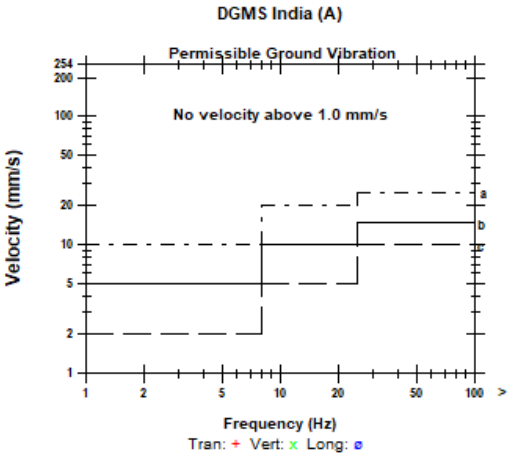
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

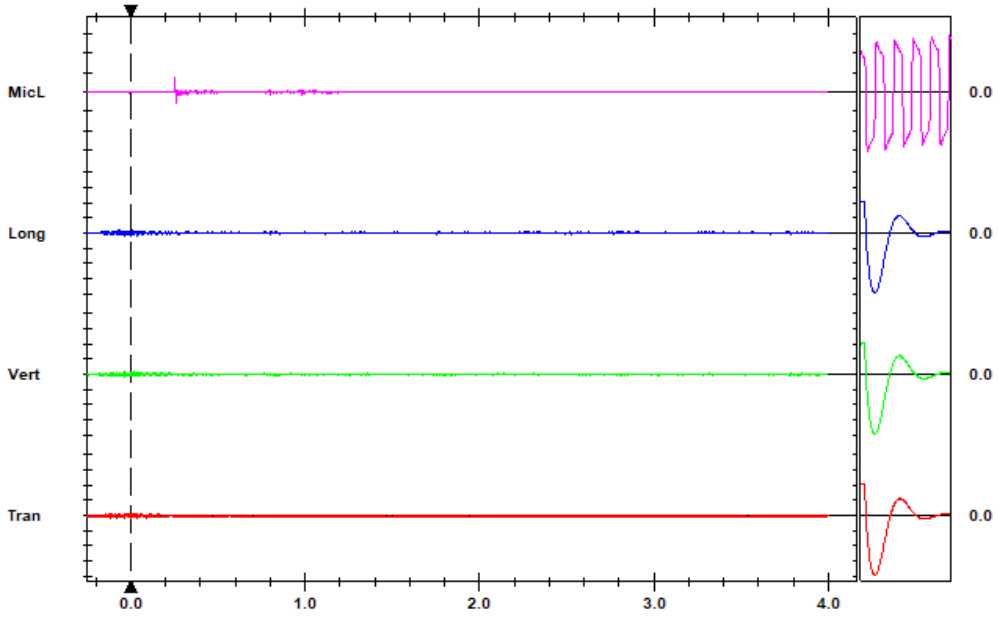
Microphone Linear Weighting
PSPL 111.5 dB(L) at 0.253 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	0.381	mm/s
ZC Freq	85	85	64	Hz
Time (Rel. to Trig)	0.000	-0.036	-0.066	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.582 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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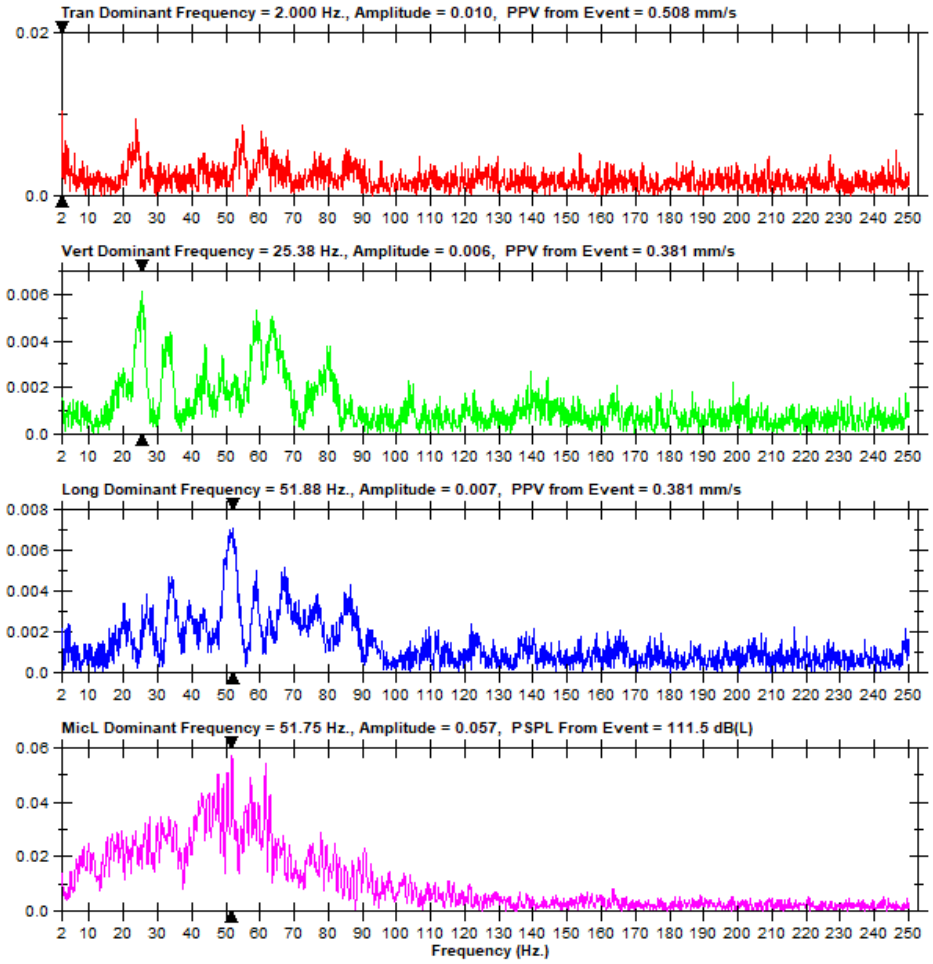
FFT Report

Date/Time	Tran at 16:12:19 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHM.CJ0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 131 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Tran at 16:11:27 January 11, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUHM.B30

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

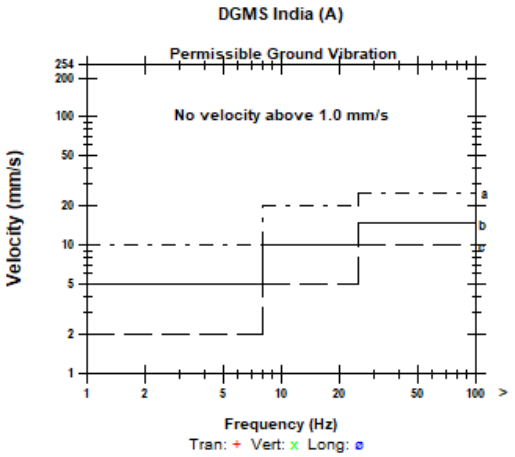
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 156 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

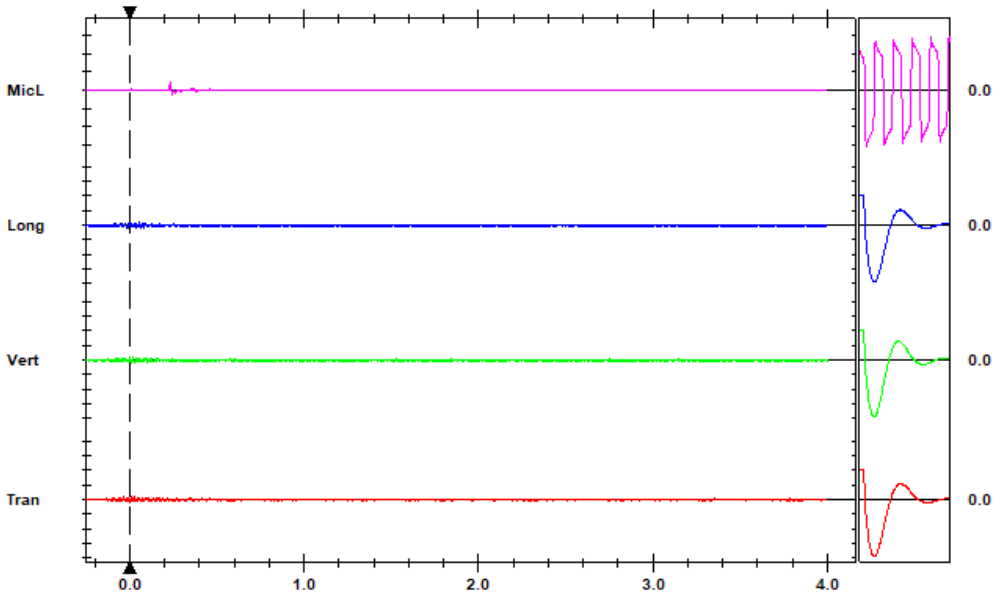
Microphone	Linear Weighting
PSPL	107.0 dB(L) at 0.234 sec
ZC Freq	43 Hz
Channel Test	Passed (Freq = 20.5 Hz Amp = 509 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	0.381	mm/s
ZC Freq	64	>100	85	Hz
Time (Rel. to Trig)	0.000	0.005	-0.013	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.2	Hz
Overswing Ratio	3.9	3.3	4.0	

Peak Vector Sum 0.596 mm/s at 0.010 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

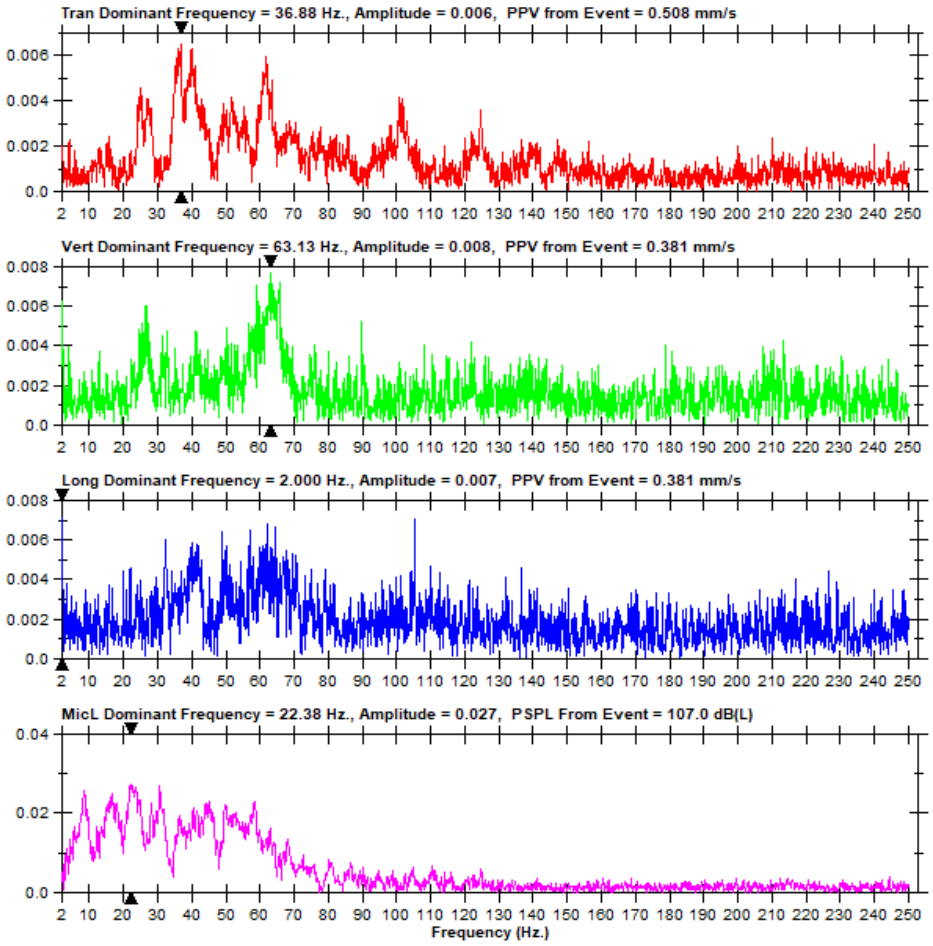
FFT Report

Date/Time	Tran at 16:11:27 January 11, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUHM.B30
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 3.00 Kg, Distance - 156 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 16:16:47 January 11, 2023
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20230111161647.IDFW

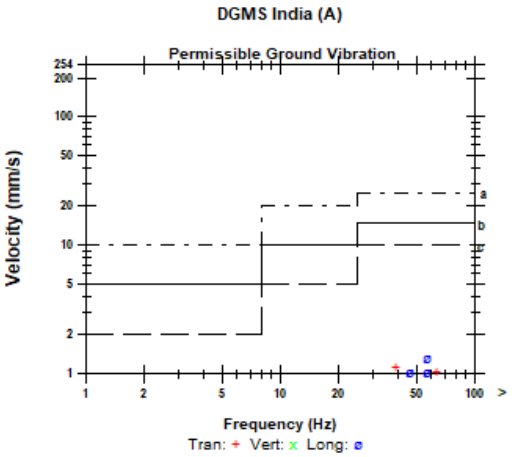
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 8, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.00 Kg, Distance - 75 m

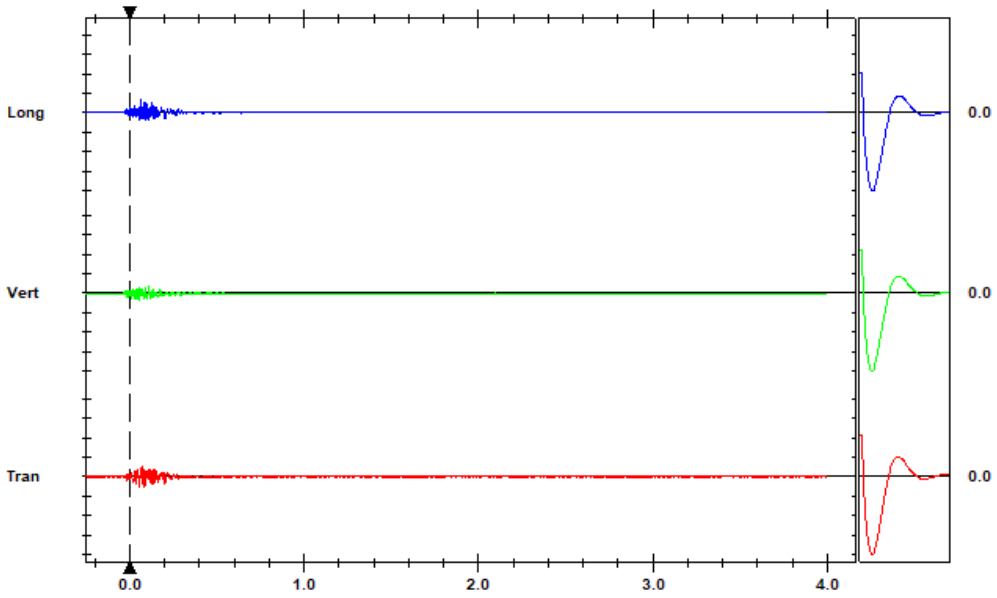
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.127	0.694	1.308	mm/s
ZC Freq	39	64	57	Hz
Time (Rel. to Trig)	0.069	0.052	0.067	sec
Peak Acceleration	0.071	0.070	0.077	g
Peak Displacement	0.004	0.004	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 1.625 mm/s at 0.067 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

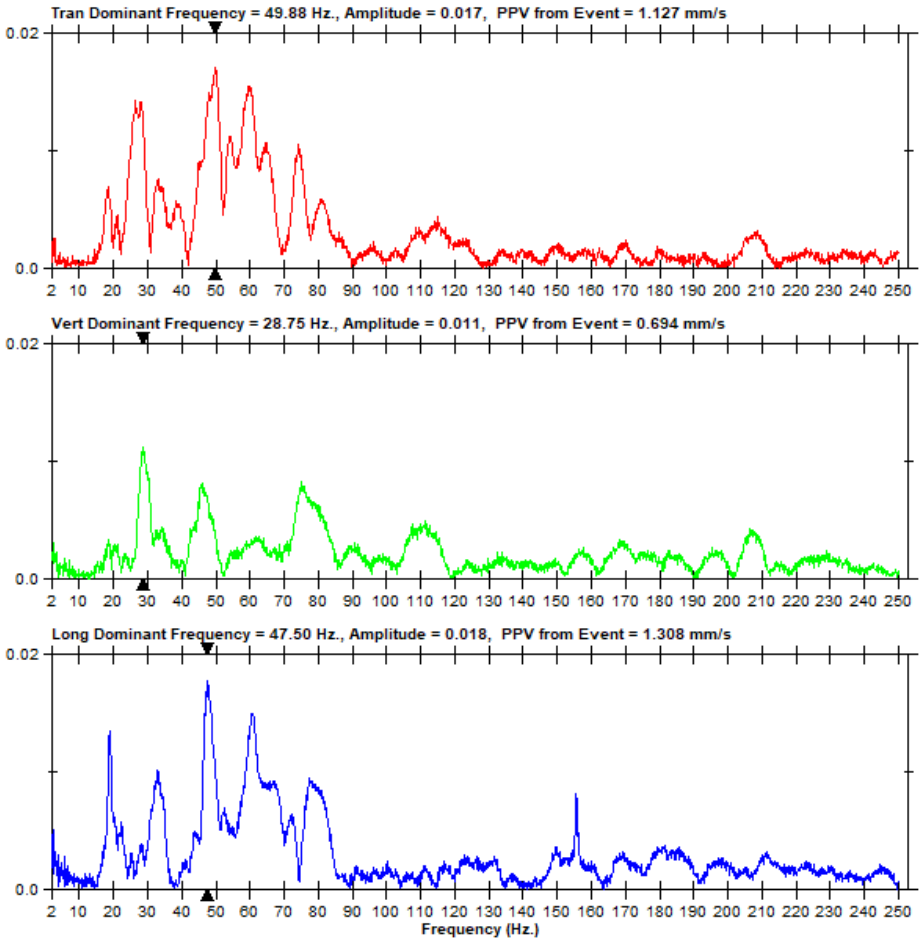
FFT Report

Date/Time	Long at 16:16:47 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111161647.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 8, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.00 Kg, Distance - 75 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 16:15:50 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHM.IE0
Post Event Notes
Total No. of holes - 8, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.00 Kg, Distance - 85 m

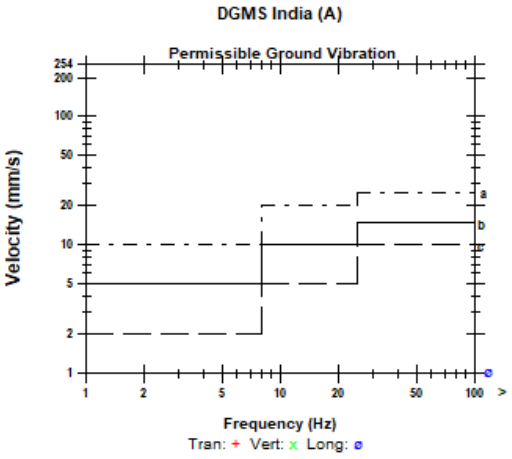
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

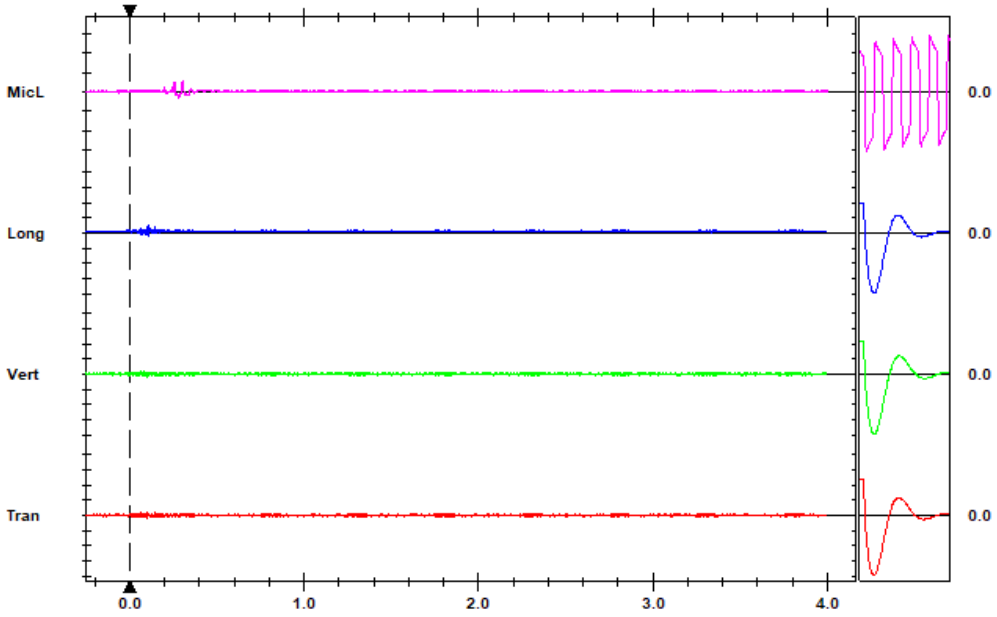
Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.304 sec
ZC Freq 30 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.061	0.066	0.105	sec
Peak Acceleration	0.040	0.027	0.066	g
Peak Displacement	0.000	0.001	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.047 mm/s at 0.105 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

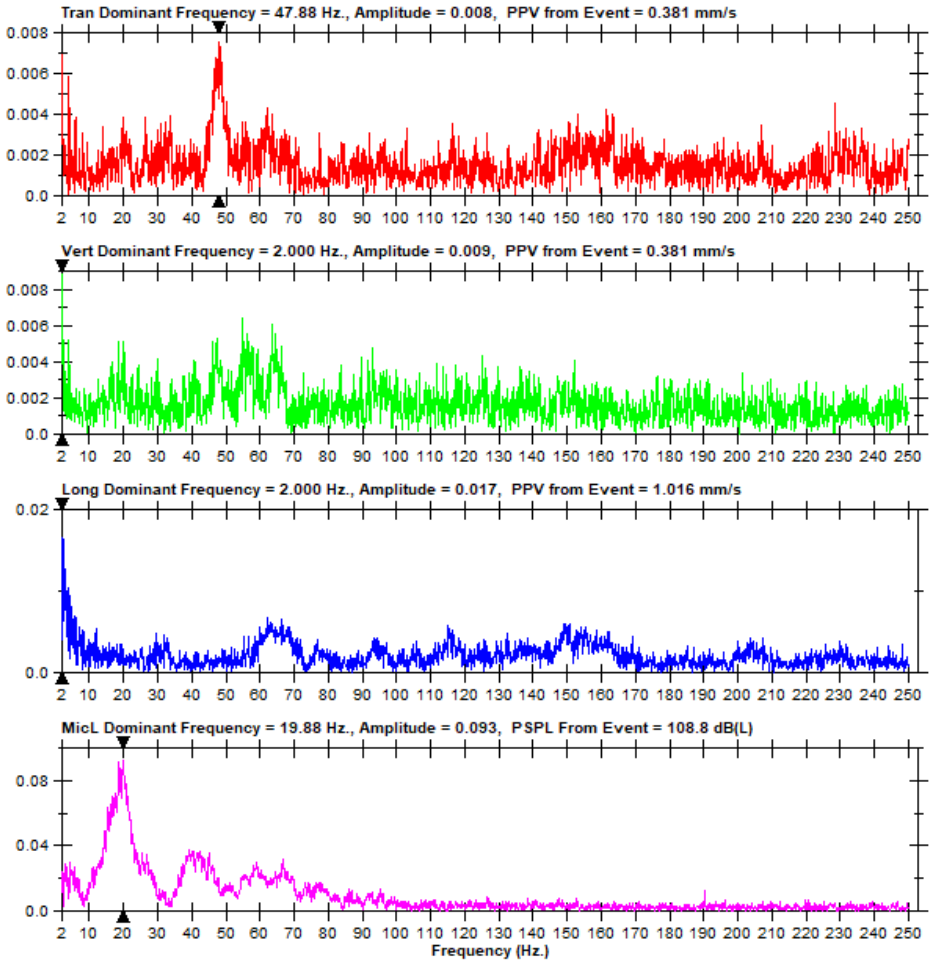
FFT Report

Date/Time	Long at 16:15:50 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHM.IE0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 8, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.00 Kg, Distance - 85 m



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Event Report

Date/Time	Tran at 16:19:00 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111161900.IDFW

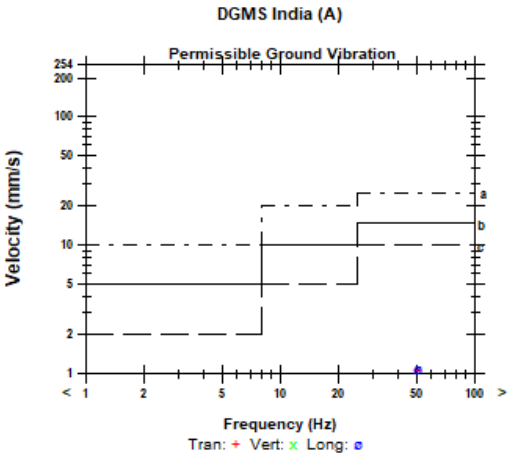
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 78 m

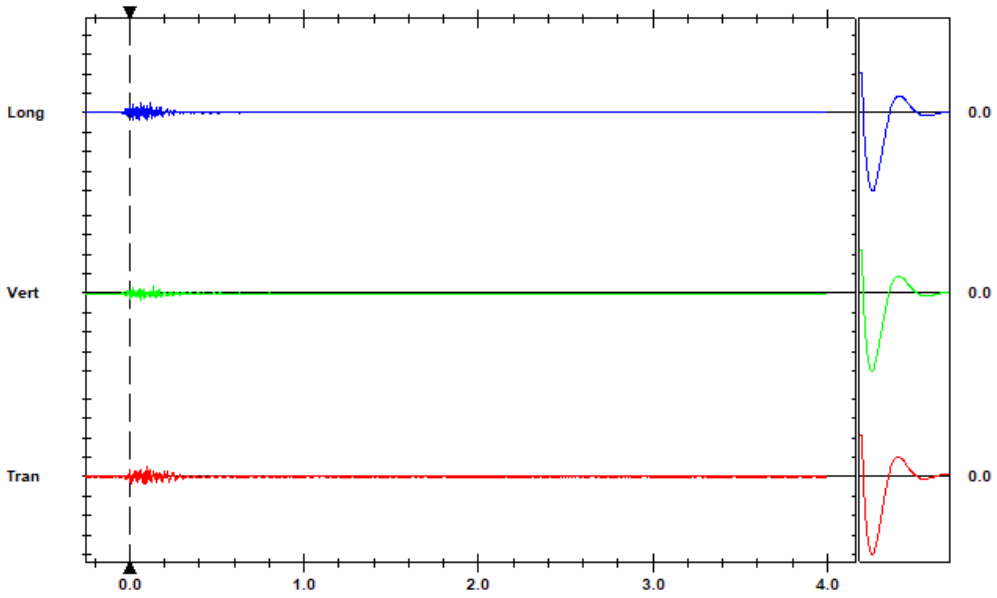
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.048	0.701	1.080	mm/s
ZC Freq	51	85	51	Hz
Time (Rel. to Trig)	0.099	0.137	0.117	sec
Peak Acceleration	0.053	0.053	0.087	g
Peak Displacement	0.003	0.010	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 1.254 mm/s at 0.099 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

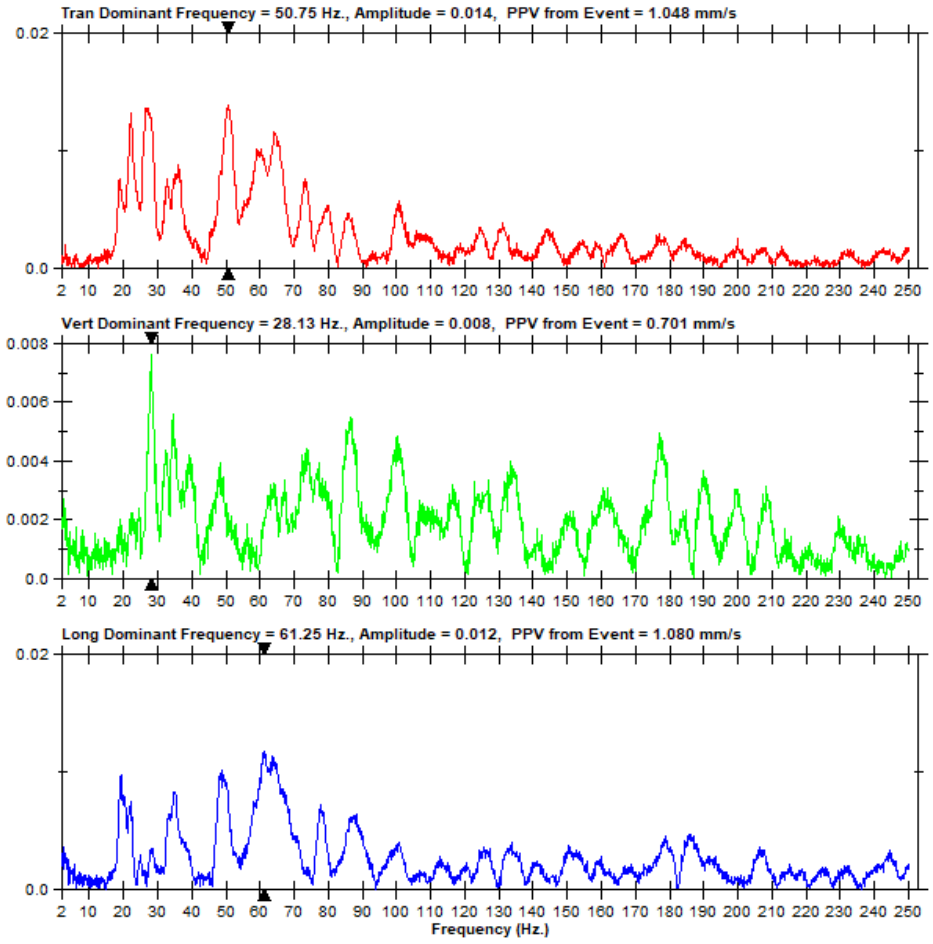
FFT Report

Date/Time	Tran at 16:19:00 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111161900.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 78 m



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Event Report

Date/Time Long at 16:18:03 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHM.M30
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 78 m

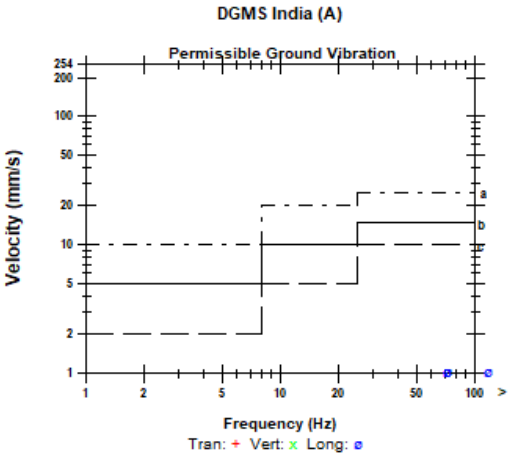
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

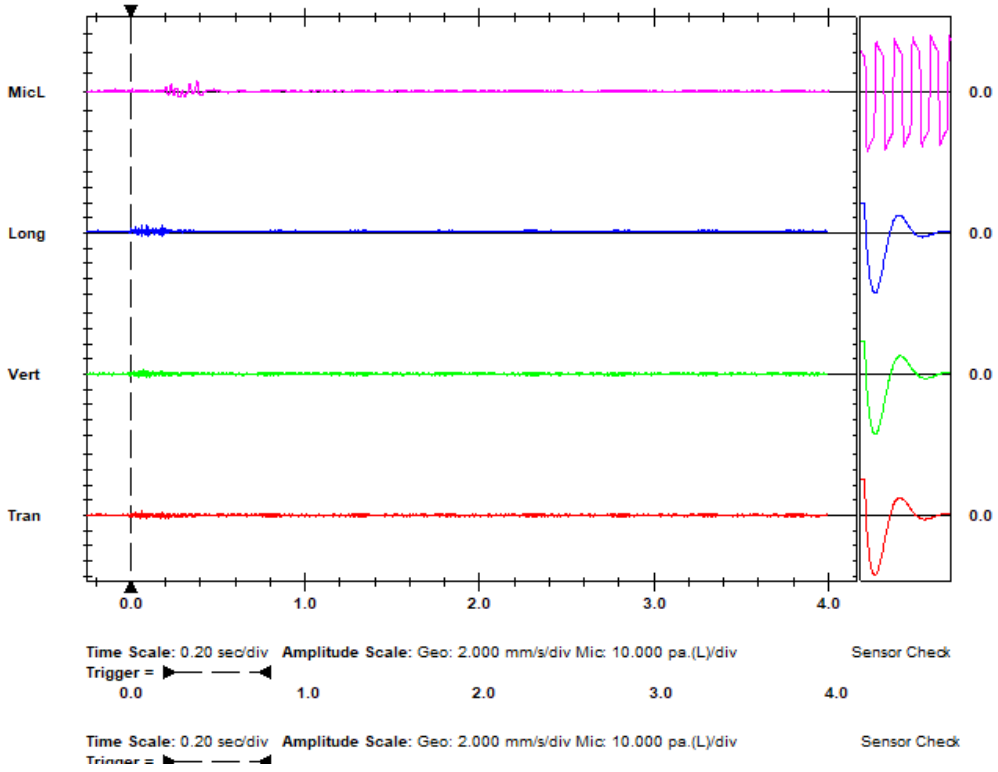
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 108.8 dB(L) at 0.382 sec
ZC Freq 22 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.635	0.635	1.016	mm/s
ZC Freq	>100	85	73	Hz
Time (Rel. to Trig)	0.063	0.069	0.063	sec
Peak Acceleration	0.053	0.040	0.080	g
Peak Displacement	0.000	0.001	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.205 mm/s at 0.063 sec





Instantel

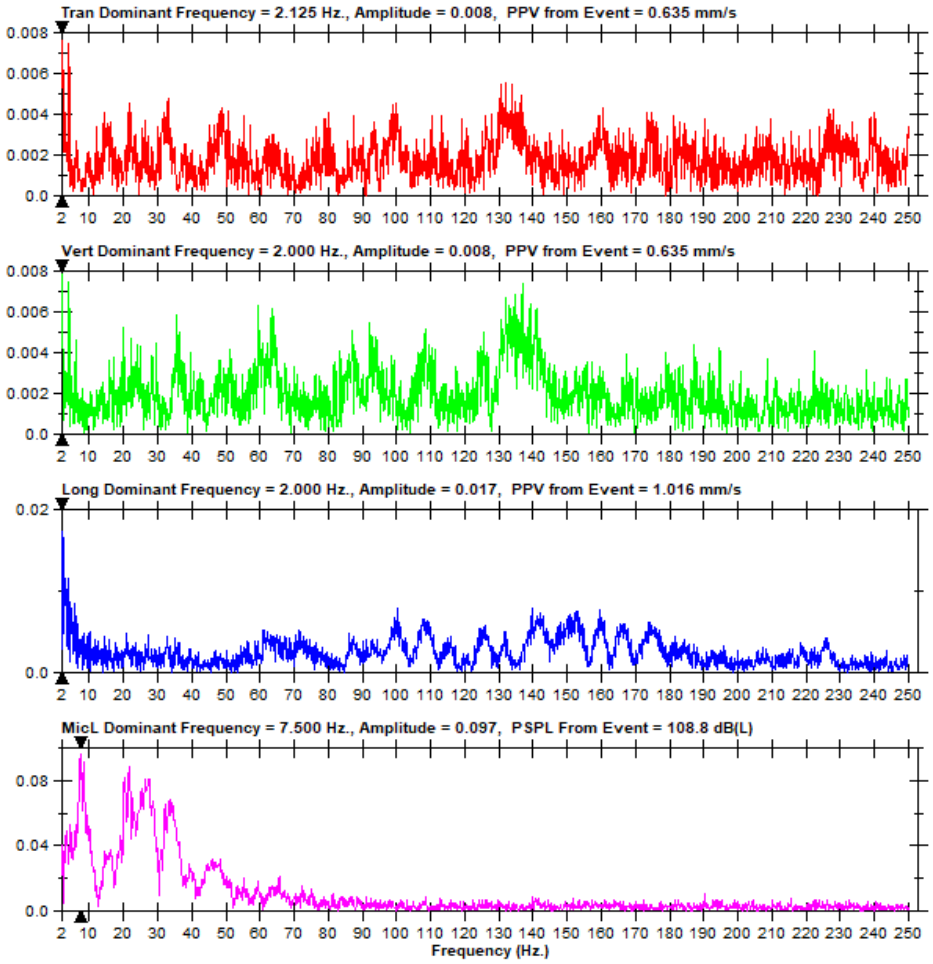
FFT Report

Date/Time	Long at 16:18:03 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHM.M30

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 78 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Tran at 16:21:00 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111162100.IDFW

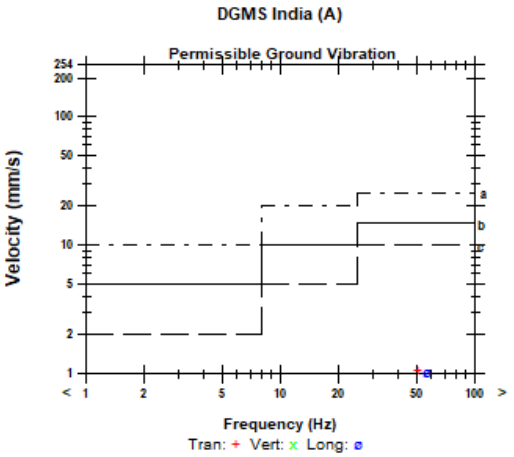
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 80 m

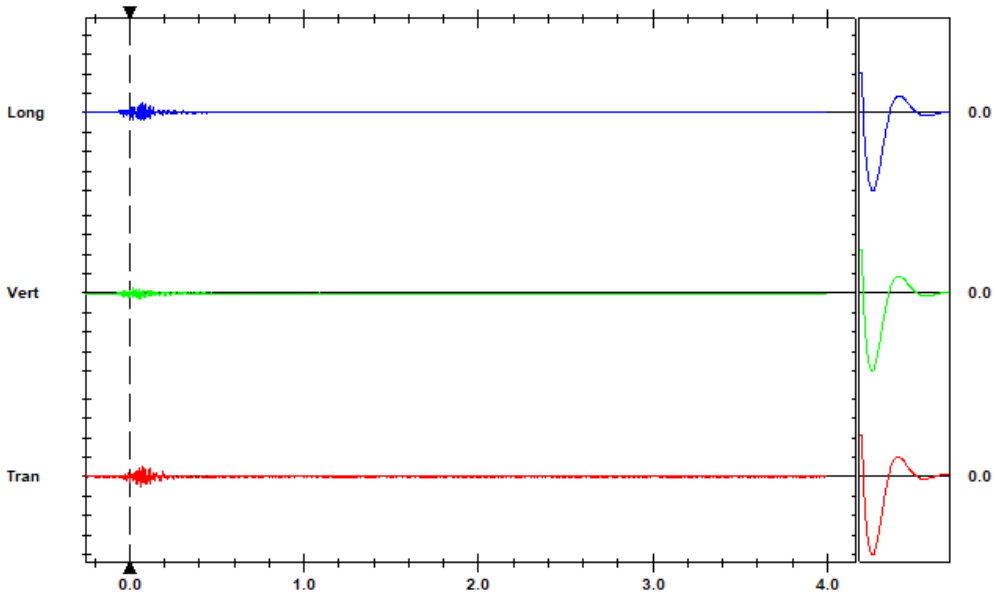
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.056	0.528	1.033	mm/s
ZC Freq	51	64	57	Hz
Time (Rel. to Trig)	0.076	0.063	0.077	sec
Peak Acceleration	0.077	0.046	0.081	g
Peak Displacement	0.003	0.010	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 1.476 mm/s at 0.077 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

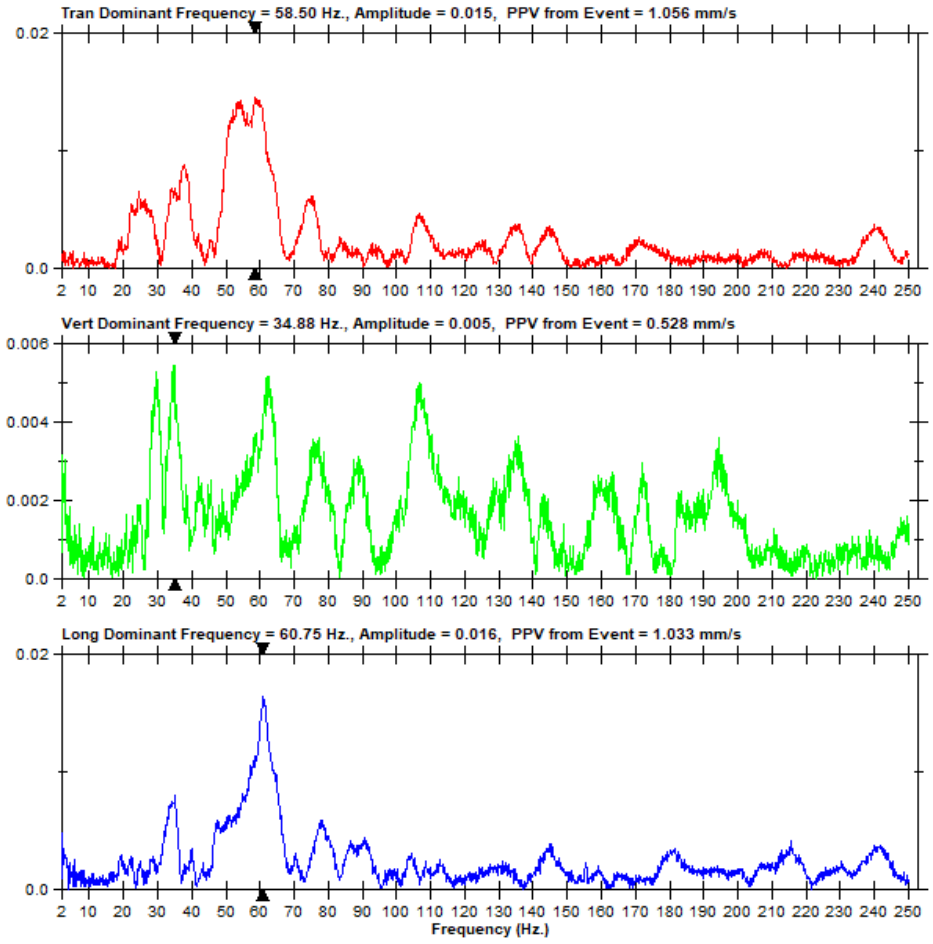
FFT Report

Date/Time	Tran at 16:21:00 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111162100.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 80 m



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Event Report

Date/Time Tran at 16:20:58 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUHM.QY0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 154 m

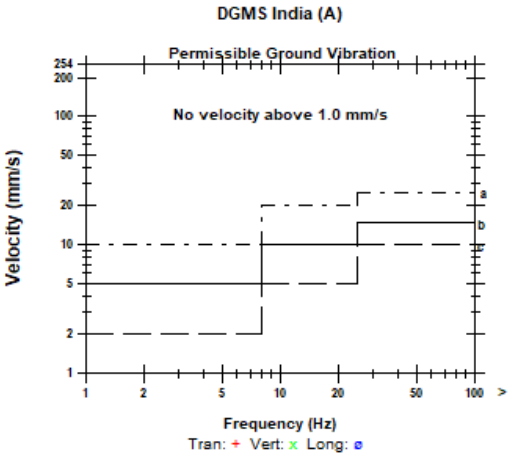
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

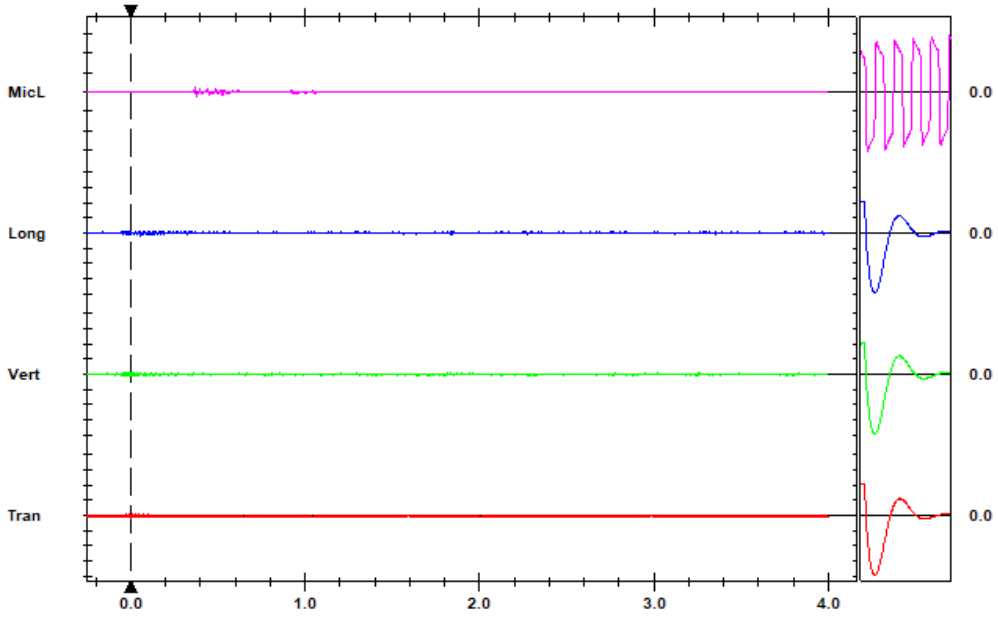
Microphone Linear Weighting
PSPL 102.8 dB(L) at 0.368 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 468 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	-0.006	0.060	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.000	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.6	Hz
Overswing Ratio	3.9	3.5	3.7	

Peak Vector Sum 0.524 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

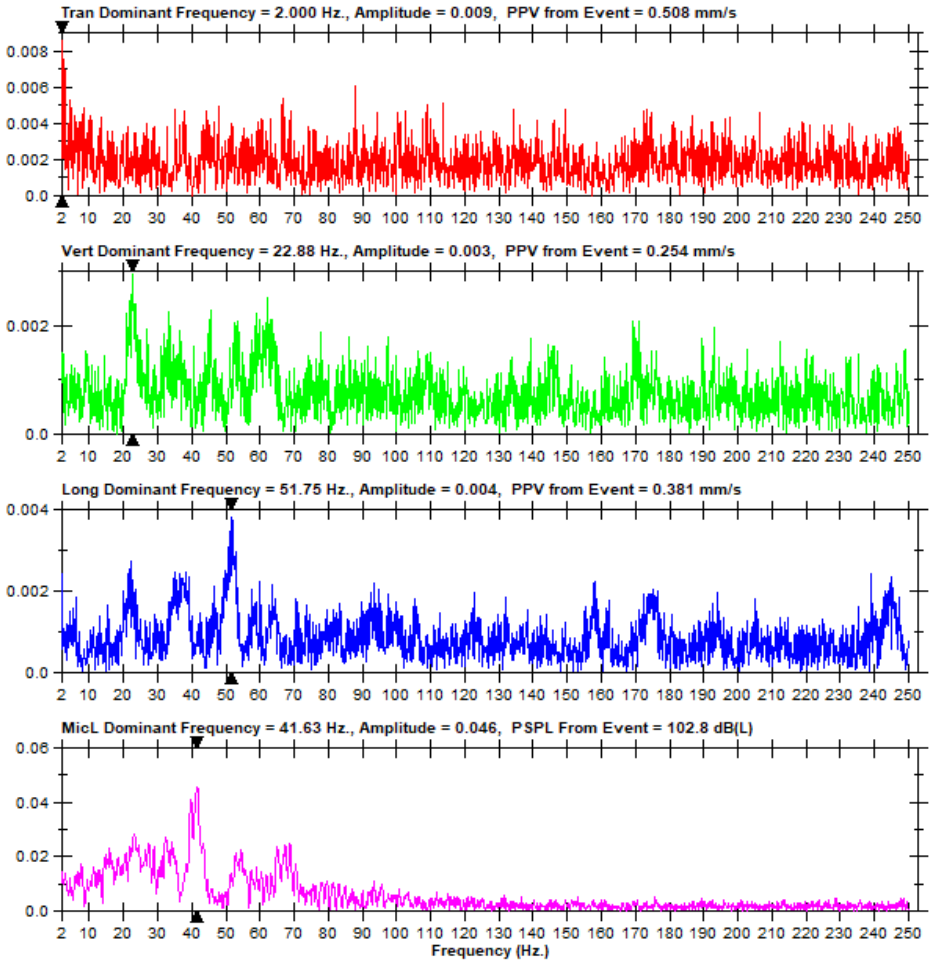
FFT Report

Date/Time	Tran at 16:20:58 January 11, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUHM.QY0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/hole - 0.25 Kg, MCPD - 0.5 Kg, Total Charge - 2.5 Kg, Distance - 154 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Long at 16:22:43 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111162243.IDFW

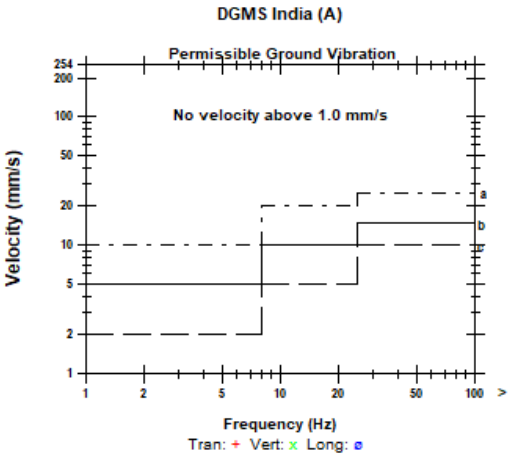
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.875 Kg, Distance - 110 m

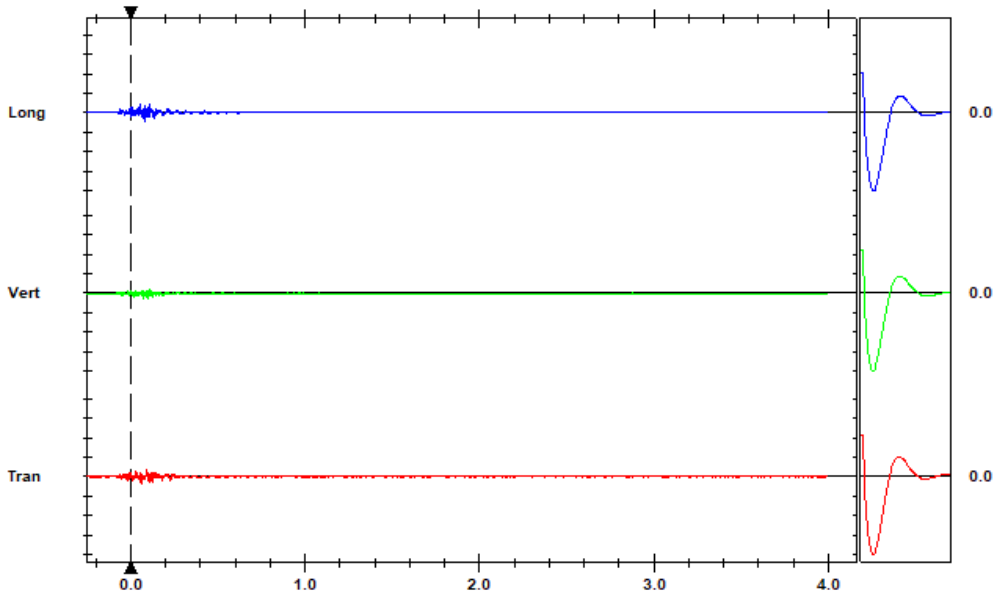
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.717	0.504	0.883	mm/s
ZC Freq	57	64	>100	Hz
Time (Rel. to Trig)	0.061	0.070	0.078	sec
Peak Acceleration	0.055	0.059	0.081	g
Peak Displacement	0.002	0.006	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	7.1	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.886 mm/s at 0.078 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

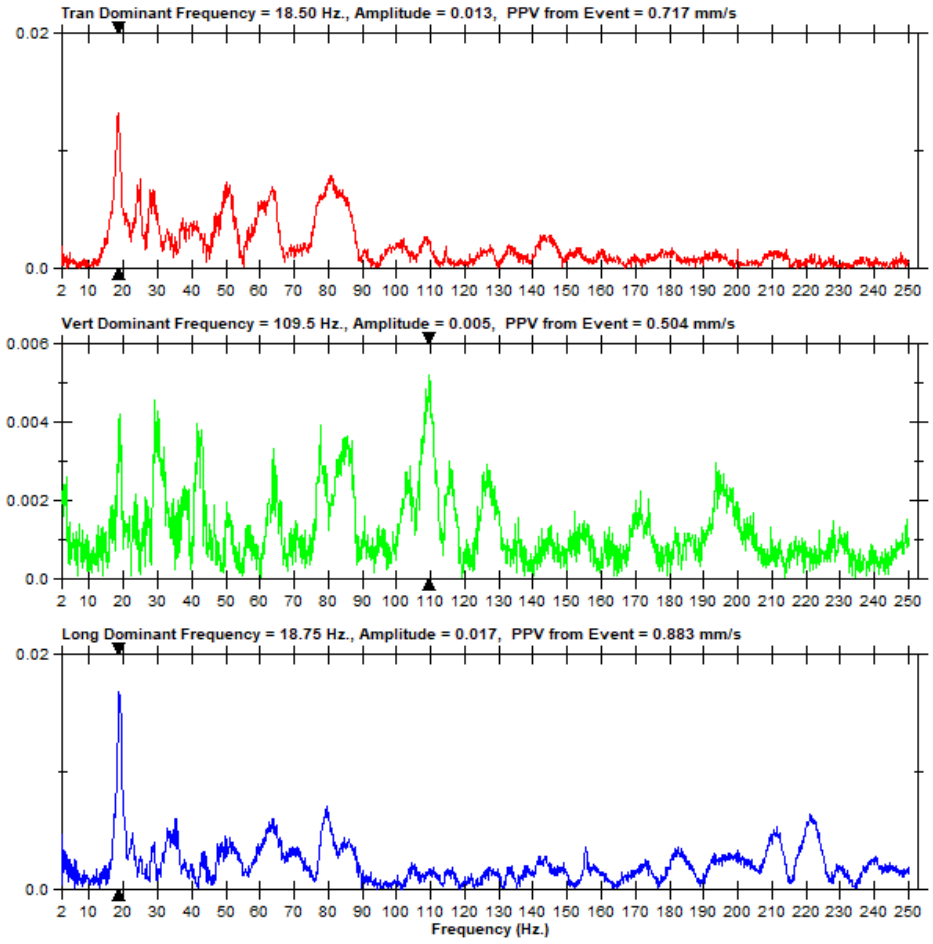
FFT Report

Date/Time	Long at 16:22:43 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111162243.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.875 Kg, Distance - 110 m



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Event Report

Date/Time Long at 16:21:45 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHM.S90
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.875 Kg, Distance - 92 m

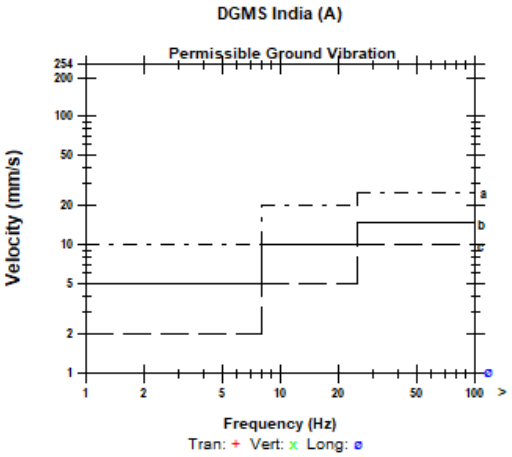
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

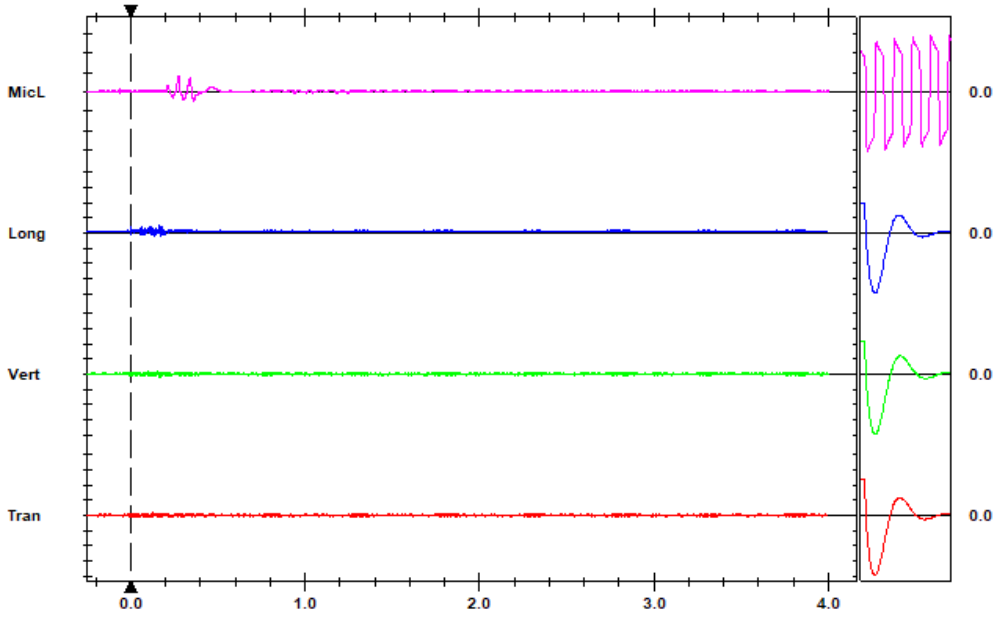
Microphone Linear Weighting
PSPL 112.6 dB(L) at 0.274 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	1.016	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.126	0.104	0.167	sec
Peak Acceleration	0.027	0.027	0.080	g
Peak Displacement	0.000	0.000	0.010	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.047 mm/s at 0.167 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

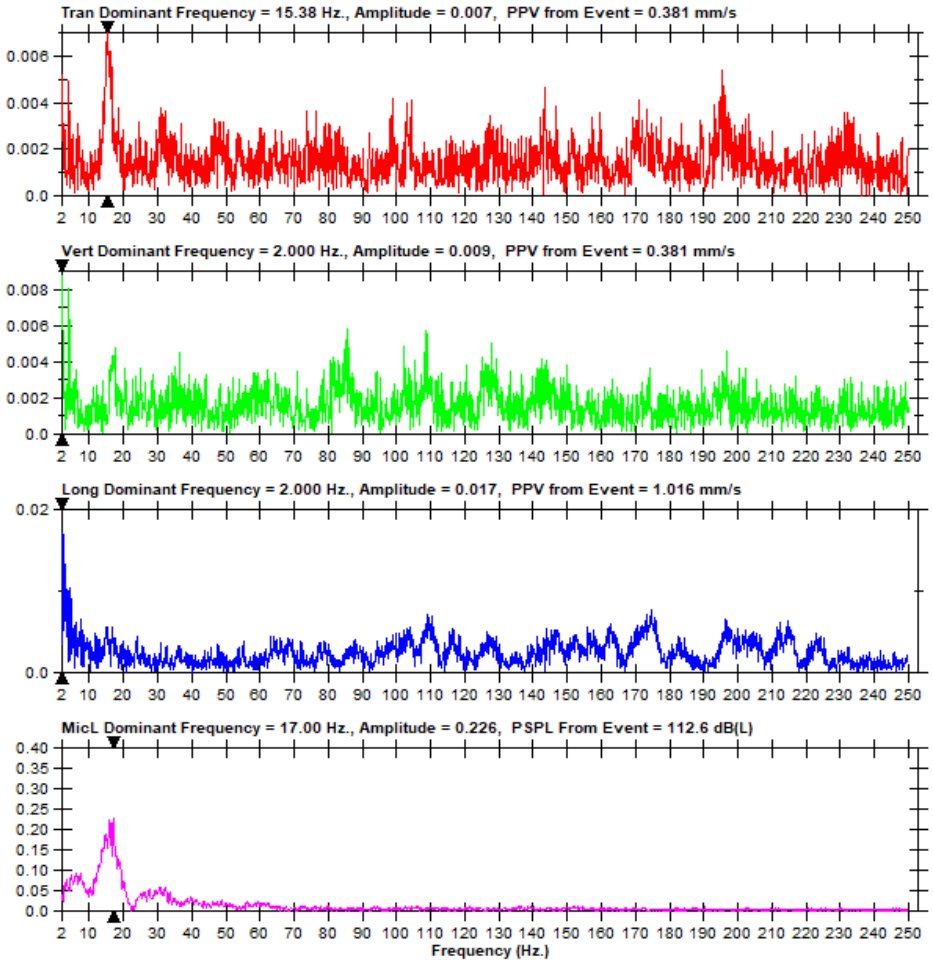
FFT Report

Date/Time	Long at 16:21:45 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHM.S90

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 4.875 Kg, Distance - 92 m



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Event Report

Date/Time	Long at 16:24:36 January 11, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230111162436.IDFW

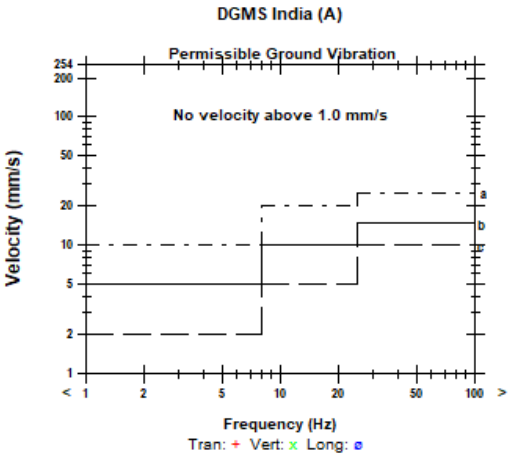
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 100 m

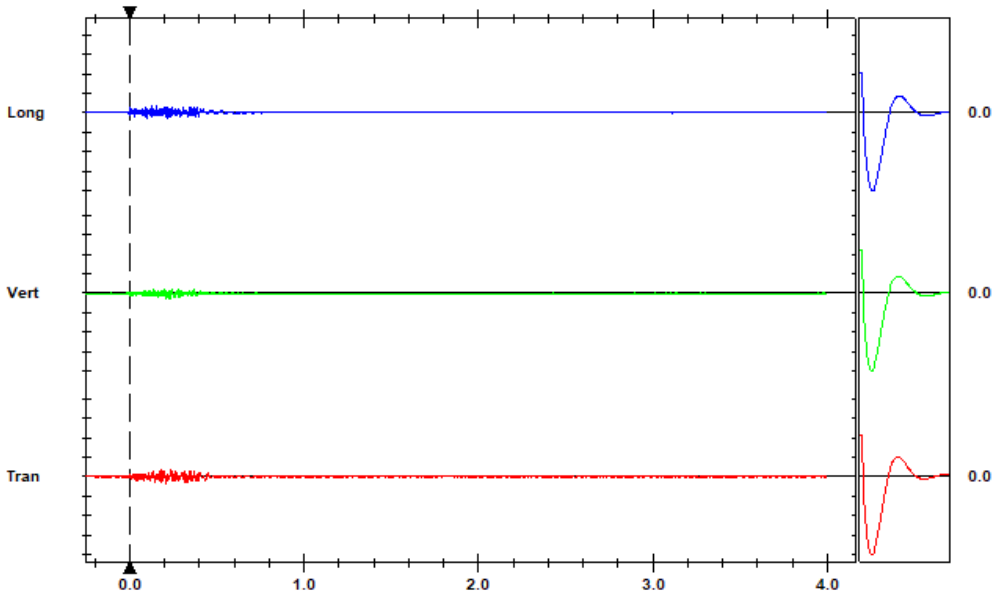
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.686	0.544	0.670	mm/s
ZC Freq	64	>100	57	Hz
Time (Rel. to Trig)	0.185	0.205	0.151	sec
Peak Acceleration	0.086	0.058	0.071	g
Peak Displacement	0.002	0.002	0.073	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.1	

Peak Vector Sum 0.835 mm/s at 0.202 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

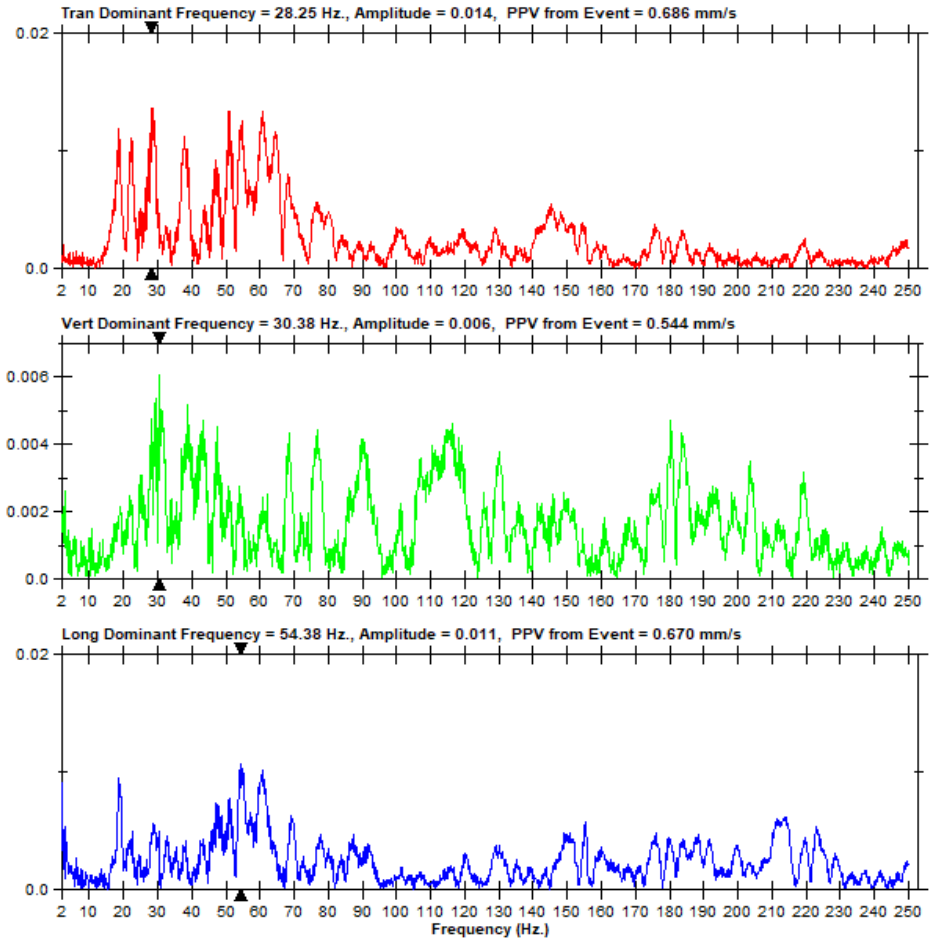
FFT Report

Date/Time	Long at 16:24:36 January 11, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230111162436.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 100 m



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Event Report

Date/Time Long at 16:23:38 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUHM.VE0
Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 82 m

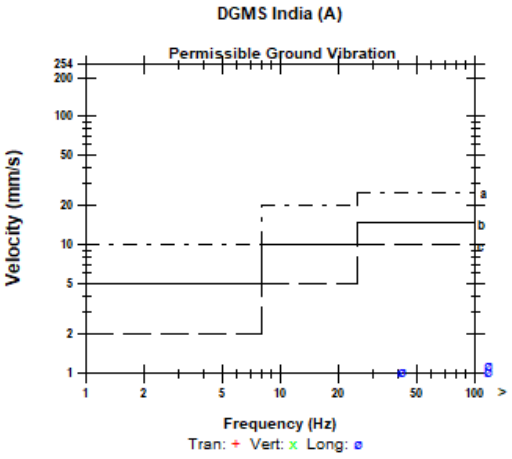
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

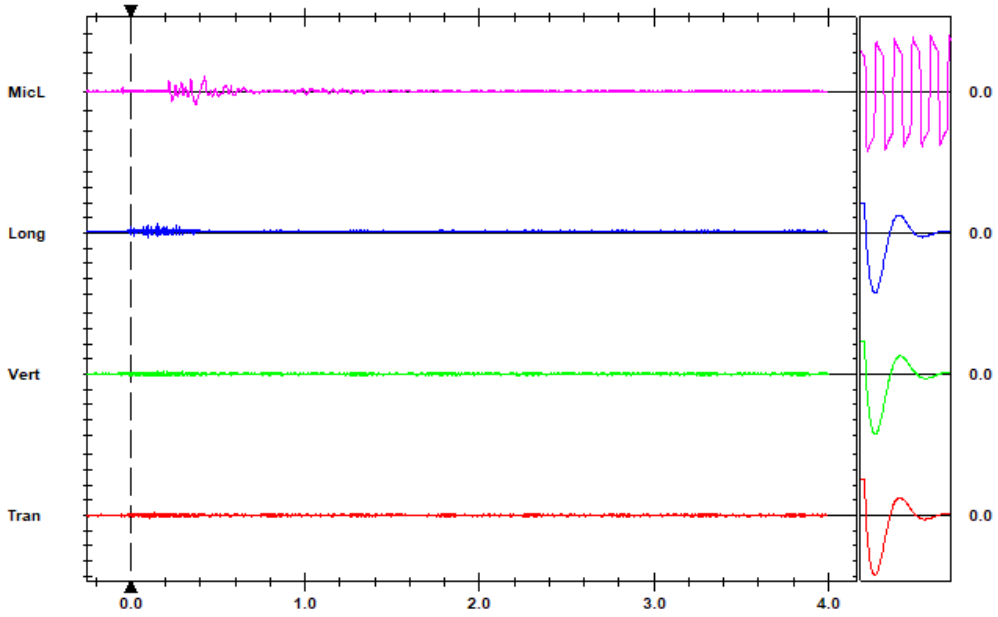
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 112.3 dB(L) at 0.424 sec
ZC Freq 13 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.508	0.381	1.143	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.133	0.156	0.150	sec
Peak Acceleration	0.053	0.040	0.093	g
Peak Displacement	0.000	0.000	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.6	3.5	3.6	

Peak Vector Sum 1.150 mm/s at 0.150 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

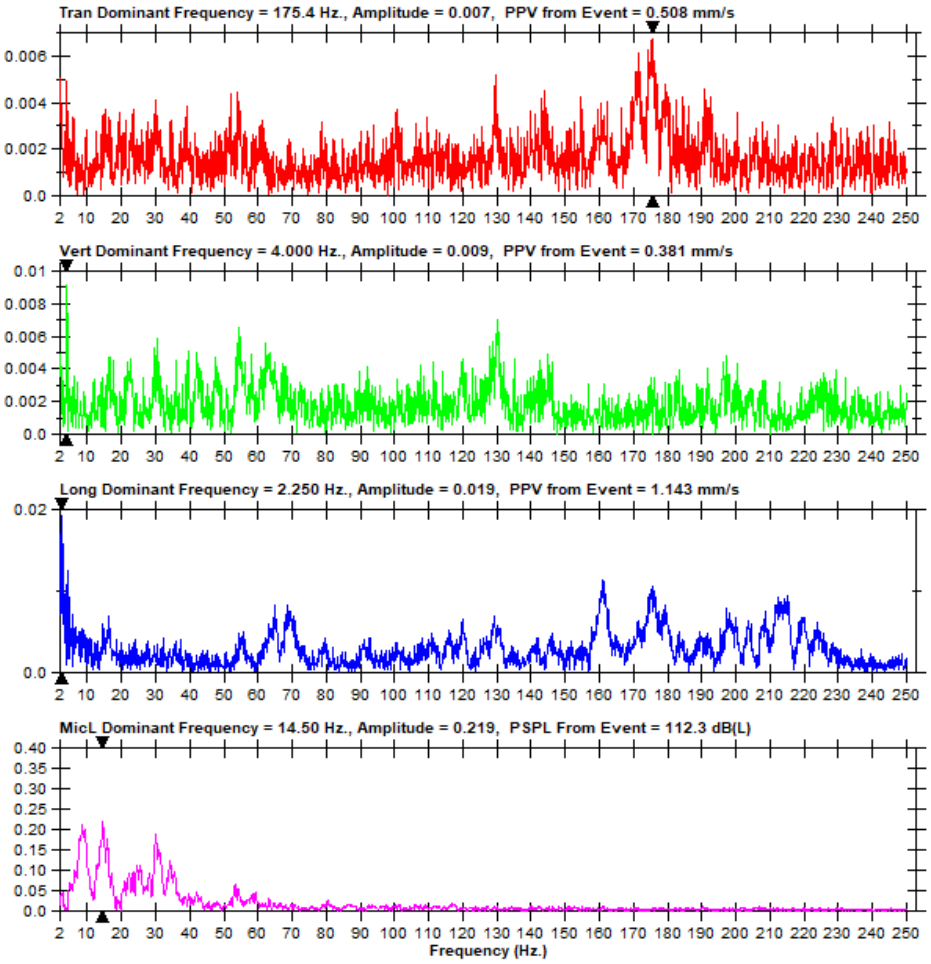
FFT Report

Date/Time	Long at 16:23:38 January 11, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUHM.VE0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 82 m



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Event Report

Date/Time Vert at 16:23:45 January 11, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUHM.VL0
Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 136 m

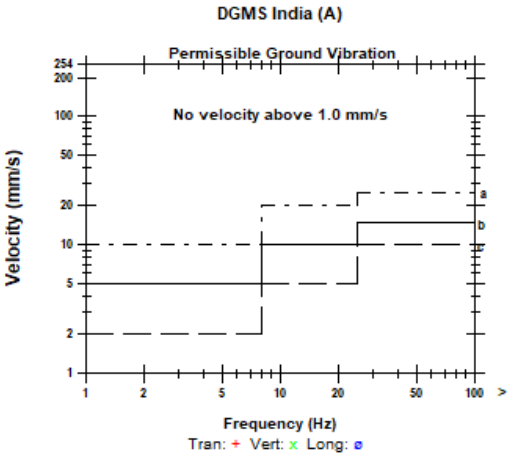
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

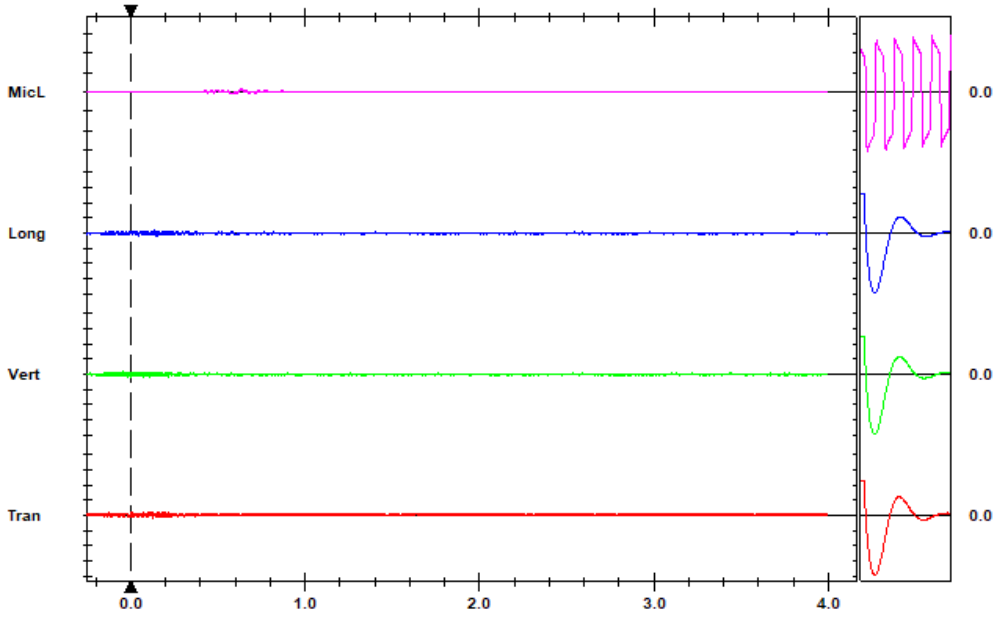
Microphone Linear Weighting
PSPL 95.92 dB(L) at 0.630 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 489 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.508	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.184	0.000	0.133	sec
Peak Acceleration	0.040	0.040	0.027	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 0.622 mm/s at 0.184 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

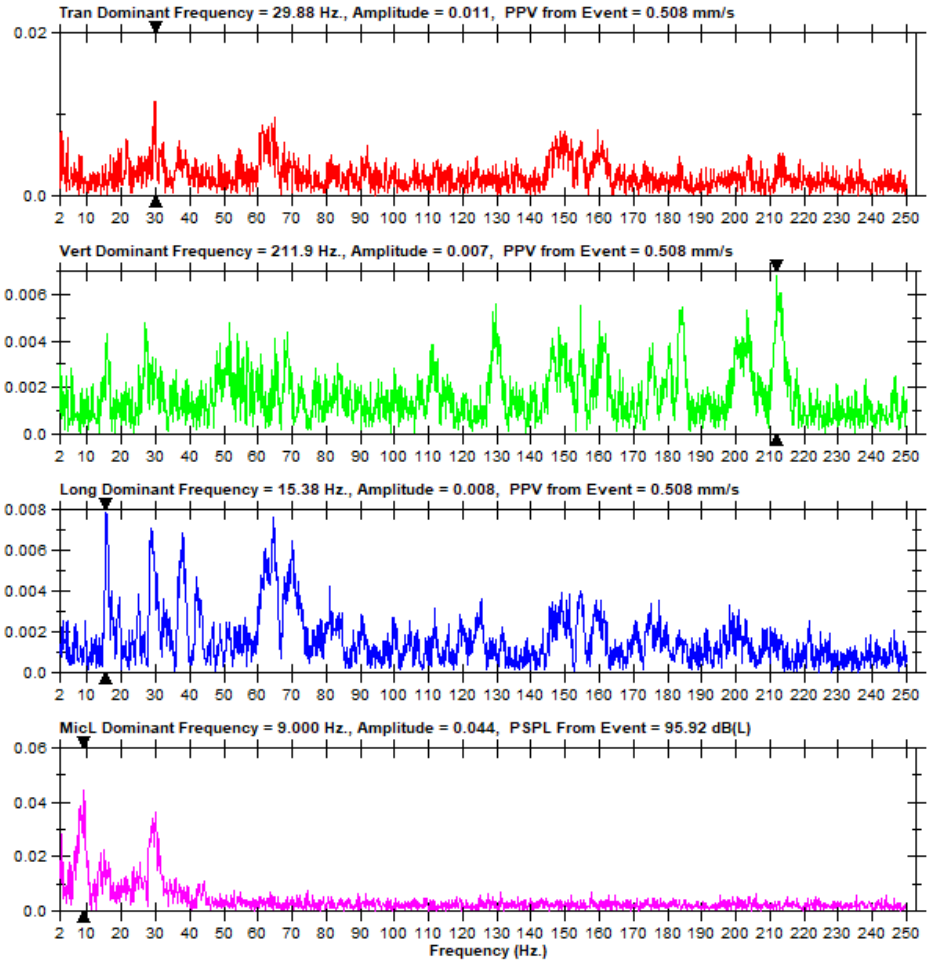
FFT Report

Date/Time	Vert at 16:23:45 January 11, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUHM.VL0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 25, Hole Depth - 1.8 m, Charge/hole - 0.375 Kg, MCPD - 0.75 Kg, Total Charge - 9.875 Kg, Distance - 136 m



Printed: February 21, 2023 (V 10.72 - 10.72)

ANNEXURE-8

Event and FFT Reports of Ground Vibration Recorded at Granite Building Stone Quarry owned by Sudheesh A. T., Wayanad District

Instantel

Event Report

Date/Time	Long at 13:46:53 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUMZ.M50

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

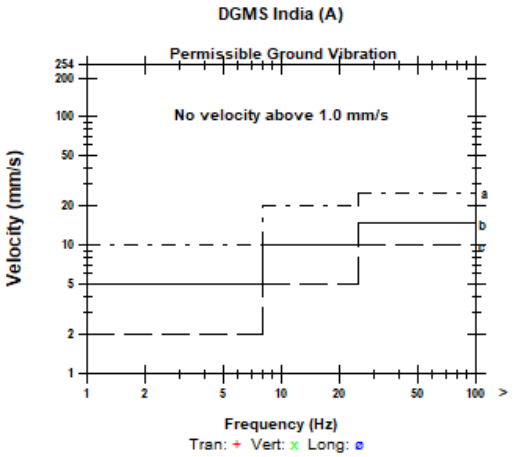
Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.75 Kg, Distance - 112 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

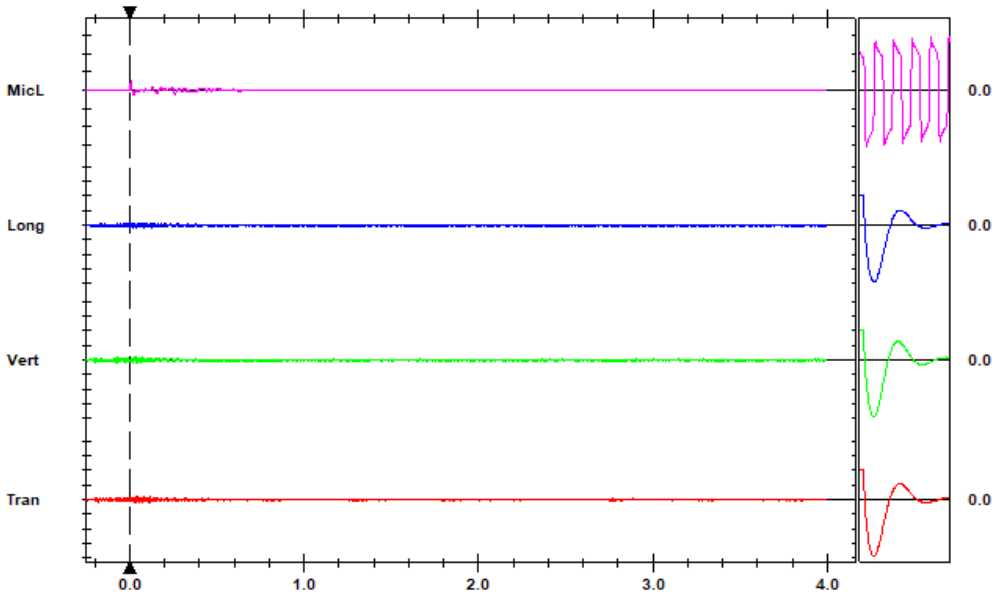
Microphone	Linear Weighting
PSPL	108.0 dB(L) at 0.008 sec
ZC Freq	43 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 583 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.508	mm/s
ZC Freq	>100	73	>100	Hz
Time (Rel. to Trig)	0.047	0.021	0.000	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.8	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 0.635 mm/s at 0.021 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

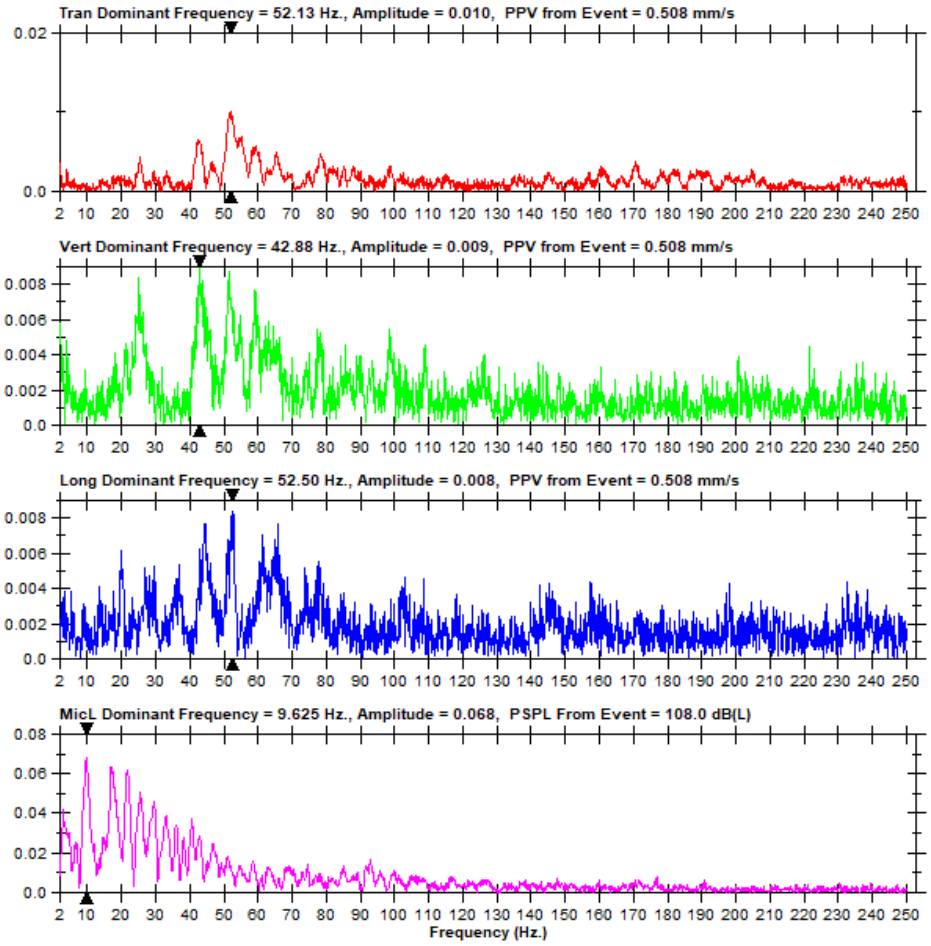
FFT Report

Date/Time	Long at 13:46:53 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUMZ.M50
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 15, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.75 Kg, Distance - 112 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Vert at 13:50:56 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUMZ.SW0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

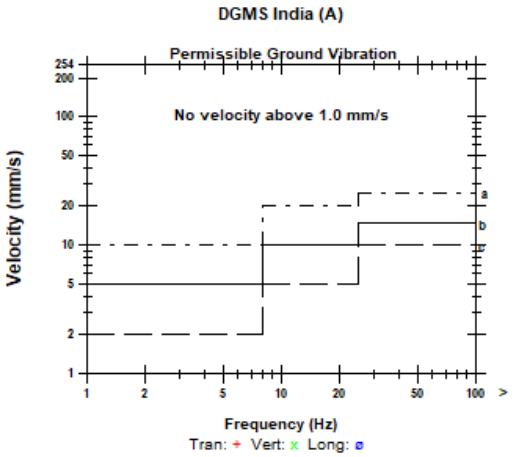
Post Event Notes
Total No. of holes - 13, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.00 Kg, Distance - 130 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

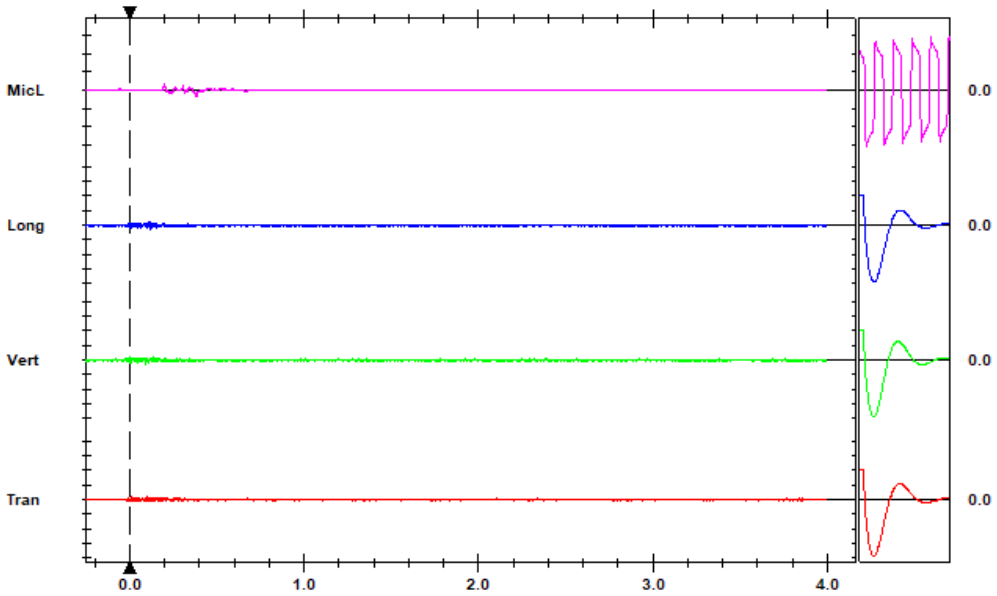
Microphone	Linear Weighting
PSPL	105.5 dB(L) at 0.200 sec
ZC Freq	32 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 591 mv)

	Tran	Vert	Long	
PPV	0.508	0.635	0.635	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.102	0.095	0.117	sec
Peak Acceleration	0.040	0.040	0.053	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 0.696 mm/s at 0.117 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

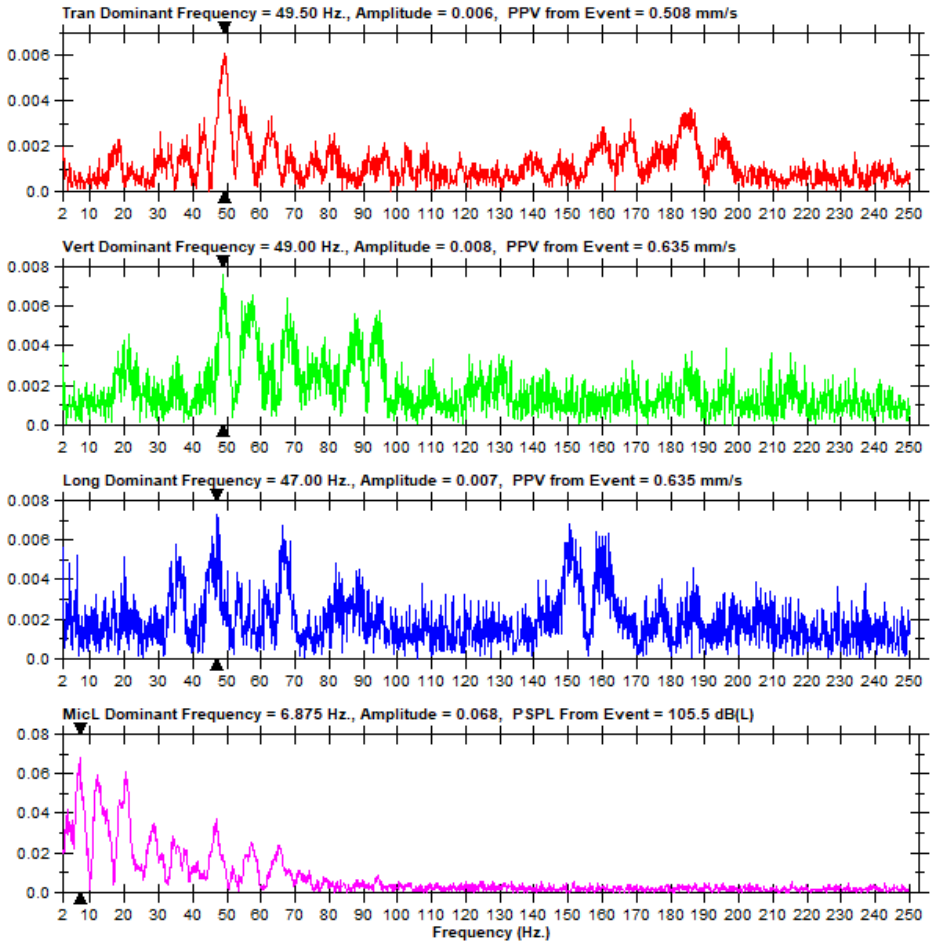
FFT Report

Date/Time	Vert at 13:50:56 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUMZ.SW0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 13, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.00 Kg, Distance - 130 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time	Tran at 14:08:59 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUN0.MZ0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

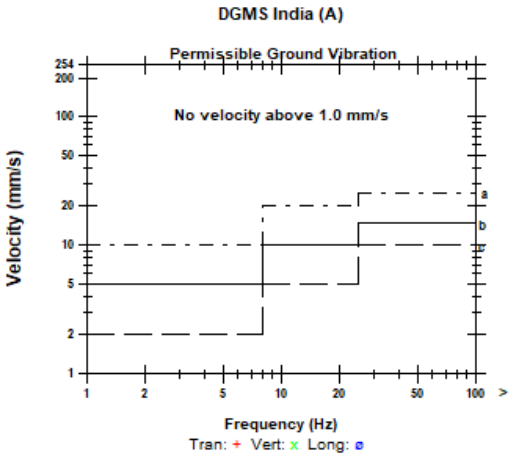
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.125 Kg, Distance - 145 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

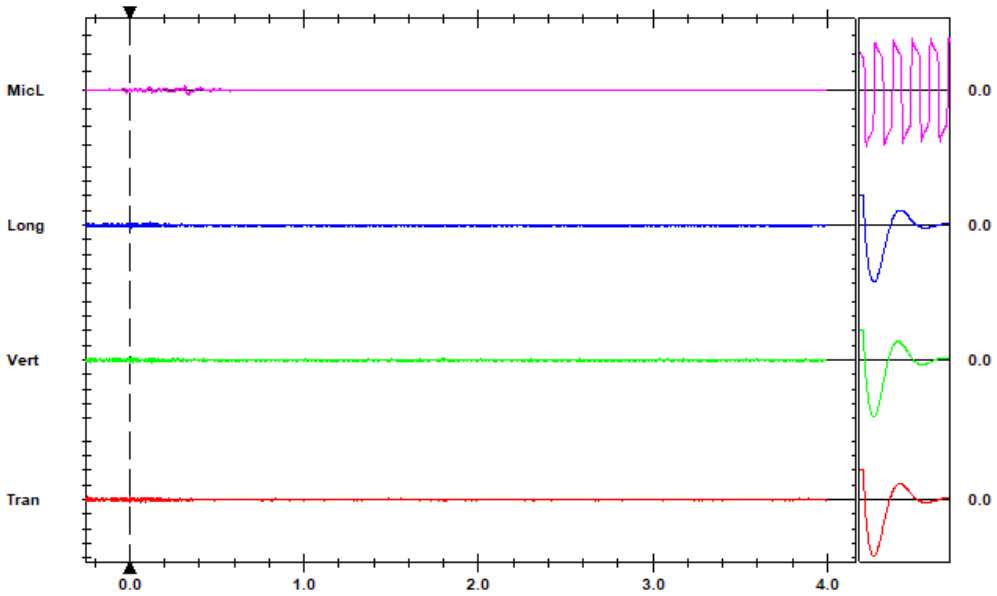
Microphone	Linear Weighting
PSPL	101.9 dB(L) at 0.316 sec
ZC Freq	24 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 566 mv)

	Tran	Vert	Long	
PPV	0.508	0.508	0.381	mm/s
ZC Freq	>100	85	85	Hz
Time (Rel. to Trig)	0.000	0.017	0.006	sec
Peak Acceleration	0.053	0.040	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 0.582 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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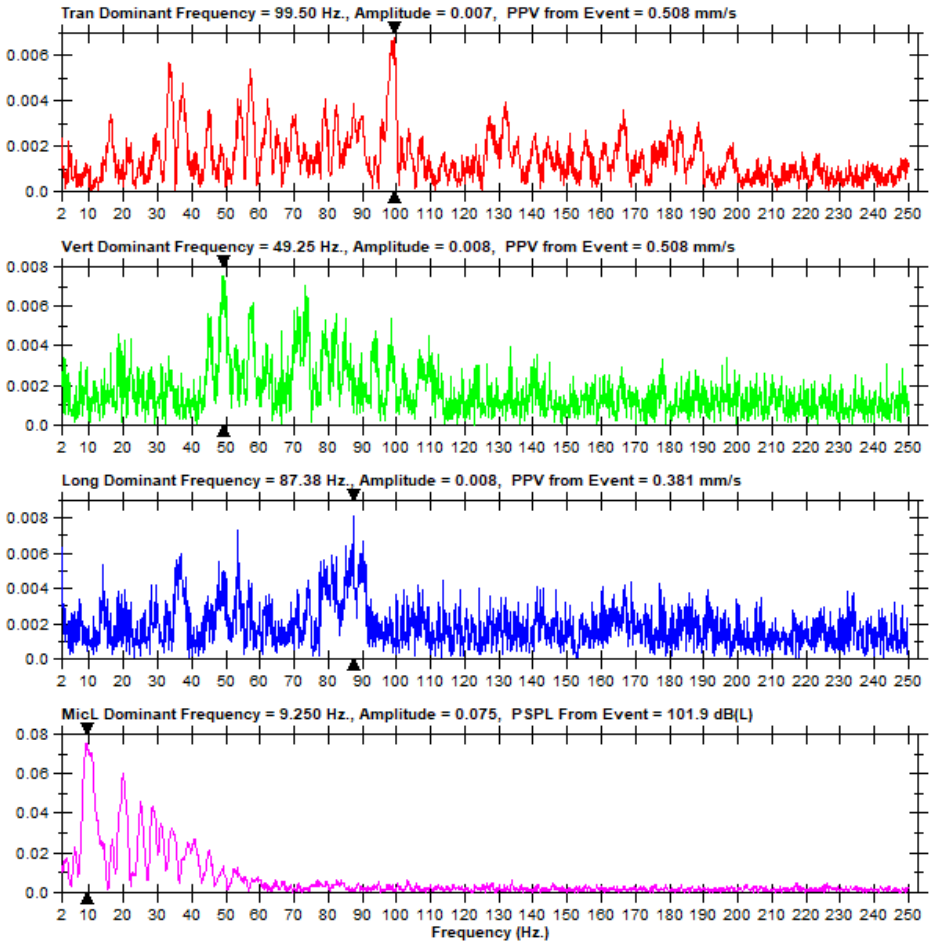
FFT Report

Date/Time	Tran at 14:08:59 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN0.MZ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.750 Kg, Total Charge - 4.125 Kg, Distance - 145 m



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Event Report

Date/Time Long at 14:18:29 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

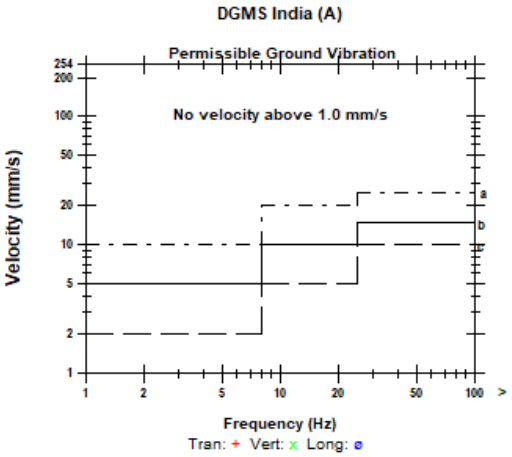
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 103.5 dB(L) at 0.359 sec
ZC Freq 18 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 496 mv)

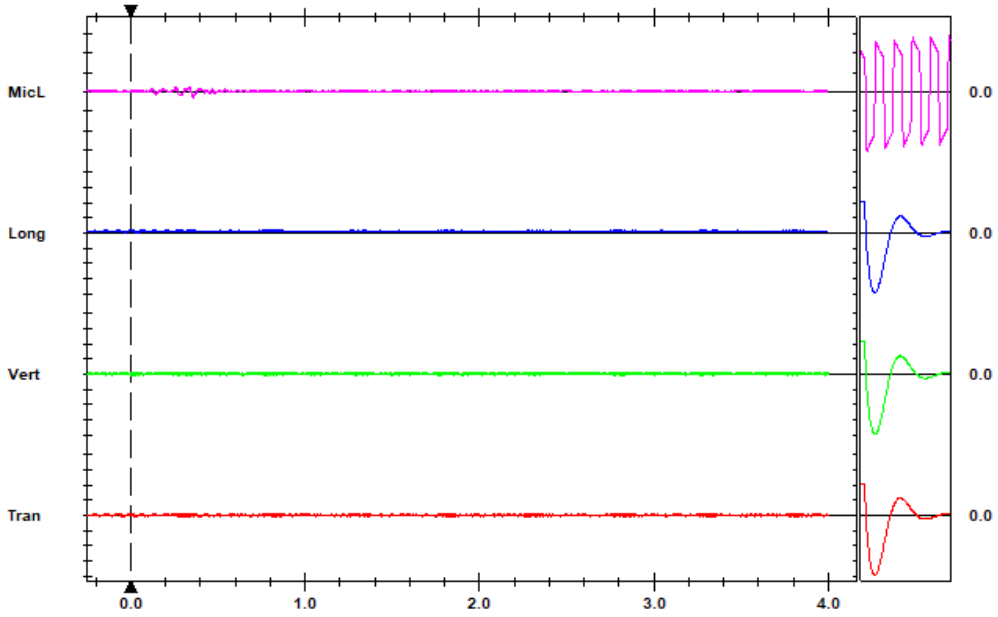
	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	15	Hz
Time (Rel. to Trig)	0.035	-0.049	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.017	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.8	

Peak Vector Sum 0.524 mm/s at 0.000 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUN1.2T0
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 190 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

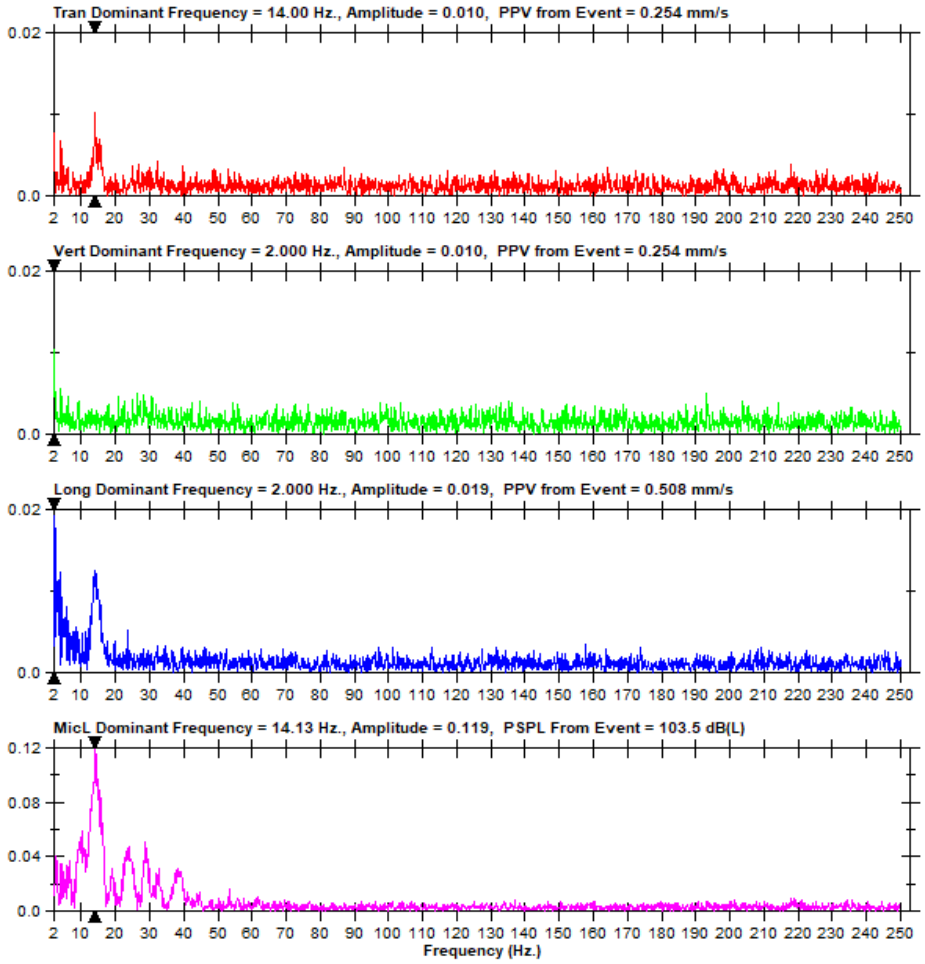
FFT Report

Date/Time	Long at 14:18:29 January 14, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUN1.2T0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 190 m



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Event Report

Date/Time Long at 14:28:19 January 14, 2023
Trigger Source Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Job Number: 1

Serial Number BE20376 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration November 2, 2022 by CIMFR Dhanbad
File Name V376JUN1.J70

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

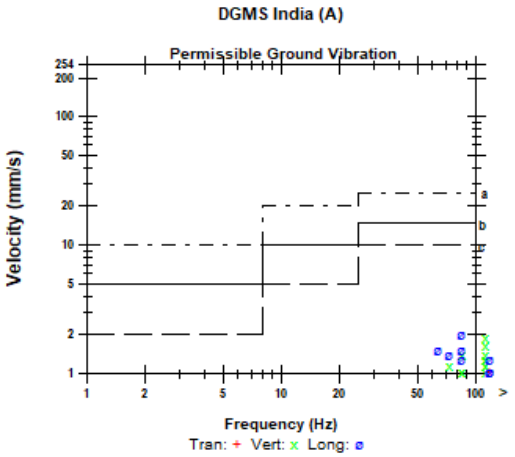
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 42 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

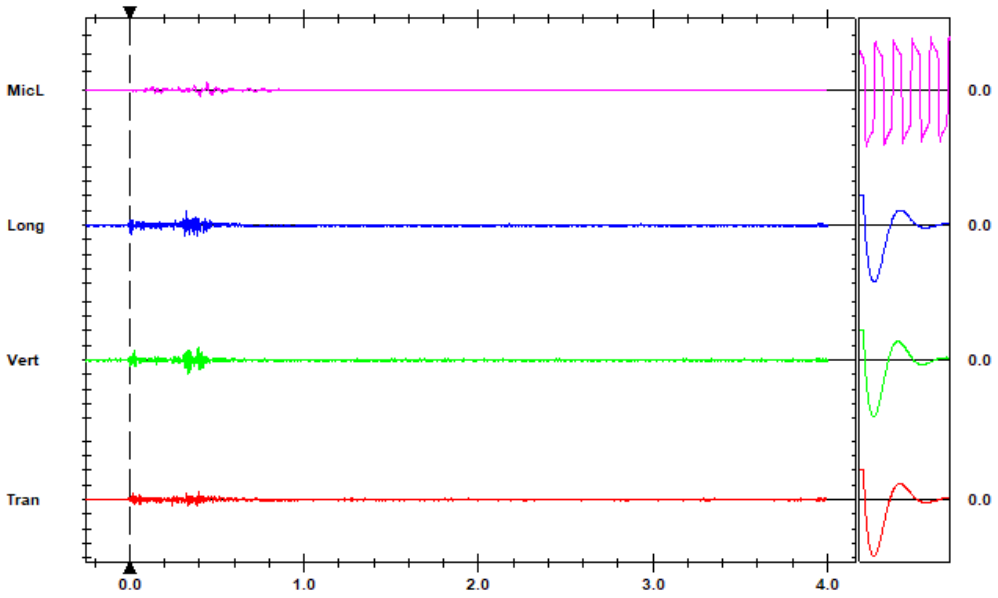
Microphone Linear Weighting
PSPL 106.5 dB(L) at 0.444 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 475 mv)

	Tran	Vert	Long	
PPV	1.016	1.905	2.032	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.395	0.338	0.324	sec
Peak Acceleration	0.066	0.119	0.106	g
Peak Displacement	0.002	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 2.222 mm/s at 0.324 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

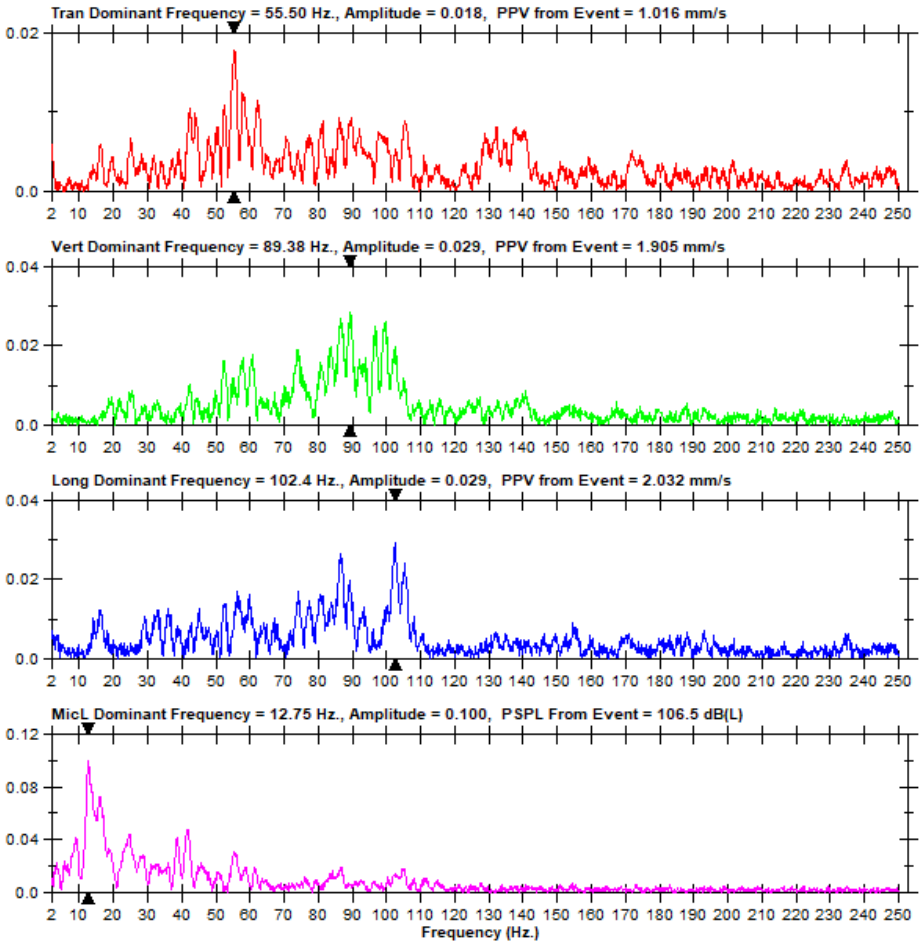
FFT Report

Date/Time	Long at 14:28:19 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN1.J70
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 42 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 14:28:19 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

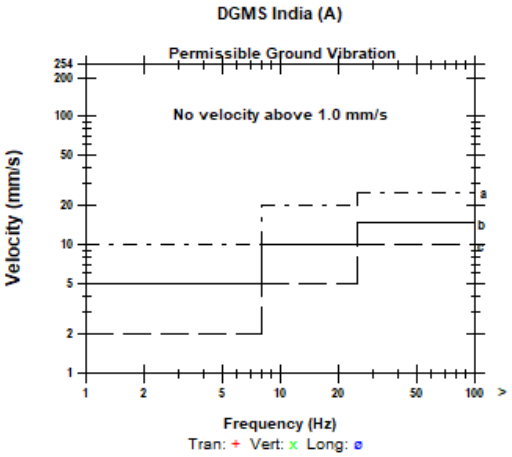
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 101.0 dB(L) at 0.284 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 501 mv)

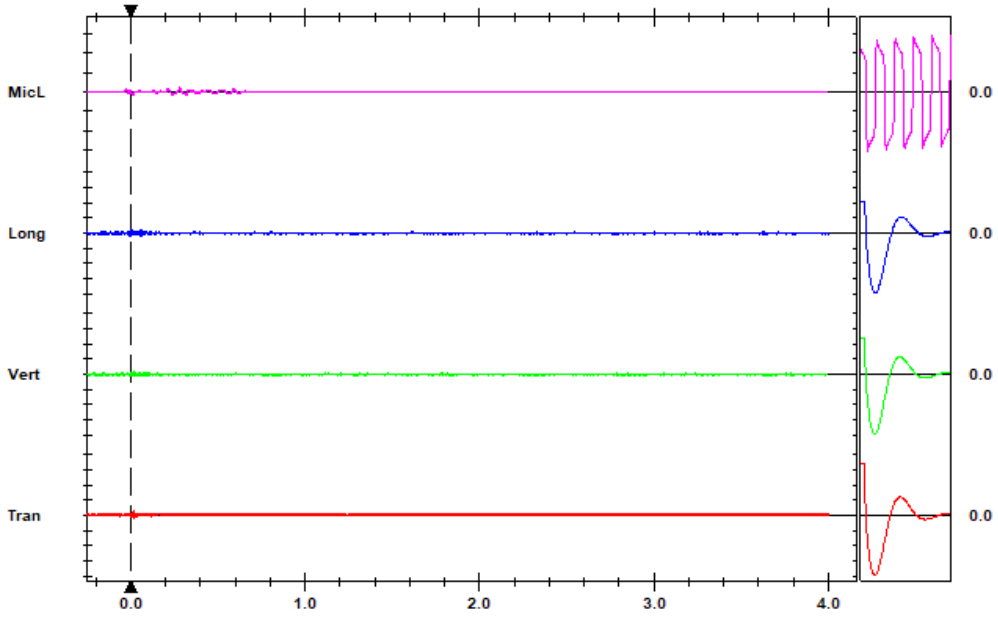
	Tran	Vert	Long	
PPV	0.635	0.381	0.508	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.016	0.019	0.000	sec
Peak Acceleration	0.040	0.027	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	4.0	

Peak Vector Sum 0.684 mm/s at 0.017 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUN1.J70
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 162 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

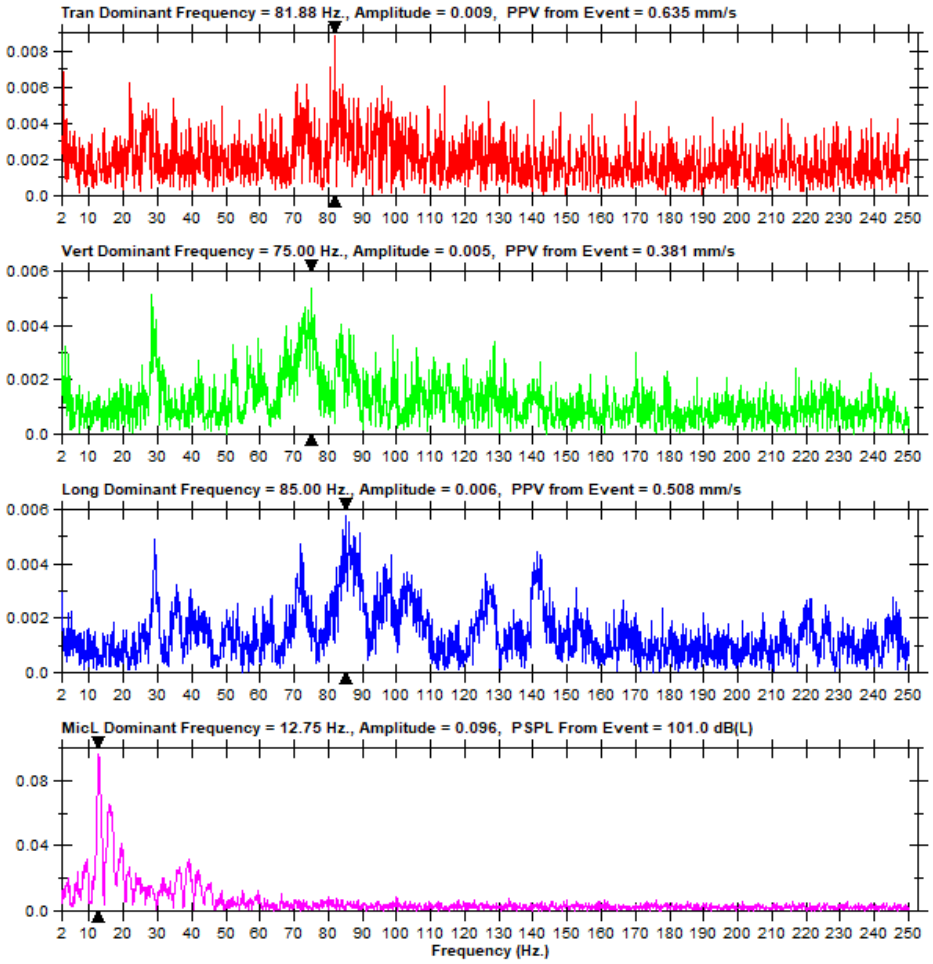
FFT Report

Date/Time	Long at 14:28:19 January 14, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUN1.J70

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 162 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 14:28:20 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUN1.J80
Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 197 m

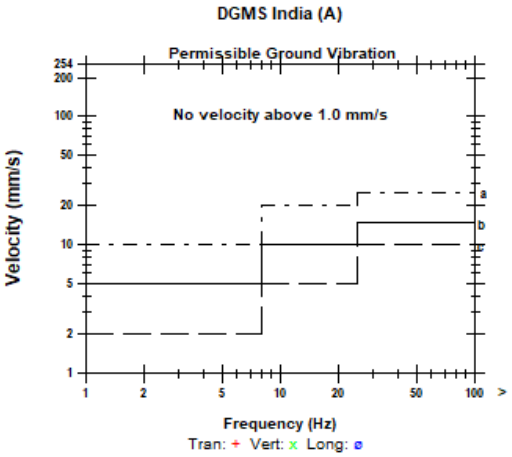
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

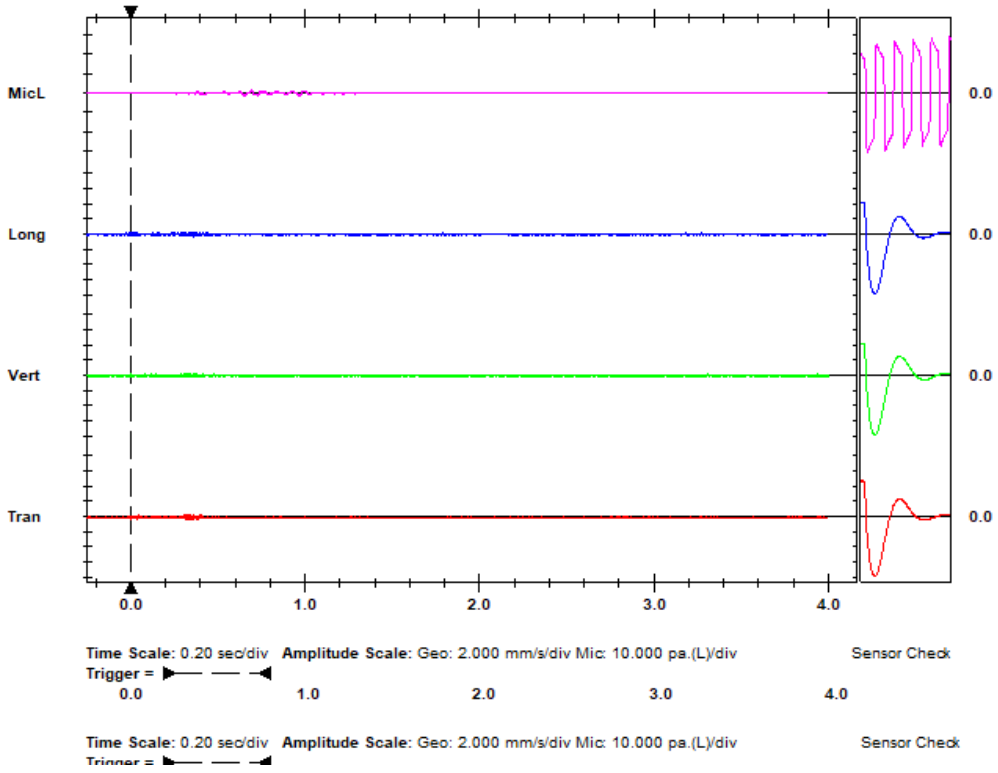
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 97.50 dB(L) at 0.650 sec
ZC Freq 20 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 366 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	-0.005	0.363	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.8	3.4	3.7	

Peak Vector Sum 0.554 mm/s at 0.363 sec





Instantel

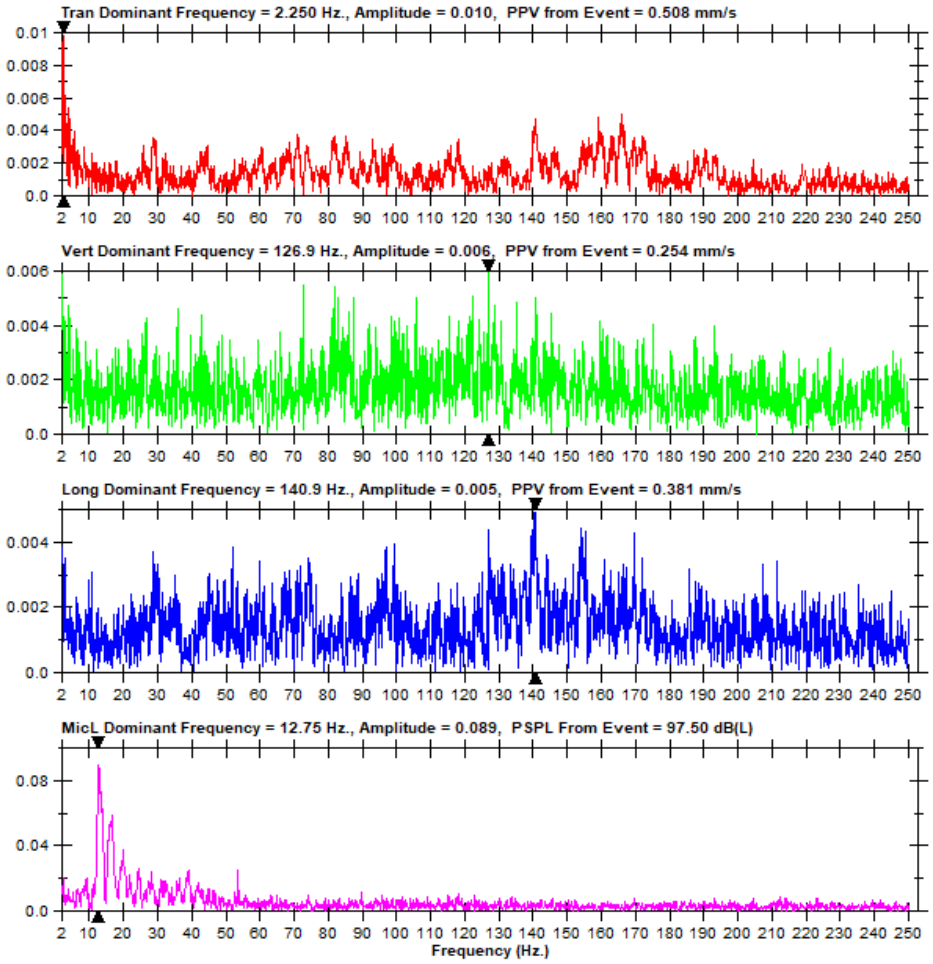
FFT Report

Date/Time	Tran at 14:28:20 January 14, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUN1.J80

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 12, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.75 Kg, Distance - 197 m



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Event Report

Date/Time	Vert at 14:30:18 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUN1.MI0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

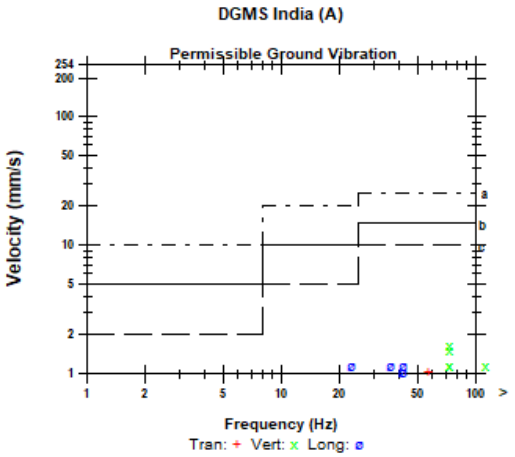
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 48 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

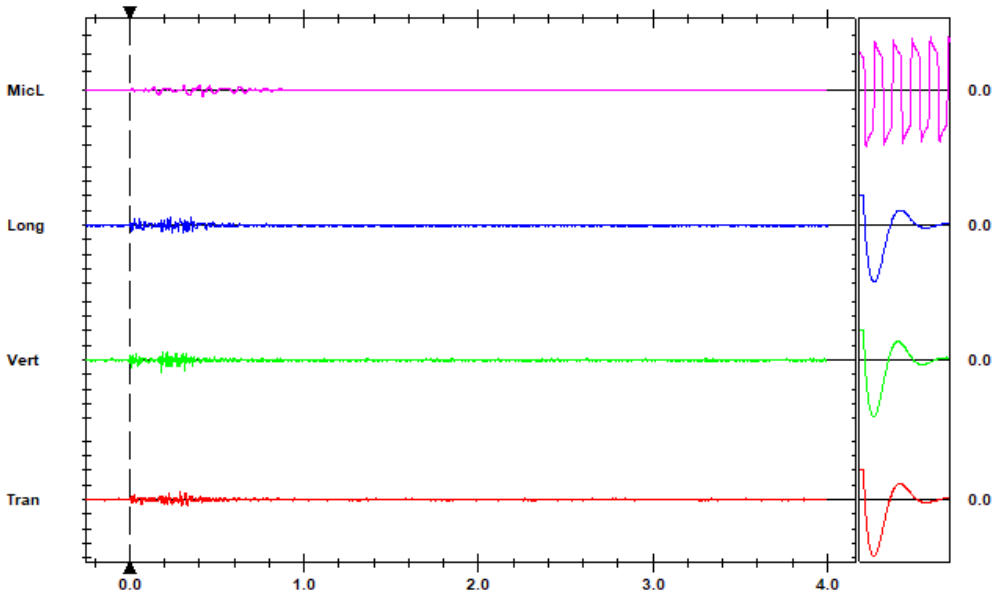
Microphone	Linear Weighting
PSPL	104.9 dB(L) at 0.421 sec
ZC Freq	16 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 535 mv)

	Tran	Vert	Long	
PPV	1.016	1.651	1.143	mm/s
ZC Freq	57	73	23	Hz
Time (Rel. to Trig)	0.289	0.184	0.242	sec
Peak Acceleration	0.066	0.080	0.053	g
Peak Displacement	0.003	0.003	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 1.823 mm/s at 0.185 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

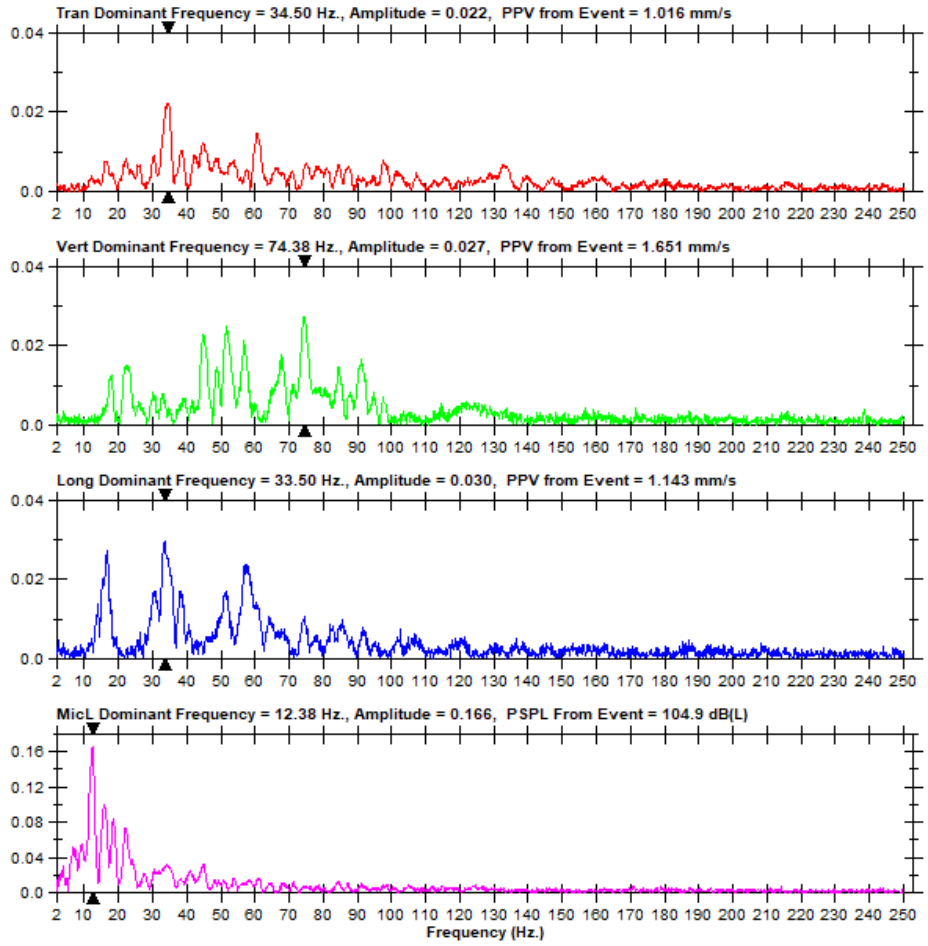
FFT Report

Date/Time	Vert at 14:30:18 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN1.MI0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 48 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Vert at 14:30:18 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

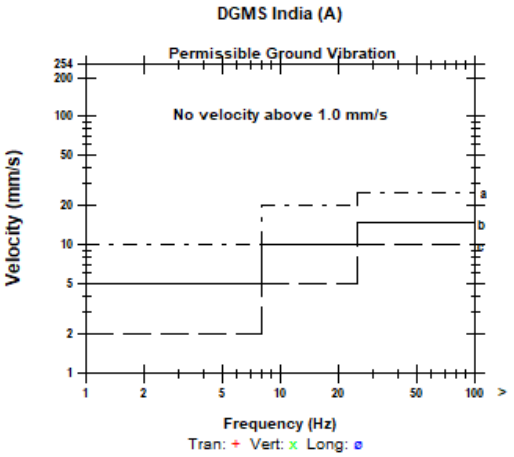
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.447 sec
ZC Freq 23 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 504 mv)

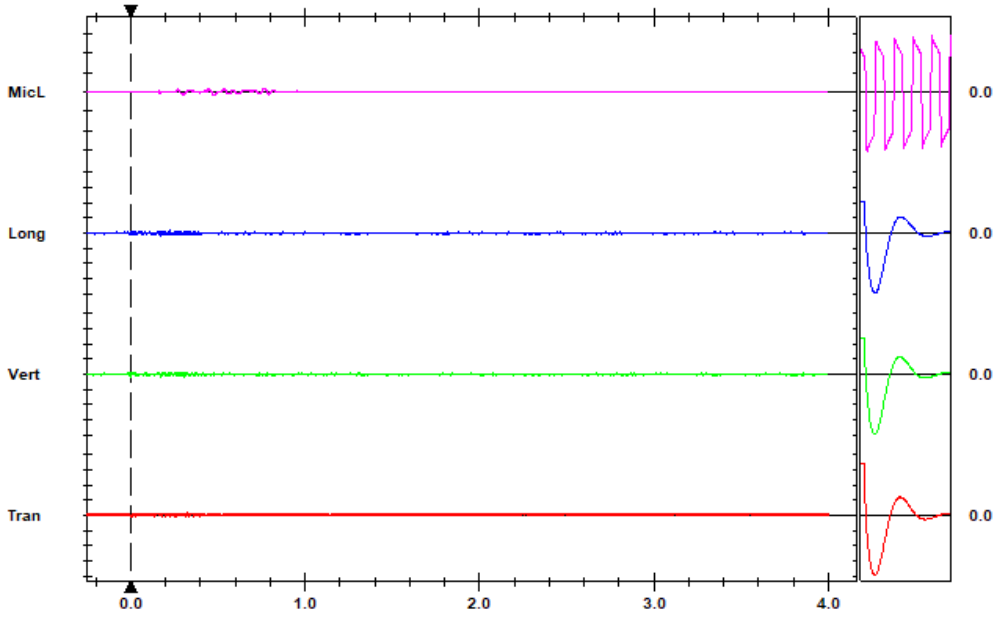
	Tran	Vert	Long	
PPV	0.381	0.508	0.381	mm/s
ZC Freq	85	85	>100	Hz
Time (Rel. to Trig)	0.324	0.000	0.171	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	4.0	

Peak Vector Sum 0.568 mm/s at 0.001 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUN1.MI0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 116m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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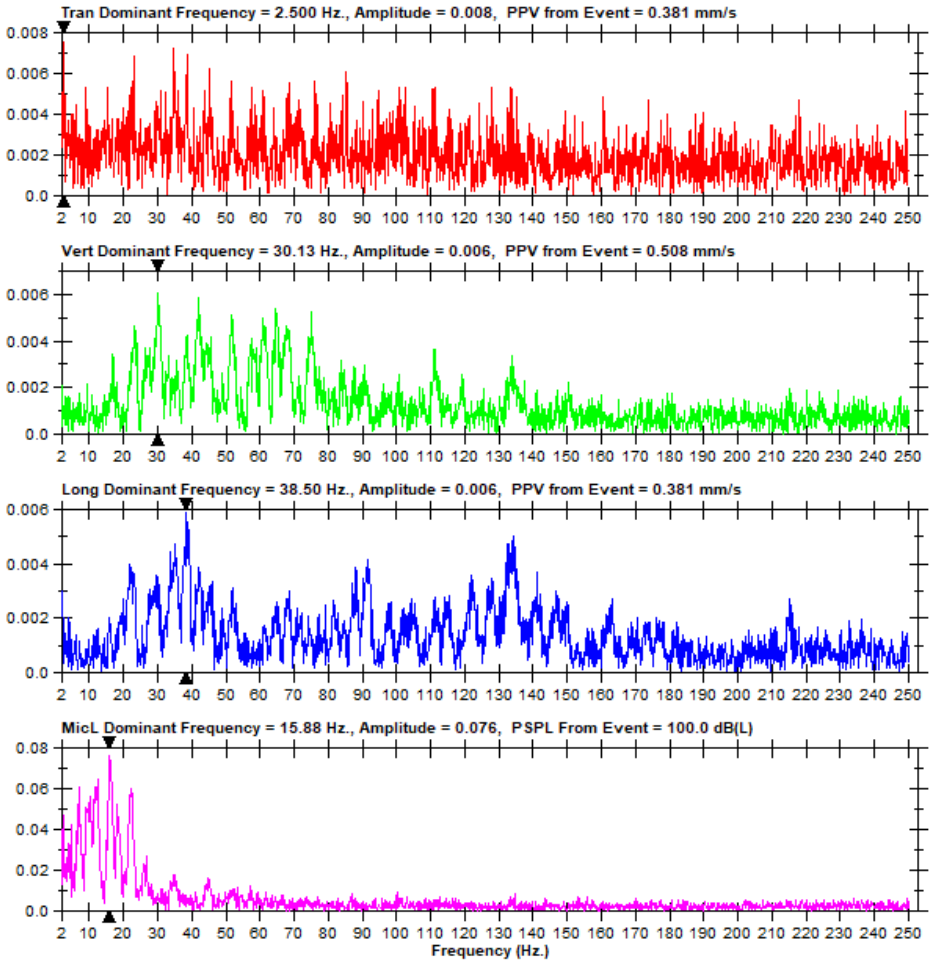
FFT Report

Date/Time	Vert at 14:30:18 January 14, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUN1.MI0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 116m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 14:30:19 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUN1.MJ0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 156 m

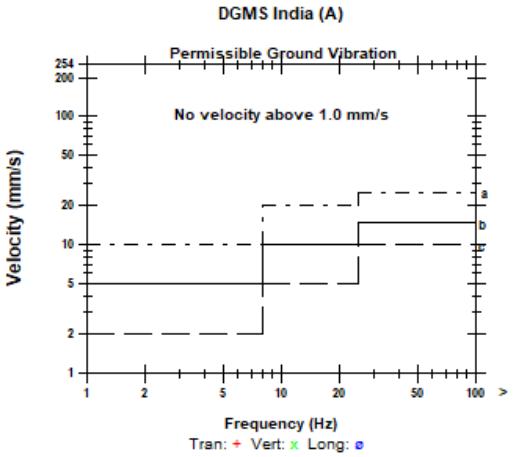
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

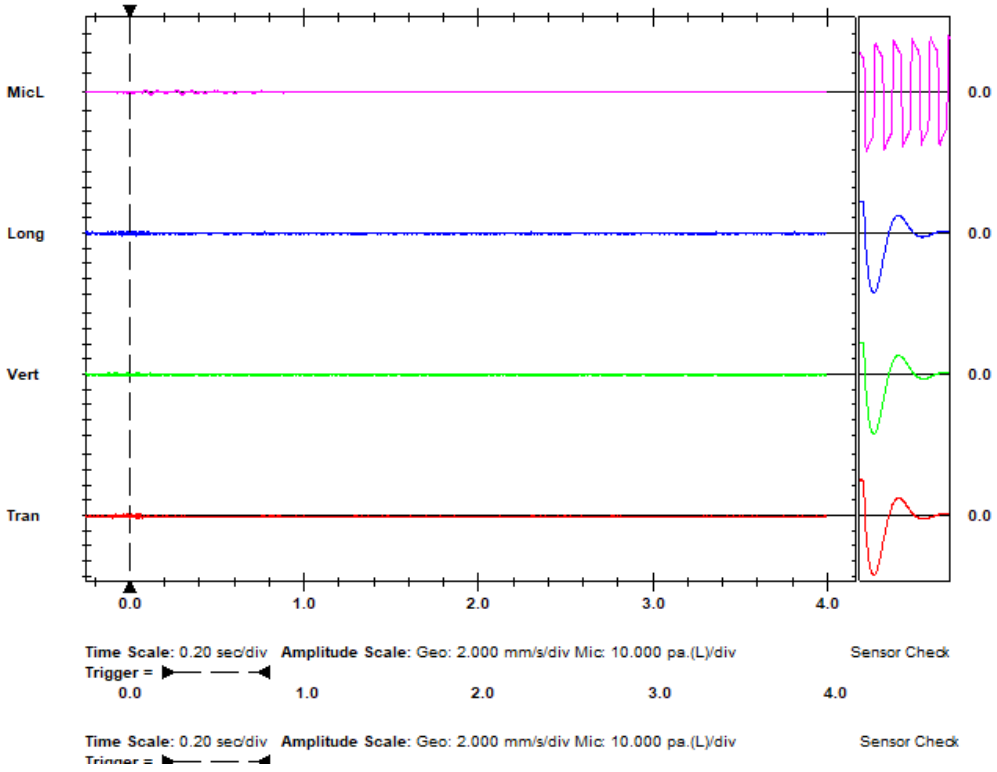
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 95.92 dB(L) at 0.116 sec
ZC Freq 16 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 366 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	-0.104	-0.047	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.001	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.8	3.4	3.7	

Peak Vector Sum 0.539 mm/s at 0.006 sec





Instantel

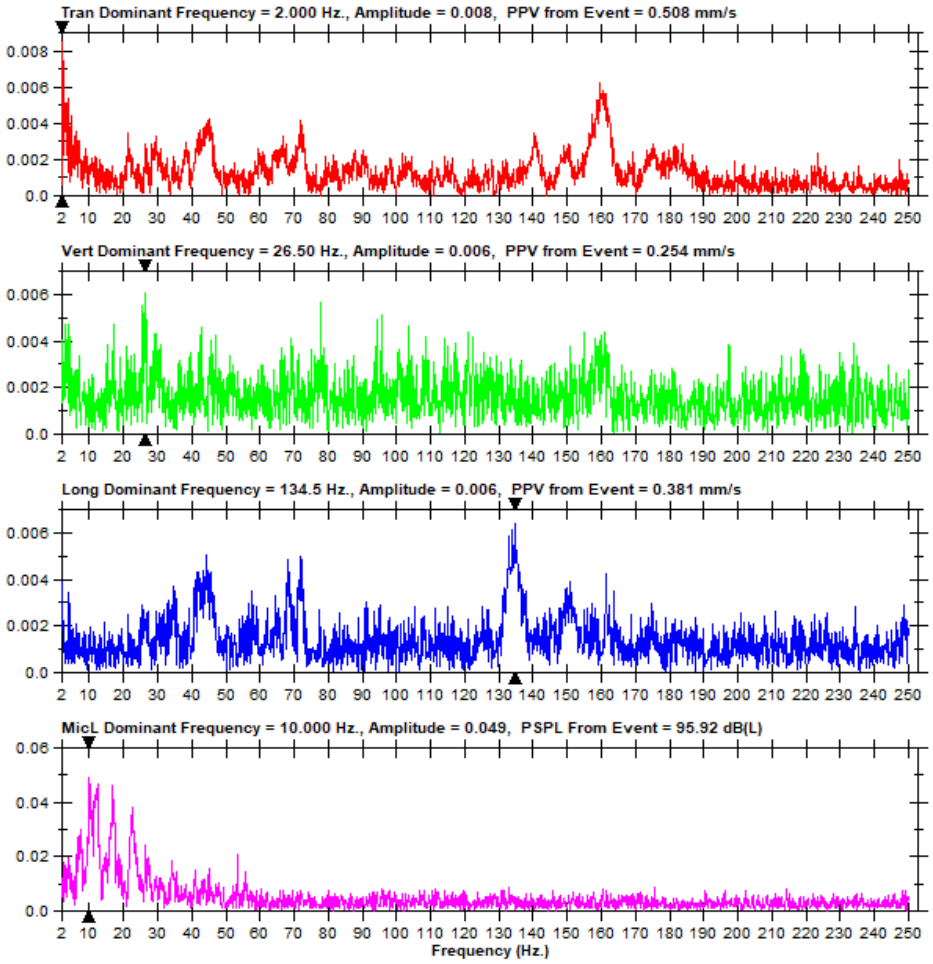
FFT Report

Date/Time	Tran at 14:30:19 January 14, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUN1.MJ0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 156 m



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Event Report

Date/Time	Long at 14:32:45 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUN1.QL0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

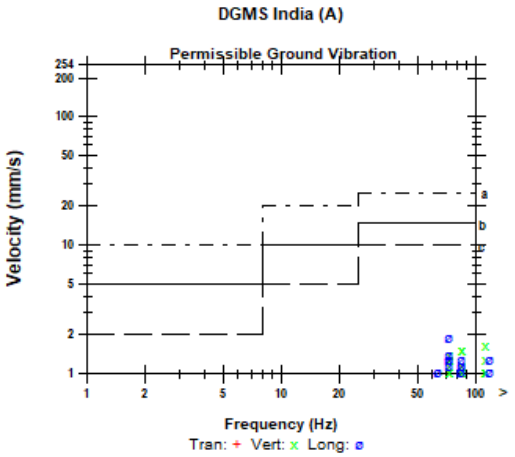
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 47 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

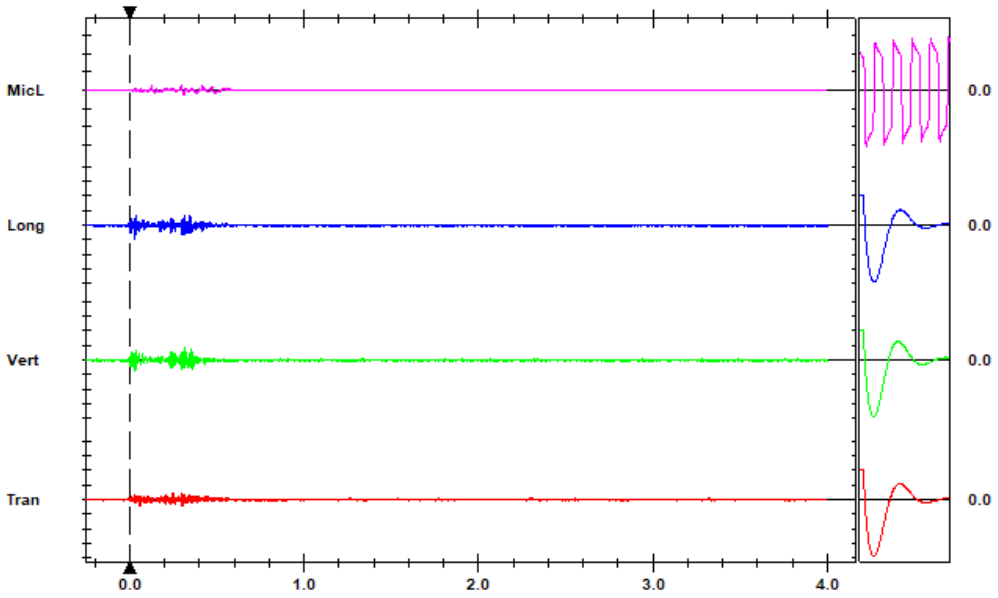
Microphone	Linear Weighting
PSPL	101.9 dB(L) at 0.297 sec
ZC Freq	37 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 557 mv)

	Tran	Vert	Long	
PPV	0.889	1.651	1.905	mm/s
ZC Freq	>100	>100	73	Hz
Time (Rel. to Trig)	0.243	0.314	0.031	sec
Peak Acceleration	0.066	0.093	0.106	g
Peak Displacement	0.002	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 1.992 mm/s at 0.032 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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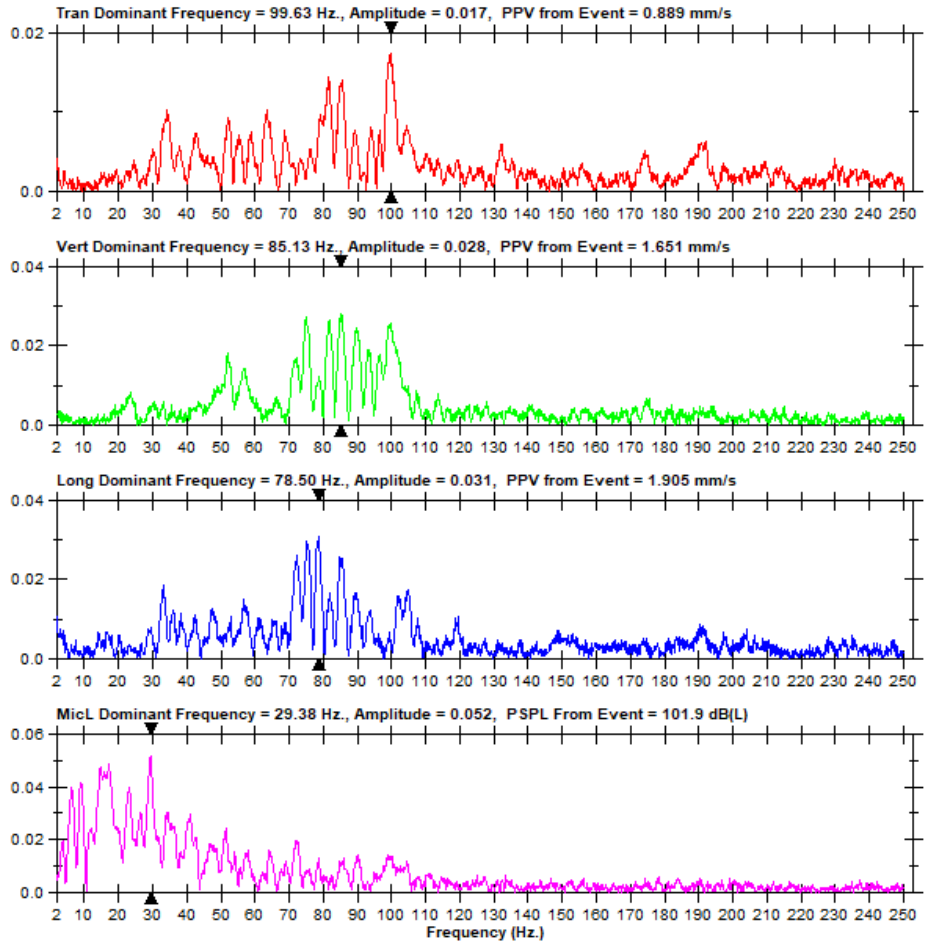
FFT Report

Date/Time	Long at 14:32:45 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN1.QL0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 47 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 14:32:45 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

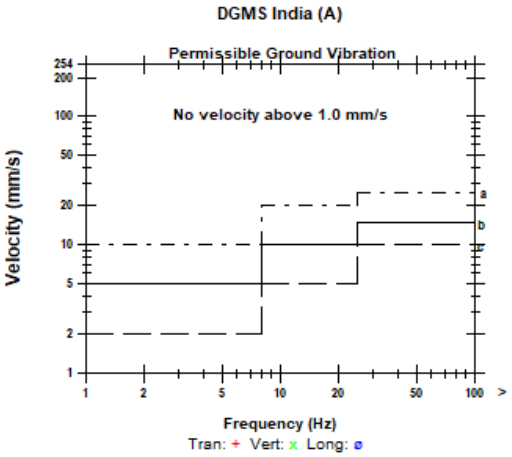
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 97.50 dB(L) at -0.021 sec
ZC Freq 37 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 497 mv)

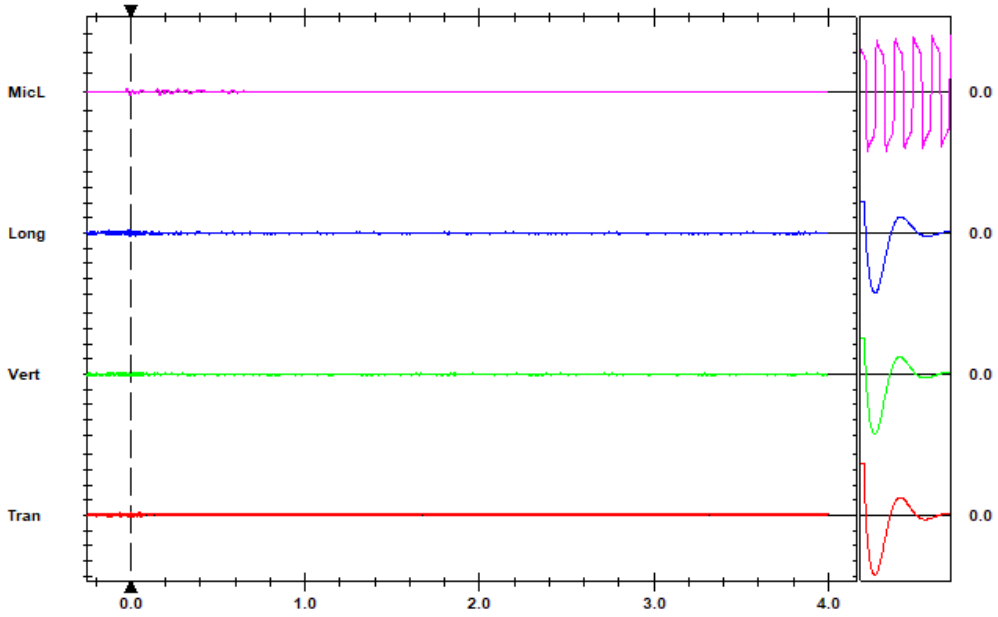
	Tran	Vert	Long	
PPV	0.508	0.254	0.508	mm/s
ZC Freq	85	>100	>100	Hz
Time (Rel. to Trig)	0.052	-0.101	0.000	sec
Peak Acceleration	0.027	0.027	0.040	g
Peak Displacement	0.001	0.000	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	4.0	

Peak Vector Sum 0.648 mm/s at 0.000 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUN1.QL0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 153 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

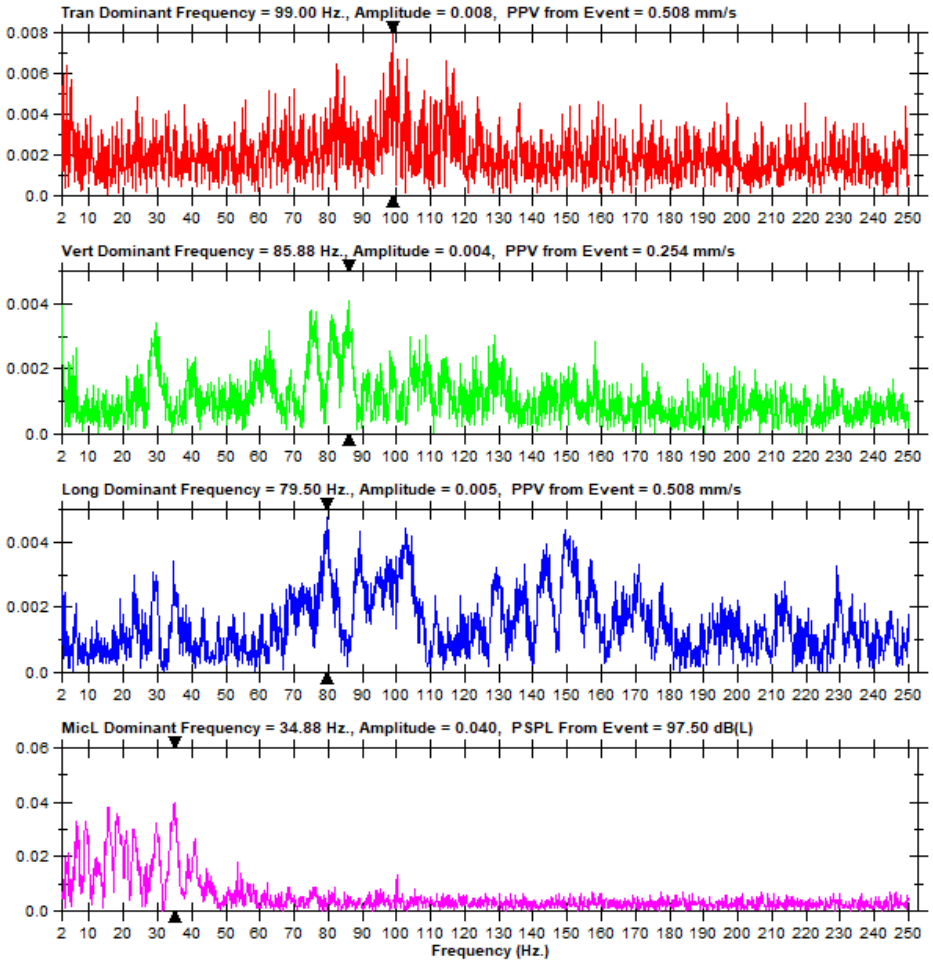
FFT Report

Date/Time	Long at 14:32:45 January 14, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUN1.QL0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 153 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Tran at 14:32:46 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUN1.QM0
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 153 m

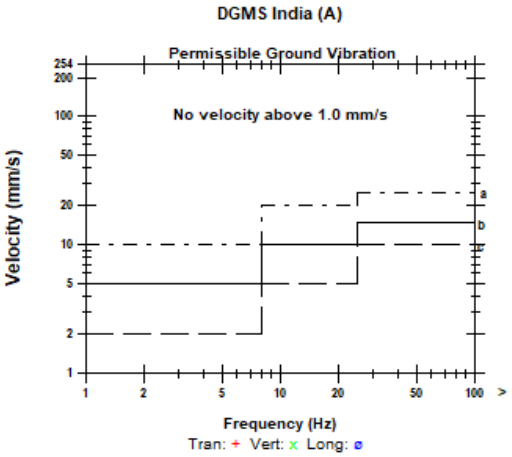
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

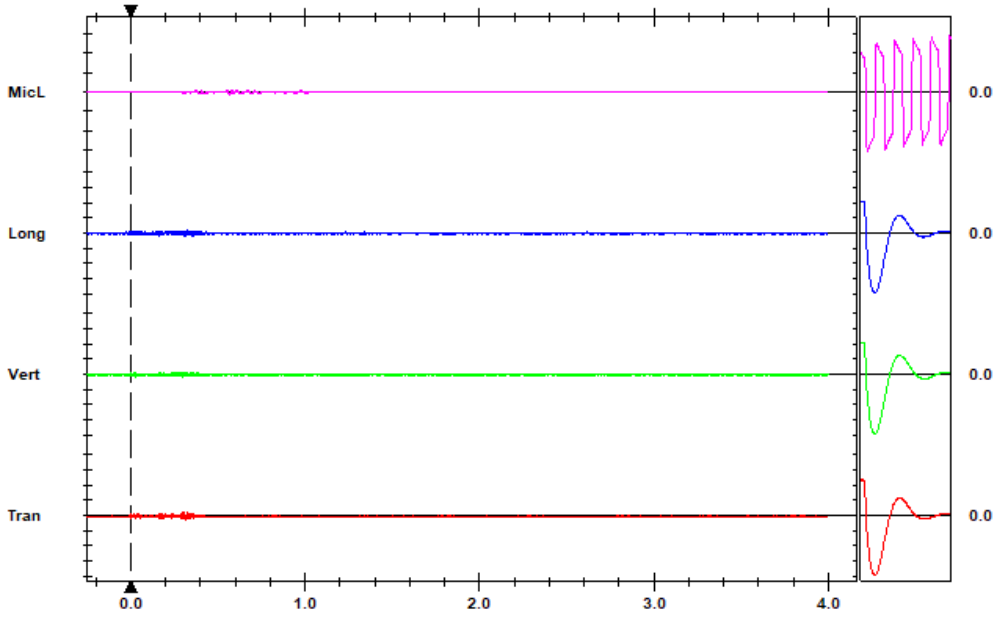
Microphone Linear Weighting
PSPL 95.92 dB(L) at 0.563 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 366 mv)

	Tran	Vert	Long	
PPV	0.635	0.381	0.381	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.313	0.025	0.166	sec
Peak Acceleration	0.053	0.027	0.040	g
Peak Displacement	0.001	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.8	3.4	3.7	

Peak Vector Sum 0.660 mm/s at 0.313 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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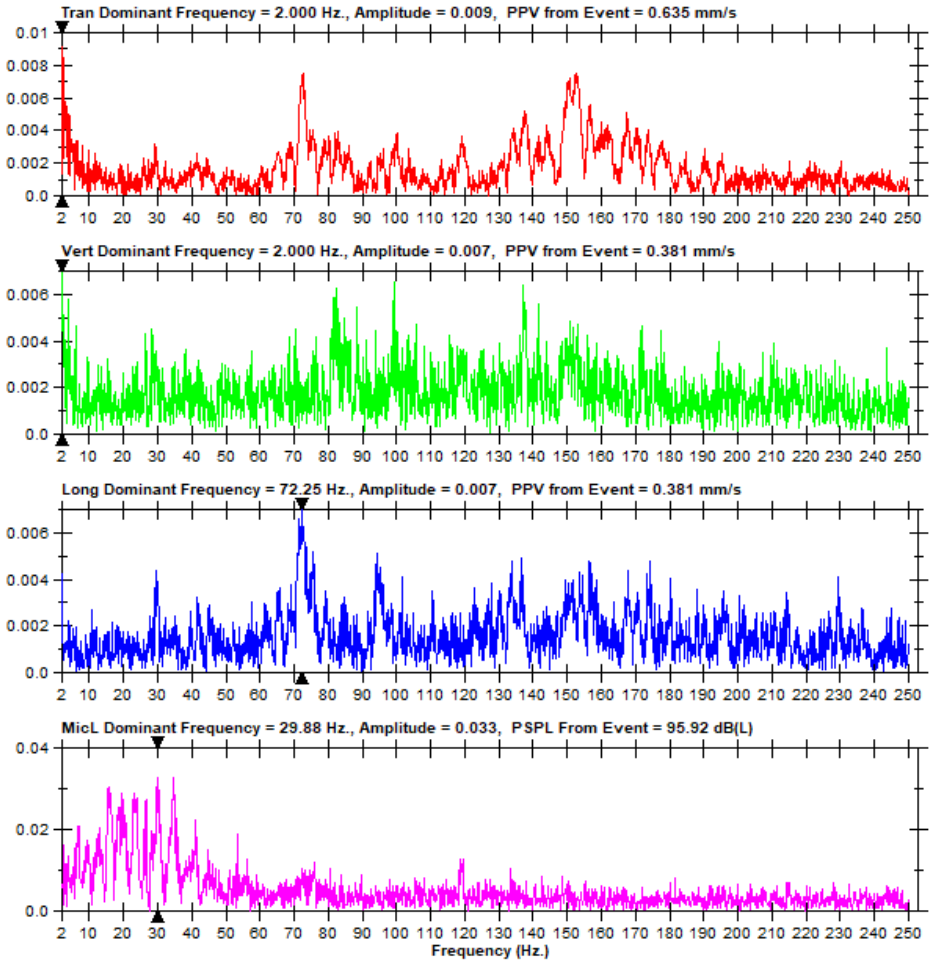
FFT Report

Date/Time	Tran at 14:32:46 January 14, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUN1.QM0

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 153 m



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Event Report

Date/Time	Long at 14:35:00 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUN1.UC0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

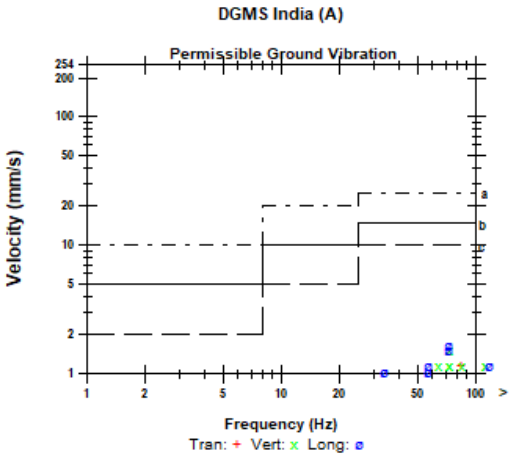
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 50 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

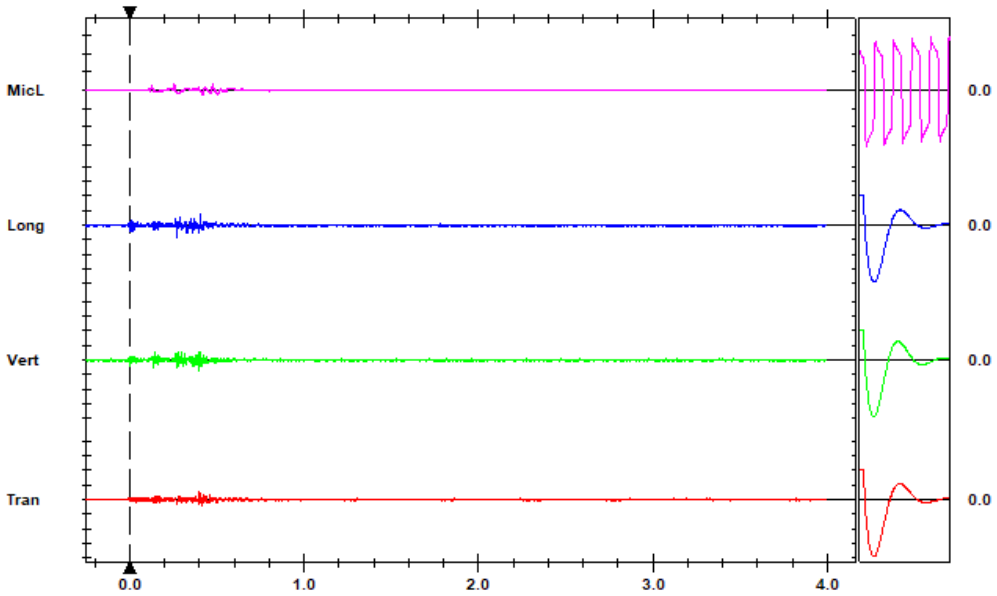
Microphone	Linear Weighting
PSPL	104.2 dB(L) at 0.257 sec
ZC Freq	34 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 591 mv)

	Tran	Vert	Long	
PPV	1.143	1.524	1.651	mm/s
ZC Freq	85	73	73	Hz
Time (Rel. to Trig)	0.400	0.396	0.272	sec
Peak Acceleration	0.093	0.080	0.080	g
Peak Displacement	0.002	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 1.849 mm/s at 0.396 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

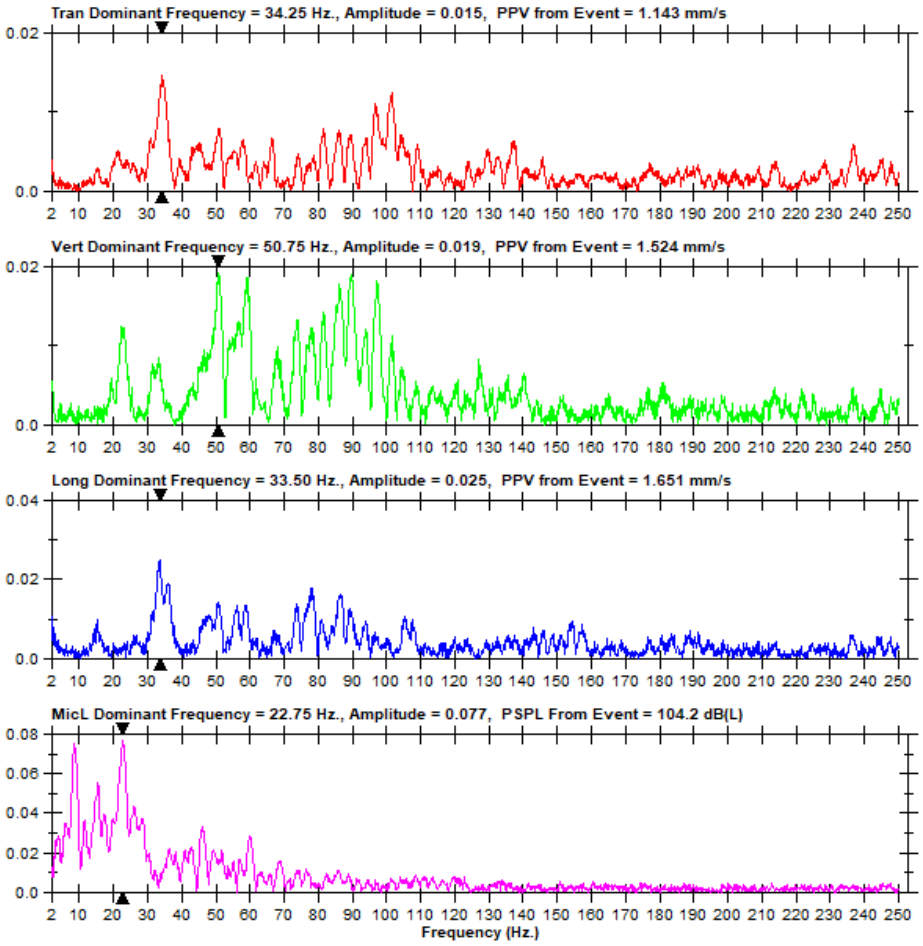
FFT Report

Date/Time	Long at 14:35:00 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN1.UC0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 50 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time	Vert at 14:37:19 January 14, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUN1.Y70

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

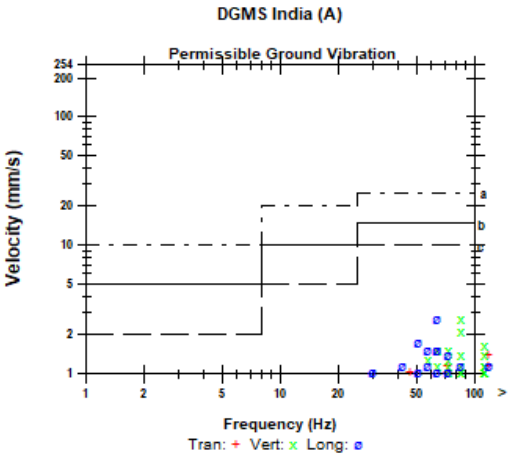
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 40 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

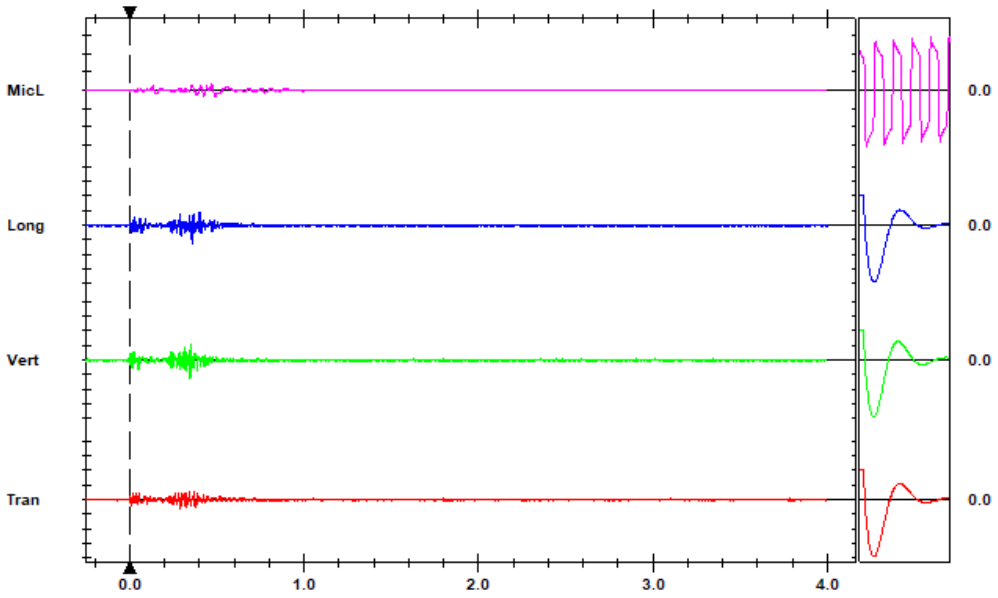
Microphone	Linear Weighting
PSPL	104.2 dB(L) at 0.425 sec
ZC Freq	28 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 587 mv)

	Tran	Vert	Long	
PPV	1.397	2.667	2.667	mm/s
ZC Freq	>100	85	64	Hz
Time (Rel. to Trig)	0.292	0.347	0.358	sec
Peak Acceleration	0.080	0.146	0.119	g
Peak Displacement	0.003	0.004	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.7	7.1	Hz
Overswing Ratio	3.9	3.3	4.1	

Peak Vector Sum 2.865 mm/s at 0.358 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

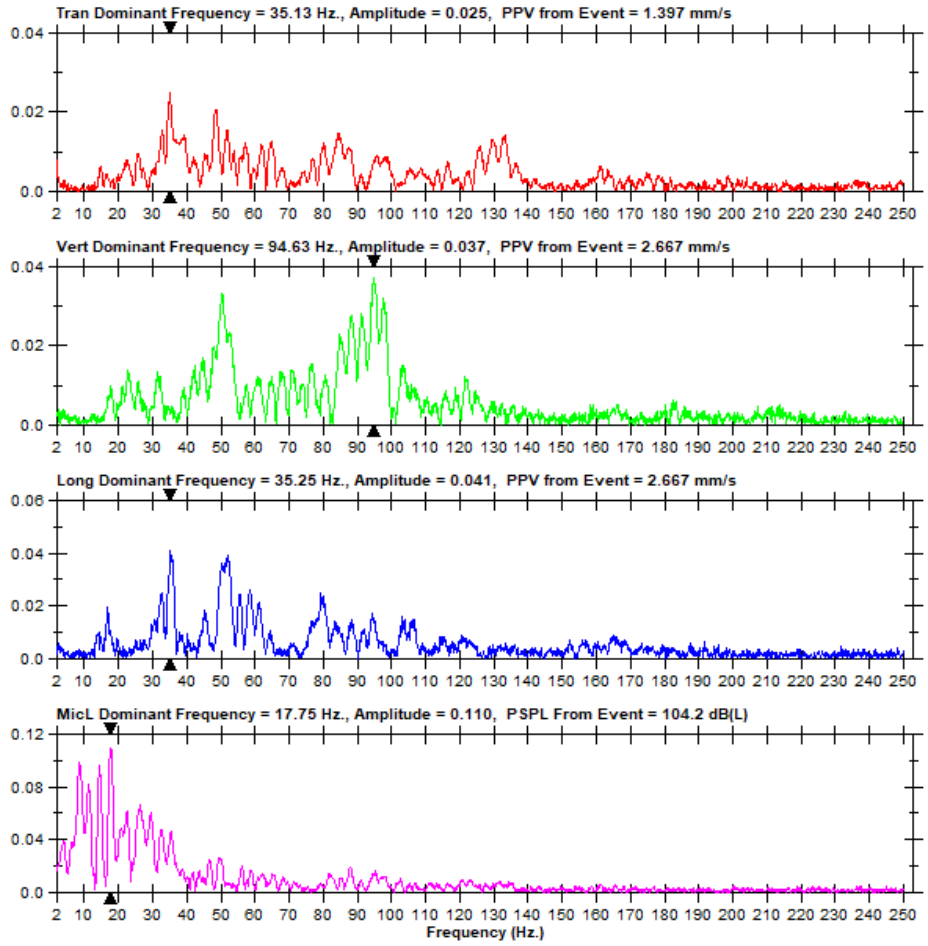
FFT Report

Date/Time	Vert at 14:37:19 January 14, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUN1.Y70
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 40 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 14:37:19 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

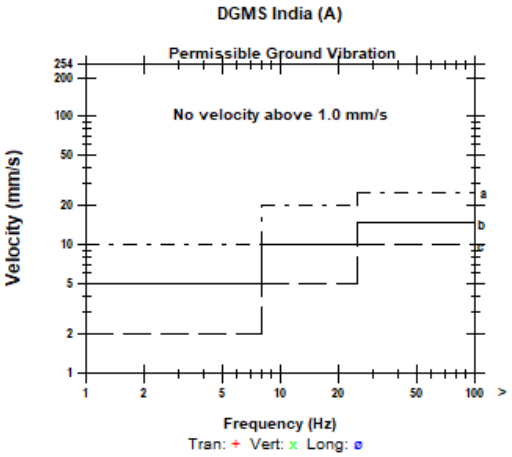
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 104.2 dB(L) at 0.610 sec
ZC Freq 26 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

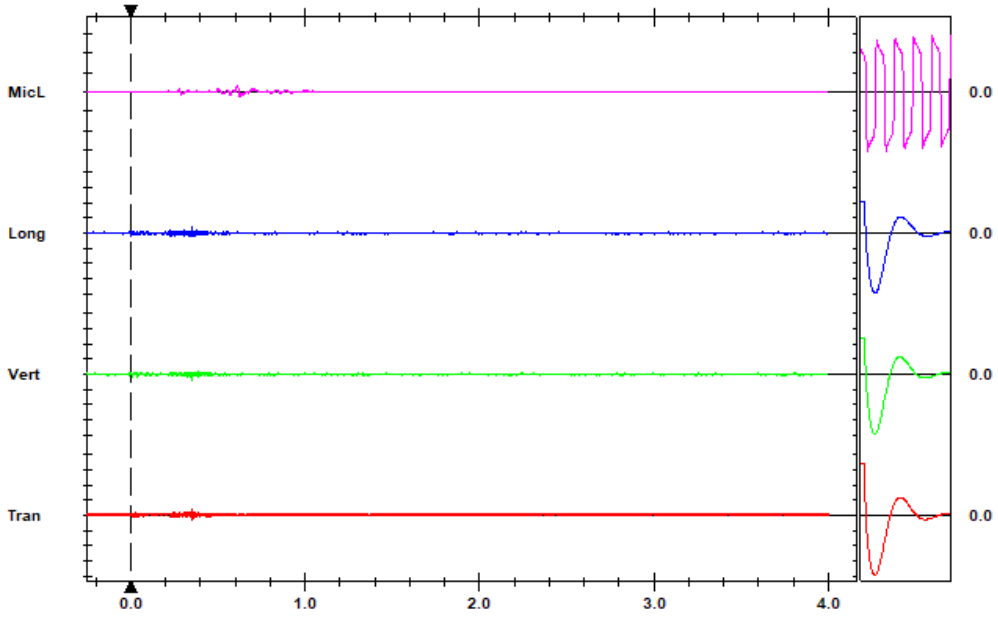
	Tran	Vert	Long	
PPV	0.762	0.762	0.889	mm/s
ZC Freq	85	73	>100	Hz
Time (Rel. to Trig)	0.354	0.350	0.352	sec
Peak Acceleration	0.053	0.040	0.053	g
Peak Displacement	0.001	0.002	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.2	Hz
Overswing Ratio	3.5	3.7	4.0	

Peak Vector Sum 0.959 mm/s at 0.352 sec

Serial Number BE21860 V 10.72-1.1 Minimate Blaster
Battery Level 6.1 Volts
Unit Calibration June 4, 2022 by CIMFR Dhanbad
File Name W860JUN1.Y70
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 104 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

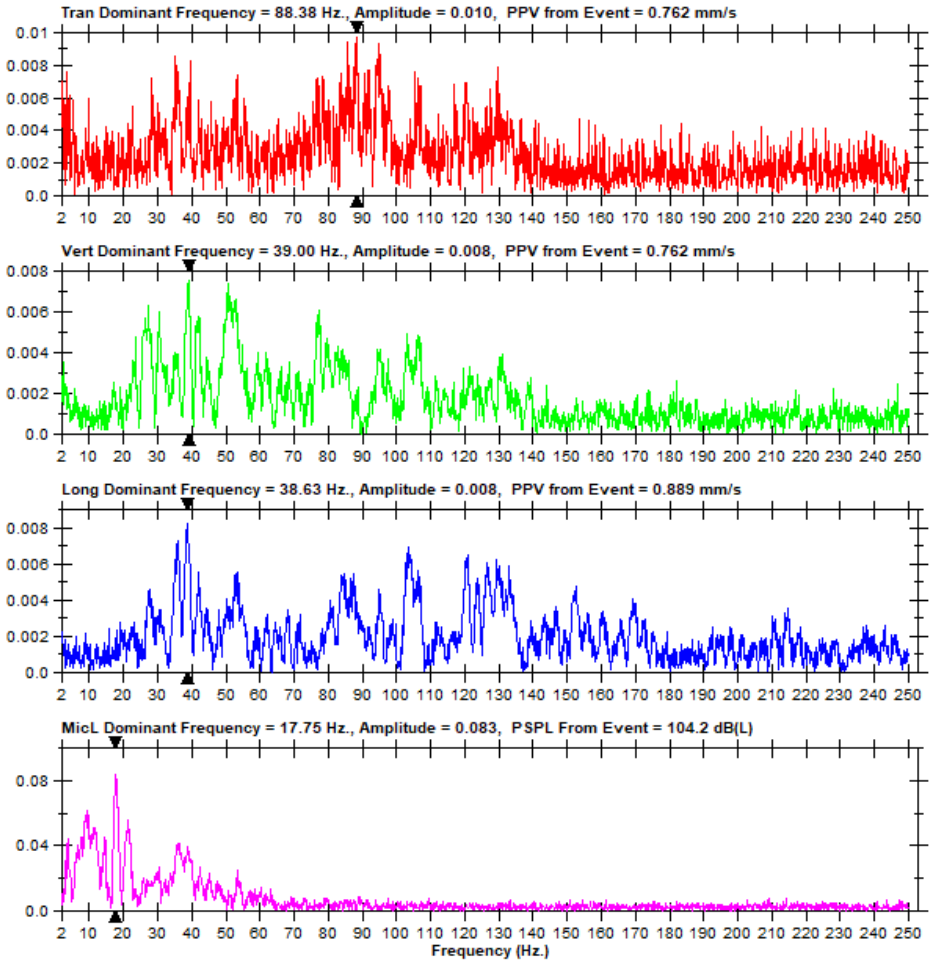
FFT Report

Date/Time	Long at 14:37:19 January 14, 2023	**Serial Number**	BE21860 V 10.72-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 4, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	W860JUN1.Y70

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 104 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Tran at 14:37:20 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17247 V 10.20-1.1 Minimate Blaster
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S247JUN1.Y80
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 112 m

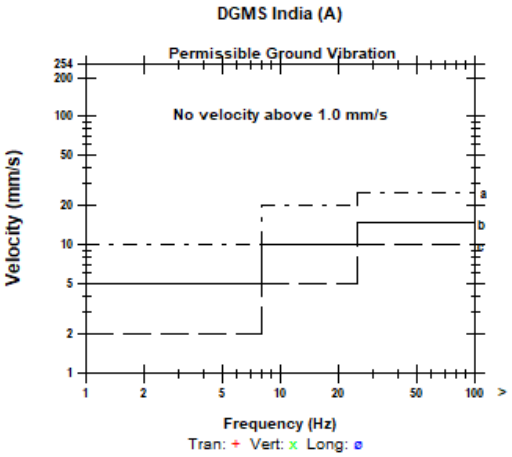
Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

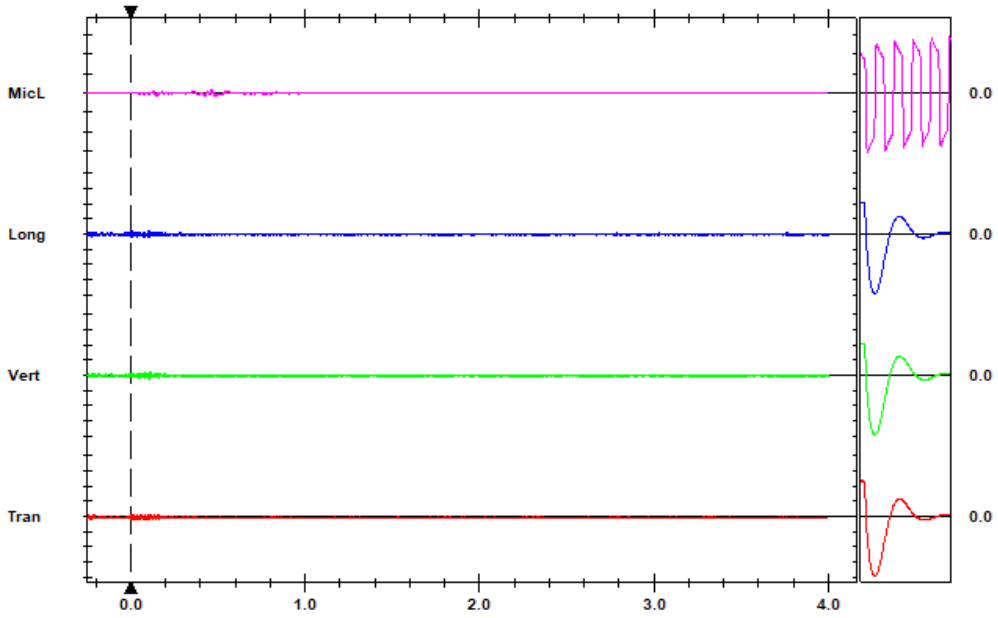
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.466 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 366 mv)

	Tran	Vert	Long	
PPV	0.508	0.635	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.000	0.105	0.010	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.6	Hz
Overswing Ratio	3.8	3.4	3.7	

Peak Vector Sum 0.833 mm/s at 0.105 sec





Instantel

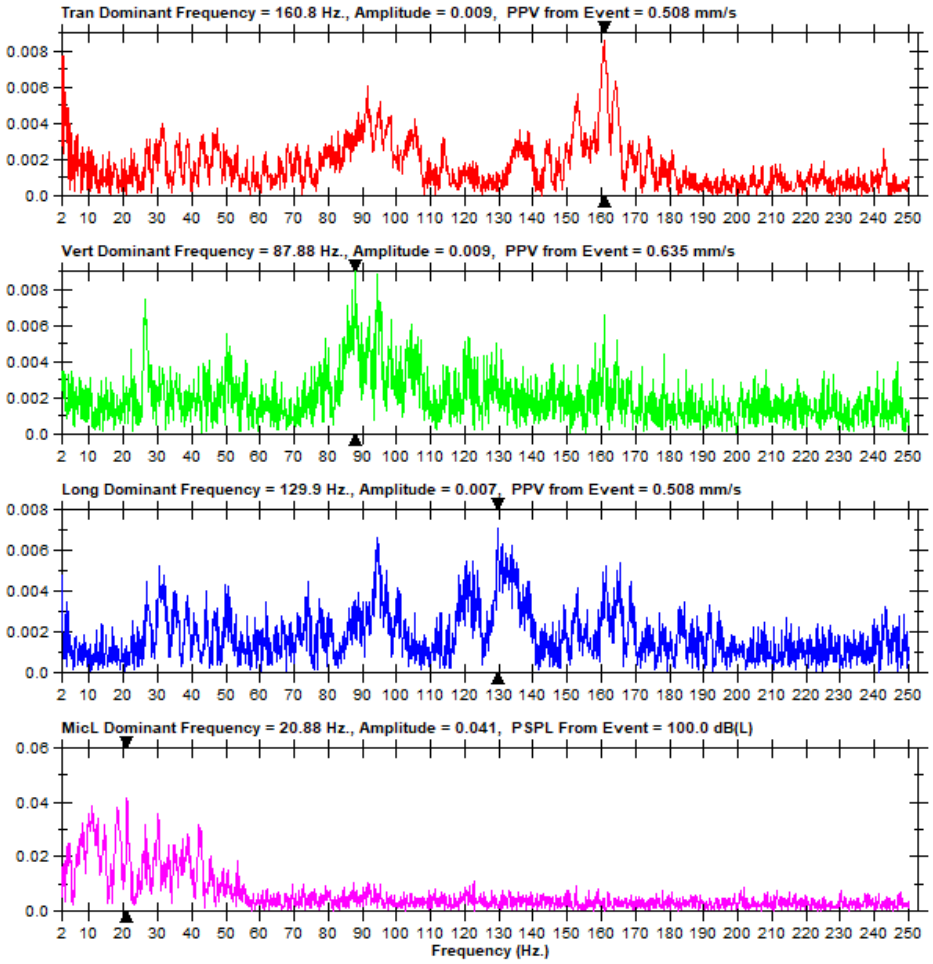
FFT Report

Date/Time	Tran at 14:37:20 January 14, 2023	**Serial Number**	BE17247 V 10.20-1.1 Minimate Blaster
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S247JUN1.Y80

Notes
Location: On the Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 112 m



Printed: February 21, 2023 (V 10.72 - 10.72)

Instantel

Event Report

Date/Time Long at 14:37:18 January 14, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

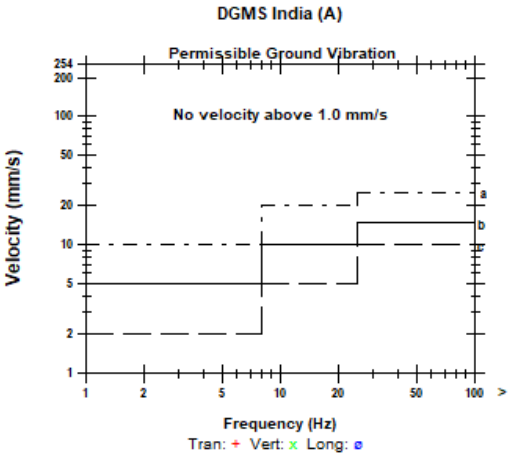
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 102.8 dB(L) at 0.304 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.5 Hz Amp = 496 mv)

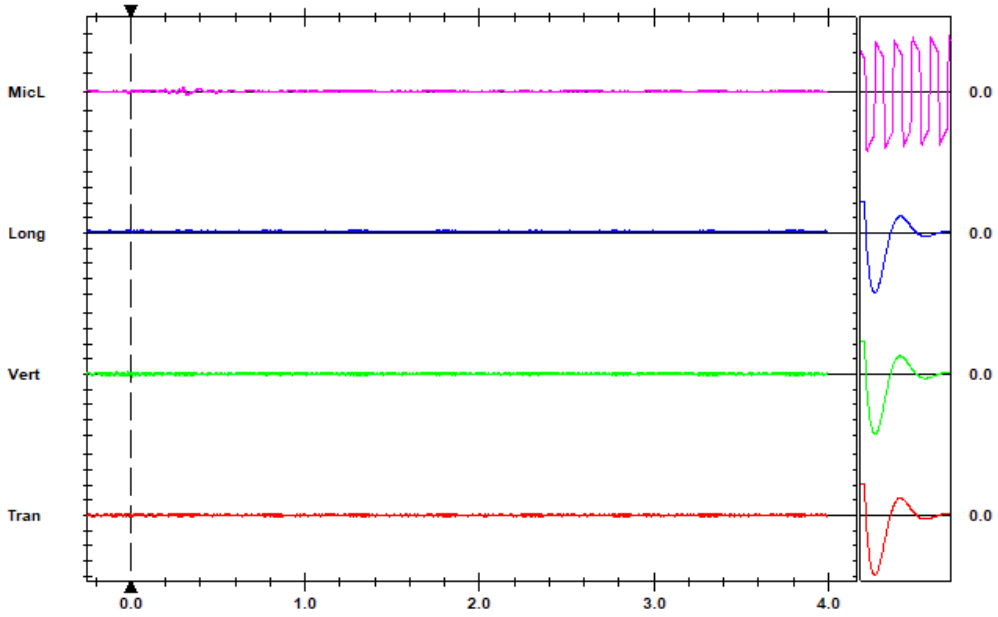
	Tran	Vert	Long	
PPV	0.254	0.381	0.508	mm/s
ZC Freq	>100	>100	28	Hz
Time (Rel. to Trig)	-0.058	-0.076	0.000	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.000	0.001	0.012	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	3.7	3.5	3.8	

Peak Vector Sum 0.596 mm/s at -0.019 sec

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.4 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUN1.Y60
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 112 m



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

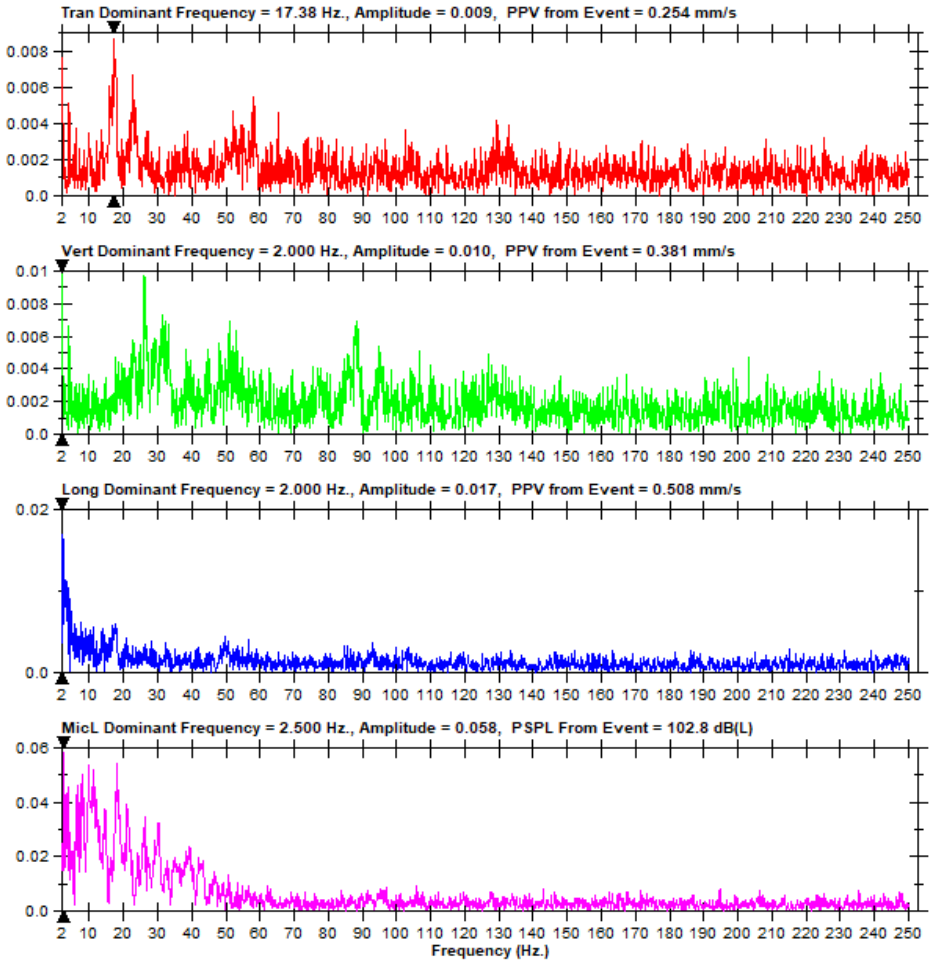
FFT Report

Date/Time	Long at 14:37:18 January 14, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUN1.Y60

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.5 m, Charge/hole - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 112 m



Printed: February 21, 2023 (V 10.72 - 10.72)

ANNEXURE-9

Event and FFT Reports of Ground Vibration Recorded at Granite Stone Quarry owned by P M Abdul Rahman, Kasargod District

Instantel

Event Report

Date/Time	Long at 12:13:05 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW4.LT0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

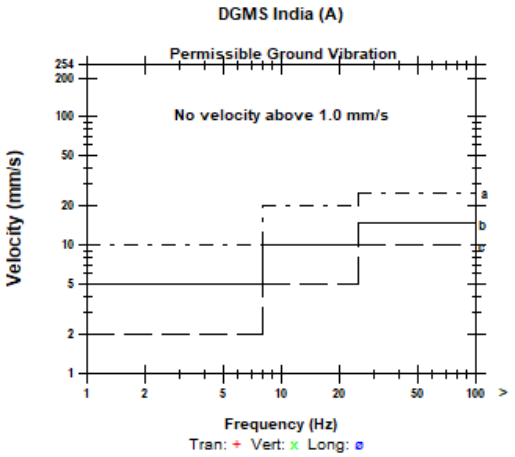
Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 56 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

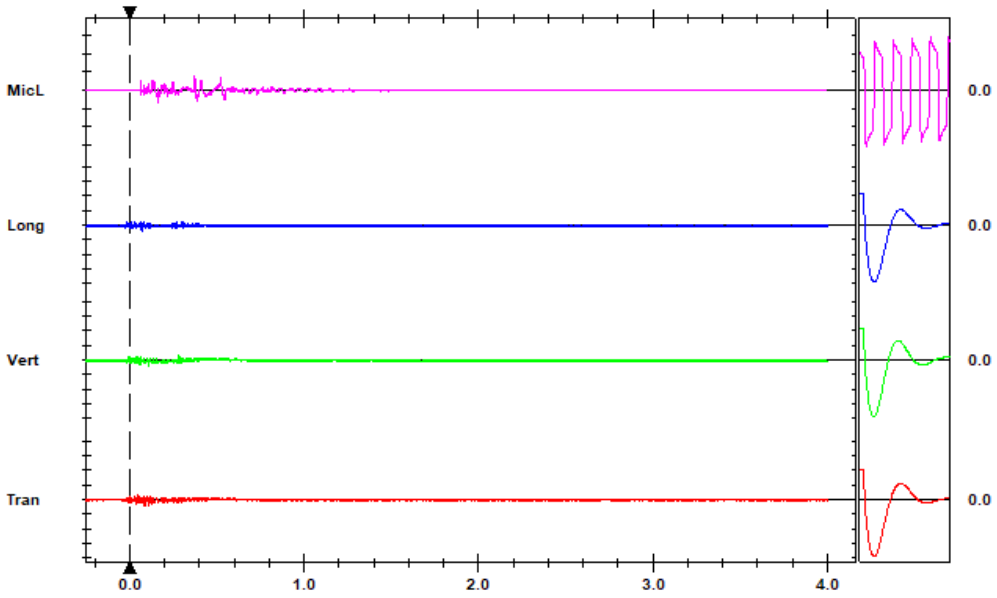
Microphone	Linear Weighting
PSPL	111.8 dB(L) at 0.373 sec
ZC Freq	39 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 480 mv)

	Tran	Vert	Long	
PPV	0.889	0.889	0.762	mm/s
ZC Freq	64	57	64	Hz
Time (Rel. to Trig)	0.110	0.111	0.069	sec
Peak Acceleration	0.053	0.040	0.040	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.276 mm/s at 0.110 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

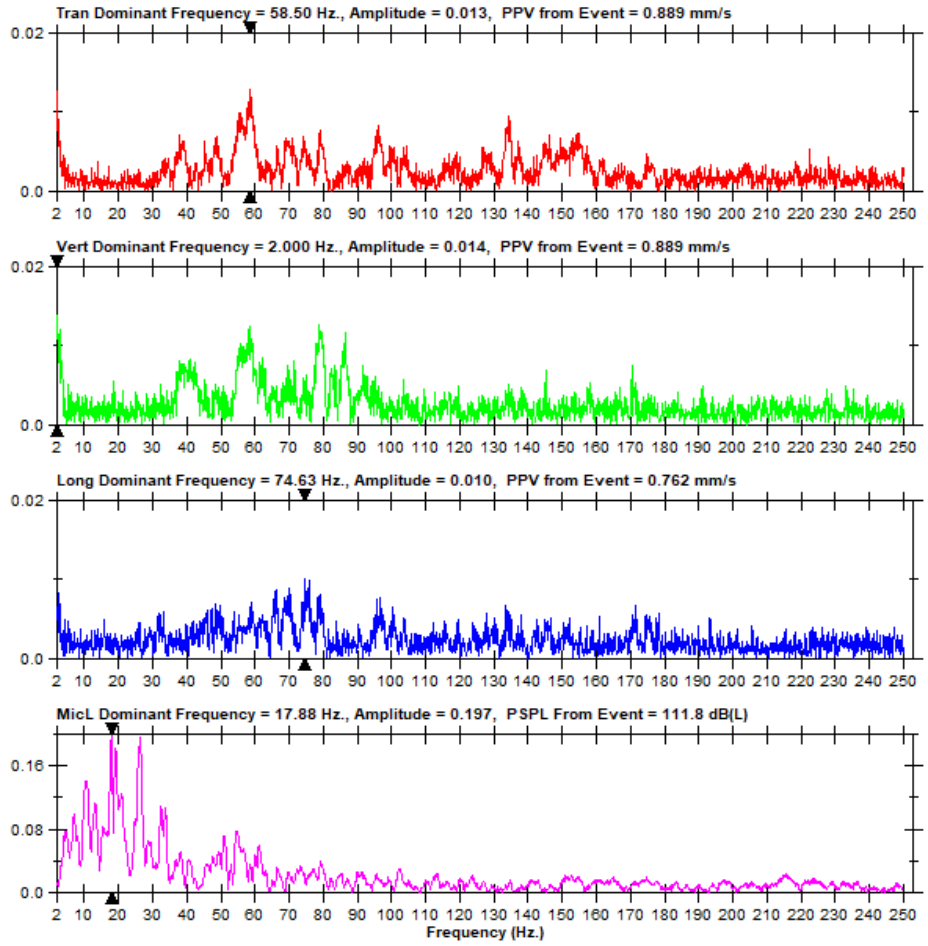
FFT Report

Date/Time	Long at 12:13:05 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW4.LT0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes - 10, Hole Depth - 1.8 m, Charge/holes - 0.25 - 0.375 Kg, MCPD - 0.375 Kg, Total Charge - 3.125 Kg, Distance - 56 m



Printed: February 21, 2023 (V 10.72 - 10.72)

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Event Report

Date/Time Long at 12:13:11 January 19, 2023
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20230119121311.IDFW

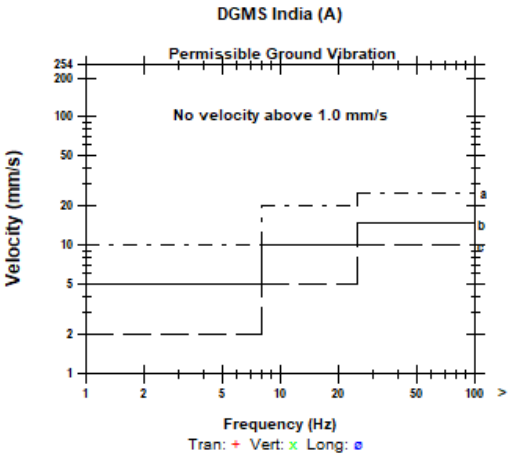
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.125 kg, Distance-59 m.

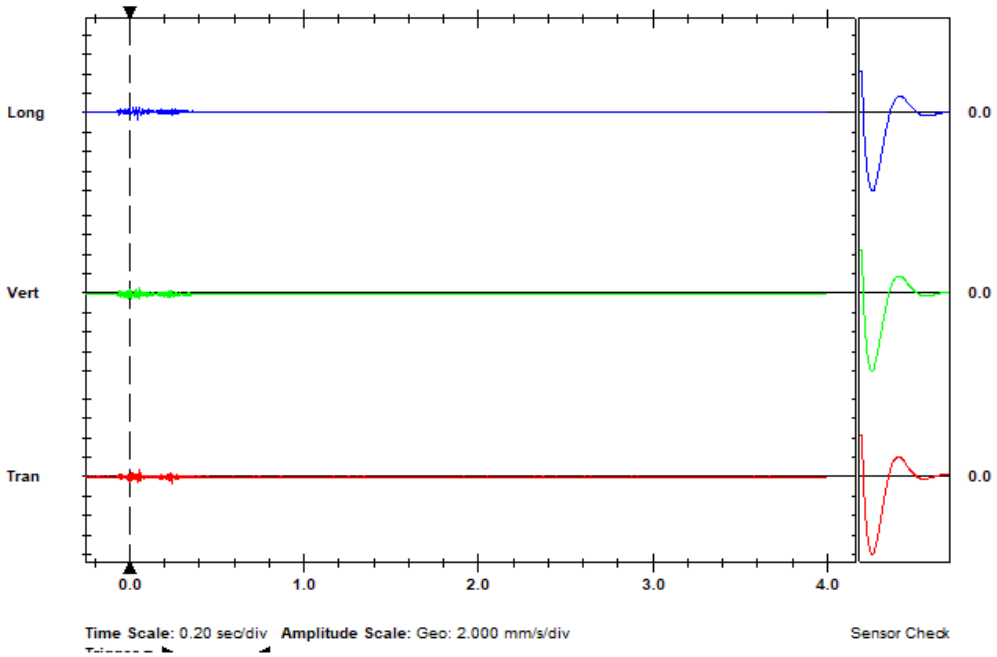
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.717	0.536	0.678	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.240	0.055	0.045	sec
Peak Acceleration	0.070	0.067	0.046	g
Peak Displacement	0.001	0.009	0.012	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.3	5.1	5.2	

Peak Vector Sum 1.017 mm/s at 0.053 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check

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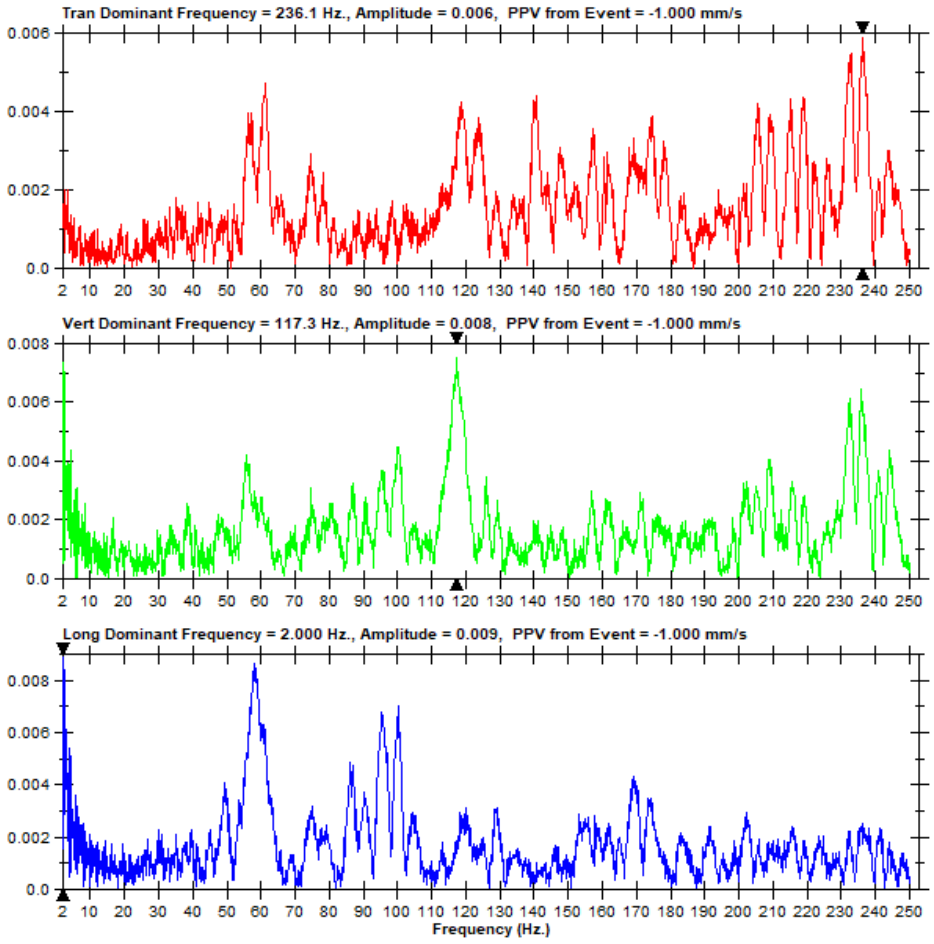
FFT Report

Date/Time	Long at 12:13:11 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119121311.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.125 kg, Distance-59 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Long at 12:14:13 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW4.NP0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

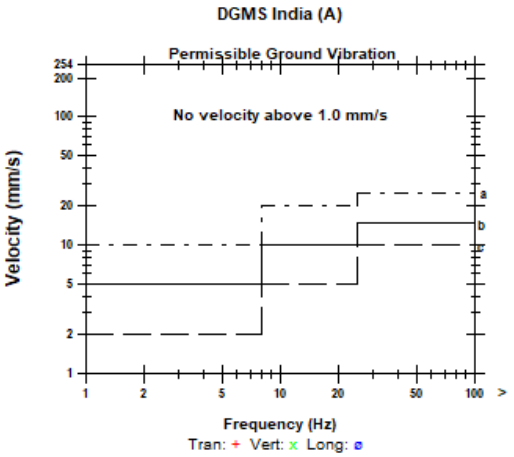
Post Event Notes
Total No. of holes-21, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-6.375 kg, Distance-50 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

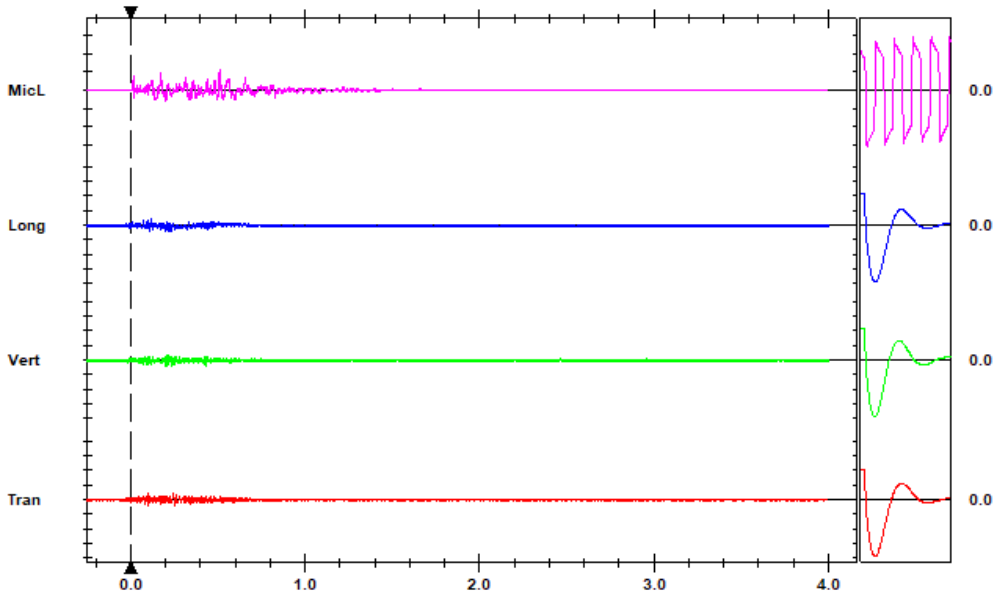
Microphone	Linear Weighting
PSPL	114.8 dB(L) at 0.510 sec
ZC Freq	64 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 465 mv)

	Tran	Vert	Long	
PPV	0.889	0.889	0.889	mm/s
ZC Freq	>100	73	51	Hz
Time (Rel. to Trig)	0.100	0.203	0.196	sec
Peak Acceleration	0.106	0.053	0.053	g
Peak Displacement	0.002	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.8	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.178 mm/s at 0.254 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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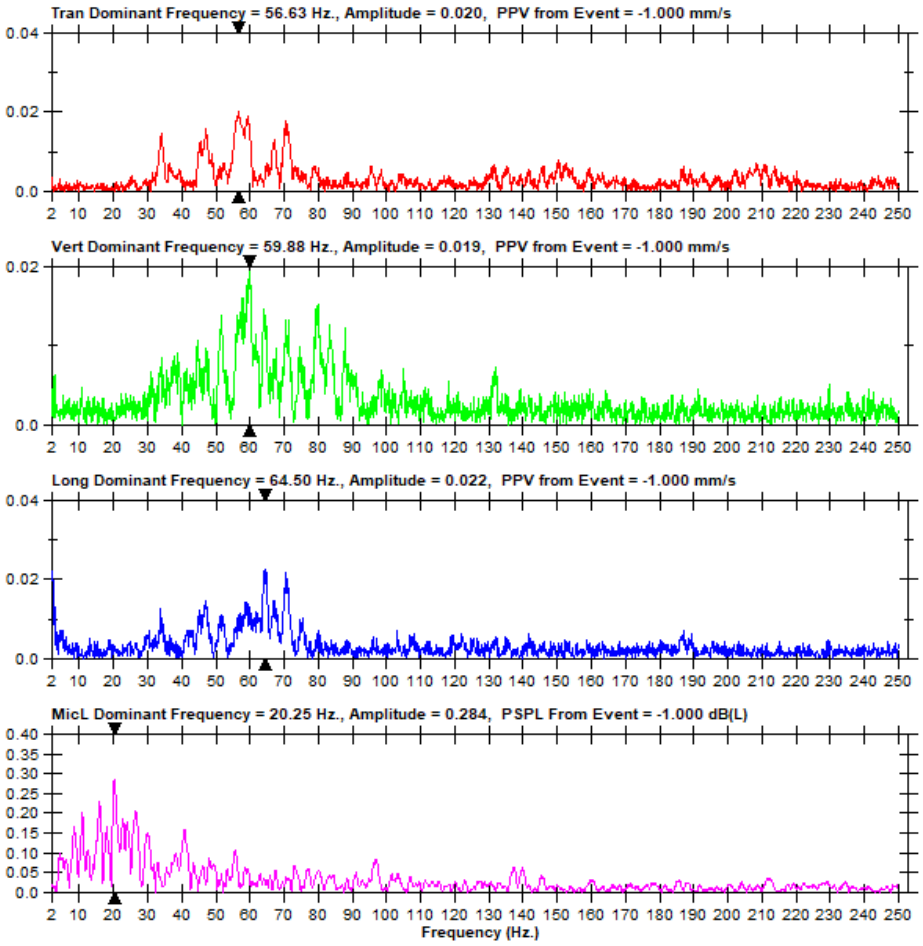
FFT Report

Date/Time	Long at 12:14:13 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW4.NP0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-21, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-6.375 kg, Distance-50 m.



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Event Report

Date/Time	Long at 12:14:18 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119121418.IDFW

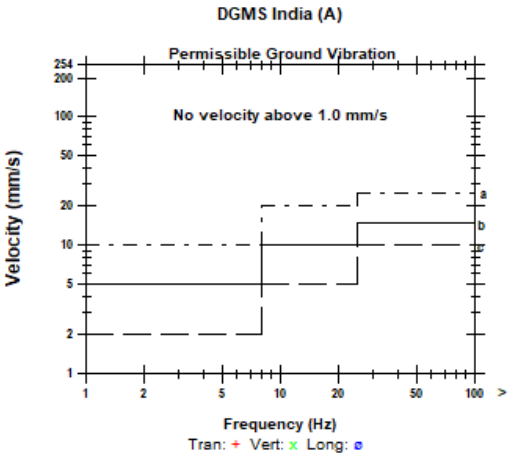
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-21, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-6.375 kg, Distance-60 m.

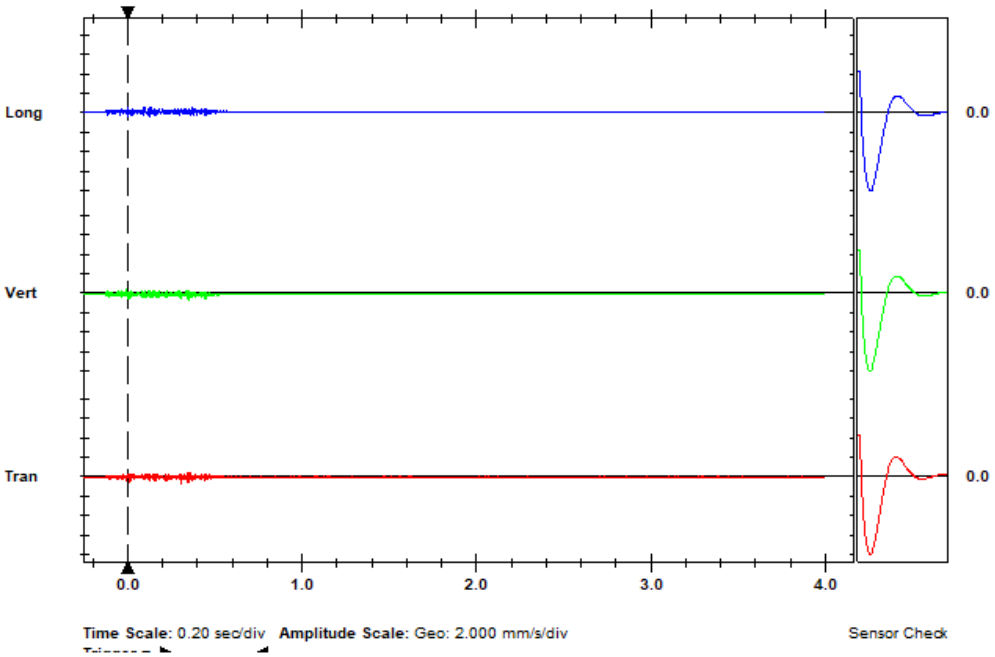
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.725	0.709	0.591	mm/s
ZC Freq	>100	>100	51	Hz
Time (Rel. to Trig)	0.306	0.350	0.133	sec
Peak Acceleration	0.062	0.063	0.045	g
Peak Displacement	0.001	0.007	0.008	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 0.908 mm/s at 0.350 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check

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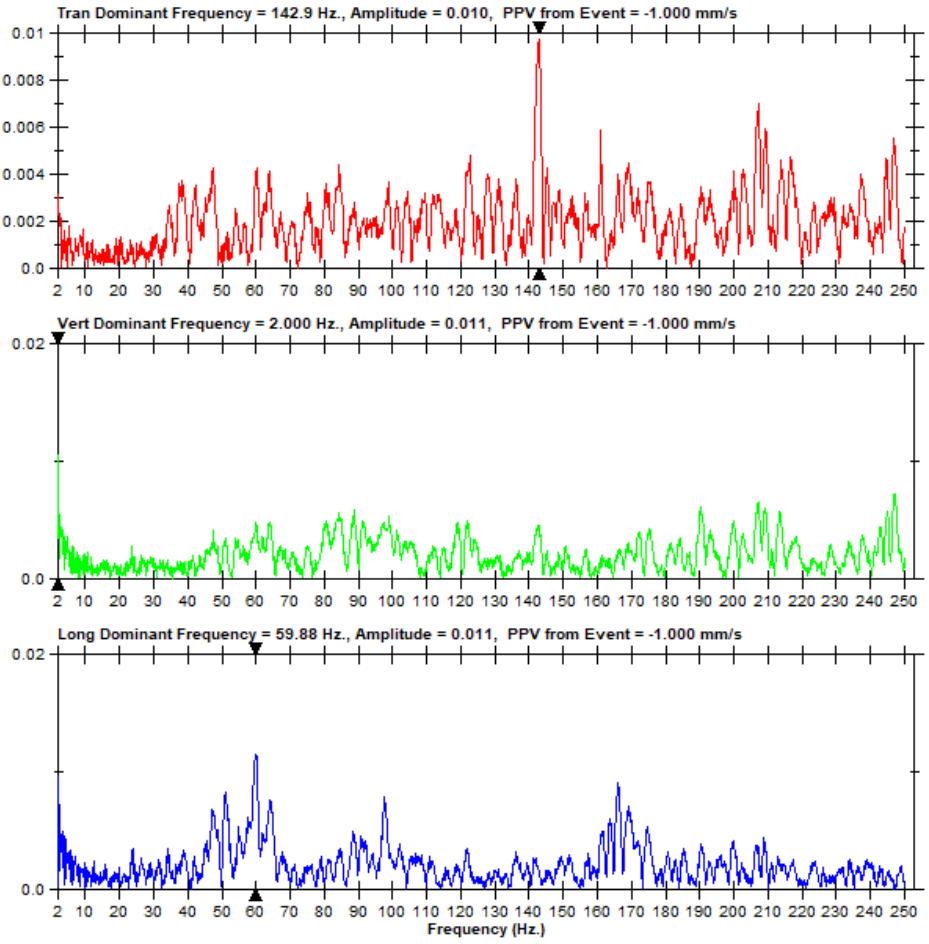
FFT Report

Date/Time	Long at 12:14:18 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119121418.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-21, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-6.375 kg, Distance-60 m.



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Event Report

Date/Time	Tran at 12:15:43 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW4.Q70

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

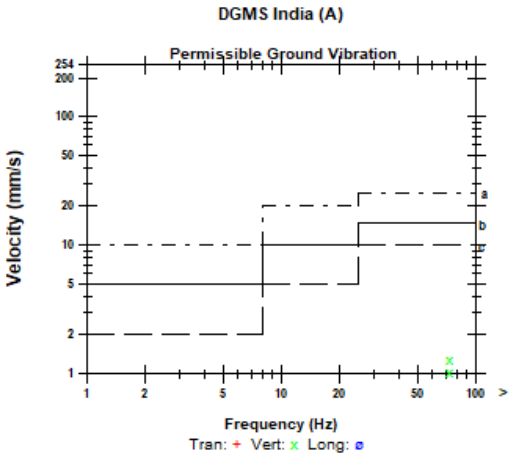
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-62 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

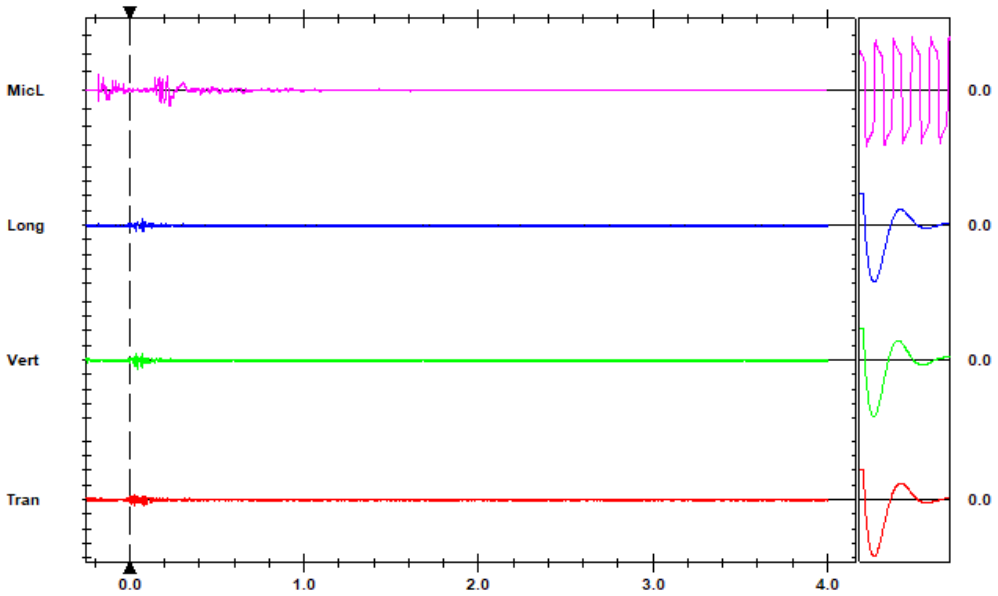
Microphone	Linear Weighting
PSPL	112.8 dB(L) at -0.180 sec
ZC Freq	>100 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 447 mv)

	Tran	Vert	Long	
PPV	0.762	1.270	0.889	mm/s
ZC Freq	>100	73	85	Hz
Time (Rel. to Trig)	0.025	0.044	0.037	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.002	0.002	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.391 mm/s at 0.044 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check

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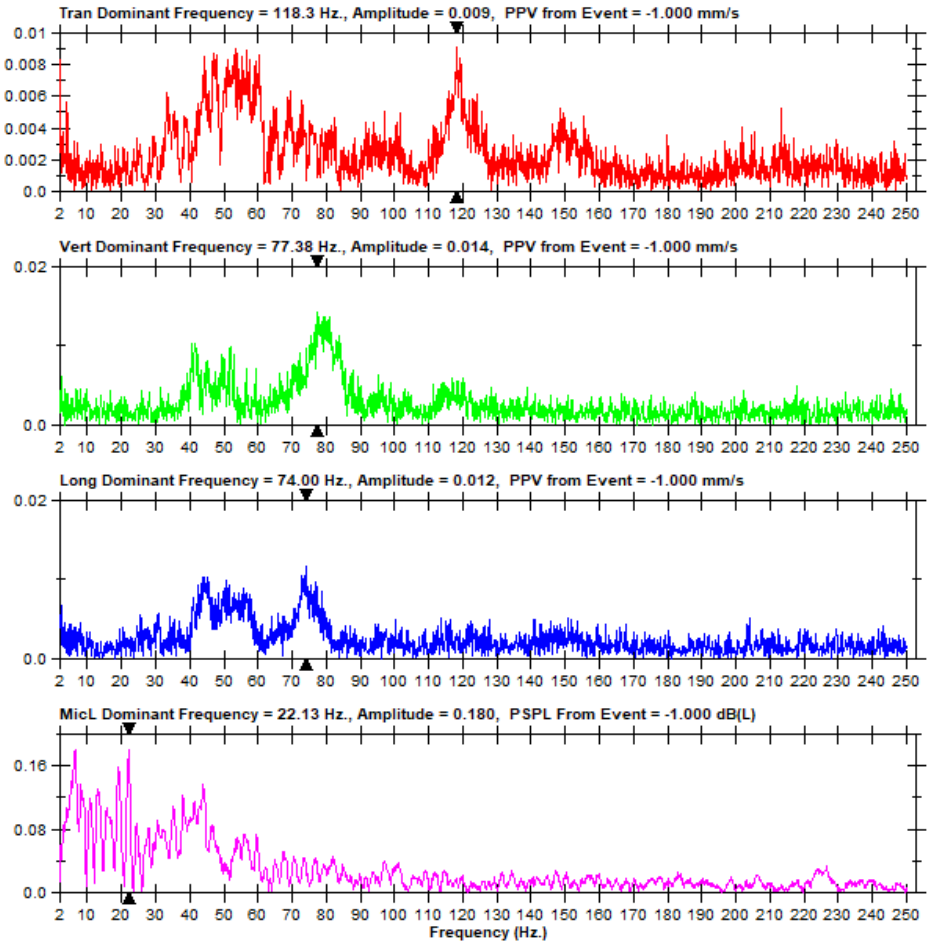
FFT Report

Date/Time	Tran at 12:15:43 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW4.Q70
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-62 m.



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Event Report

Date/Time Tran at 12:15:49 January 19, 2023
Trigger Source Geo: 0.500 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Operator/Setup: Operator/KSPCB.mmb

Serial Number UM12915 V 10-88 Micromate ISEE
Battery Level 3.8 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name UM12915_20230119121549.IDFW

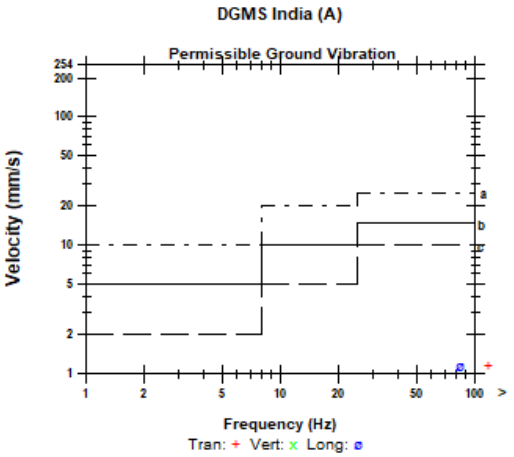
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-65 m.

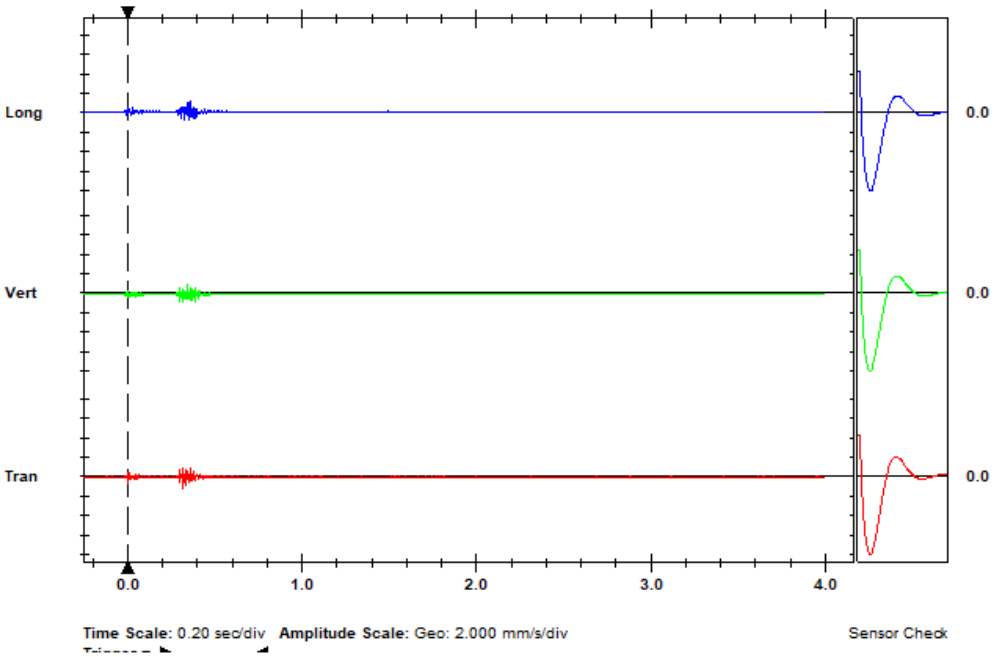
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.151	0.906	1.167	mm/s
ZC Freq	>100	>100	85	Hz
Time (Rel. to Trig)	0.314	0.316	0.357	sec
Peak Acceleration	0.102	0.104	0.065	g
Peak Displacement	0.001	0.011	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 1.383 mm/s at 0.357 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check

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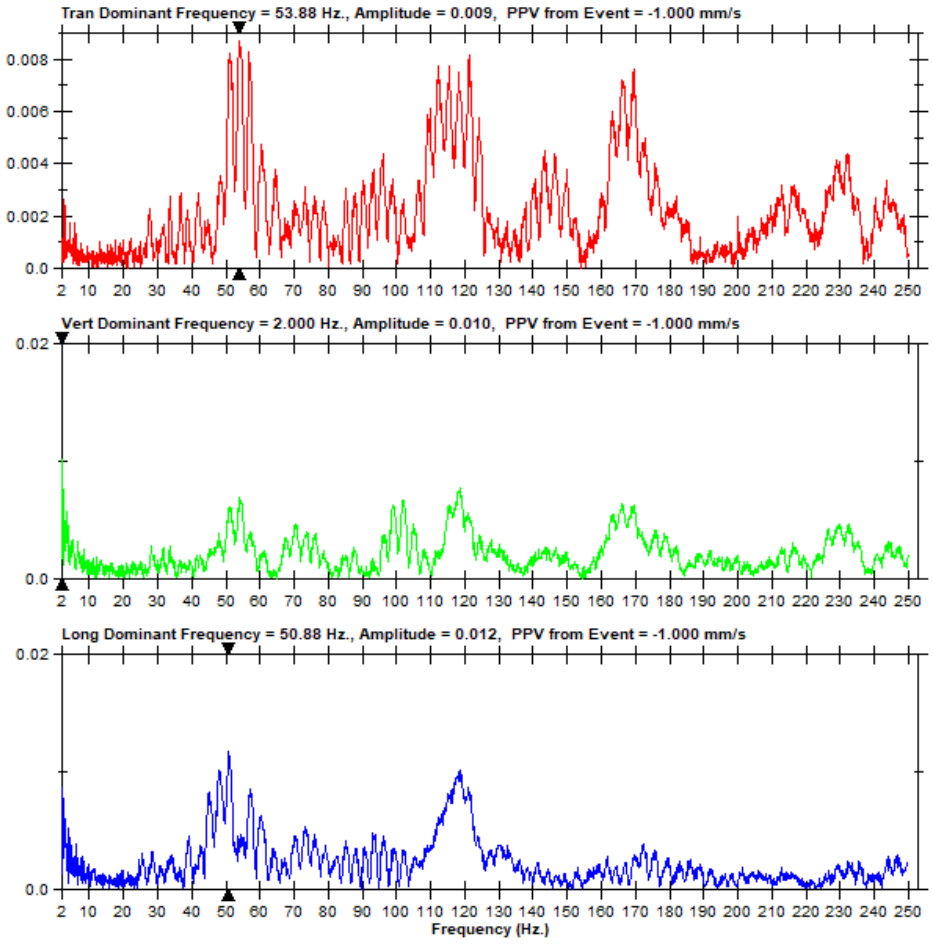
FFT Report

Date/Time	Tran at 12:15:49 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119121549.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-65 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Long at 12:15:43 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW4.Q70
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-96 m.

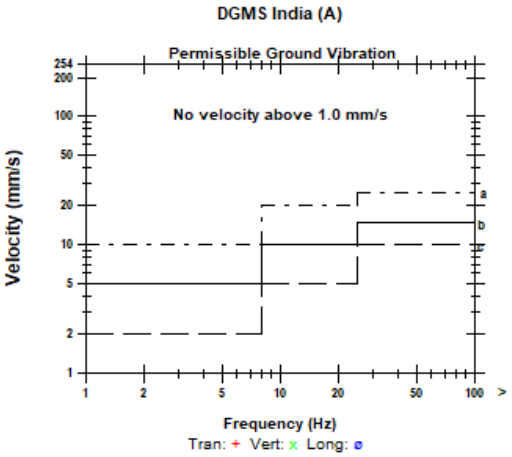
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

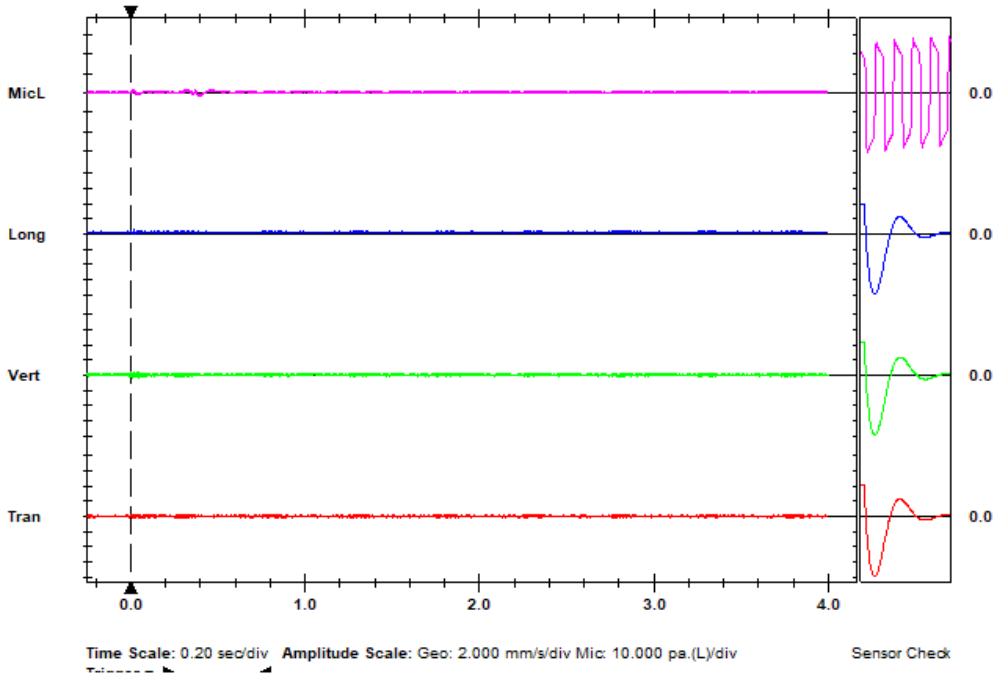
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.017 sec
ZC Freq 27 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.635	mm/s
ZC Freq	>100	>100	39	Hz
Time (Rel. to Trig)	0.001	0.007	0.019	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.001	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.696 mm/s at 0.019 sec





Printed: February 21, 2023 (V 10.74)

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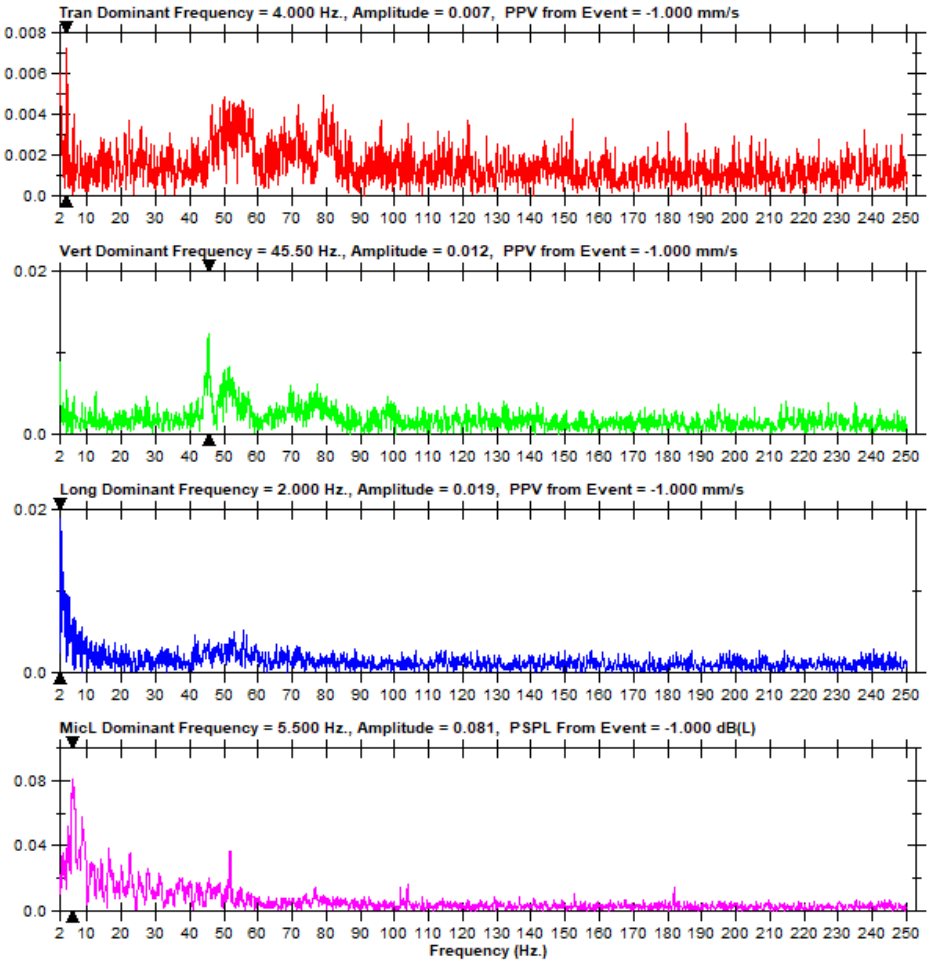
FFT Report

Date/Time	Long at 12:15:43 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW4.Q70

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-96 m.



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Event Report

Date/Time Long at 12:15:39 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JUW4.Q30
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-112 m.

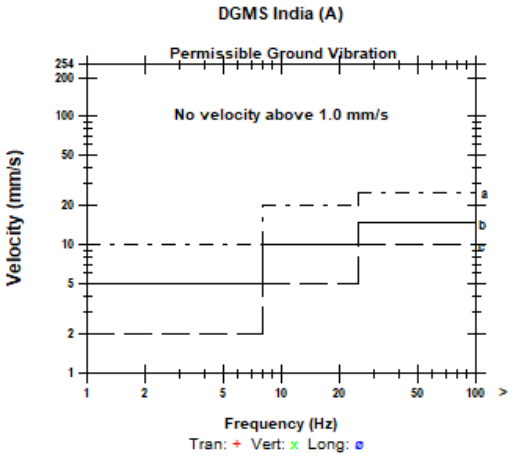
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

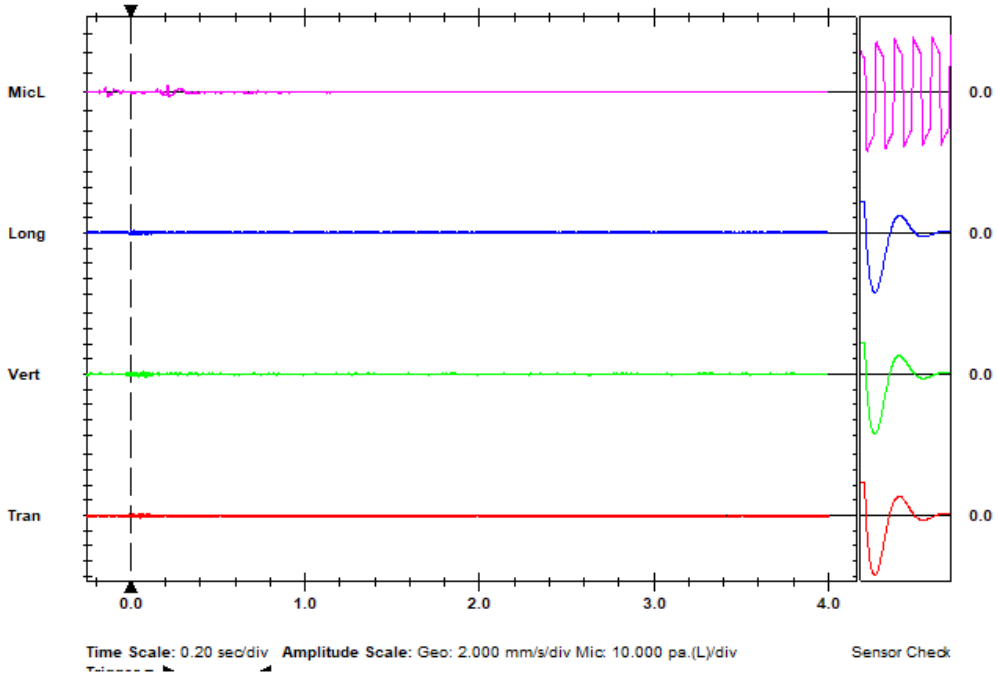
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 104.9 dB(L) at 0.211 sec
ZC Freq 51 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

	Tran	Vert	Long	
PPV	0.381	0.381	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.055	0.043	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	7.5	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.524 mm/s at 0.000 sec





Printed: February 21, 2023 (V 10.74)

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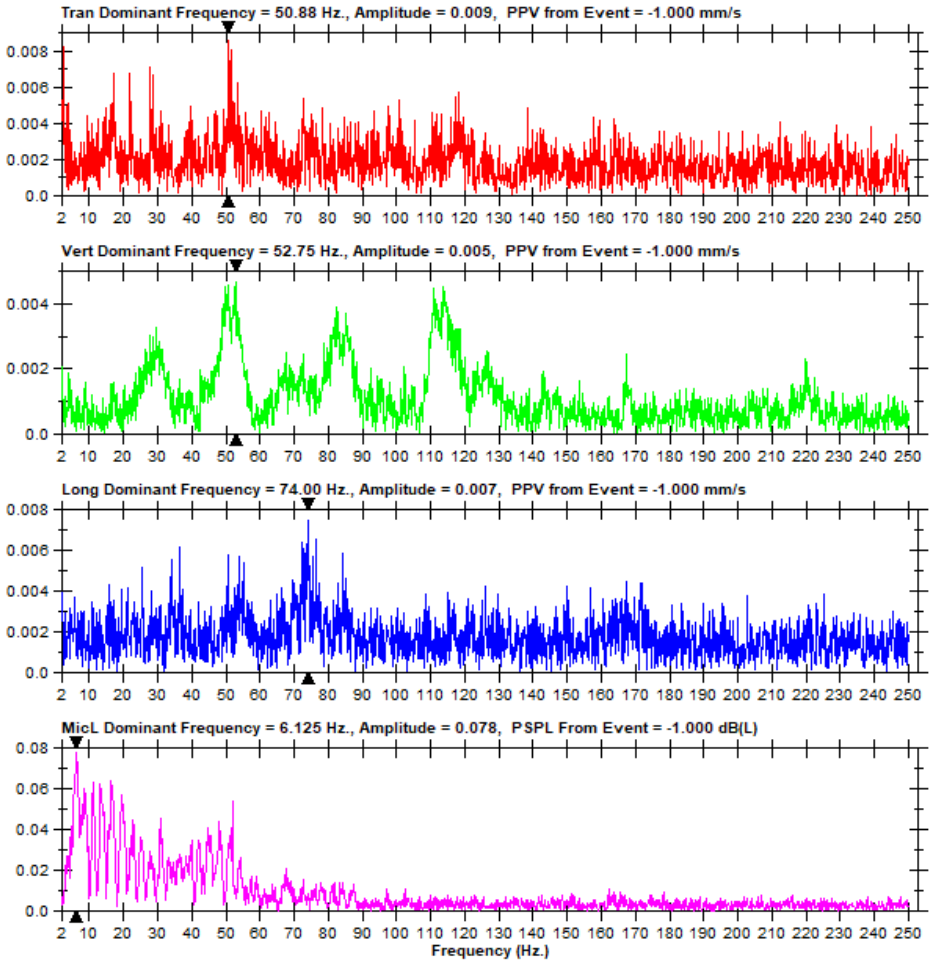
FFT Report

Date/Time	Long at 12:15:39 January 19, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JUW4.Q30

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-3.125 kg, Distance-112 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Long at 12:17:12 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119121712.IDFW

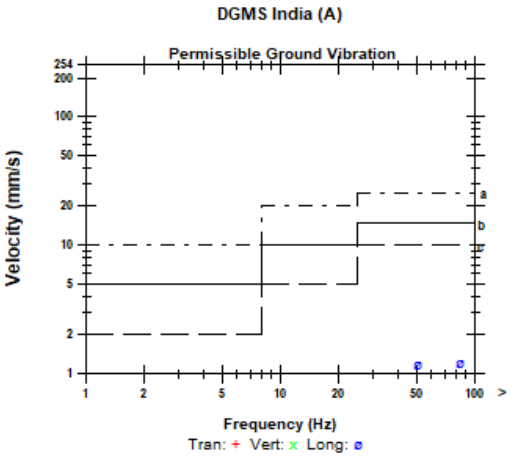
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-61 m.

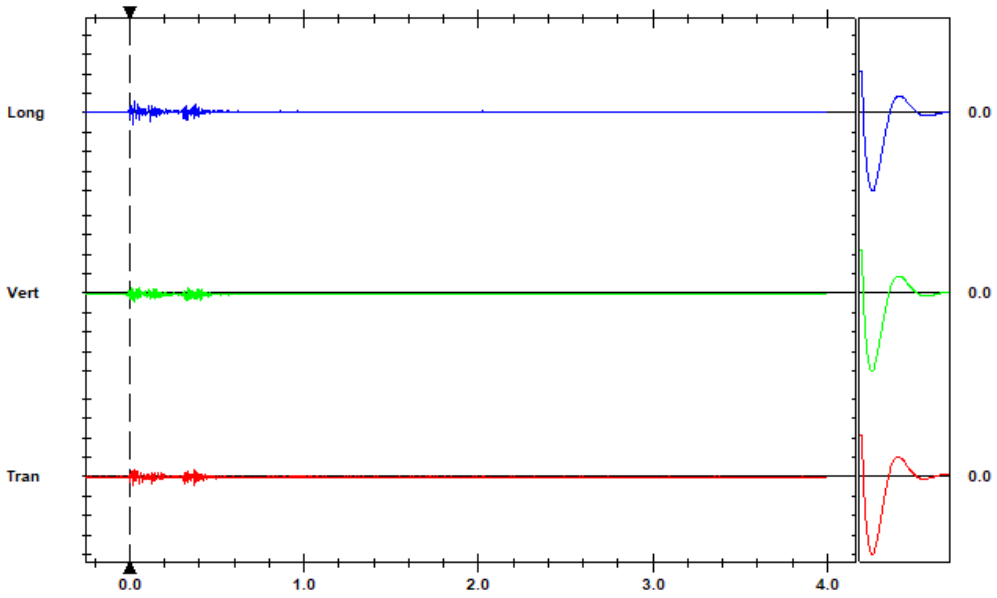
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.922	0.867	1.222	mm/s
ZC Freq	85	64	85	Hz
Time (Rel. to Trig)	0.021	0.024	0.021	sec
Peak Acceleration	0.082	0.086	0.079	g
Peak Displacement	0.001	0.012	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 1.550 mm/s at 0.021 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

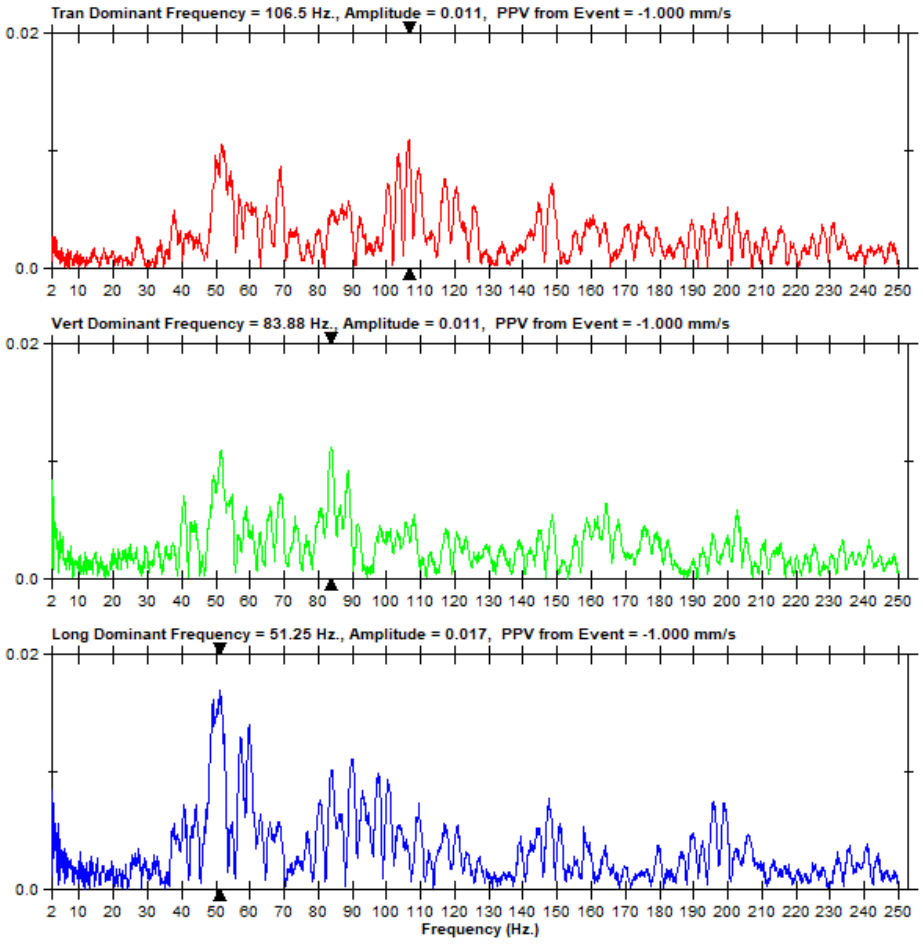
FFT Report

Date/Time	Long at 12:17:12 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119121712.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-61 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Long at 12:17:07 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW4.SJ0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

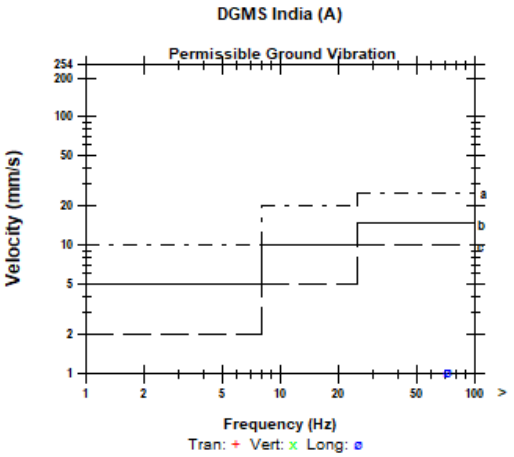
Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-79 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

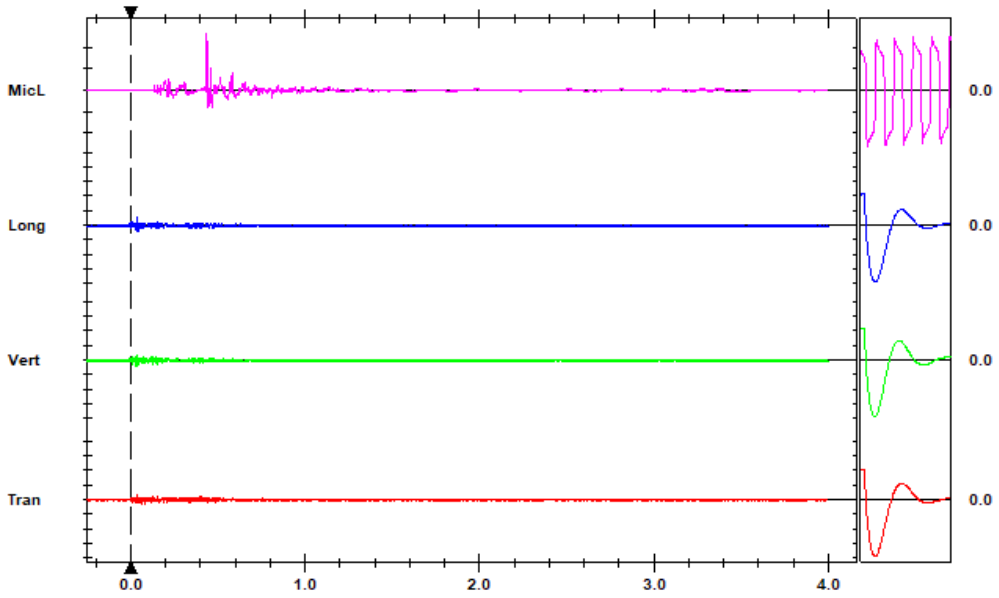
Microphone	Linear Weighting
PSPL	128.6 dB(L) at 0.437 sec
ZC Freq	64 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 435 mv)

	Tran	Vert	Long	
PPV	0.635	0.889	1.016	mm/s
ZC Freq	>100	57	73	Hz
Time (Rel. to Trig)	0.036	0.032	0.037	sec
Peak Acceleration	0.040	0.053	0.053	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.143 mm/s at 0.037 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 20.00 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 20.00 pa.(L)/div Sensor Check
Trigger =

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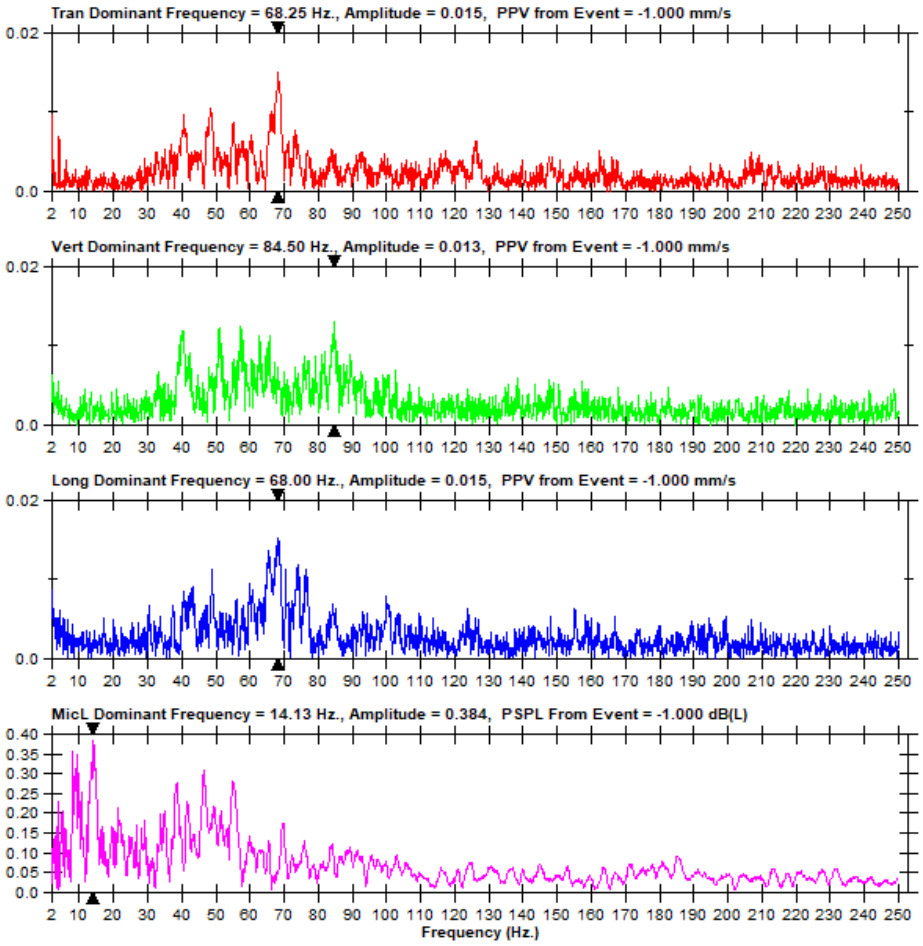
FFT Report

Date/Time	Long at 12:17:07 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW4.SJ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-79 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Long at 12:17:07 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW4.SJ0
Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-97 m.

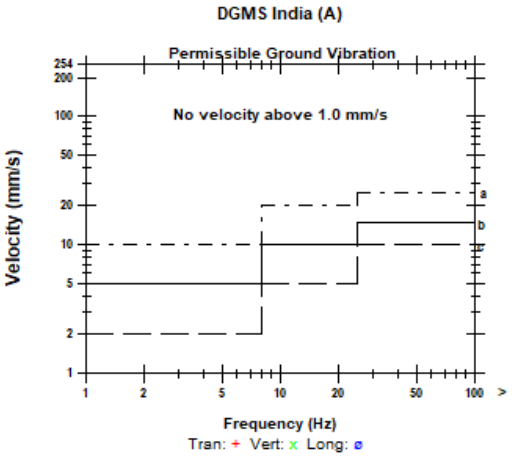
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

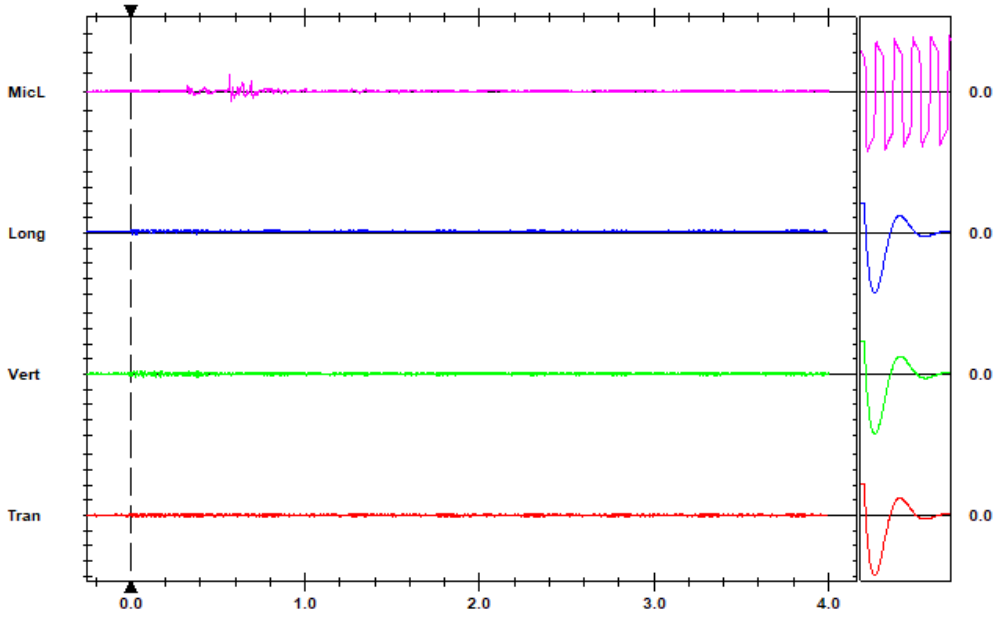
Microphone Linear Weighting
PSPL 113.3 dB(L) at 0.566 sec
ZC Freq 21 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.254	0.508	0.508	mm/s
ZC Freq	>100	73	37	Hz
Time (Rel. to Trig)	0.038	0.027	0.000	sec
Peak Acceleration	0.027	0.040	0.027	g
Peak Displacement	0.000	0.001	0.028	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.684 mm/s at 0.038 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

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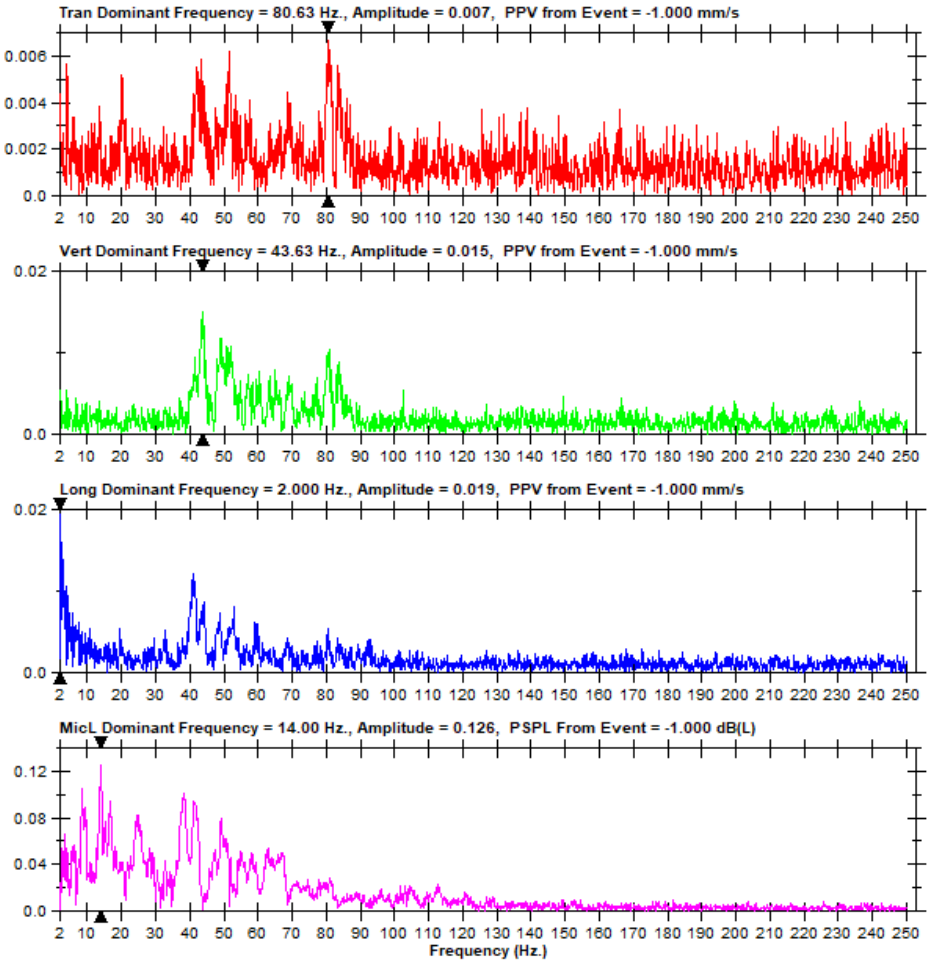
FFT Report

Date/Time	Long at 12:17:07 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW4.SJ0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-97 m.



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Event Report

Date/Time Vert at 12:17:03 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JUW4.SF0
Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-115 m.

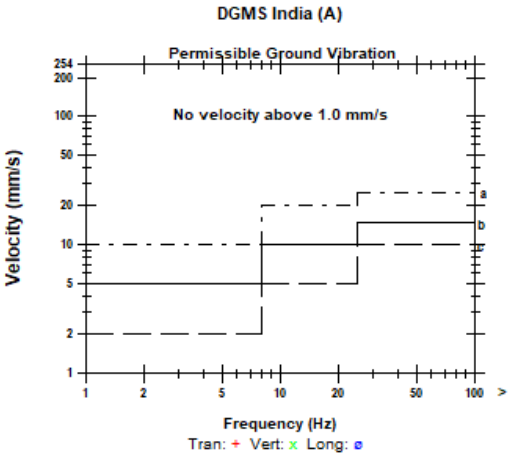
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

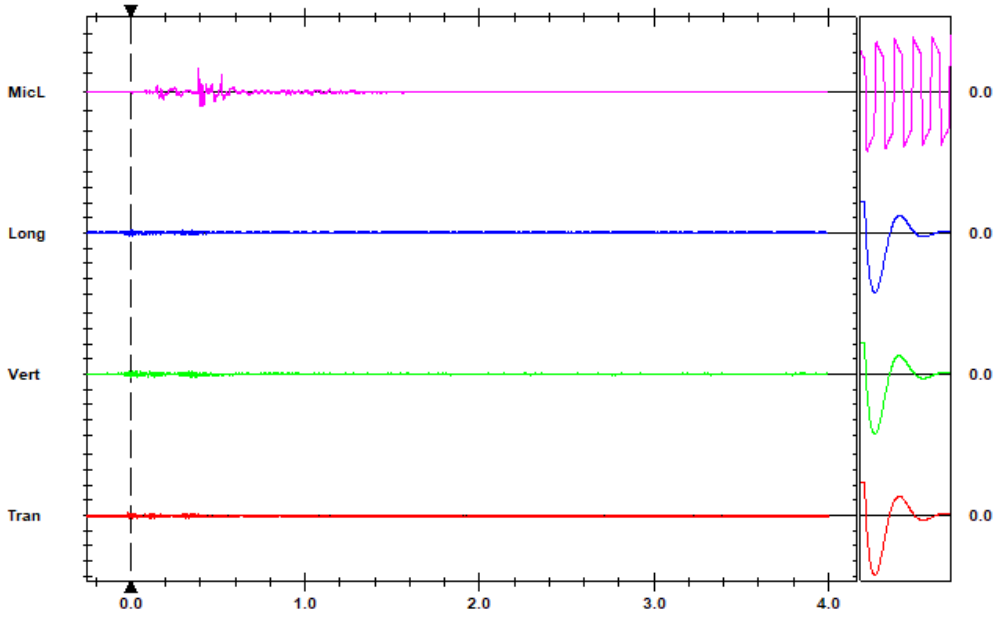
Microphone Linear Weighting
PSPL 115.6 dB(L) at 0.390 sec
ZC Freq 64 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	-0.014	0.000	0.002	sec
Peak Acceleration	0.040	0.040	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	7.5	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.660 mm/s at 0.013 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

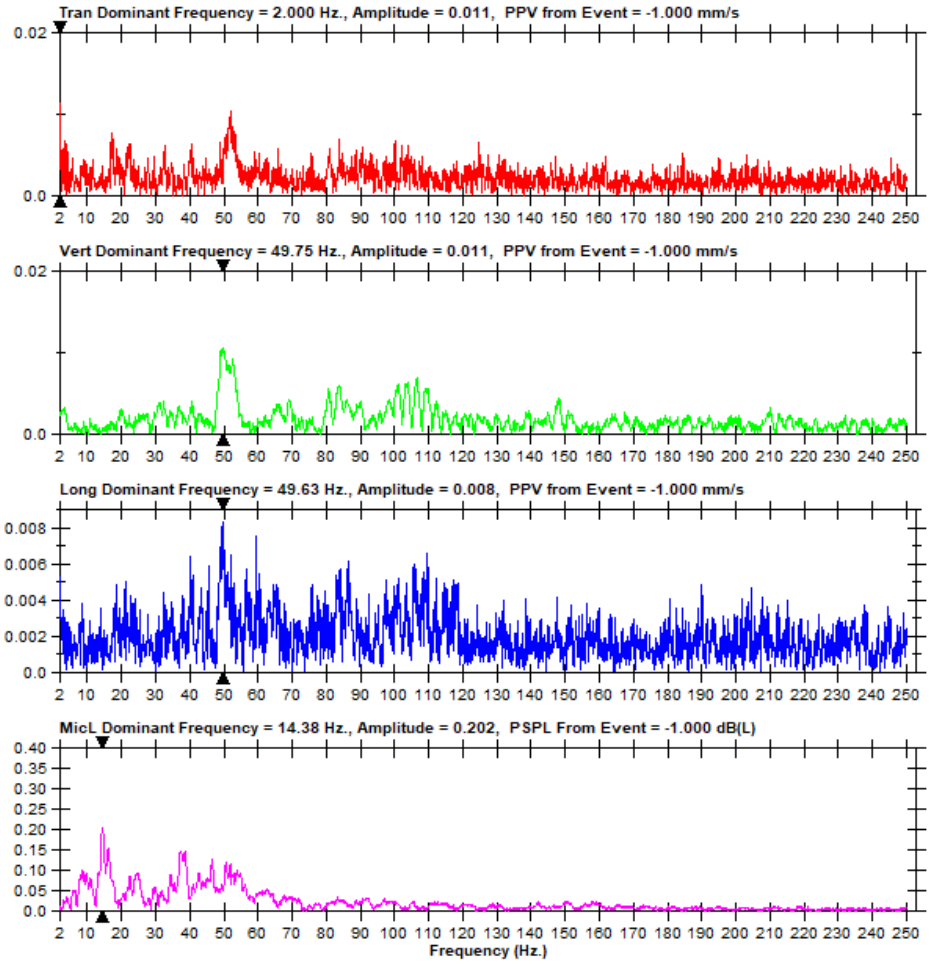
FFT Report

Date/Time	Vert at 12:17:03 January 19, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JUW4.SF0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-15, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-5.125 kg, Distance-115 m.



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Event Report

Date/Time	Long at 12:35:32 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119123532.IDFW

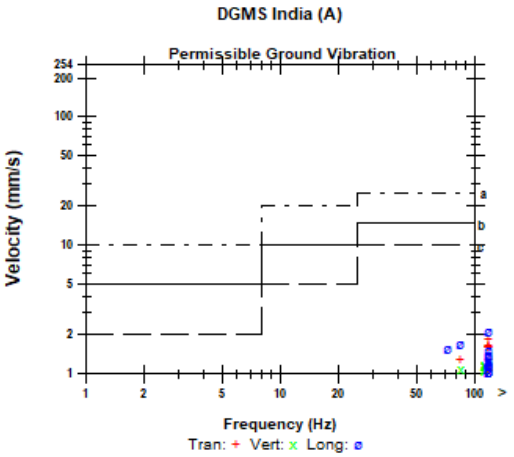
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-42 m.

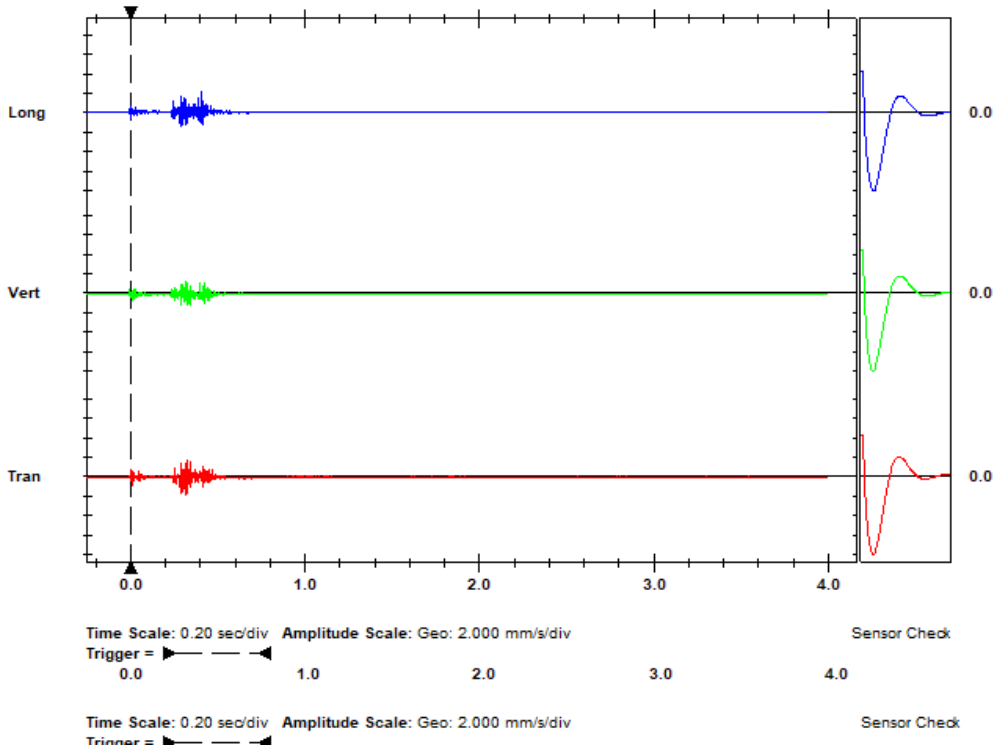
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.868	1.198	2.136	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.313	0.288	0.409	sec
Peak Acceleration	0.135	0.107	0.147	g
Peak Displacement	0.010	0.013	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 2.519 mm/s at 0.313 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



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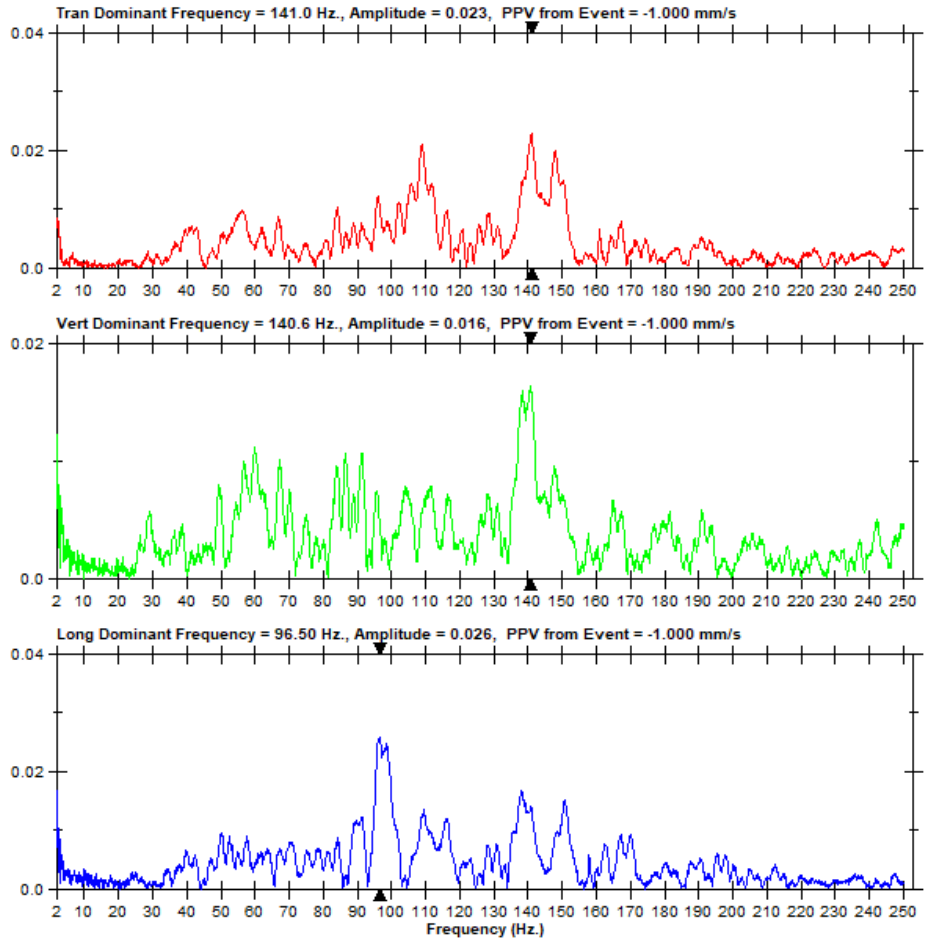
FFT Report

Date/Time	Long at 12:35:32 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119123532.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-42 m.



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Event Report

Date/Time	Vert at 12:35:26 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW5.N20

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

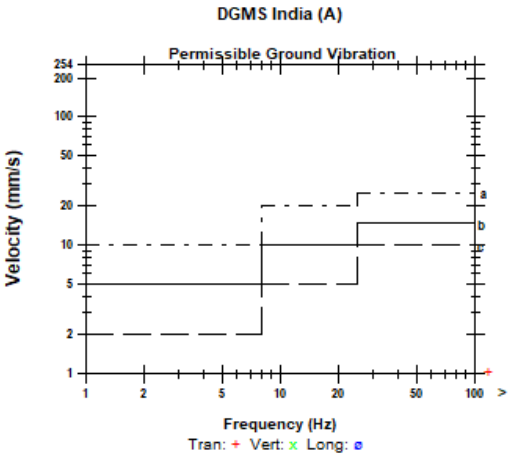
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-68 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

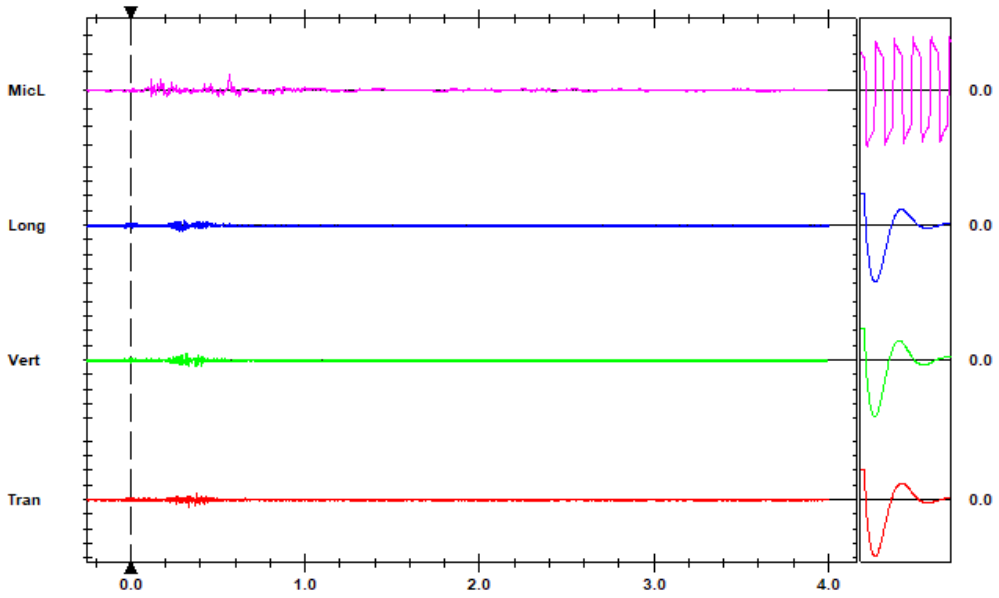
Microphone	Linear Weighting
PSPL	112.3 dB(L) at 0.566 sec
ZC Freq	17 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 471 mv)

	Tran	Vert	Long	
PPV	1.016	0.889	0.889	mm/s
ZC Freq	>100	85	85	Hz
Time (Rel. to Trig)	0.334	0.333	0.279	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.8	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.350 mm/s at 0.334 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

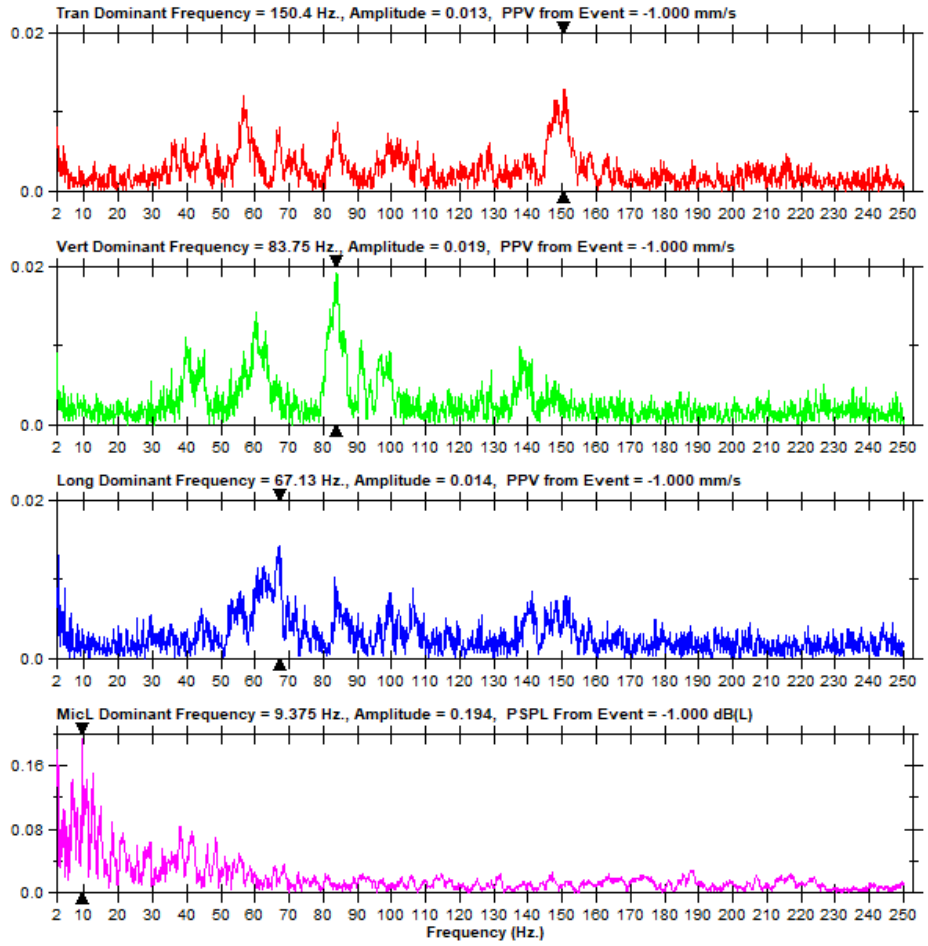
FFT Report

Date/Time	Vert at 12:35:26 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW5.N20
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-68 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Long at 12:35:26 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW5.N20
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-80 m.

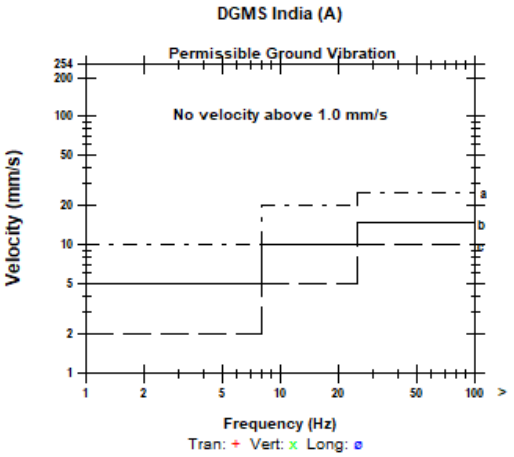
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

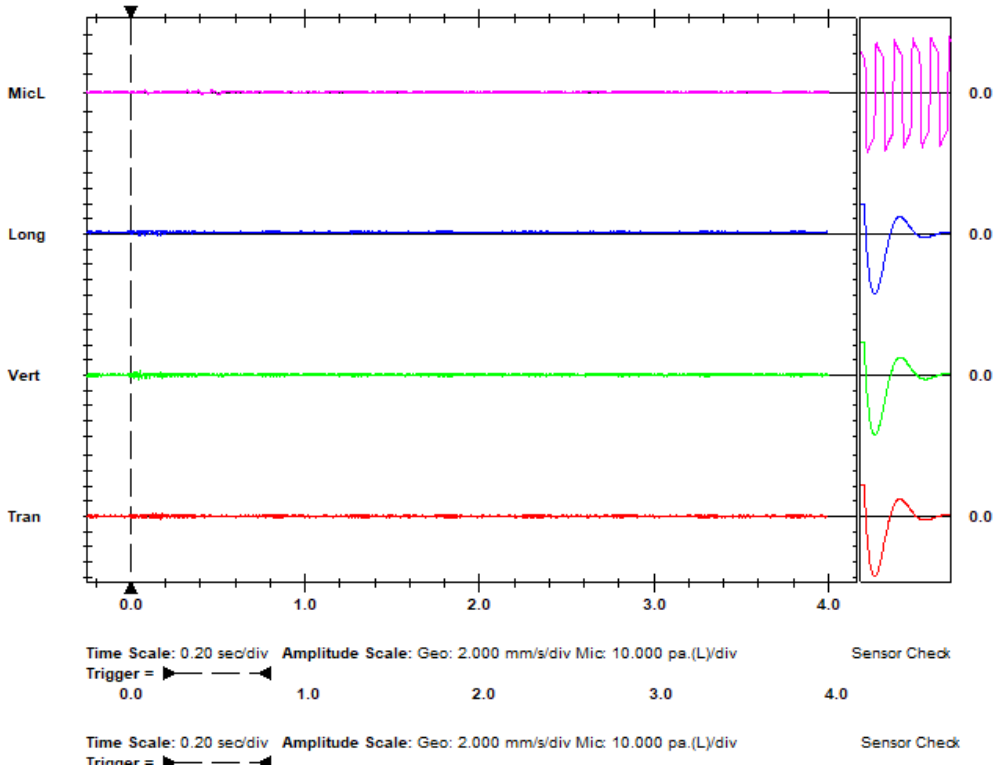
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.463 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.381	0.635	0.508	mm/s
ZC Freq	>100	>100	37	Hz
Time (Rel. to Trig)	0.129	0.048	0.000	sec
Peak Acceleration	0.027	0.040	0.040	g
Peak Displacement	0.001	0.002	0.022	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.783 mm/s at 0.056 sec





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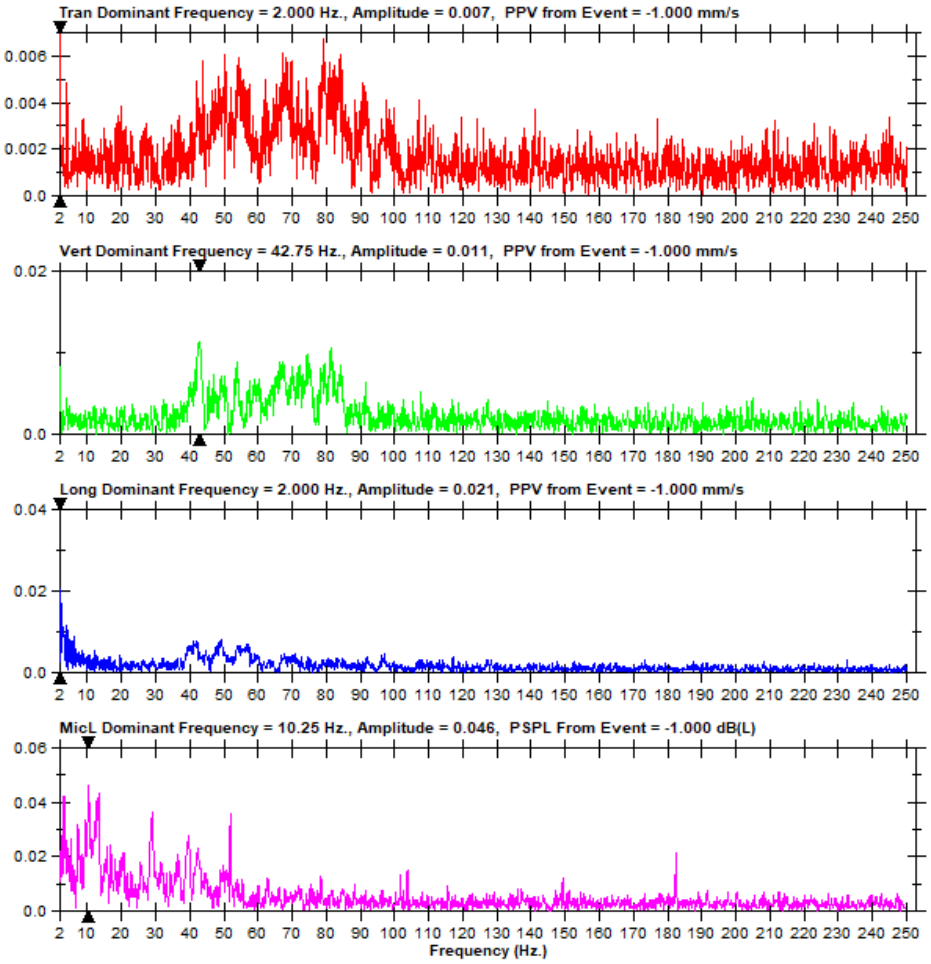
FFT Report

Date/Time	Long at 12:35:26 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW5.N20

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-80 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Tran at 12:35:22 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JUW5.MY0
Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-98 m.

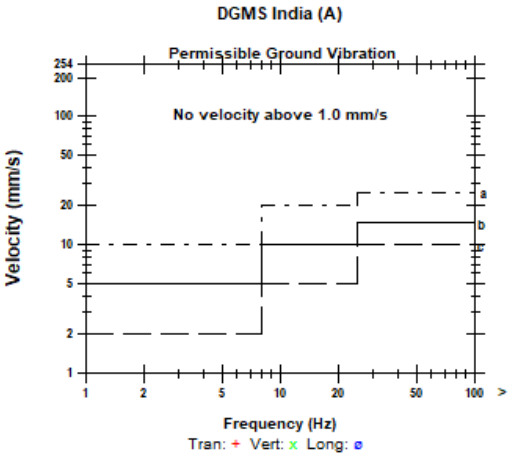
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

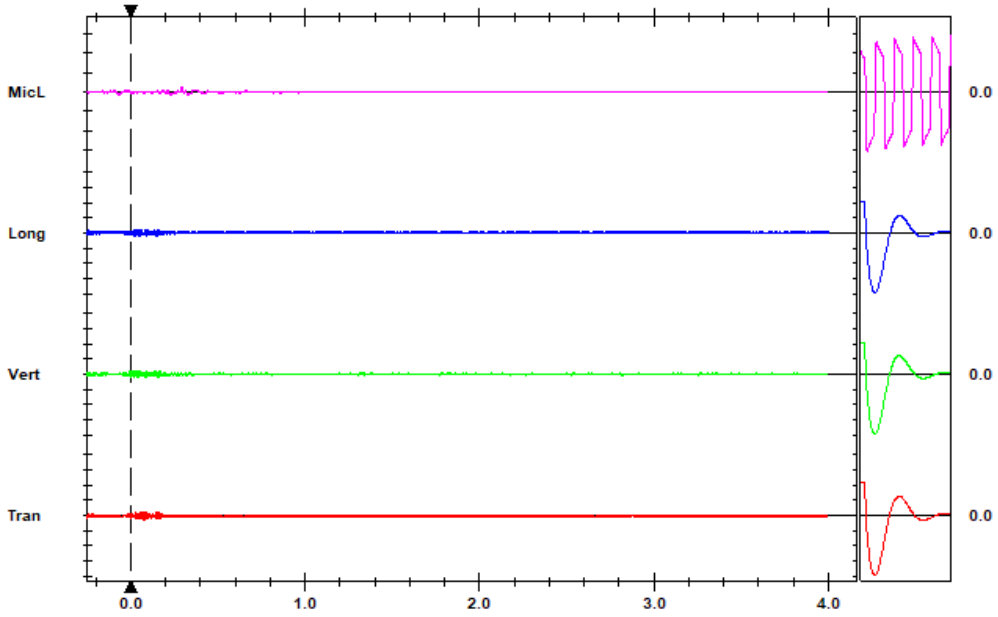
Microphone Linear Weighting
PSPL 101.9 dB(L) at 0.293 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

	Tran	Vert	Long	
PPV	0.635	0.508	0.508	mm/s
ZC Freq	>100	85	85	Hz
Time (Rel. to Trig)	0.072	0.019	0.017	sec
Peak Acceleration	0.040	0.053	0.040	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	7.5	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 0.718 mm/s at 0.019 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

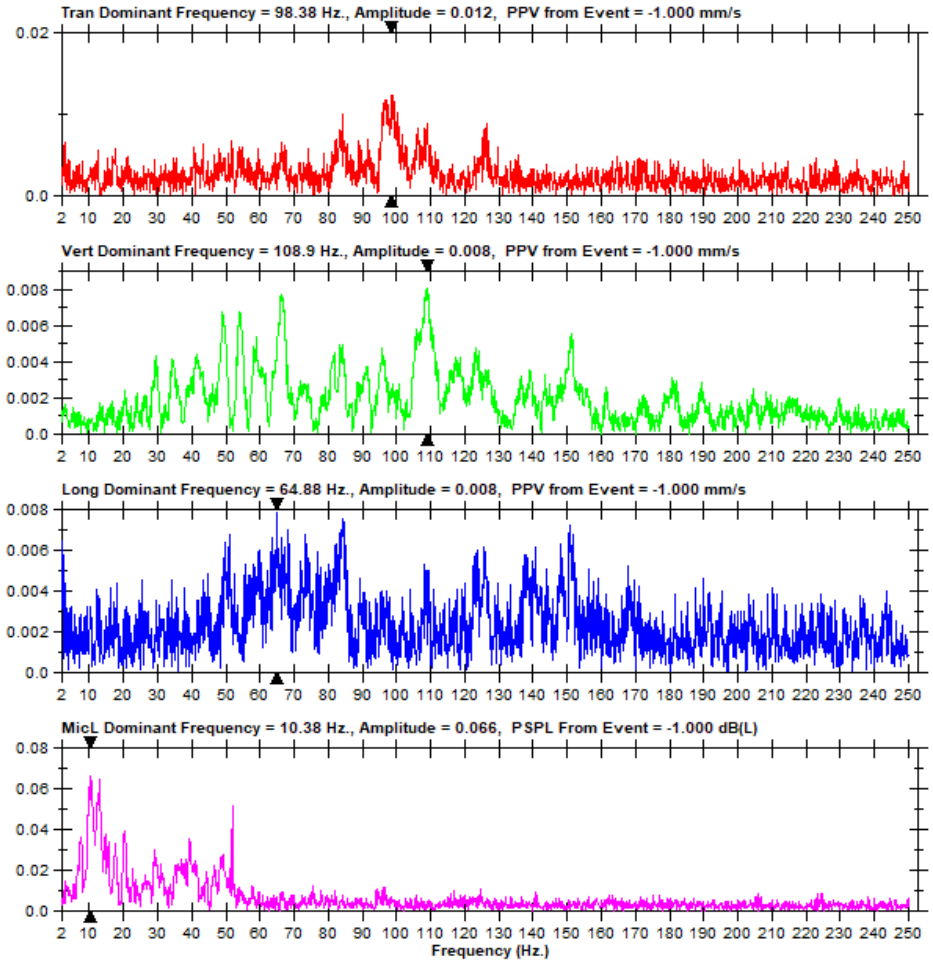
FFT Report

Date/Time	Tran at 12:35:22 January 19, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JUW5.MY0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-10, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.375 kg, Total charge-3.437 kg, Distance-98 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Vert at 12:36:31 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119123631.IDFW

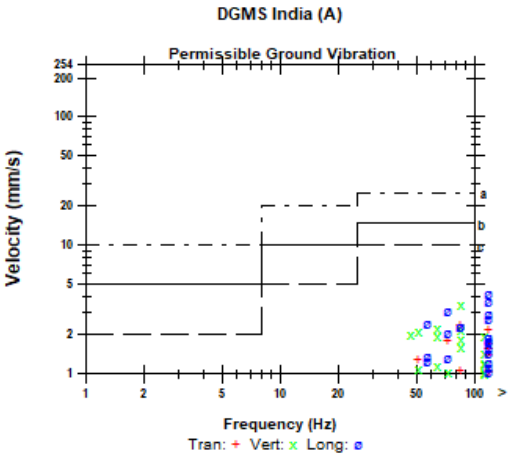
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-36 m.

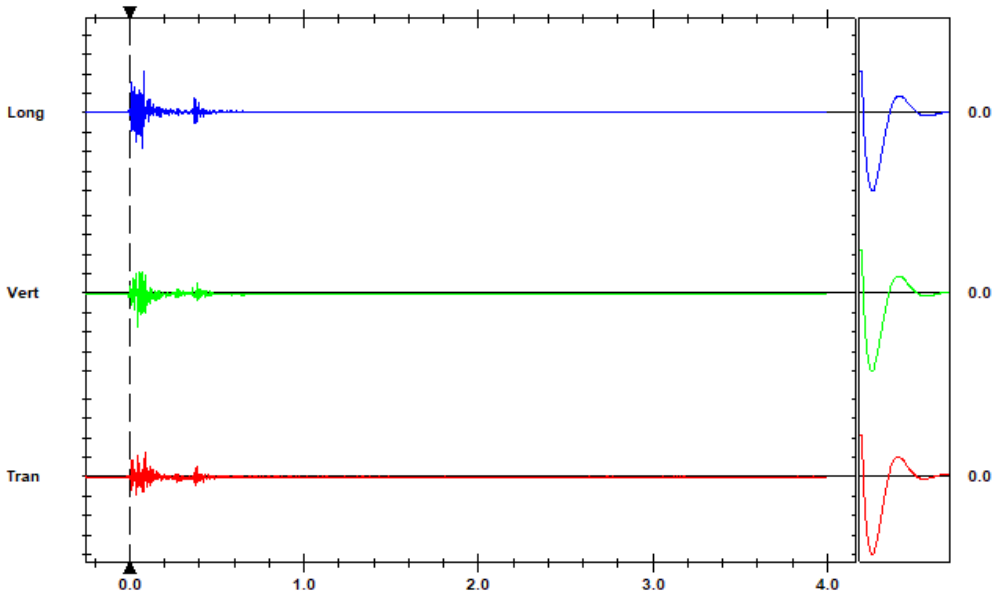
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	2.420	3.468	4.217	mm/s
ZC Freq	85	85	>100	Hz
Time (Rel. to Trig)	0.089	0.045	0.079	sec
Peak Acceleration	0.176	0.193	0.323	g
Peak Displacement	0.004	0.013	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 4.475 mm/s at 0.045 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

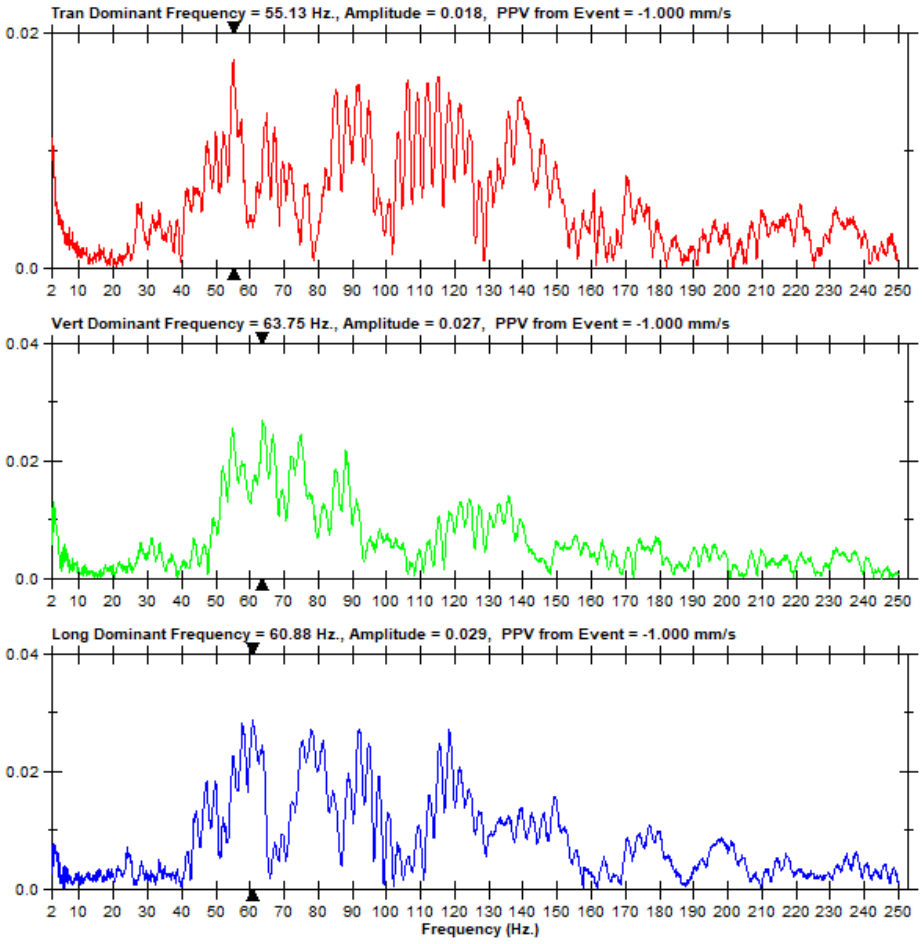
FFT Report

Date/Time	Vert at 12:36:31 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119123631.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-36 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time	Long at 12:36:26 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW5.OQ0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

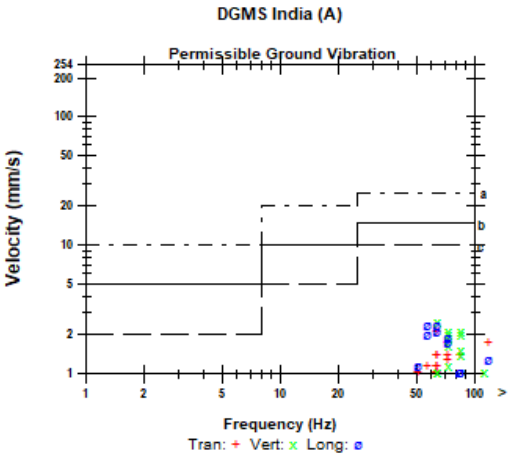
Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-50 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

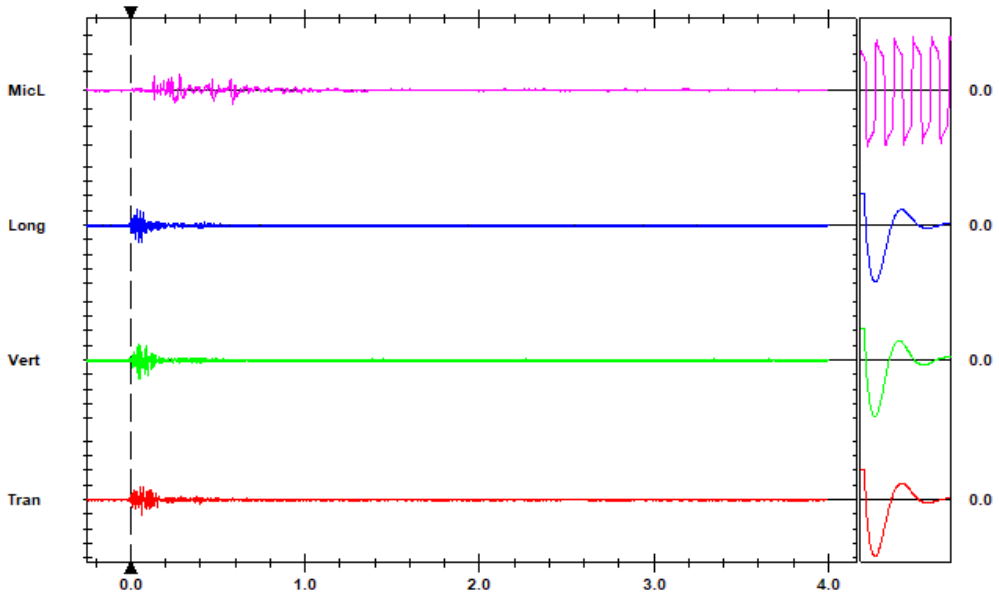
Microphone	Linear Weighting
PSPL	112.3 dB(L) at 0.281 sec
ZC Freq	43 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 438 mv)

	Tran	Vert	Long	
PPV	2.159	2.540	2.413	mm/s
ZC Freq	64	64	64	Hz
Time (Rel. to Trig)	0.064	0.051	0.046	sec
Peak Acceleration	0.106	0.133	0.119	g
Peak Displacement	0.005	0.006	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.8	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 3.053 mm/s at 0.044 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

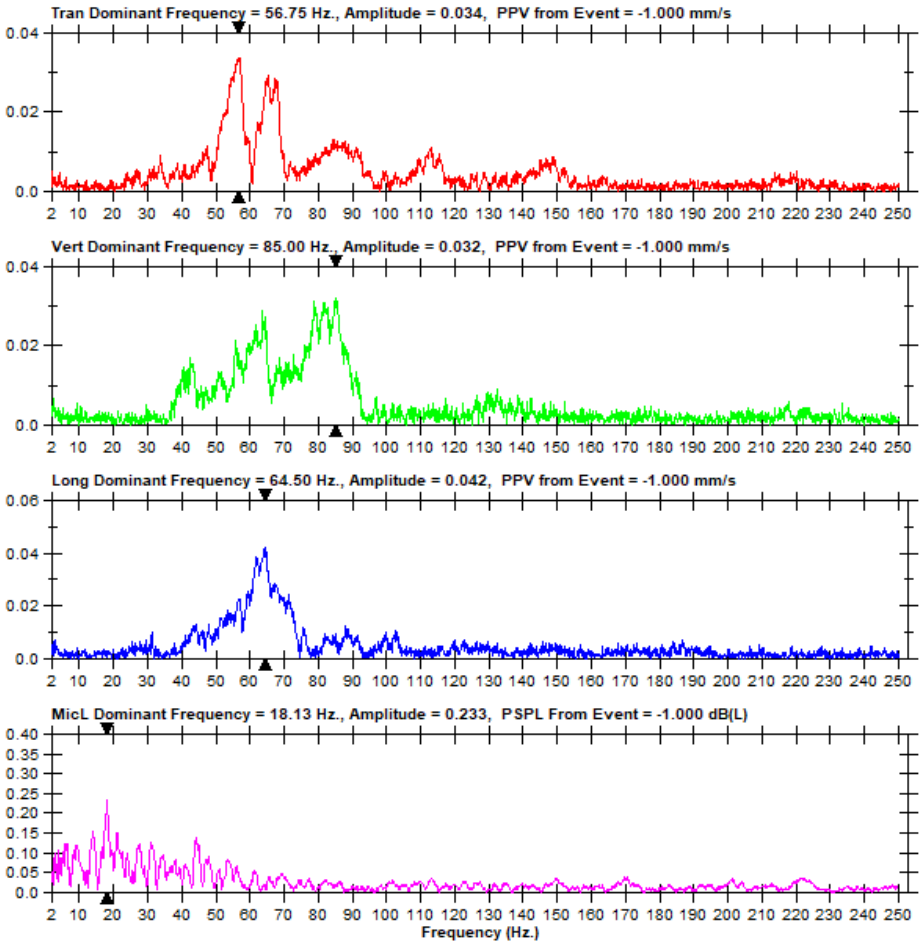
FFT Report

Date/Time	Long at 12:36:26 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW5.OQ0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-50 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time Long at 12:36:26 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW5.OQ0
Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-62 m.

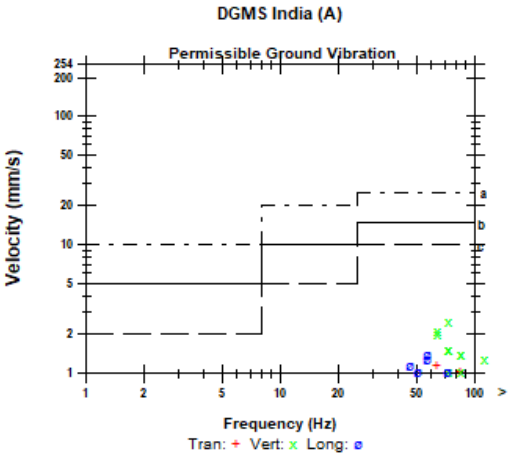
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

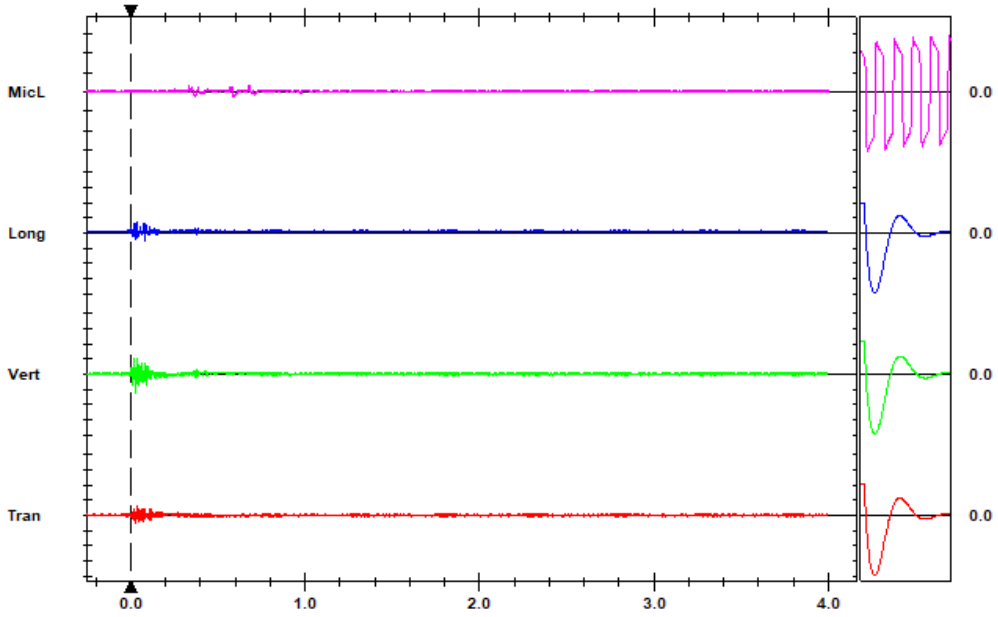
Microphone Linear Weighting
PSPL 103.5 dB(L) at 0.335 sec
ZC Freq 37 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	1.143	2.540	1.397	mm/s
ZC Freq	64	73	57	Hz
Time (Rel. to Trig)	0.036	0.028	0.039	sec
Peak Acceleration	0.053	0.106	0.053	g
Peak Displacement	0.003	0.005	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 2.700 mm/s at 0.028 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

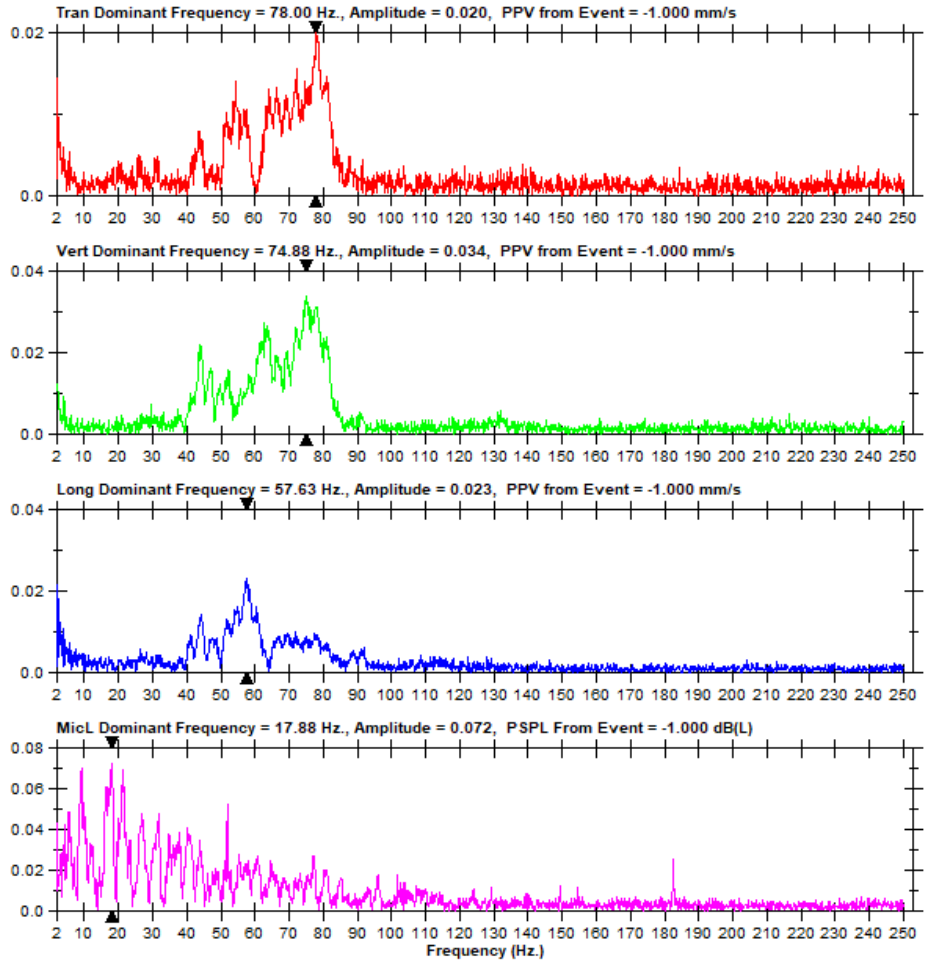
FFT Report

Date/Time	Long at 12:36:26 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW5.OQ0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-62 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Vert at 12:36:21 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

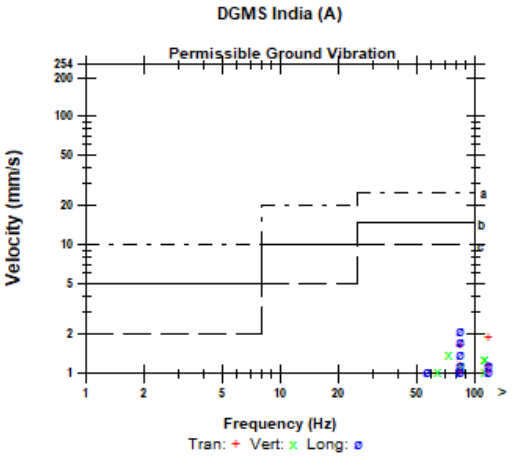
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

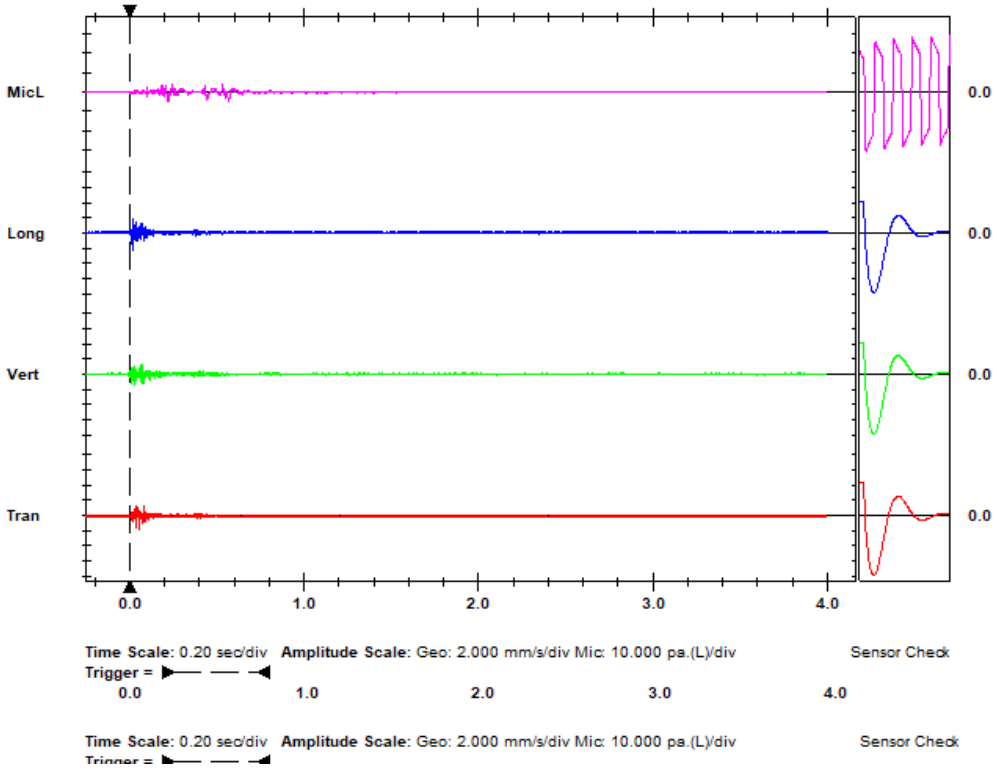
Microphone Linear Weighting
PSPL 108.0 dB(L) at 0.219 sec
ZC Freq 24 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

	Tran	Vert	Long	
PPV	1.905	1.397	2.159	mm/s
ZC Freq	>100	73	85	Hz
Time (Rel. to Trig)	0.055	0.025	0.017	sec
Peak Acceleration	0.119	0.106	0.119	g
Peak Displacement	0.003	0.003	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	7.5	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 2.250 mm/s at 0.017 sec

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JUW5.OL0
Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-70 m.





Instantel

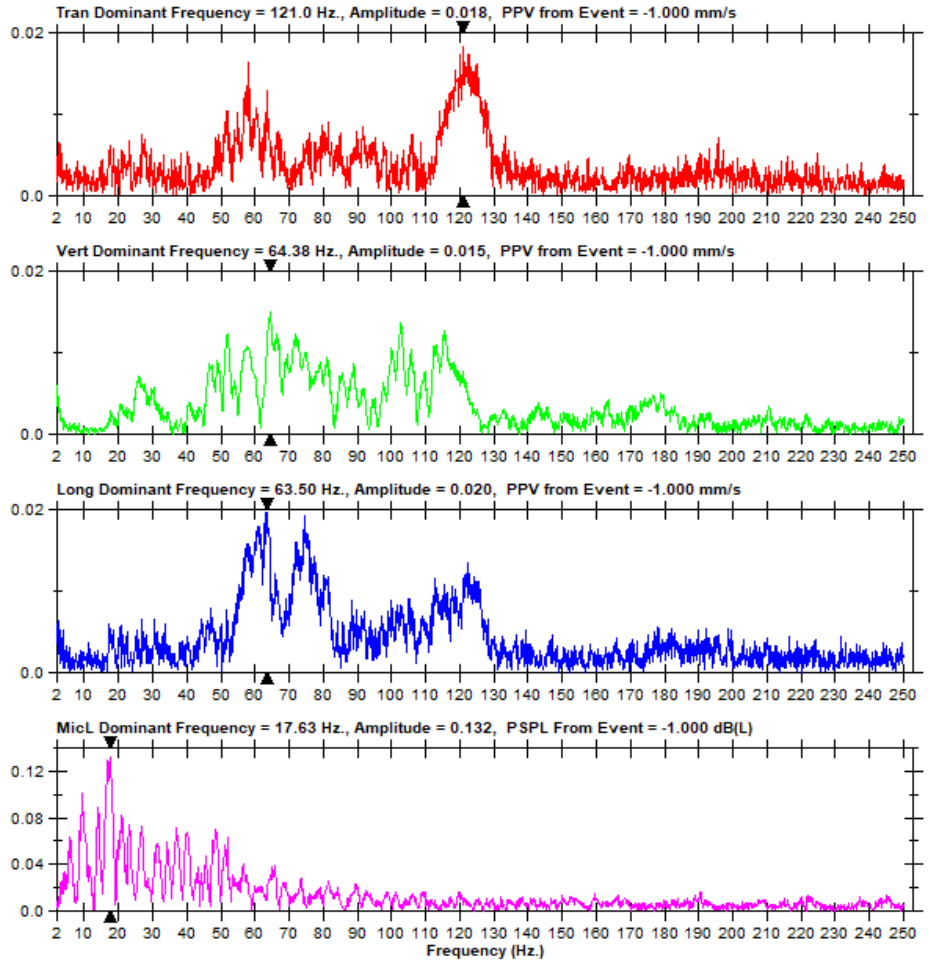
FFT Report

Date/Time	Vert at 12:36:21 January 19, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JUW5.OL0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-4.813 kg, Distance-70 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time	Vert at 12:38:22 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119123822.IDFW

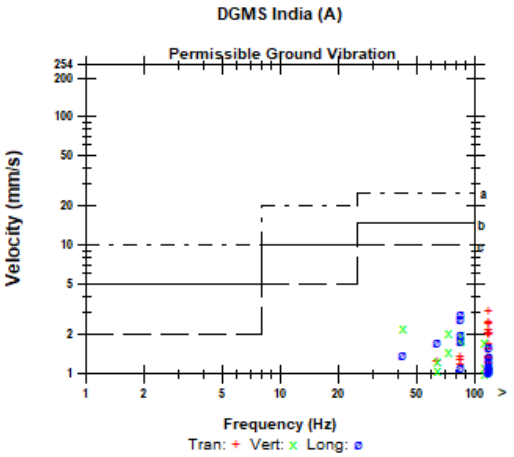
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-35 m.

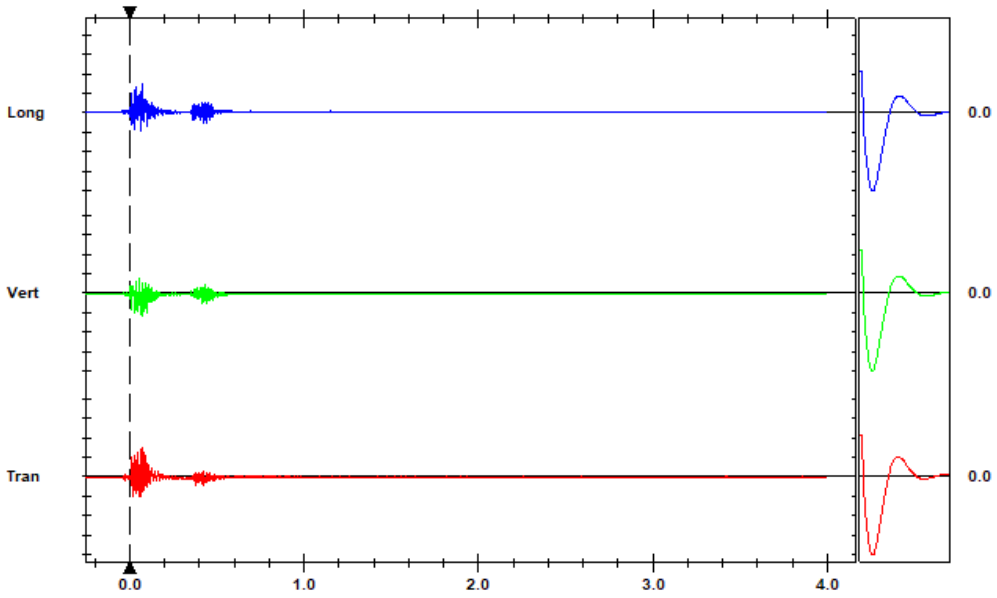
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	3.050	2.238	2.932	mm/s
ZC Freq	>100	43	85	Hz
Time (Rel. to Trig)	0.069	0.069	0.070	sec
Peak Acceleration	0.208	0.128	0.143	g
Peak Displacement	0.008	0.011	0.013	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.3	5.1	5.2	

Peak Vector Sum 4.664 mm/s at 0.069 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

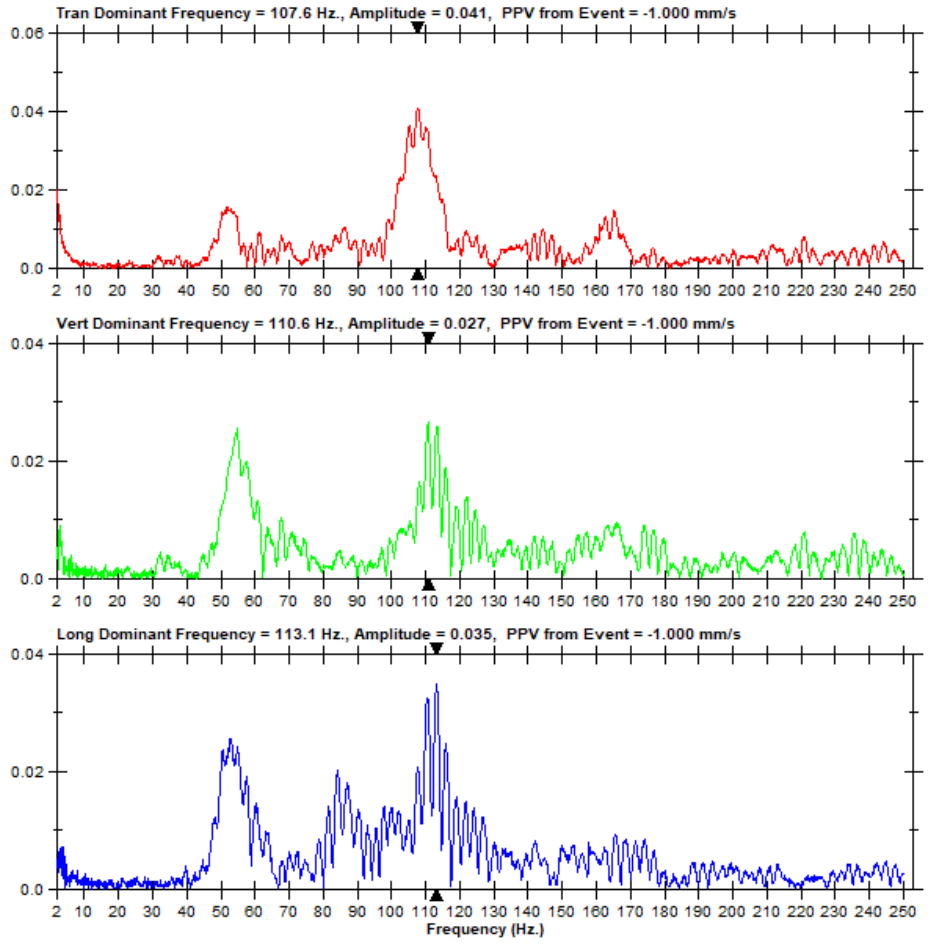
FFT Report

Date/Time	Vert at 12:38:22 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119123822.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-35 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time Vert at 12:38:12 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE7928 V 10.30-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name I928JUW5.RO0
Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-87 m.

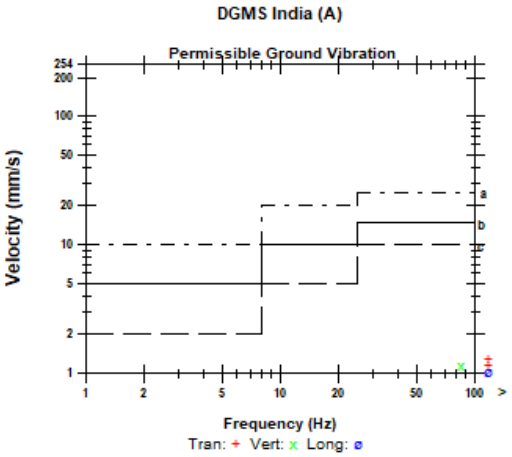
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

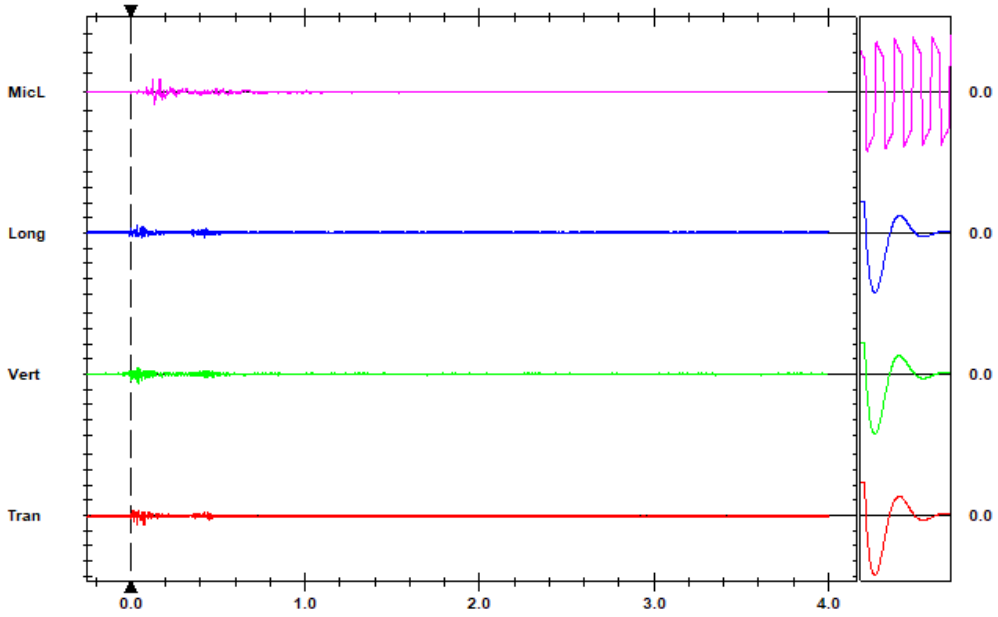
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 110.6 dB(L) at 0.136 sec
ZC Freq 32 Hz
Channel Test Passed (Freq = 19.7 Hz Amp = 495 mv)

	Tran	Vert	Long	
PPV	1.270	1.143	1.016	mm/s
ZC Freq	>100	85	>100	Hz
Time (Rel. to Trig)	0.077	0.043	0.040	sec
Peak Acceleration	0.066	0.066	0.066	g
Peak Displacement	0.002	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.7	7.7	7.5	Hz
Overswing Ratio	3.4	3.5	3.7	

Peak Vector Sum 1.571 mm/s at 0.077 sec





Instantel

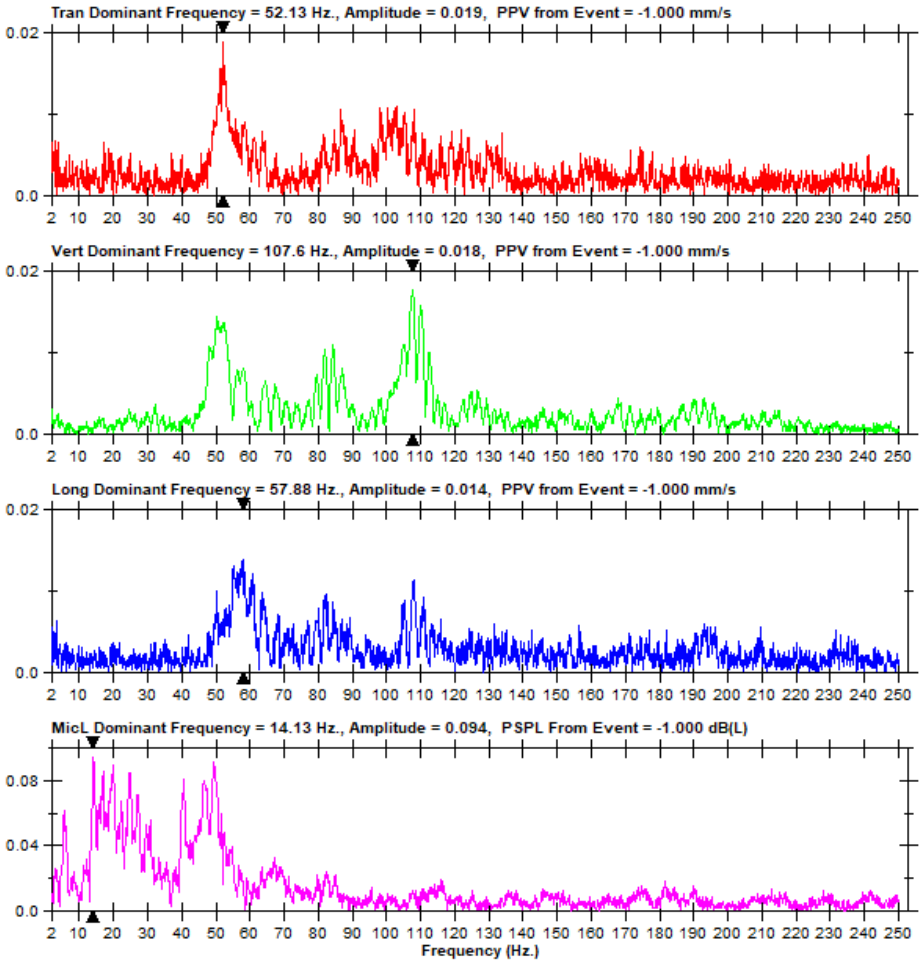
FFT Report

Date/Time	Vert at 12:38:12 January 19, 2023	**Serial Number**	BE7928 V 10.30-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	I928JUW5.RO0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-87 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time	Long at 12:38:16 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW5.RS0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

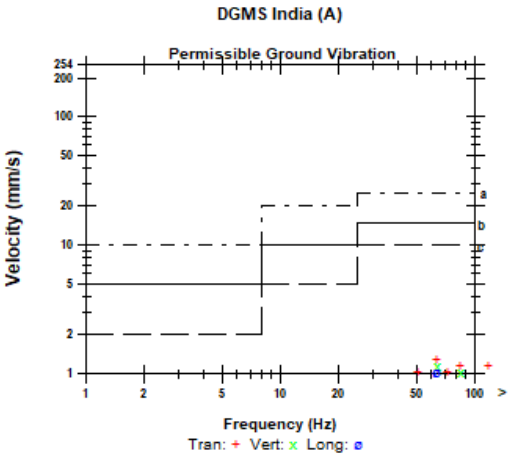
Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-93 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

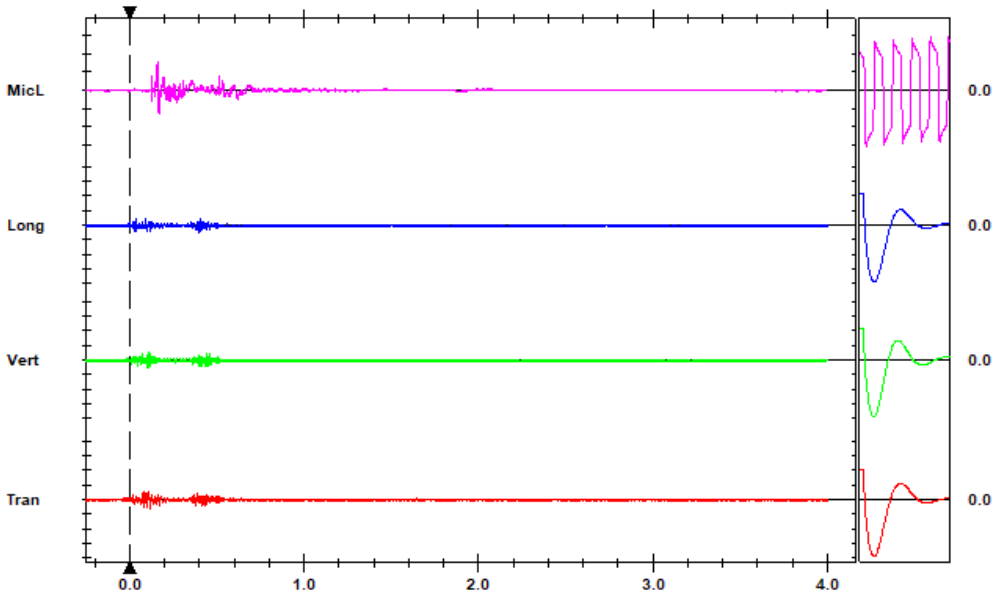
Microphone	Linear Weighting
PSPL	117.9 dB(L) at 0.159 sec
ZC Freq	47 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 491 mv)

	Tran	Vert	Long	
PPV	1.270	1.143	1.016	mm/s
ZC Freq	64	64	64	Hz
Time (Rel. to Trig)	0.120	0.104	0.395	sec
Peak Acceleration	0.066	0.066	0.066	g
Peak Displacement	0.003	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.8	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.503 mm/s at 0.120 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

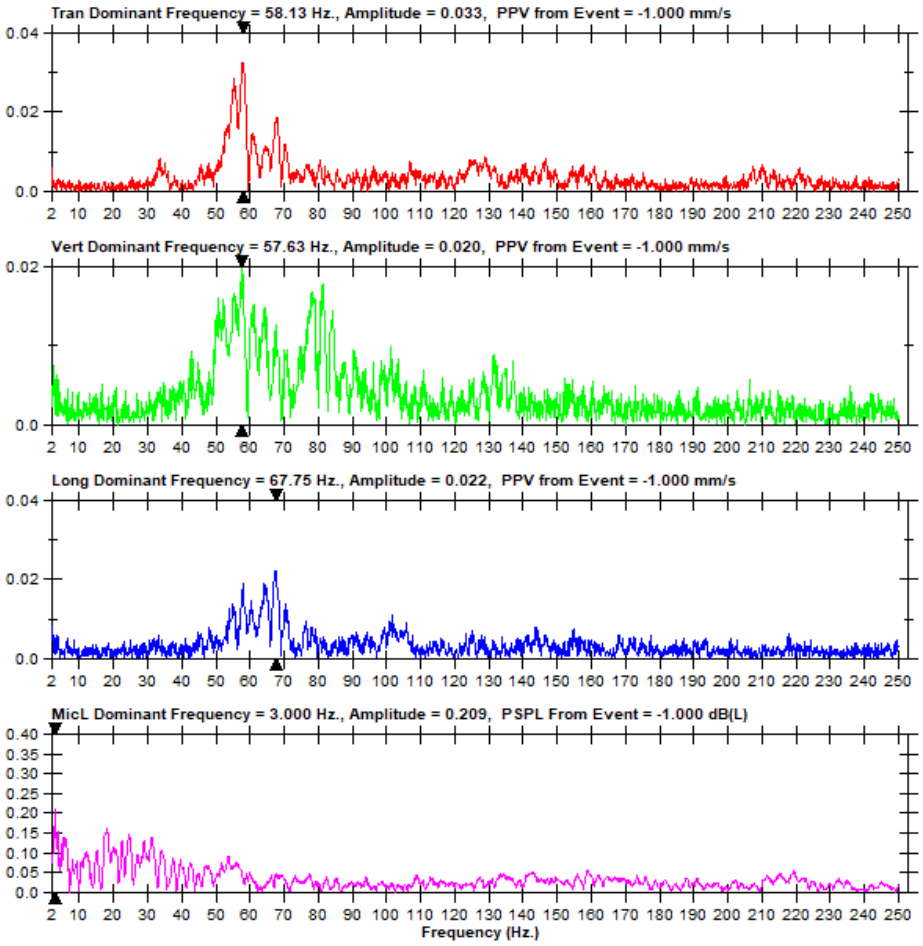
FFT Report

Date/Time	Long at 12:38:16 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW5.RS0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-93 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time Long at 12:38:16 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW5.RS0
Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-106 m.

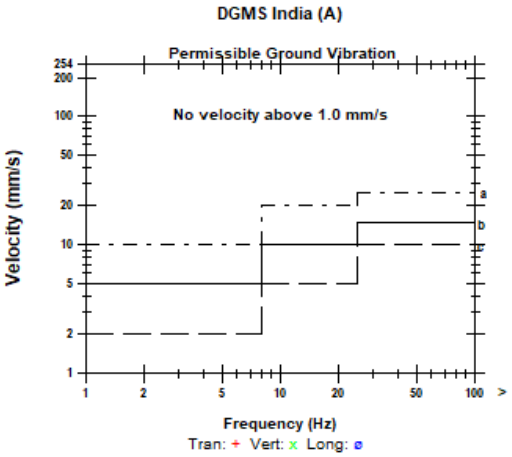
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

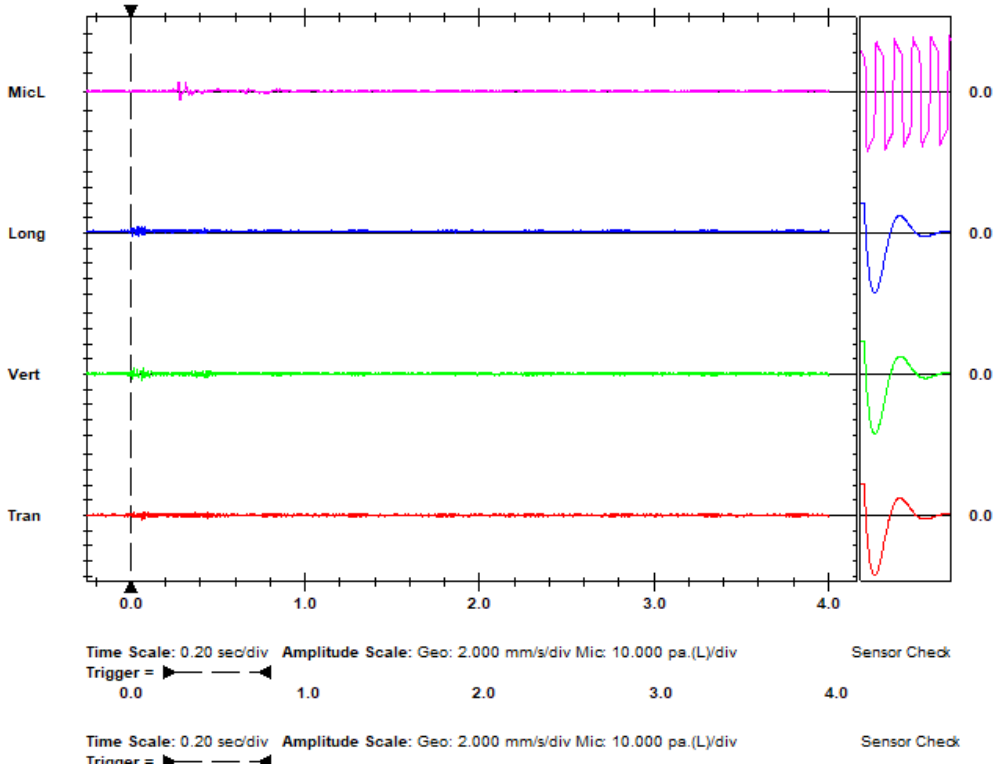
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 108.4 dB(L) at 0.276 sec
ZC Freq 34 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.635	0.762	0.762	mm/s
ZC Freq	73	73	47	Hz
Time (Rel. to Trig)	0.068	0.017	0.041	sec
Peak Acceleration	0.040	0.040	0.040	g
Peak Displacement	0.001	0.002	0.023	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 1.032 mm/s at 0.075 sec





Instantel

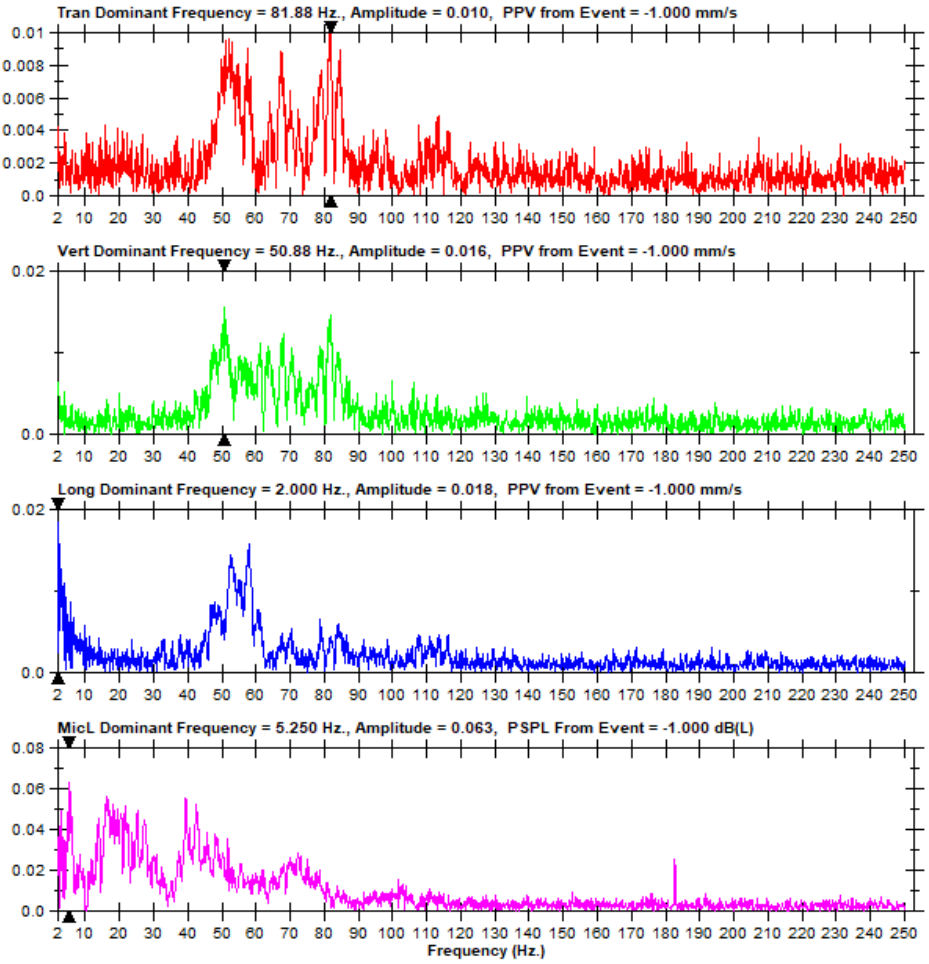
FFT Report

Date/Time	Long at 12:38:16 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW5.RS0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-18, Hole depth-1.8 m, Charge/hole-0.25 - 0.375 kg, MCPD-0.75 kg, Total charge-6.188 kg, Distance-106 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Long at 12:42:09 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW5.Y90

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

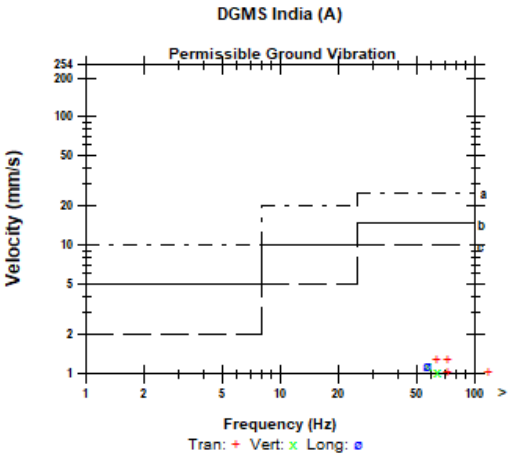
Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-45 m

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

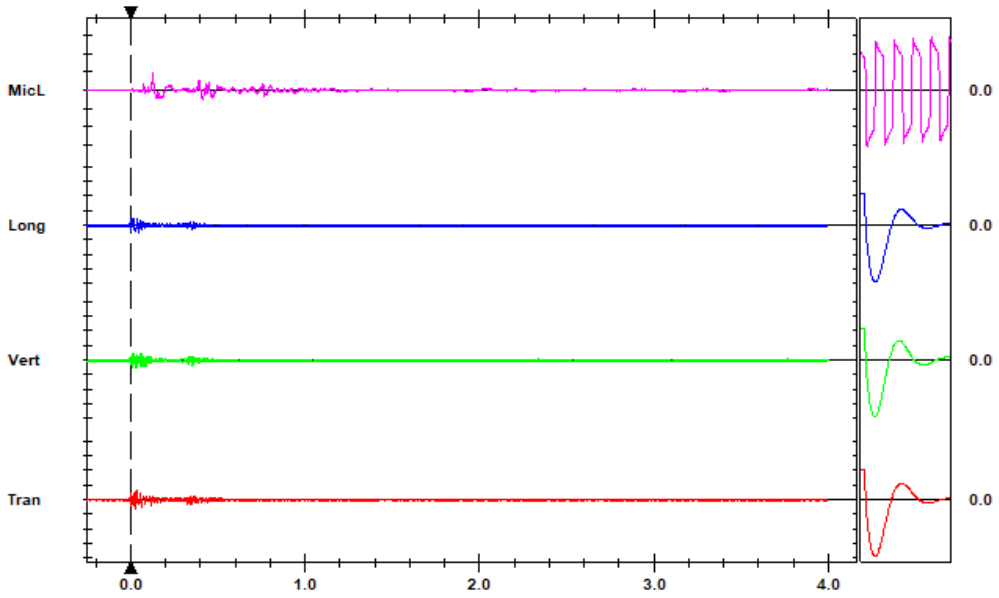
Microphone	Linear Weighting
PSPL	113.5 dB(L) at 0.126 sec
ZC Freq	24 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 477 mv)

	Tran	Vert	Long	
PPV	1.270	1.143	1.143	mm/s
ZC Freq	73	57	57	Hz
Time (Rel. to Trig)	0.029	0.032	0.044	sec
Peak Acceleration	0.093	0.053	0.066	g
Peak Displacement	0.003	0.003	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.8	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 1.566 mm/s at 0.030 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

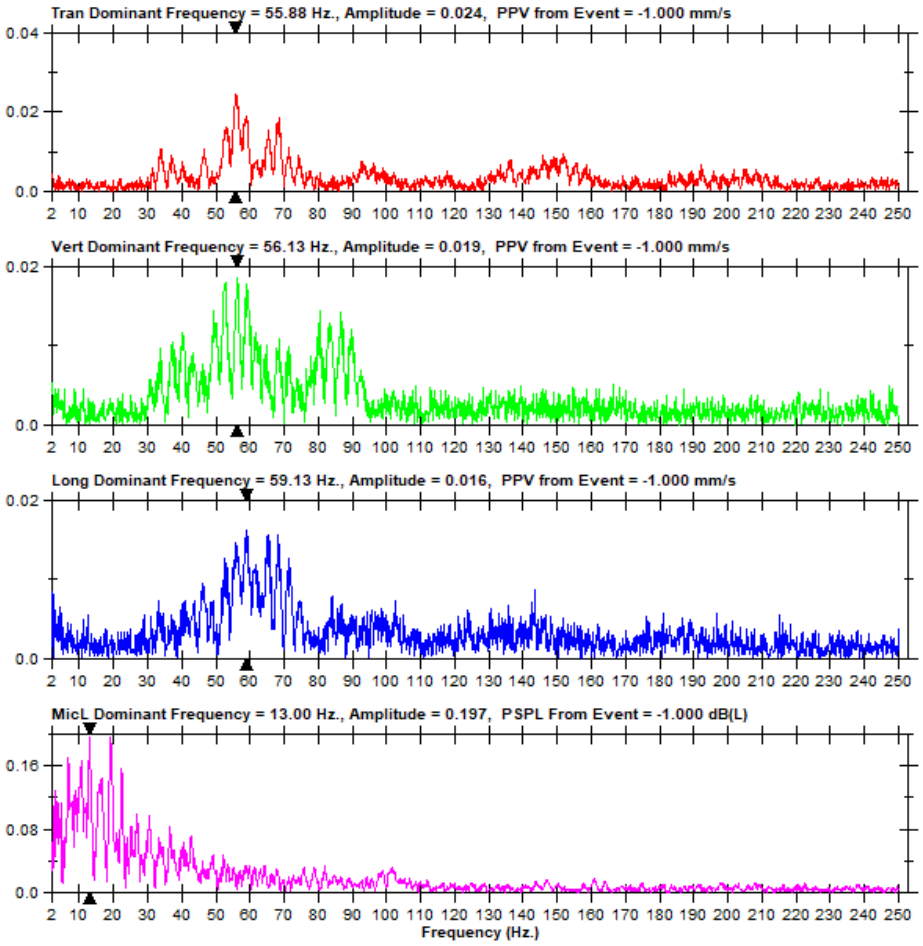
FFT Report

Date/Time	Long at 12:42:09 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW5.Y90
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-45 m



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Vert at 12:42:14 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119124214.IDFW

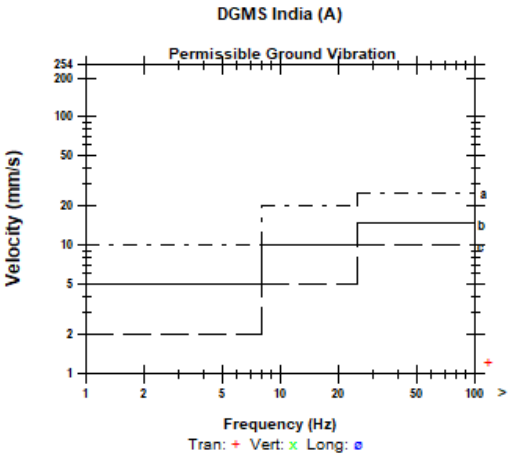
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-55 m.

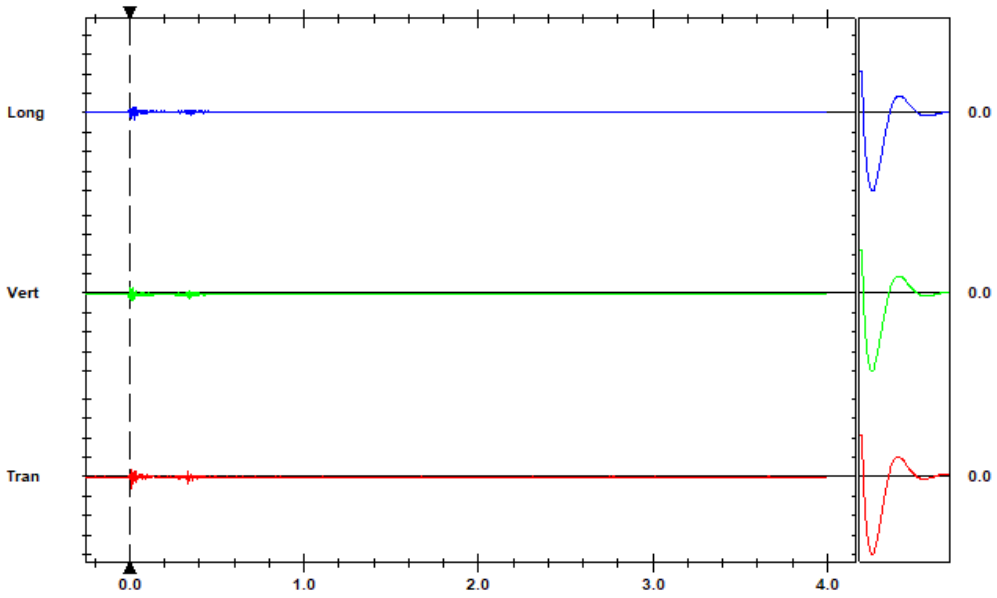
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	1.230	0.780	0.741	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.015	0.017	0.027	sec
Peak Acceleration	0.104	0.064	0.070	g
Peak Displacement	0.002	0.013	0.015	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 1.316 mm/s at 0.015 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

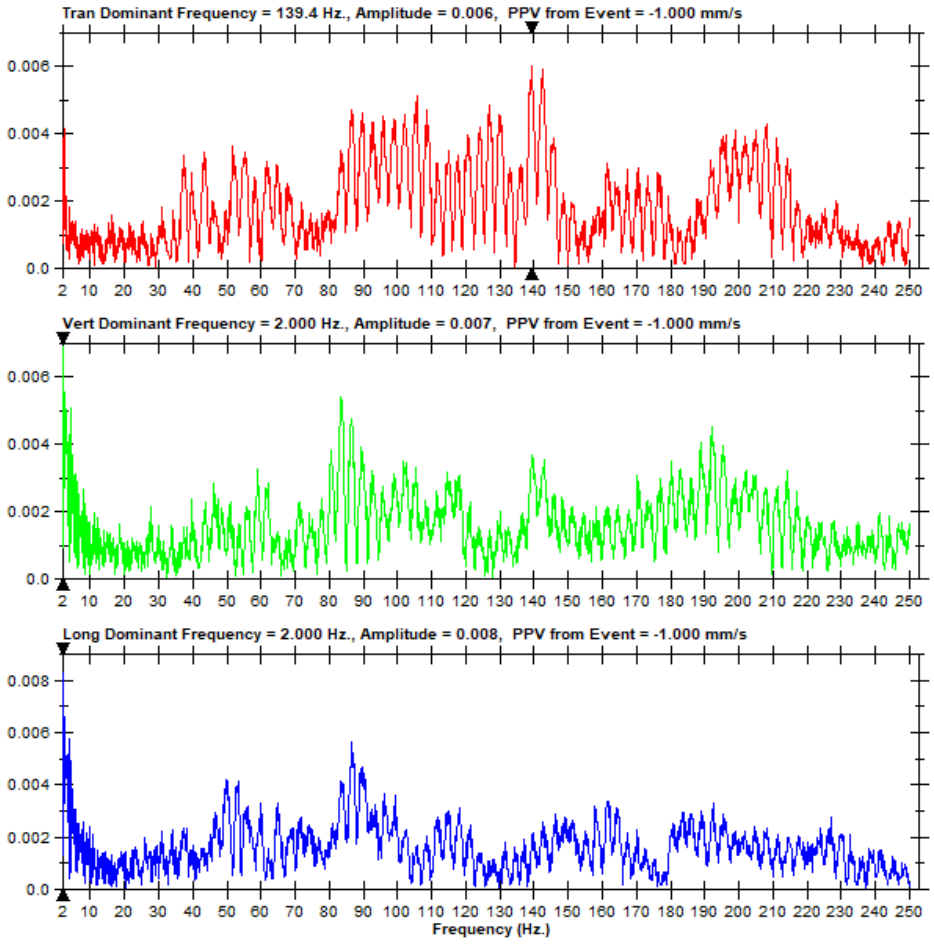
FFT Report

Date/Time	Vert at 12:42:14 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119124214.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-55 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Long at 12:42:09 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW5.Y90
Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-86 m.

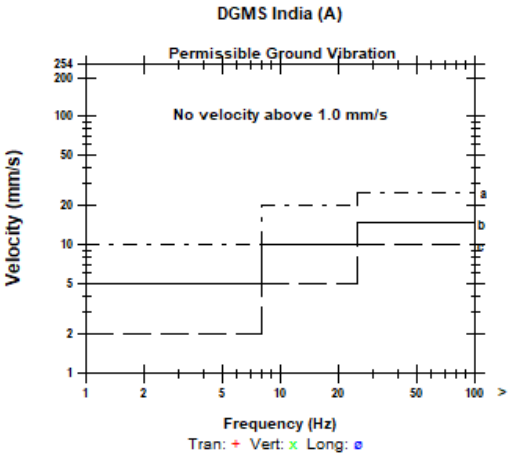
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

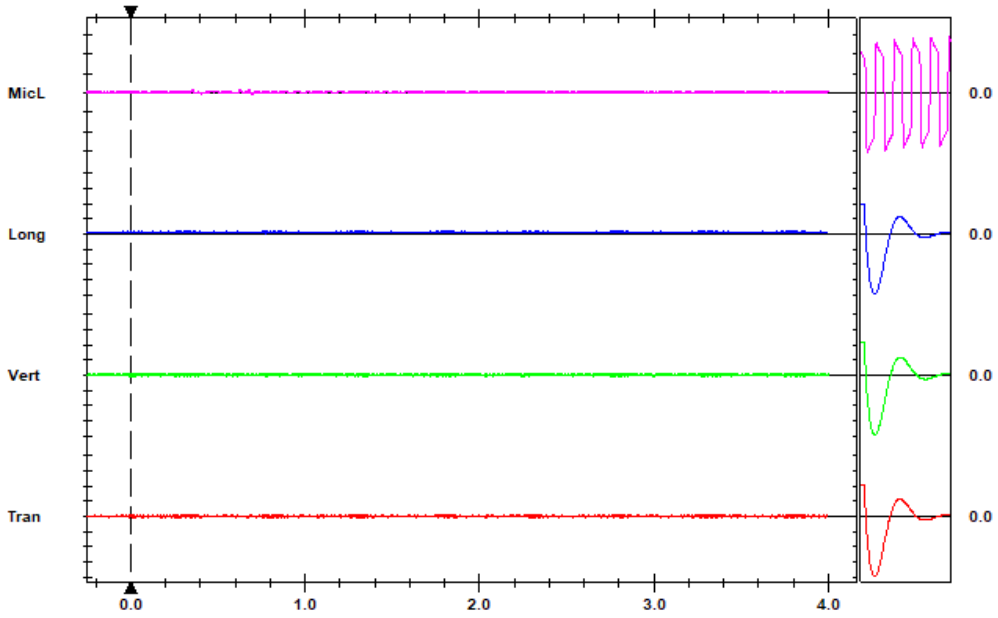
Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.355 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	37	Hz
Time (Rel. to Trig)	0.007	-0.017	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.030	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.539 mm/s at 0.002 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

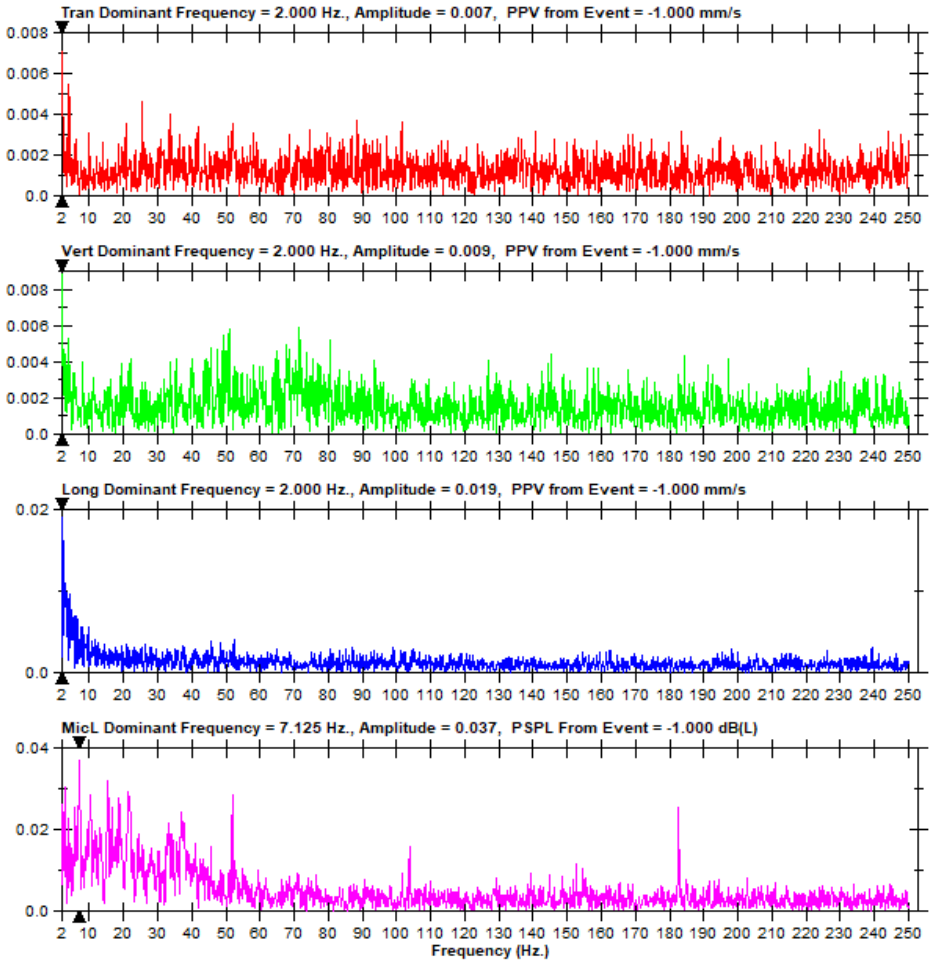
FFT Report

Date/Time	Long at 12:42:09 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW5.Y90

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-05, Hole depth-1.8 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-1.25 kg, Distance-86 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Long at 12:46:18 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119124618.IDFW

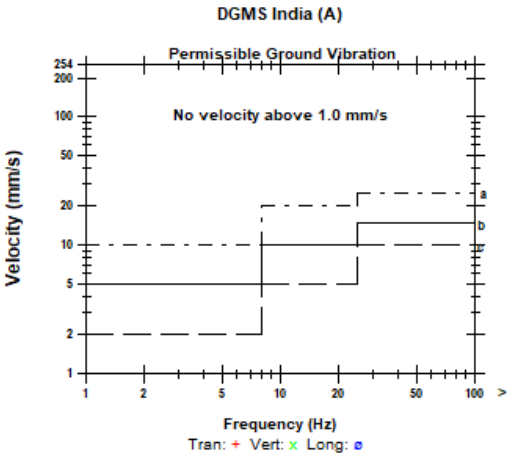
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-53 m.

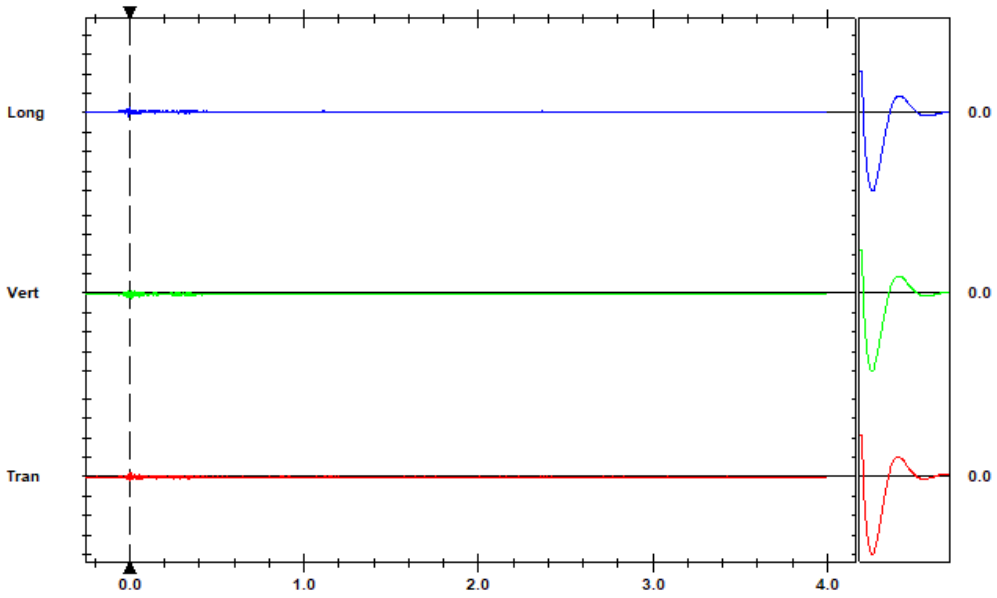
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.418	0.552	0.560	mm/s
ZC Freq	>100	>100	>100	Hz
Time (Rel. to Trig)	0.002	0.009	0.000	sec
Peak Acceleration	0.049	0.051	0.042	g
Peak Displacement	0.001	0.009	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 0.714 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

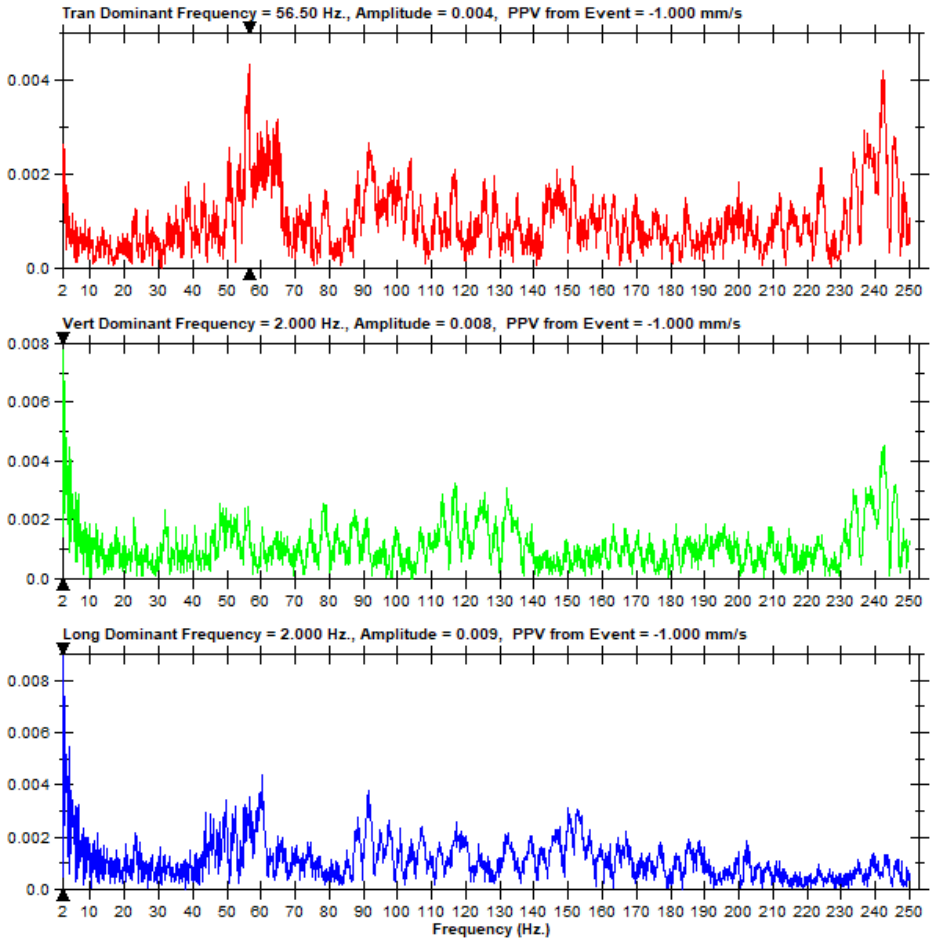
FFT Report

Date/Time	Long at 12:46:18 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119124618.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-53 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time	Vert at 12:46:13 January 19, 2023
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Job Number:	1

Serial Number	BE20376 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	November 2, 2022 by CIMFR Dhanbad
File Name	V376JUW6.510

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

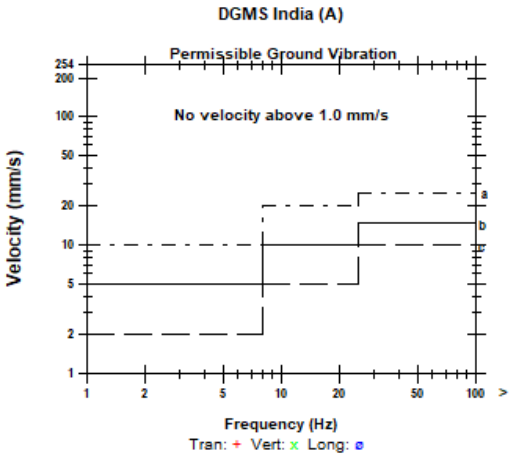
Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-83 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

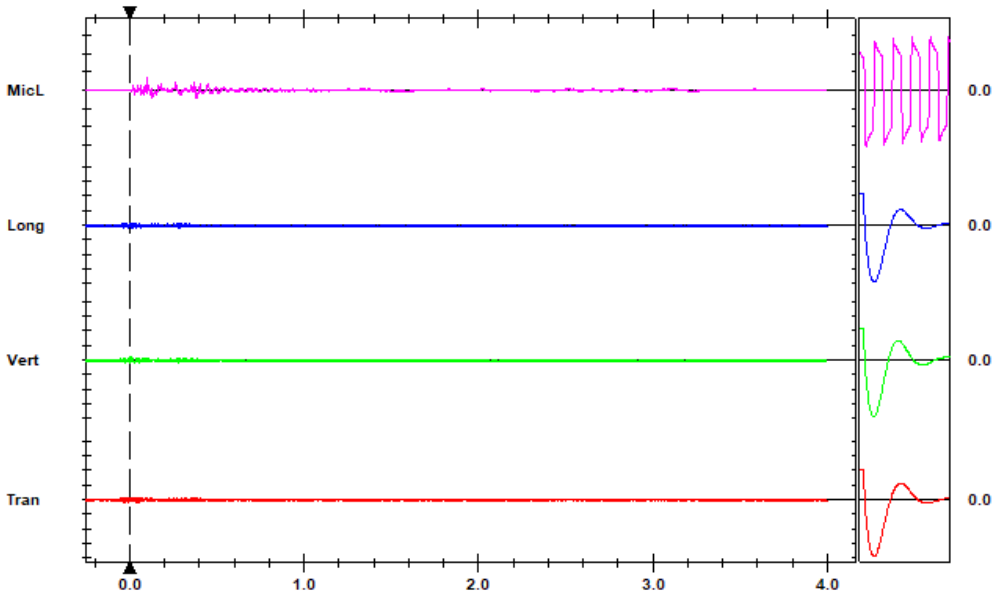
Microphone	Linear Weighting
PSPL	110.9 dB(L) at 0.102 sec
ZC Freq	43 Hz
Channel Test	Passed (Freq = 20.1 Hz Amp = 475 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	73	85	Hz
Time (Rel. to Trig)	-0.031	0.000	0.021	sec
Peak Acceleration	0.040	0.040	0.027	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.2	7.7	7.1	Hz
Overswing Ratio	3.8	3.2	4.0	

Peak Vector Sum 0.596 mm/s at -0.022 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

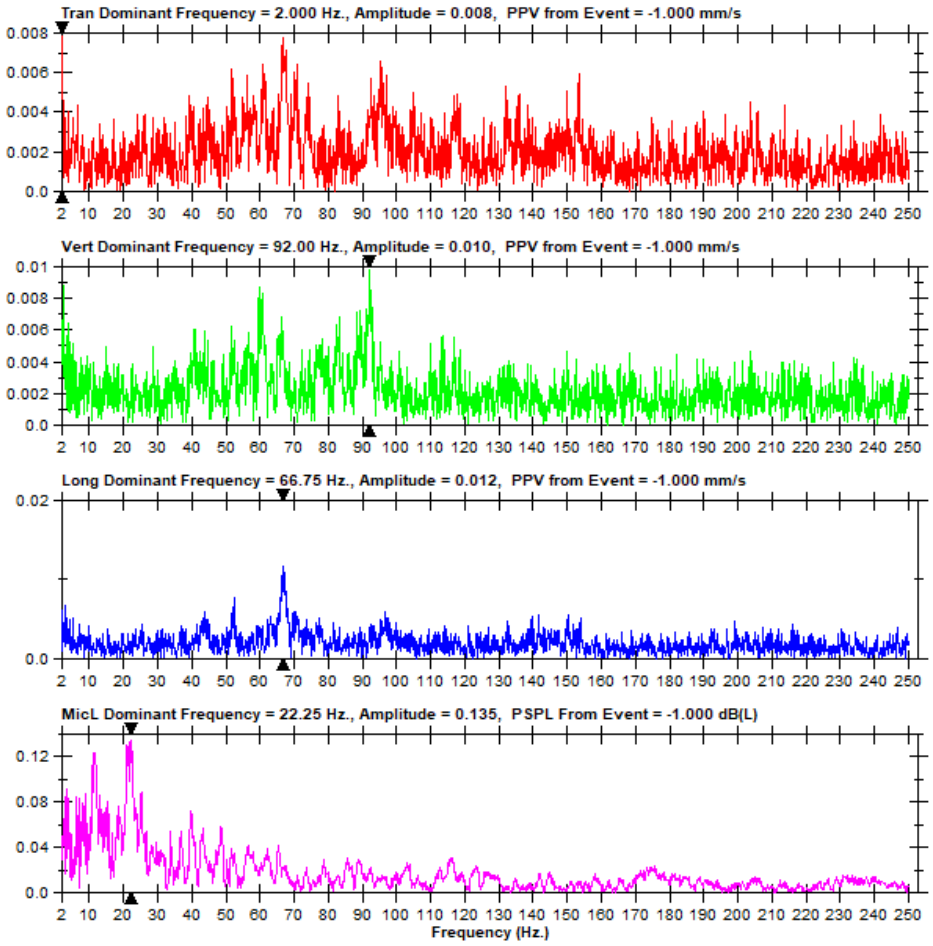
FFT Report

Date/Time	Vert at 12:46:13 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW6.510
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-63 m.



Printed: February 21, 2023 (V 10.74)

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Event Report

Date/Time Long at 12:46:13 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW6.510
Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-75 m.

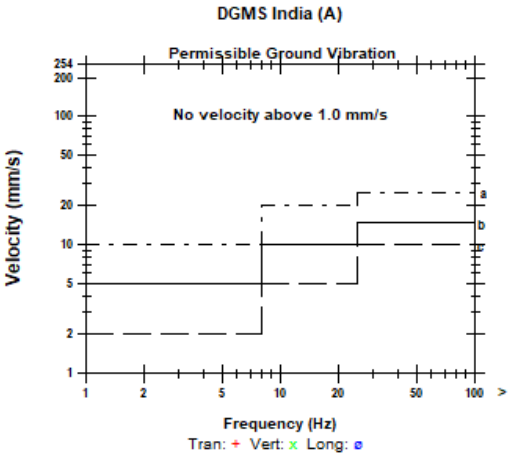
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

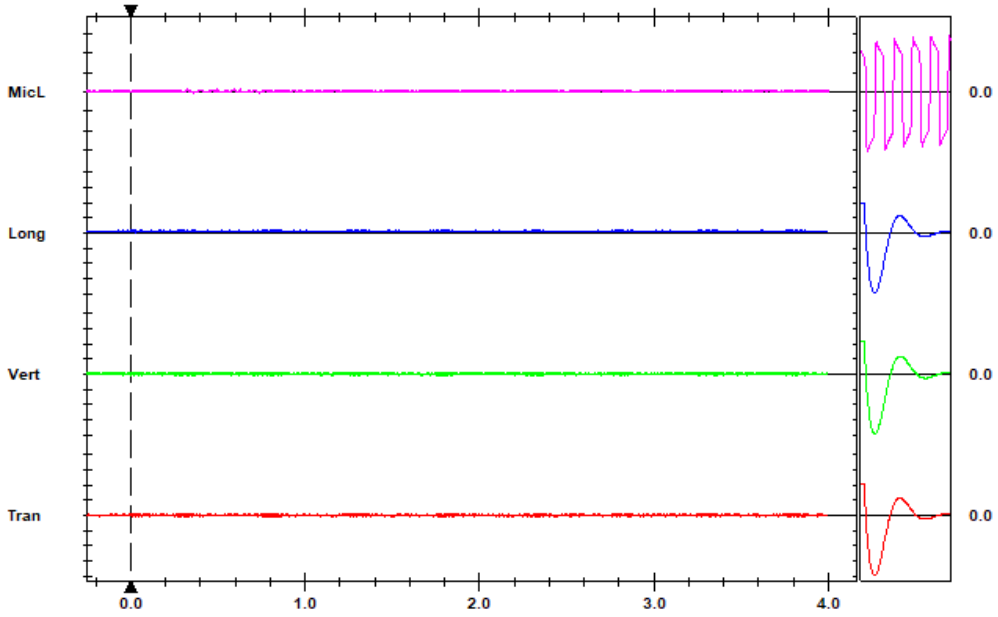
Microphone Linear Weighting
PSPL 97.5 dB(L) at 0.326 sec
ZC Freq 28 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.254	0.254	0.508	mm/s
ZC Freq	>100	>100	4.1	Hz
Time (Rel. to Trig)	2.854	0.015	0.000	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.000	0.000	0.017	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.524 mm/s at 0.000 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

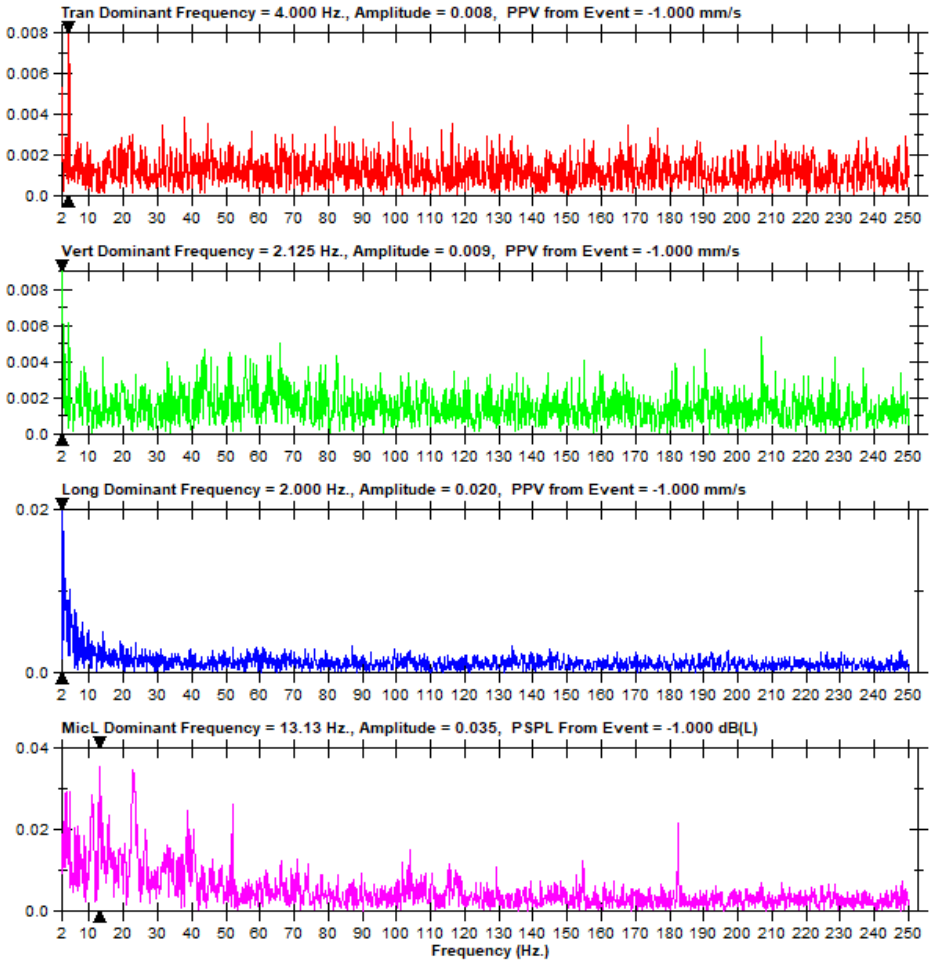
FFT Report

Date/Time	Long at 12:46:13 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW6.510

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-11, Hole depth-1.5 m, Charge/hole-0.25 kg, MCPD-0.25 kg, Total charge-2.75 kg, Distance-75 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time	Tran at 12:48:27 January 19, 2023
Trigger Source	Geo: 0.500 mm/s
Range	Geo: 254.0 mm/s
Record Time	4.0 sec at 1024 sps
Operator/Setup:	Operator/KSPCB.mmb

Serial Number	UM12915 V 10-88 Micromate ISEE
Battery Level	3.8 Volts
Unit Calibration	June 5, 2022 by CIMFR Dhanbad
File Name	UM12915_20230119124827.IDFW

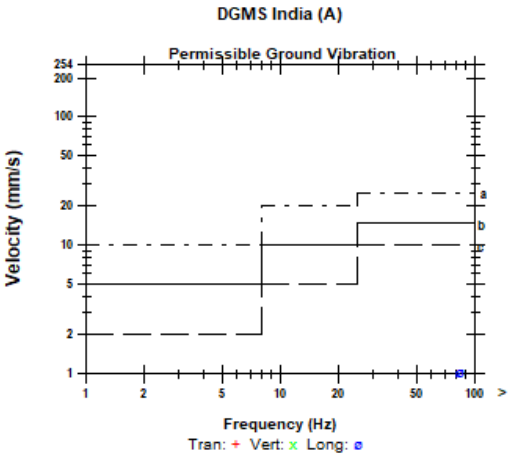
Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-53 m.

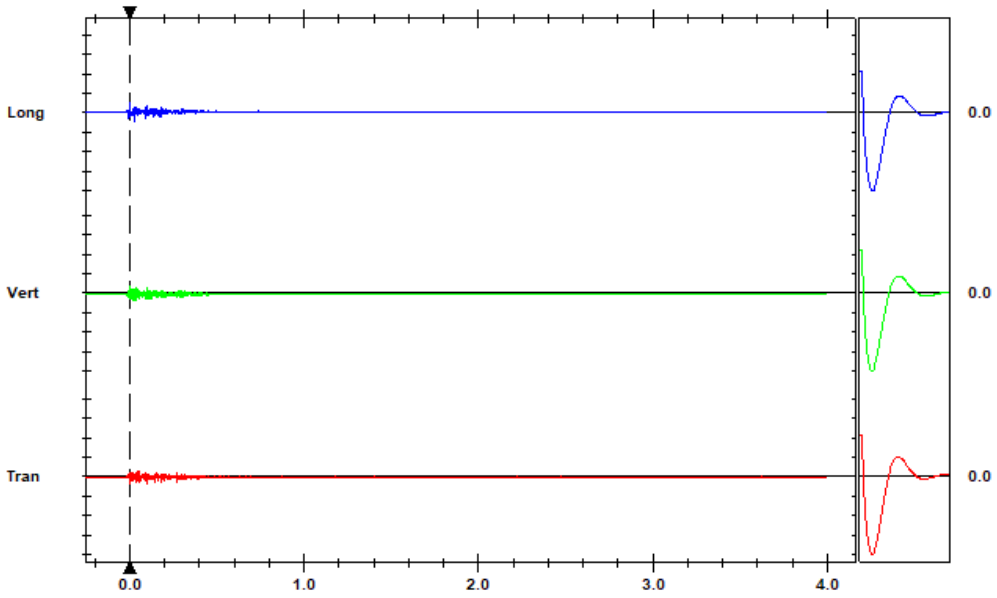
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

	Tran	Vert	Long	
PPV	0.725	0.701	1.033	mm/s
ZC Freq	>100	64	85	Hz
Time (Rel. to Trig)	0.097	0.033	0.001	sec
Peak Acceleration	0.057	0.072	0.065	g
Peak Displacement	0.002	0.012	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.3	6.9	Hz
Overswing Ratio	4.4	5.1	5.2	

Peak Vector Sum 1.267 mm/s at 0.001 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check
Trigger =

Instantel

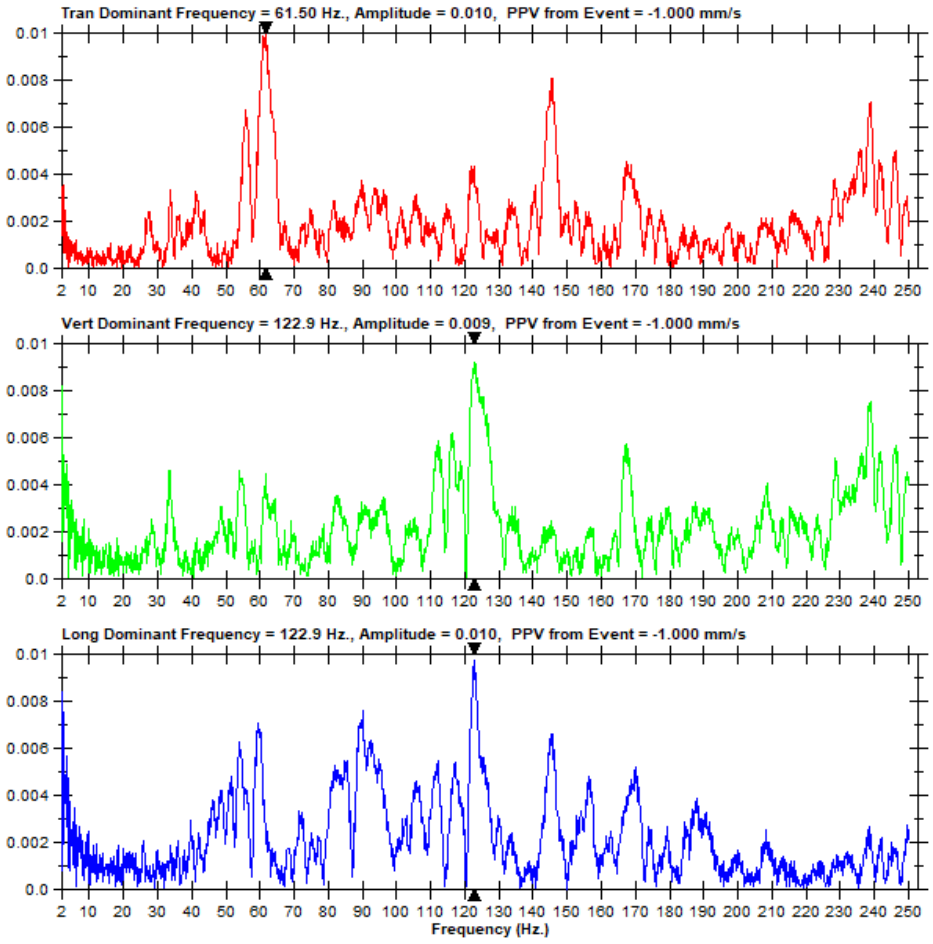
FFT Report

Date/Time	Tran at 12:48:27 January 19, 2023	**Serial Number**	UM12915 V 10-88 Micromate ISEE
Trigger Source	Geo: 0.500 mm/s	**Battery Level**	3.8 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	UM12915_20230119124827.IDFW
Operator/Setup:	Operator/KSPCB.mmb		

Notes
Location: On Ground surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-53 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time Long at 12:48:22 January 19, 2023
Trigger Source Geo: 0.510 mm/s, Mic: 120.0 dB(L)
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps
Job Number: 1

Serial Number BE20376 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration November 2, 2022 by CIMFR Dhanbad
File Name V376JUW6.8M0

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

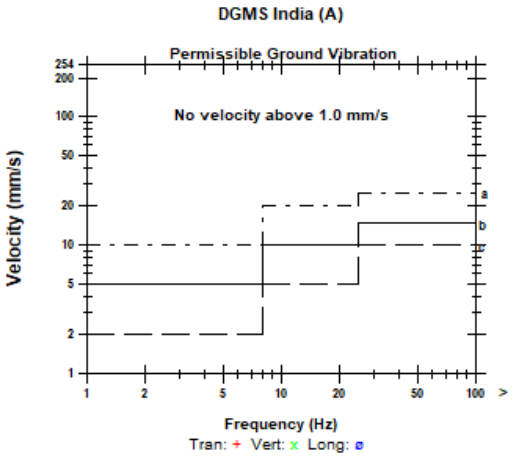
Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-61 m.

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

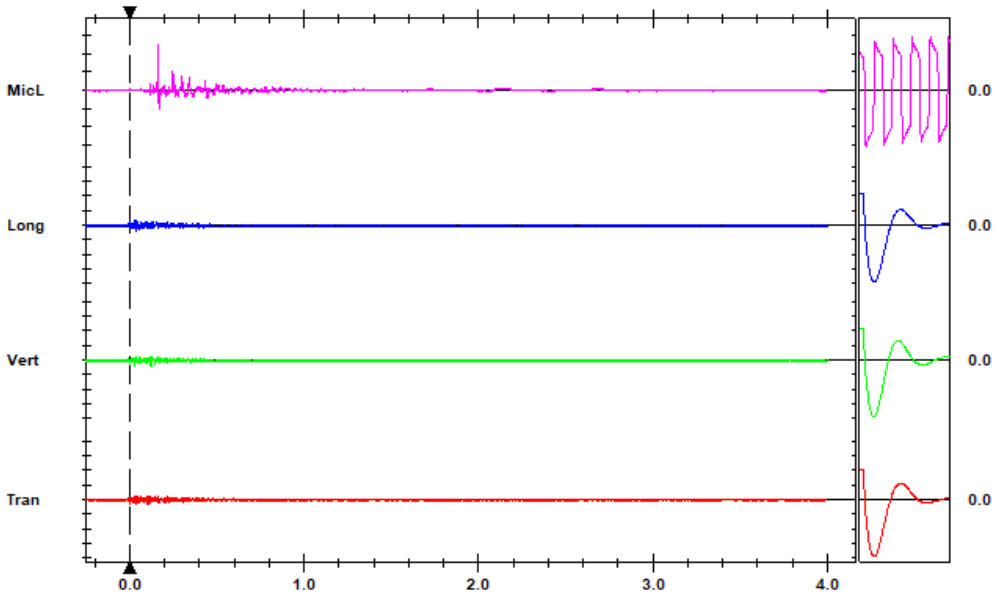
Microphone Linear Weighting
PSPL 121.8 dB(L) at 0.161 sec
ZC Freq 85 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 467 mv)

	Tran	Vert	Long	
PPV	0.635	0.889	0.889	mm/s
ZC Freq	>100	73	85	Hz
Time (Rel. to Trig)	0.004	0.122	0.036	sec
Peak Acceleration	0.053	0.040	0.066	g
Peak Displacement	0.001	0.002	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.1	7.7	7.1	Hz
Overswing Ratio	3.8	3.1	4.0	

Peak Vector Sum 1.100 mm/s at 0.036 sec



a)Industrial Buildings
b)Domestic houses/structures
c)Historic objects, sensitive structures



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

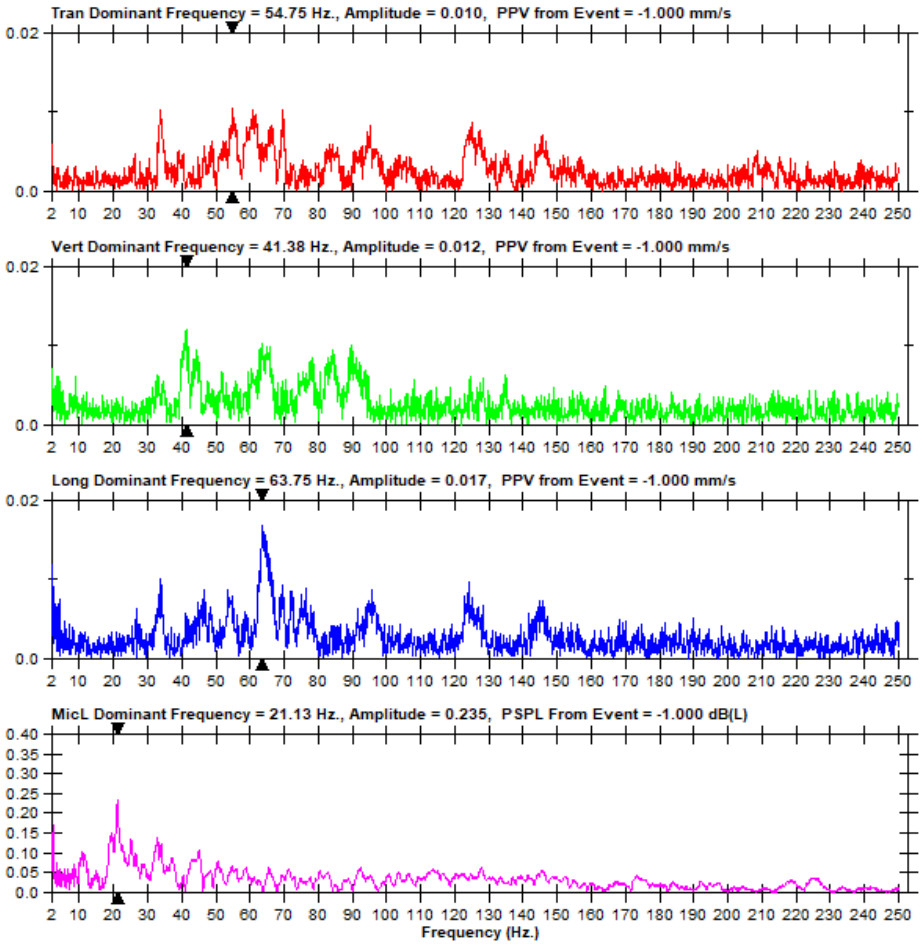
FFT Report

Date/Time	Long at 12:48:22 January 19, 2023	**Serial Number**	BE20376 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 0.510 mm/s, Mic: 120.0 dB(L)	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	November 2, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	V376JUW6.8M0
Job Number:	1		

Notes
Location: On ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-61 m.



Printed: February 21, 2023 (V 10.74)

Instantel

Event Report

Date/Time Long at 12:48:22 January 19, 2023
Trigger Source Geo: 0.510 mm/s
Range Geo: 254.0 mm/s
Record Time 4.0 sec at 1024 sps

Serial Number BE17606 V 10.20-8.17 MiniMate Plus/8
Battery Level 6.3 Volts
Unit Calibration June 5, 2022 by CIMFR Dhanbad
File Name S606JUW6.8M0
Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-72 m.

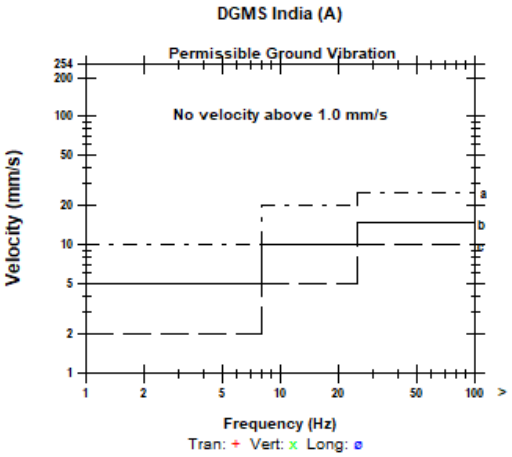
Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

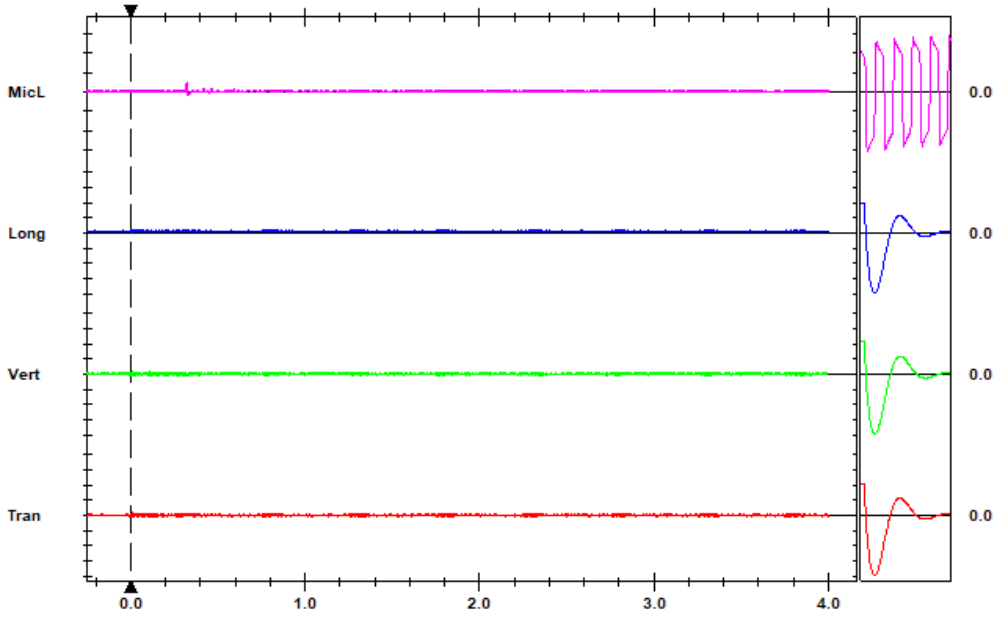
Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Microphone Linear Weighting
PSPL 108.4 dB(L) at 0.321 sec
ZC Freq 47 Hz
Channel Test Passed (Freq = 20.1 Hz Amp = 493 mv)

	Tran	Vert	Long	
PPV	0.381	0.508	0.508	mm/s
ZC Freq	>100	85	34	Hz
Time (Rel. to Trig)	0.013	0.011	0.000	sec
Peak Acceleration	0.040	0.027	0.027	g
Peak Displacement	0.000	0.001	0.018	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.5	Hz
Overswing Ratio	3.7	3.6	3.7	

Peak Vector Sum 0.660 mm/s at 0.013 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =
0.0 1.0 2.0 3.0 4.0

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div Sensor Check
Trigger =

Instantel

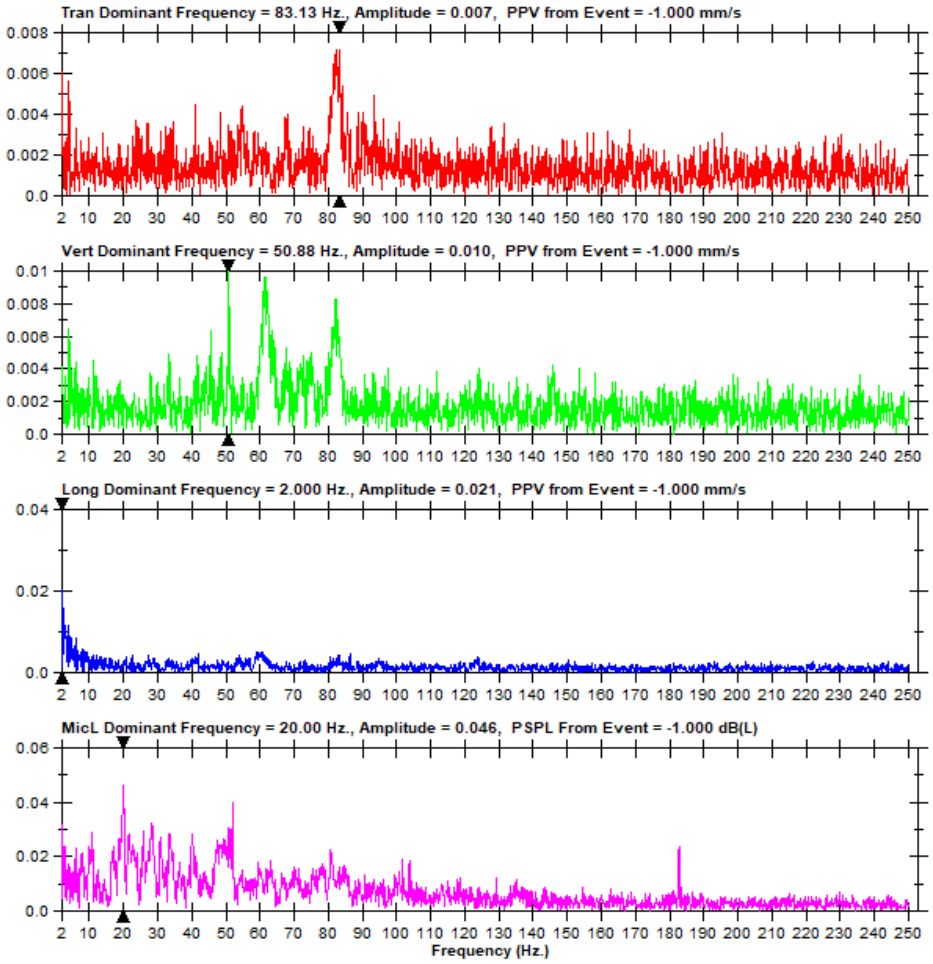
FFT Report

Date/Time	Long at 12:48:22 January 19, 2023	**Serial Number**	BE17606 V 10.20-8.17 MiniMate Plus/8
Trigger Source	Geo: 0.510 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	June 5, 2022 by CIMFR Dhanbad
Record Time	4.0 sec at 1024 sps	**File Name**	S606JUW6.8M0

Notes
Location: On Ground Surface
Client: Kerala State Pollution Control Board
User Name: CSIR-CIMFR, Dhanbad (JH)
General:

Extended Notes
Ground vibration study due to blasting at different quarries in the state of Kerala

Post Event Notes
Total No. of holes-14, Hole depth-1.5-1.8 m, Charge/hole-0.25-0.375 kg, MCPD-0.375 kg, Total charge-3.938 kg, Distance-72 m.



Printed: February 21, 2023 (V 10.74)

ANEXURE-10

Table A1. Complaints of house owners and measured values of vibrations during study at Granite Building Stone Quarry of M/s Adukadu Granites Pvt. Ltd., Pathanamthitta District

Name of person/ house owner	Response/Complaints		Distance from Blasting patches [m]	Measured values of vibration [mm/s]	Air Overpressure [dB(L)]
Mr. Kamalaha-san	Rattling of house hold items	Yes	85	-	-
	Severity of the vibration felt	Very High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Generally, vibration and noise are very high.			
Mrs. C.G. Thomas	Rattling of house hold items	Yes	175 - 230	< 0.5	NA
	Severity of the vibration felt	Very High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Sudha K	Rattling of house hold items	Yes	170	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	No vibration feels during trial blast. Generally, vibration and noise are very high.			
Mr. Jijo V	Rattling of house hold items	Yes	130	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	The well got cracked, water leakage problem in the roof. Kindly blasting power is reduced.			
Mr. Reena Samuel	Rattling of house hold items	Yes	85	-	-

	Severity of the vibration felt	high			
	Severity of the air-vibration/ Noise felt	high			
	Disturbance	Extremely			
	Remarks	Generally, vibration and noise are very high.			
Mr. Mathagikkutti	Rattling of house hold items	Yes	50	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	The vibration and dust are severe at their location. Generally, the vibration and noise are very high.			
Mr. Nihu	Rattling of house hold items	Yes	150	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	The roof has got cracks due to blasting. Generally, vibration and noise are very high.			
Mr. E.S. George	Rattling of house hold items	Yes	200	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Cracks are found on the wall.			
Mr. Thomas Vargeese	Rattling of house hold items	Yes	260-325	< 0.5	NA
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Generally, vibration and noise are very high.			
Mr. Ibraham Daniel	Rattling of house hold items	No	570-584	< 0.5	NA
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Low			
	Disturbance	Not at all			
	Remarks	Generally, vibration and noise are very high.			

ANEXURE-11

Table A2- Complaints of house owners and measured values of vibrations during study at Granite/Building Stone Quarry of Md. Roshen Kollam District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Laiju Thomas	Rattling of house hold items.	yes	150	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	high			
	Disturbance	Extremely			
	Remarks	Dust and Chemical smell issue.			
Mr. Marykutty Chacku, Joseph	Rattling of house hold items.	yes	269	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	high			
	Disturbance	Extremely			
	Remarks	Utensils fall down during blasting, Cracks generated in house due to blasting.			
Mr. Vinusha Begam	Rattling of house hold items.	yes	270	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	high			
	Disturbance	Extremely			
	Remarks	Due to fear on blasting activity of children stopped going by foot to school. Arrange auto for separate transport for safety.			
Mr. Saleena Bivee	Rattling of house hold items.	yes	276	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	high			
	Disturbance	Extremely			

	Remarks	Ground water level is gone down, Dust and blasting sound create problems.			
Mr. Sreejeth	Rattling of house hold items.	yes	180	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	high			
	Disturbance	Extremely			
	Remarks	Dust issue, Chemical smell after blast			
Mr. Saiju	Rattling of house hold items.	No	500	-	-
	Severity of the vibration felt.	Low			
	Severity of the air-vibration/ Noise felt.	Low			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Navisha Biwi	Rattling of house hold items.	Yes	142-185	< 0.5	NA
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Dust issue, one cow and goat miscarriage due to blasting, Ground water is gone down.			
Mr. Thomas Devasia	Rattling of house hold items.	Yes	500	-	-
	Severity of the vibration felt.	Moderate			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Slightly			
	Remarks	They are feeling insecure due to blasting and feel vibration by heavy vehicle movement.			
MR. Jose K. V.	Rattling of house hold items.	Yes	450	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Allergy due to dust.			
Mr. Sulekha Bibi	Rattling of house hold items.	Yes	271	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			

	Remarks	Asthma happen after mining started. Doses of medicine increases.			
Mr. Salanudeen	Rattling of house hold items.	Yes	275	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Abdul Sattar	Rattling of house hold items.	Yes	274	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Heart Patient, asthma, Kidney Problem.			
Mr. Sharabudeen	Rattling of house hold items.	Yes	273	-	-
	Severity of the vibration felt.	Not at all			
	Severity of the air-vibration/ Noise felt.	Not at all			
	Disturbance	Not at all			
	Remarks	Asthma and pacemaker installed within 2 months due to blasting its effect on health.			
Mr. Saboo	Rattling of house hold items.	No	280	-	-
	Severity of the vibration felt.	Moderate			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Moderate			
	Remarks	Cracks in kitchen due to blasting.			

ANEXURE-12

Table A3- Complaints of house owners and measured values of vibrations during study at Granite Building Stone Quarry of M/s POABS granite Granites Pvt. Ltd Vellanadu Trivandrum District

Name of person/ house owner	Response/Complaints		Distance from Blasting patches [m]	Measured values of vibration [mm/s]	Air Overpressure [dB(L)]
Mr. Manikandan Nair	Rattling of house hold items	No	500	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			
	Remarks	Note at all			
Mrs. Suresh#319	Rattling of house hold items	No	475-530	< 0.5	NA
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	none			
	Disturbance	Not at all			
	Remarks	They did notice vibration and sound.			
Mr. Vijayakumar	Rattling of house hold items	No	420	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			
	Remarks	None			
Mr. St Joseph sister Sophia	Rattling of house hold items	No	300	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	None			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Rai M	Rattling of house hold items	No	340	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			

	Remarks	Only they can hear the sound.			
Mr. Prabhakaran	Rattling of house hold items	No	350	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	None			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Sukumari M	Rattling of house hold items	No	340	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			
	Remarks	Not at all			

ANEXURE-13

Table A4- Complaints of house owners and measured values of vibrations during study at Parackal Stone Quarry of M/s Parackal Granite Kerala Private, Kothamangala Ernakulam District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Anthros	Rattling of house hold items	No	479-523	< 0.5	NA
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Low			
	Disturbance	Not at all			
	Remarks	Note at all			
Mr. Jins Joy	Rattling of house hold items	No	212-228	0.568-0.751	100-103.5
	Severity of the vibration felt	Perceptible			
	Severity of the air-vibration/ Noise felt	Low			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Gireesh V K	Rattling of house hold items	No	600	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			
	Remarks	None			
Mr. Varghess	Rattling of house hold items	No	199	-	-
	Severity of the vibration felt	Low			
	Severity of the air-vibration/ Noise felt	Moderate			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Leelas Y	Rattling of house hold items	Yes	219-264	0.540-1.048	100-106
	Severity of the vibration felt	High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Very huge blast, blasting 6.0 am to 6.0 pm			

Mr. Ajeesh Baby	Rattling of house hold items	yes	-	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Huge blast afraid to stay at home, due to blast cracks at home.			
Mr. P M Joseph	Rattling of house hold items	yes	200	-	-
	Severity of the vibration felt	High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Due to the impact of the blast's cracks on wall of the house appeared.			
Mr. Saji T. S.	Rattling of house hold items	yes	100	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Santha Sudakaran	Rattling of house hold items	yes	125	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Due to impact of the blast's cracks on wall of the house appeared.			
Mr. Shaju	Rattling of house hold items	yes	-	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Due to impact of the blast's cracks all over the house. Sound problem.			
Mr. Surendran	Rattling of house hold items	yes	150	-	-
	Severity of the vibration felt	Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Extremely			
	Remarks	Not at all			

ANEXURE-14

Table A5- Complaints of house owners and measured values of vibrations during study at Rubble Stone quarry of M/s Manakkadu stone quarry of United Granites & Metal Pvt. Ltd. Thodupuzha, Idukki District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Sibi Kootanod	Rattling of house hold items.	yes	485	-	-
	Severity of the vibration felt.	High			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Generally, the vibration and noise are very high.			
Mr. P O Chaeko	Rattling of house hold items.	No	500	-	-
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Perceptible			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Jacob K K	Rattling of house hold items.	No	272-395	0.596-0.696	91.48-100
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Perceptible			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Thomos Joseph	Rattling of house hold items.	yes	354	0.651	100
	Severity of the vibration felt.	Low			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Moderate			
	Remarks	Before 10 years they are having problem with blasting. Now they are ok with current blasting.			
Mr. George K V	Rattling of house hold items.	No	318	-	-
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Perceptible			

	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Sandy George	Rattling of house hold items.	Yes	440	-	-
	Severity of the vibration felt.	High			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Mary	Rattling of house hold items.	No	440-514	< 0.5	NA
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Perceptible			
	Disturbance	Not at all			
	Remarks	Today blast vibration was very less.			
Mr. Marry James	Rattling of house hold items.	Yes	500	-	-
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Cracks and health issue.			

ANEXURE-15

Table A6- Complaints of house owners and measured values of vibrations during study at Granite stone quarry of M/s Cochin Blue Metal Industries Pvt. Ltd. Ramapuram, Meenachil Taluk, Kottayam District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Paulose T V	Rattling of house hold items.	No	250m	-	-
	Severity of the vibration felt.	Perceptible			
	Severity of the air-vibration/ Noise felt.	Low			
	Disturbance	Slightly			
	Remarks	Not at all			
Mr. Vijayan V P	Rattling of house hold items.	Yes	500m	-	-
	Severity of the vibration felt.	High			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Vijayan Kesavan	Rattling of house hold items.	Yes	500m	-	-
	Severity of the vibration felt.	Moderate			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Moderate			
	Remarks	Not at all			
Mr. Sivaraman	Rattling of house hold items.	yes	290m	-	-
	Severity of the vibration felt.	Moderate			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Moderate			
	Remarks	Crakes in wall.			
Mr. Joshi Augustin	Rattling of house hold items.	Yes	200-241	1.024-0.813	93.98-95.5
	Severity of the vibration felt.	Very high			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Not at all			

Mr. Dhinu E S	Rattling of house hold items.	Yes	320	-	-
	Severity of the vibration felt.	Low			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Slightly			
	Remarks	Not at all			
Mr. A Augustin	Rattling of house hold items.	Yes	460	-	-
	Severity of the vibration felt.	High			
	Severity of the air-vibration/ Noise felt.	Moderate			
	Disturbance	Moderate			
	Remarks	Not at all			
Mr. Abraham Augustin	Rattling of house hold items.	No	500	-	-
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Low			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. M L Antony	Rattling of house hold items.	Yes	298-565	< 0.5	NA
	Severity of the vibration felt.	High			
	Severity of the air-vibration/ Noise felt.	High			
	Disturbance	Extremely			
	Remarks	Not at all			
Mr. Sethunath	Rattling of house hold items.	No	250-351	< 0.5	NA
	Severity of the vibration felt.	None			
	Severity of the air-vibration/ Noise felt.	Low			
	Disturbance	Not at all			
	Remarks	Not at all			

ANEXURE-16

Table A7- Complaints of house owners and measured values of vibrations during study at Granite (Building Stone) Quarry of M/s Penta Granites, Kizhakkencheri-2 Alathur, Palakkad District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Gearge Edatha-lla house	Rattling of house hold items	Yes	321-388	< 0.5	NA
	Severity of the vibration felt	Moderate			
	Severity of the air-vibration/ Noise felt	Moderate			
	Disturbance	Slightly			
	Remarks	People leaving this area due to quarry.			
Mrs. Thanka-mani House	Rattling of house hold items	No	302-369	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible / Low			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Joy K E house	Rattling of house hold items	No	276-335	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Chella-ppar K. K. house	Rattling of house hold items	No	340	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	Perceptible / Low			
	Disturbance	Not at all			
	Remarks	Dust issue from vehicle moment.			
Mr. Scbasti-an James house	Rattling of house hold items	Yes	370	-	-
	Severity of the vibration felt	Low / Moderate			
	Severity of the air-vibration/ Noise felt	Moderate / high			
	Disturbance	Slightly / Moderate			
	Remarks	Because of the study going on the intensity is low.			

		10 Wheel heavy vehicle movement also a concern.			
Mr. Roy Abraham house	Rattling of house hold items	Yes	35-156	0.524-4.474	100.0-111.5
	Severity of vibration felt	High / Very high			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Moderate / Extremely			
	Remarks	1-Fly rock. 2-Due to scarcity of water rubber plant production decreases.			

ANEXURE-17

Table A8- Complaints of house owners and measured values of vibrations during study at Granite stone quarry owned by Sudheesh A. T. Vengappally, Wayanad District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Sanoop V S	Rattling of house hold items	Yes	224	-	-
	Severity of the vibration felt	High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Moderately / Extremely			
	Remarks	Not at all			
Mrs. Devi T J	Rattling of house hold items	Yes	240	< 0.5	NA
	Severity of the vibration felt	High			
	Severity of the air-vibration/ Noise felt	High			
	Disturbance	Moderately / Extremely			
	Remarks	Water get muddy after blast in the well.			
Mr. Krishna Das	Rattling of house hold items	No	216	-	-
	Severity of the vibration felt	Low			
	Severity of the air-vibration/ Noise felt	Moderate			
	Disturbance	Slightly / Moderately			
	Remarks	Not at all			
Mr. Ranjitha B	Rattling of house hold items	Yes	400	-	-
	Severity of the vibration felt	Low / Moderate			
	Severity of the air-vibration/ Noise felt	Low / Moderate			
	Disturbance	Moderate			
	Remarks	Small cracks / fly rock observes by the owner. No sirens from quarry before blasting.			
Mr. Mini S Kumar	Rattling of house hold items	Yes	520	< 0.5	NA
	Severity of the vibration felt	Low / Moderate			
	Severity of the air-vibration/ Noise felt	Low / Moderate			

	Disturbance	Slightly			
	Remarks	Vehicle movement creating dust pollution. Feeling vibration since last two months.			
Mr. Madhusu -dhan	Rattling of house hold items	No	380	-	-
	Severity of the vibration felt	Low			
	Severity of the air-vibration/ Noise felt	Low			
	Disturbance	Slightly			
	Remarks	Movement of vehicle creating dust pollution. Nearby other quarry they are having some issue.			
Mr. Gopal K	Rattling of house hold items	Yes	190	-	-
	Severity of the vibration felt	Low			
	Severity of the air-vibration/ Noise felt	Low / moderate			
	Disturbance	Not at all / Slightly			
	Remarks	Not at all.			
Mr. Suresh Kumar V P	Rattling of house hold items	Yes	112-197	0.524– 0.66	97.5 – 103.5
	Severity of the vibration felt	High / Very high			
	Severity of the air-vibration/ Noise felt	Moderate / High			
	Disturbance	Slightly / Moderate			
	Remarks	Fly rock. Break/cracks in Well. Level of water also reduced.			
Mr. Anil Kumar	Rattling of house hold items	Yes	225-250	-	-
	Severity of the vibration felt	High / Very high			
	Severity of the air-vibration/ Noise felt	Moderate / High			
	Disturbance	Moderate / Extremely			
	Remarks	Dust pollution problem.			
Mr. Kalyani	Rattling of house hold items	Yes	186-220	-	-
	Severity of the vibration felt	High / Very high			
	Severity of the air-vibration/ Noise felt	Moderate / High			
	Disturbance	Moderate / Extremely			
	Remarks	Cracks occurs due to blasting.			

ANEXURE-18

Table A9- Complaints of house owners and measured values of vibrations during study at Granite Building Stone Quarry owned by P. M. Abdul Rahman, Thayannor Kasargod District

Name of person/ house owner	**Response/Complaints**		**Distance from Blasting patches [m]**	**Measured values of vibration [mm/s]**	**Air Overpressure [dB(L)]**
Mr. Akhil	Rattling of house hold items	None	420m	-	-
	Severity of the vibration felt	None			
	Severity of the air-vibration/ Noise felt	None			
	Disturbance	Not at all			
	Remarks	Not at all			
Mrs. P P S Nair	Rattling of house hold items	No	565	< 0.5	NA
	Severity of the vibration felt	Low / Moderate			
	Severity of the air-vibration/ Noise felt	Low / Moderate			
	Disturbance	Not at all			
	Remarks	Not at all			
Mr. Hareendran	Rattling of house hold items	Yes	356m	-	-
	Severity of the vibration felt	Moderate			
	Severity of the air-vibration/ Noise felt	Low / Moderate			
	Disturbance	Moderately			
	Remarks	This is difficult to do farming.			
Mr. Ravi	Rattling of house hold items	Yes	200m	< 0.5	NA
	Severity of the vibration felt	Moderate / High			
	Severity of the air-vibration/ Noise felt	Low / Moderate			
	Disturbance	Slightly / Moderate			
	Remarks	Small cracks/fly rock observe.			

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 12-12-2022 to 15-12-2022

Name and Address of the Stone Quarry Site	**M/s. Aducadu Granites Private Limited, Pathanamthitta, Konni, Pathanamthitta District, Kerala**			
Geo-coordinates	Latitude	09°15'05.7"N	Longitude	76°52'08.0"E

1.0. Stone Quarry Site Description

1.1 General information

M/s. Aducadu Granites Private Limited, Pathanamthitta which is attached with captive crusher unit. It is owned by Shri. Martin Varghese. As per the information provided by the stone quarry, the present quarrying lease commenced on 12.11.2019 and the validity of lease is for 5 years. This quarry has obtained Environmental Clearance dated 16.12.2017 and is valid upto15.12.2023. It also has Consent to Operate dated 12.09.2022 with validity upto12.10.2024

Area of mining is 4.3804 Ha. Nearest residential area is 62 metres from the boundary of the approved mining area. There are no forests or wildlife sanctuaries located nearby. There are no rivers or such other water bodies nearby. The approach roads to the quarry are wide and well maintained, with a length of about 500 meters to nearest major road.

This quarry cannot sell granite boulders outside other than into their captive crusher unit itself. The surrounding ground is plain, with vegetation, rubber plantation and habitations in various direction around the quarry.

1.2 Topography & Geology

Stone quarry site had the lithology of Charnockite. As per the information provided by the Unit, Charnockite group is the dominant formation of the area within which occur concordant, linear and lenosidal bodies of calc granulite and quartzitre of Khondalite Group. The Charnockite Group comprises Charnockite (hypersthenses granite), pyroxene-granulite and cordierite gneiss. The rock is generally dark grey and crudely foliated. The highest elevation in this area is 140 m above MSL and lowest elevation is 97.6 m above MSL.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, hand shovels etc. followed by controlled blasting (NONEL TECHNOLOGY) using class 2explosives. The rock braking is

done using pneumatic rock breaker and transported to the crusher site using trucks/ tippers of 15T for various products. Every day, blasting is carried out in 2 or 3 prefixed timings.

2.0 Location attributes			
2.1 Altitude (m)	60	2.2 Area (Ha)	4.3804
2.3 Terrain	Undulating	2.4 Lithology	Charnockite
2.5 Soil type	Laterite	2.6 Total Mineable reserve	1745583 MT
2.6 (a) Remaining Mineable reserve	1514167.50MT	2.6 (b) Approximate mined quantity per annum	58621MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	03	2.10 Wildlife movement (Yes/ No)	Yes

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	12-12-2022	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	13-12-2022	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	14-12-2022	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
4	15-12-2022	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations
The quarry area has a deep excavation which has more length in the east west direction than in the North South direction. From the surrounding ground level, it is 30m-50m deep. The present blasting zone is towards west of the quarry area. Hence the 50m, 100m and 200m stations towards West, South East and North East are inside the excavated area or the surrounding un-mined area.

The other points are in the higher benches outside the present blasting area. Further stations like 300m and 500m were all outside the quarry premises, in private properties. In total, 11 coordinates were fixed with the actual blasting zone as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other.

Nine locations were inside the quarry premises and 2 locations were outside the quarry premises. In the West line, beyond 200m, the land was sloping, had thicker vegetation, hence, monitoring station could not be fixed. Since, it is in the predominant upwind direction, it was of less significance, hence 500m point in the West direction could not be installed. Also, in the upwind direction SE, the farthest residence was 300m from the blasting zone as there were no structure/houses/other salient features within 500m this point and hence, this point was made the farthest point and marked as SE 500.Photographs taken during the site assessment at M/s. Aducadu Granites Private Limited, Pathanamthitta, Konni, Pathanamthitta District, Kerala is given as Annexure-1.

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations			
S. No.	***Station Points***	***Latitude***	***Longitude***
1	W50	9.2534368	76.8700689
2	W100	9.2539305	76.8700779
3	W200	9.2545877	76.8701648
4	NE50	9.2521376	76.8699002
5	NE100	9.2517865	76.869629
6	NE200	9.251175	76.8699177
7	NE500	9.249406	76.8710646
8	SE50	9.2525761	76.8692588
9	SE100	9.2522558	76.8692548
10	SE200	9.2517687	76.8691811
11	SE500	9.2515539	76.8682329

5.0 Monitoring activities

5.1 Background monitoring (13-12-2022)

The ambient air and sound monitoring started at 6:00am in all 11 stations in the quarry. The quarry activities were kept completely idle on 13th December 2022 to do ambient monitoring and all stations were ensured working properly. At each station, one Assistant Engineer / Instrument operator was stationed for the continuous monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. The ambient air monitoring had maximum outage of 4.5 hrs at one station. The weather data were recorded from a station inside the quarry at NE200 and wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 91 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used was Ammonium Nitrate– 375gm per drill hole. The CIMFR team also identified 8 locations for the seismic analysis. 4 locations were inside the quarry (NE 200, W 200, SE 200, SE 50 and quarry office) and 4 locations were outside the quarry (NE 500,2 residences, and SE 500). CIMFR Team also conducted a social survey on the response of the public about quarrying activities, through a questionnaire.

5.2 Monitoring during Stone Quarry Operation (on 14-12-2022)

The air and noise monitoring was started at 06 AM. The monitoring was continued without any interruption from beginning to end. Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and 91 no. of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 11.45am. Connections were also established for the blasting, under the overall supervision of CIMFR Team. The crusher was kept idle on quarrying monitoring day in view of the blasting activity. All the 10 blasts as planned were conducted. Immediately after the blasting was completed, regular activity such as vehicular movement, breaking of boulders using pneumatic rock breakers and hauling of the quarry product using haulers were carried out. These quarrying activities as well as monitoring of ambient air, noise levels were continued full-fledged until the end of the day at 5 pm; 11 hours in total. It was forced to be stopped due to rain.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (13-12-2022)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	09:00	26	79	6, E
2	10:00	28	66	6, SW
3	11:00	29	66	5, S
4	12:00	29	64	5, S
5	13:00	29	62	9, SW
6	14:00	28	61	10, SW
7	15:00	30	60	10, W
8	16:00	27	82	3, W
9	17:00	28	82	3, W
10	18:00	28	83	3, W

Weather: Quarrying day (14-12-2022)

S.No.	*Time (Hrs)*	*Temperature (°C)*	*Humidity (%)*	*Wind (m/s) & Direction*
1	06:00	21	93	2, E
2	07:00	23	93	2, E
3	08:00	24	80	2, E
4	09:00	26	80	2, SE
5	10:00	27	63	1, SE
6	11:00	29	63	1, S
7	12:00	27	70	1, S
8	13:00	26	84	1, S
9	14:00	26	84	1, S
10	15:00	25	84	1, S
11	16:00	25	84	1, S
12	17:00	24	97	1, S

6.2 Particulate matters/dust

- On blasting day, at 6 out of 11 monitored locations, PM10 values observed higher than those of ambient day (Non-Quarrying day), which shows the influence of quarrying activity increasing the concentration of particulate matter (PM 10). Considerably high increase in PM 10 concentration on quarrying day over nonquarrying day was found in two stations NE50 and SE100 compared to the other stations.

- At 500m stations, increase of PM10 concentration on ambient day than blasting day can be attributed to local source of pollution like road dust. Influence of quarrying cannot be seen at all in these stations.

- In a few stations other than those at 500m, ambient day concentration is more than blasting day concentration of PM10. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations of PM10 higher which also points to an inference that the influence of dust generation in blasting is negligible in PM10 compared to general ground dust from overall quarry area including roads.

- The result in Sl.no (iii)has another explanation too. The average wind-speed on ambient day was almost twice compared to blasting day which resulted in more emanation of ground dust.

- The average humidity of quarrying day is found more than that of ambient day which also contribute to the specified result.

- The results of PM2.5 shows that ambient day values are generally more than blasting day values. In NE50 where PM10 concentration had increased very much, PM2.5 concentration has also increased considerably. The explanations based on dust suppression, wind-speed, humidity and local influence at far-off stations given for PM10 hold here also.

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Table: PM10 & PM2.5 values in non-quarrying and quarrying day

Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m^3)*		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	28.16666667	55.09615385	59.70739423	36.17153309
W100	100 m	32.33525734	45.72649573	58.14187827	64.02561024
W200	200 m	20.76446281	61.86684362	83.48699037	64.45180358
W500	500 m	72.62820513	53.17307692	47.50593824	51.8408453
NE50	50 m	29.29383603	46.13095238	64.09501374	55.88044185
NE100	100 m	21.11631538	34.68992248	52.7013073	49.06225831
NE200	200 m	32.14814815	40.98883573	49.27536232	55.92366817
NE500	500 m	40.46153846	39.02777778	82.14801072	90.69943549
SE50	50 m	39.94535519	47.69283747	82.09109731	62.10966989
SE100	100 m	31.8359375	33.49236641	60.02868265	68.25735992
SE200	200 m	39.40104167	46.7769296	53.0257033	52.05205205
SE500	500 m	27.8314746	36.0479798	33.33333333	34.71220138

Fig.1: PM-10 values of Quarrying and Non-quarrying days

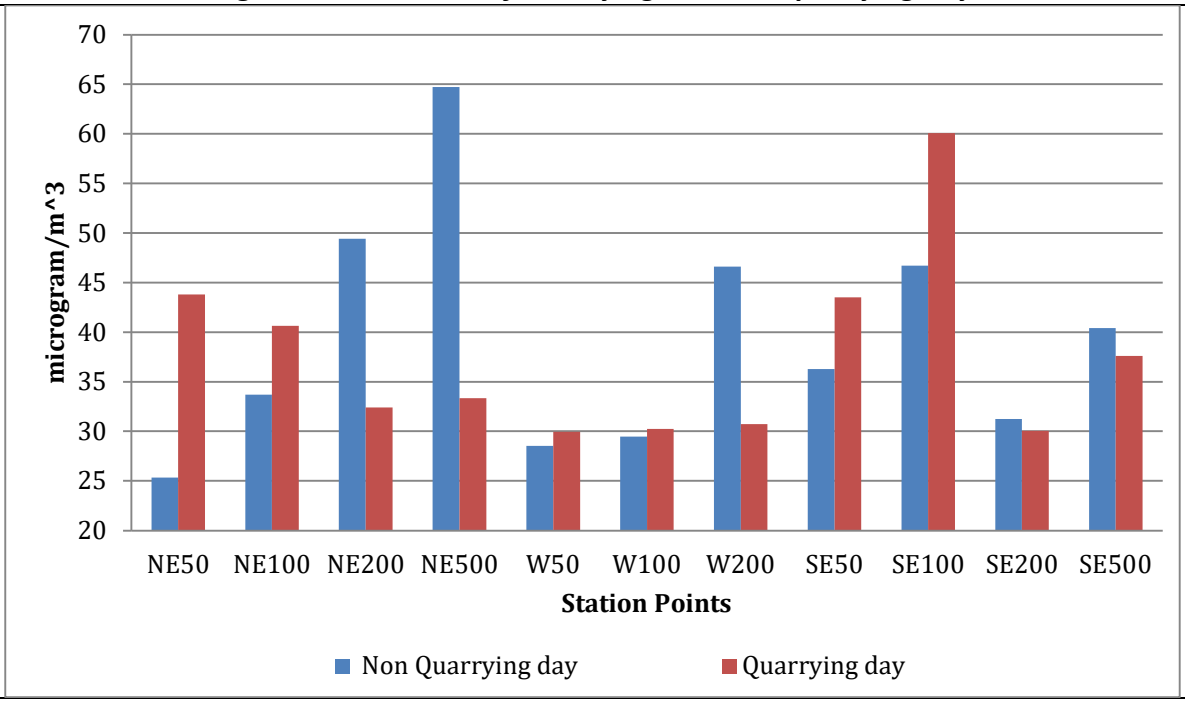
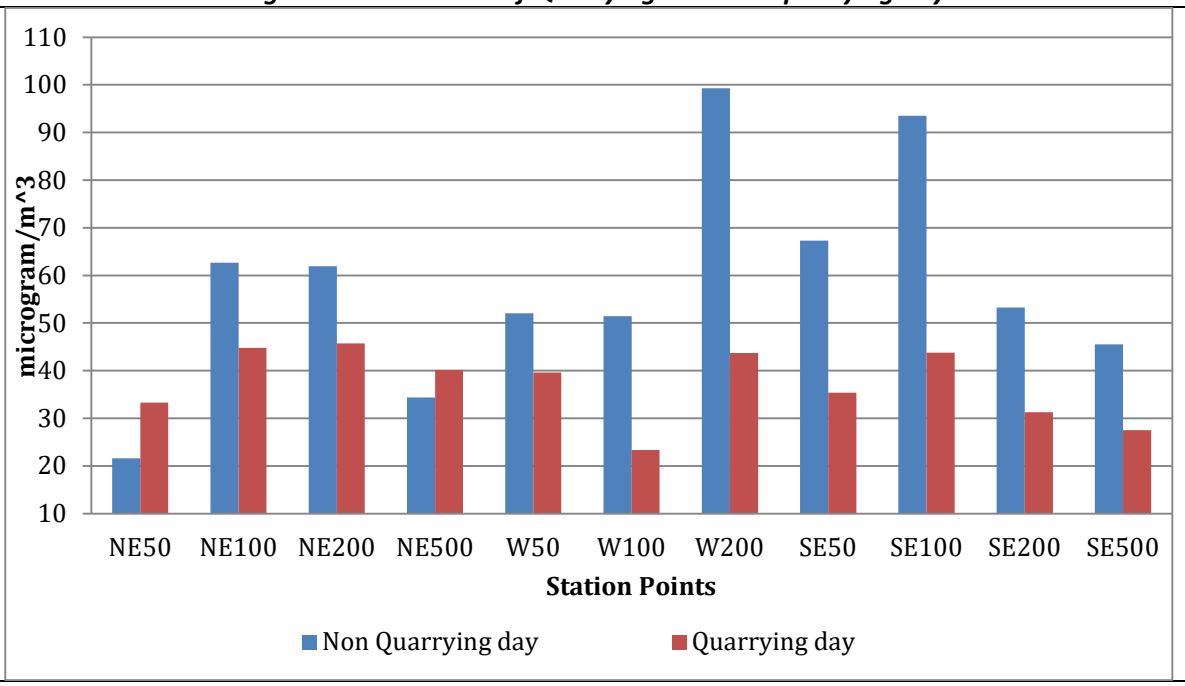


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below:

Leq= Equivalent noise level

dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level)

Observations:

- The equivalent noise level observed has higher values on blasting day than ambient day at all monitored stations.
- The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.
- More than 10 dB(A) increase in Leq was observed in all the stations except at 2 stations 500 m distant and one station 200 metre distant
- The local influences at far-off stations where influence of quarrying is very megre, resulted in minor changes in trend.
- Peak of hourly equivalent value was observed in the sixth hour which corresponds to the blasting time.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
NE 50	58.00399168	86.1	70.0604796	101.3
NE 100	52.9016632	85.6	69.9250334	104.8
NE 200	51.62918095	95.5	64.11607654	93.8
NE 500	46.61649065	78.1	49.42693878	86.1
W 50	52.78042956	90.3	69.99946052	104.2
W 100	56.08438161	87.4	70.42709207	102.5
W 200	57.13451115	92.3	56.0399376	94.8
SE 50	57.02515492	90.3	70.74838594	102.3
SE 100	60.44035033	97.8	70.82640779	106.5
SE 200	49.72105197	89.8	64.24094265	104.2
SE 500	59.57408368	86.7	58.75245192	84.4

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

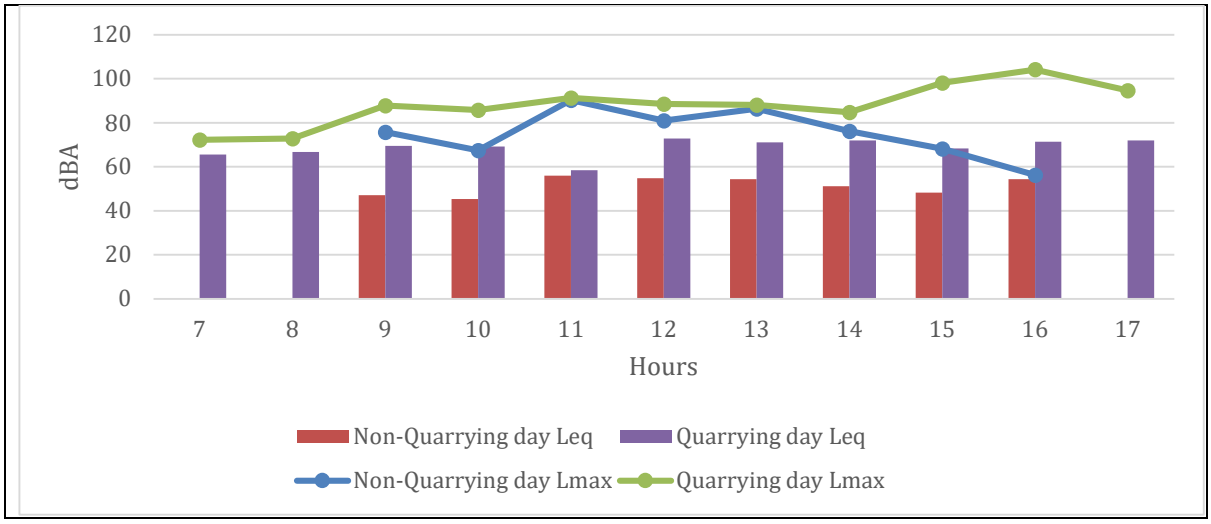


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

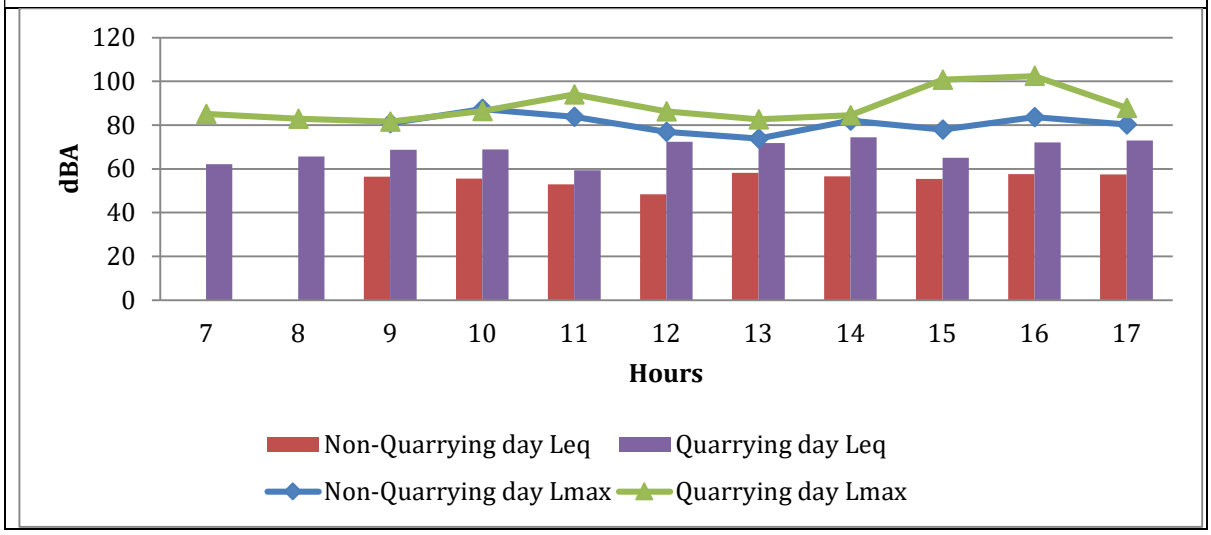


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

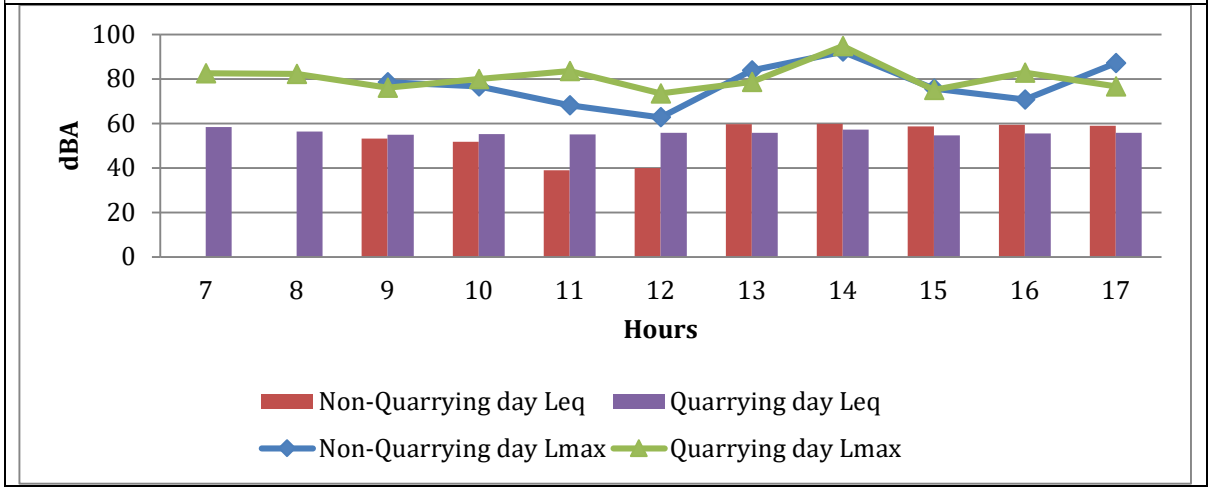


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

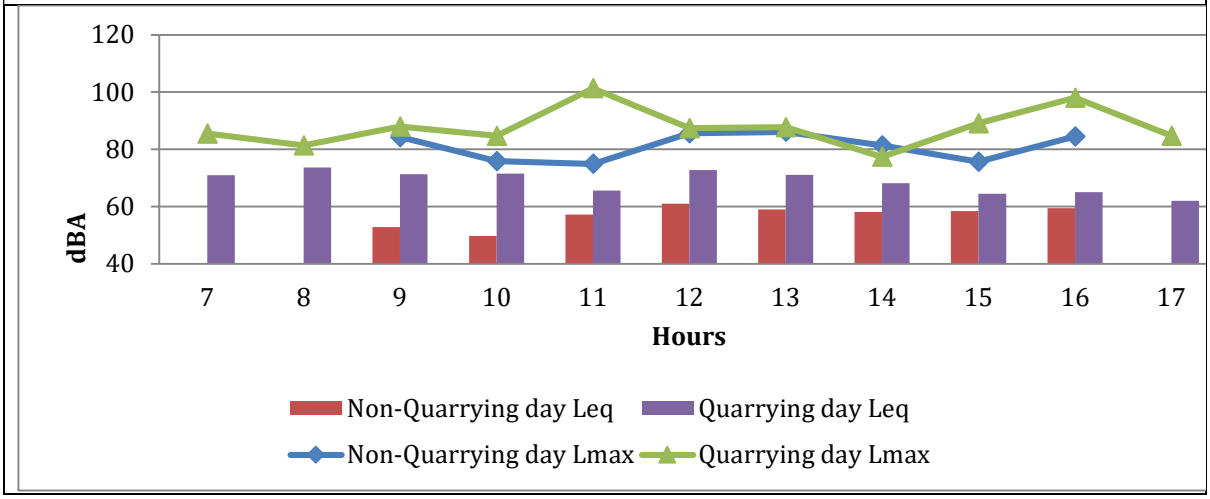


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

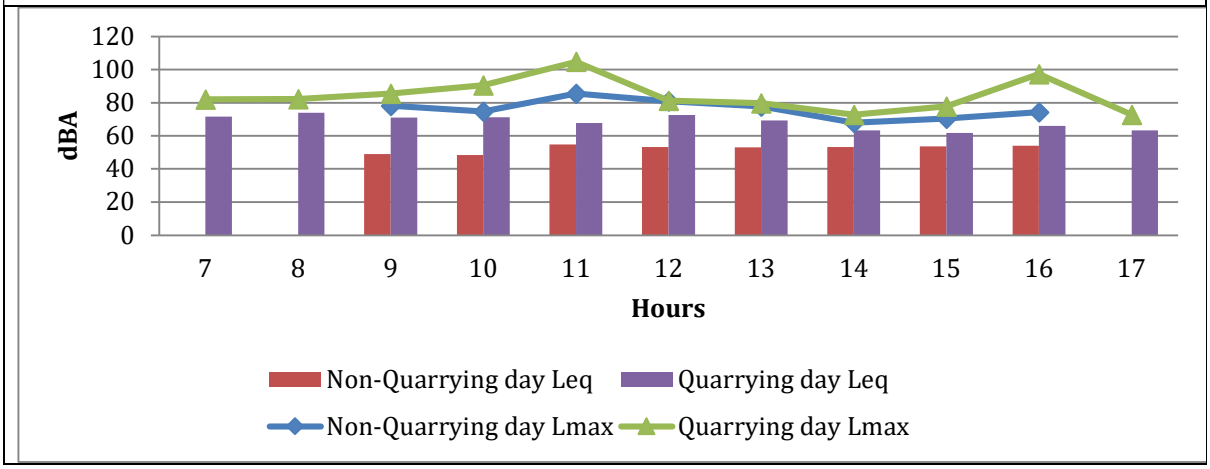


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

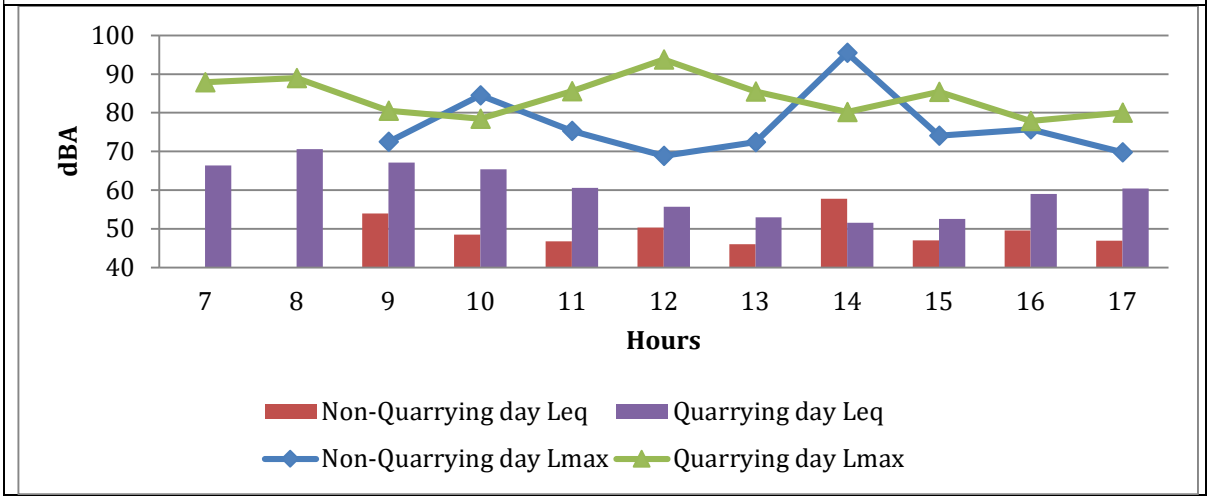


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

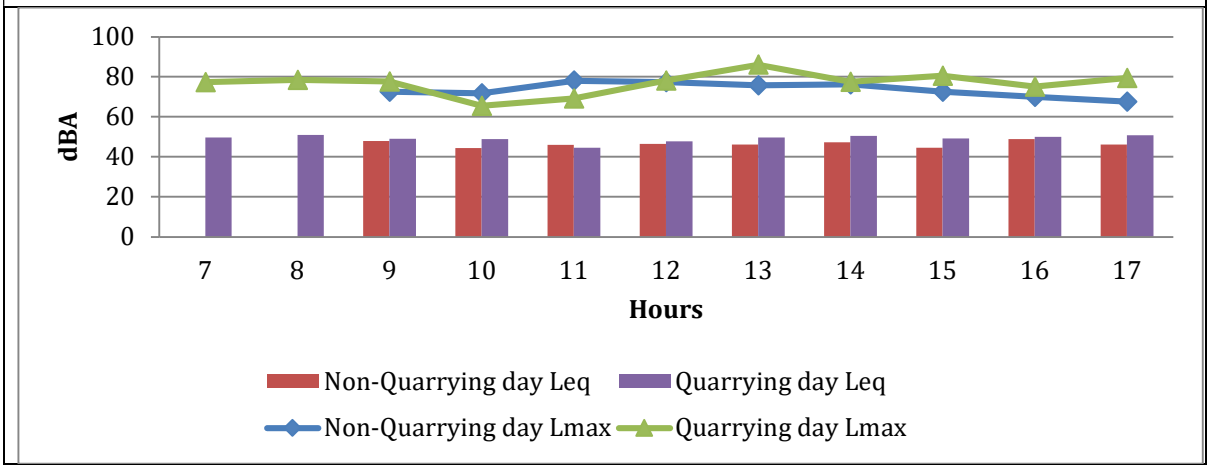


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

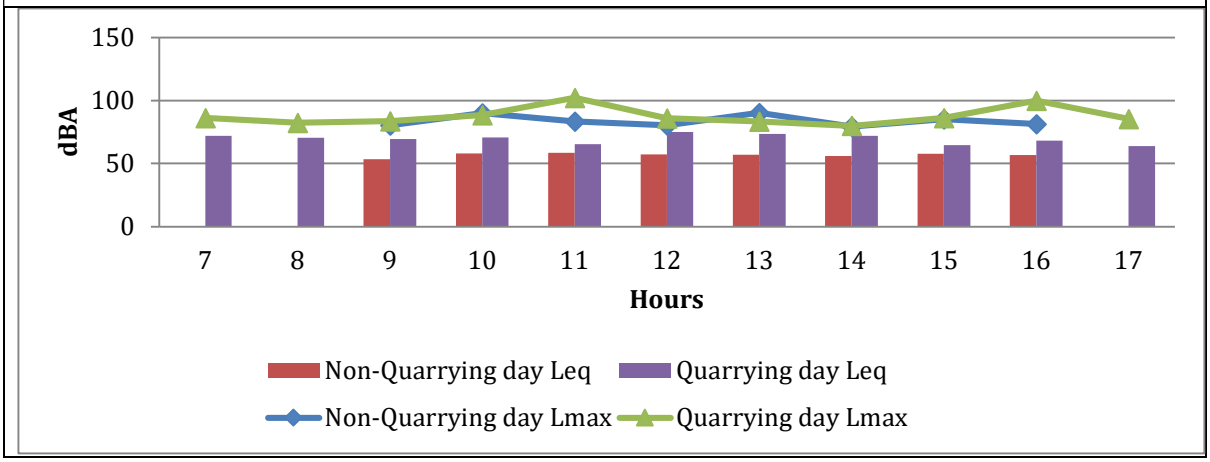


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

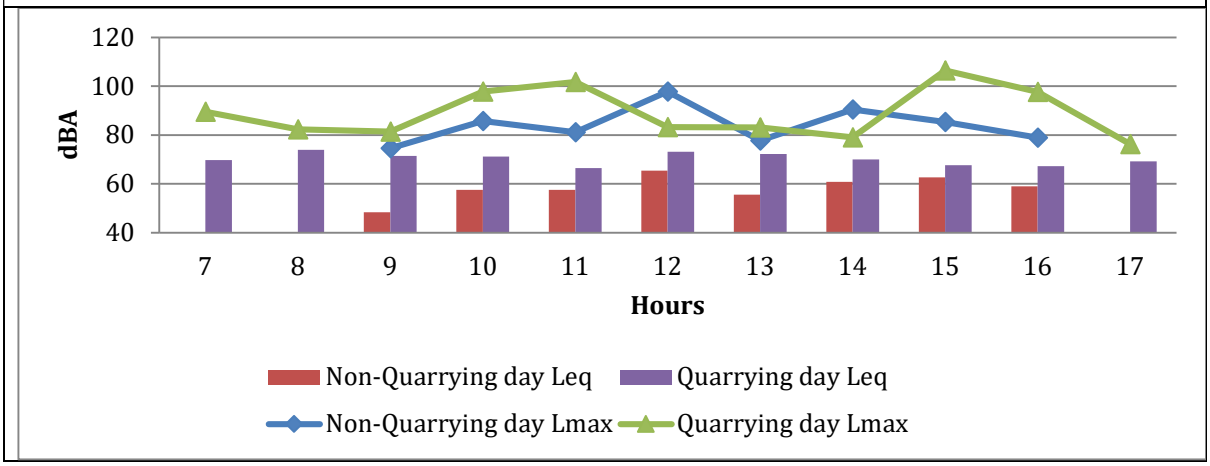


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

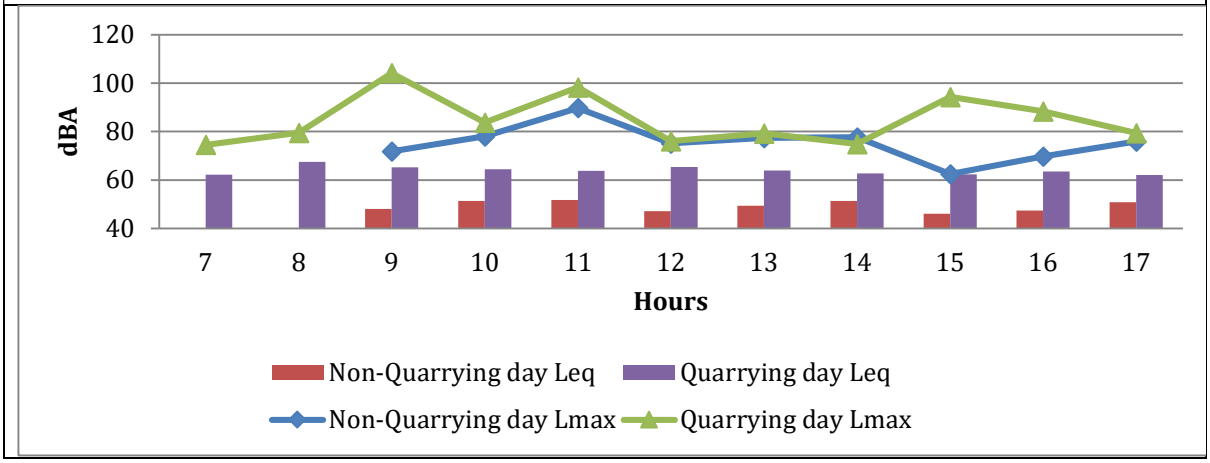


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

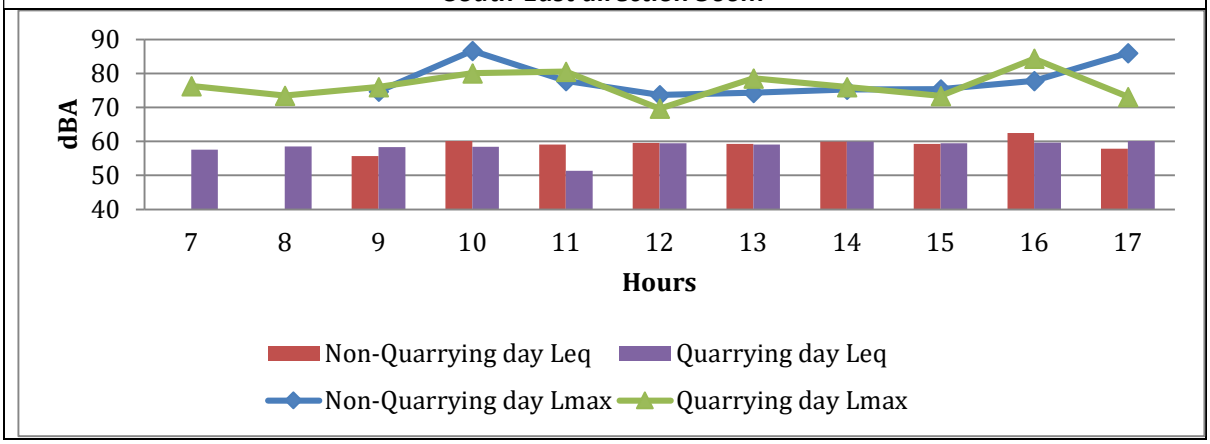
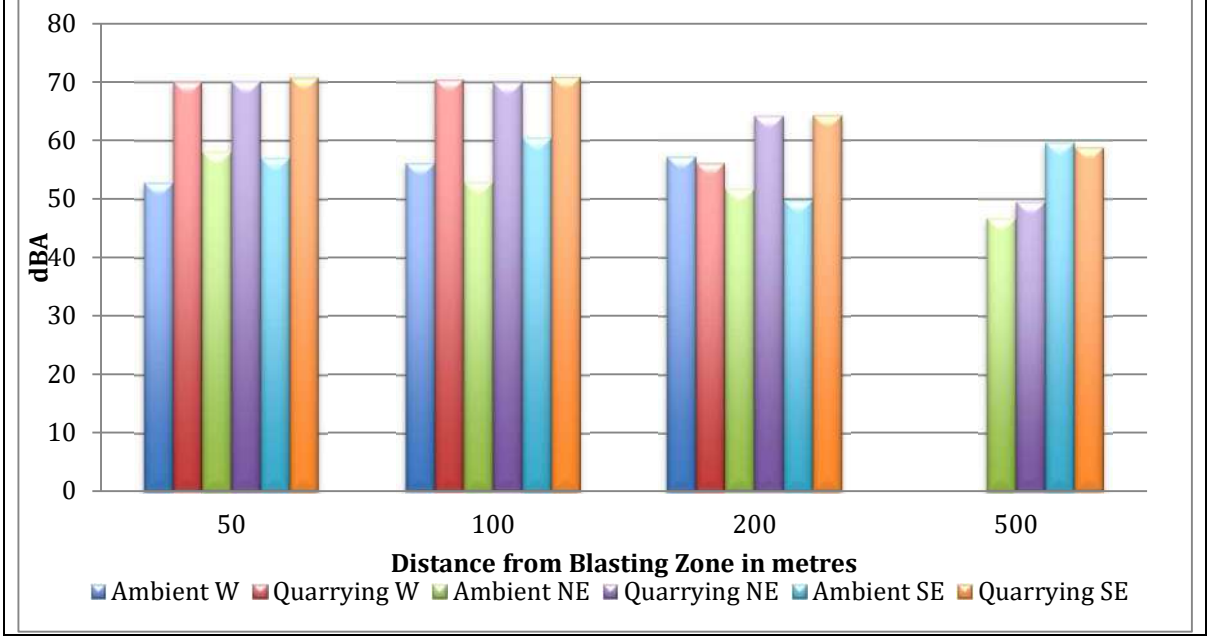


Fig.14: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: Quarry Pond			
Date of Sample: 14/12/2022			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH		6.9
2	BOD	mg/l	0.6
3	COD	mg/l	3.2
4	SS	mg/l	124
5	D.O	mg/l	4.1
6	SODIUM	mg/l	19.3
7	POTASSIUM	mg/l	8.9
8	CALCIUM	mg/l	24.8
9	MAGNESIUM	mg/l	4.86

7.0 Site specific observations made during the Visit

The quarry has a deep excavated area. High rock faces are there all around the excavation. Dust suppression is done by using dedicated tanker vehicles. A requisite personal protection equipment are given to all workers. Good shaped benches are formed and maintained. Boundary pillars are maintained intact with latitude and longitude painted on them. There is natural vegetation all around and green belt has not been developed artificially. The approach roads outside quarry premises are tarred. Settling facility is provided to remove pollutants from surface runoff during rainy season, when water from quarry excavated area is pumped out. The land surrounding the quarry premises are thickly vegetated and residences.

Photographs taken during the site assessment

Monitoring team

Quarry site

Particulate matter monitoring

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 17-12-2022 to 20-12-2022

Name and Address of the Stone Quarry Site	**Quarry of Mr. Muhammed Roshan, Cherukulam, P.O Philgiri, Kottukkal Village Kollam, Kerala 691306**			
Geo-coordinates	Latitude	08°52'54.00"N	Longitude	76°55'6.44"E

1.0. Stone Quarry Site Description

1.1 General information

Quarry of Mr. Muhammed Roshan, Cherukulam, Kottukkal Village, Kollam had the lithology of Charnockite. The present quarrying lease issued by Department of Mining and Geology, Government of Kerala, commenced on 18.06.2020 and is valid up to 23.07.2025. The quarry has obtained Environmental Clearance from State Environmental Impact Assessment Authority, Kerala on 31.10.2019 and valid up to 30.10.2024.

It also holds valid Consent to Operate of Kerala State Pollution Control Board. Area of mining is 1.21426 Ha, nearest residence is 54 metres from the quarry. The quarry is not attached to any in-house crusher. There were complaints against the operation of the quarry on matters like damages to buildings, dust pollution and noise pollution as well as damages to public roads due to vehicular movement of quarry.

The public road to the quarry from the nearest tarred road is not tarred or concreted. The approach road in the proponent's property is also not tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers or forests nearby.

1.2 Topography & Geology

Stone quarry site had the lithology of Charnockite. As per the information provided by the Unit, Charnockite group is the dominant formation of the area within which occur concordant, linear and lenosidal bodies of calc granulite and quartzitre of Khondalite Group. The Charnockite Group comprises Charnockite (hypersthenses granite), pyroxene-granulite and cordierite gneiss. The highest elevation of the mine area is 140 m above MSL and the lowest is 97.6 m above MSL.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, hand shovels etc. followed by controlled blasting (NONEL TECHNOLOGY) using class 2explosives. The rock braking is done using pneumatic rock breaker and transported to the crusher site using

trucks/ tippers of 15T for various products. Everyday, blasting is carried out in 2 or 3 prefixed timings.

2.0 Location attributes			
2.1 Altitude (m)	80	2.2 Area (Ha)	1.21426
2.3 Terrain	Undulating	2.4 Lithology	Charnockite
2.5 Soil type	Laterite	2.6 Total Mineable reserve	232620 MT
2.6 (a) Remaining Mineable reserve	309865 MT	2.6 (b) Approximate mined quantity per annum	46524 MT
2.7 Slope	Sloping	2.8 Fault	---
2.9 Distance from nearest forest (Km)	25	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	17-12-2022	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	18-12-2022	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	19-12-2022	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
4	20-12-2022	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations
The quarry area has slightly deep excavation. From the surrounding ground level, it is

20m-30m deep. The present blasting zone is towards east of the quarry area which has more length in the east west direction than in the North South direction. Towards the North East side, the quarry is open to an extent of about 100m from the blast area. Hence the 50m, 100m stations towards West, South East and North East are inside the open quarry land itself.

The other points are in the higher benches outside the present blasting area. Further stations like 200m and 500m were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other.

Six locations were inside the quarry and 6locations were outside the quarry premises. Photographs taken during the site assessment at Quarry of Mr. Muhammed Roshan, Cherukulam, Kollam District, Kerala is given as Annexure-1..

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations

S.No.	*Station Points*	*Latitude*	*Longitude*
1	W50	8.881297	76.9182856
2	W100	8.8812516	76.9185924
3	W200	8.881301	76.9195794
4	W500	8.8838507	76.9208122
5	NE50	8.8806862	76.9174363
6	NE100	8.8804791	76.9167725
7	NE200	8.880205	76.9155471
8	NE500	8.8800982	76.9133000
9	SE50	8.8812911	76.9172013
10	SE100	8.8815349	76.9169603
11	SE200	8.8824491	76.9167655
12	SE500	8.8848153	76.9154981

5.0 Monitoring activities

5.1 Background monitoring (18-12-2022)

The monitoring personnel and supervisors were ready to start ambient air and noise monitoring at 6 am. But there were problems with power supply in all the stations. These problems were resolved in about two hours. Thus, ambient air and noise monitoring could be started at 8:00am only. The quarry activities were kept completely idle on 18thdecember to do ambient monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. The weather data were recorded from a station inside the quarry and wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east. Monitoring continued up to 17.00.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 106 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used was Ammonium Nitrate - 375gm per drill hole. The CIMFR team identified 8 locations for the seismic analysis. 2 locations were inside the quarry (W 50,SE 50) and 6 locations were outside the quarry (W200, NE200, NE500,SE200,residence,church). They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 6.00pm.

5.2 Monitoring during Stone Quarry Operation (on 19-12-2022)

The air and sound monitoring started at 06 AM at all 12 stations. The monitoring was continued without any interruption from beginning to end. Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and approximately 56 no. s of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 10am. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 8 locations by 10:20am and 1st set of blasting was completed by 10:45am. Another 50 no.s of holes for 2nd blasting were drilled by 01pm and CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 8 locations by 01.20pm and blasting was completed by 02pm.About 10 experimental blasts were conducted. Immediately after the blasting was completed, vehicular movement, breaking of boulders using pneumatic rock breakers and hauling of the quarry product using haulers were carried out. These quarrying activities continued full-fledged until 5 pm. From 5 pm, there started a slight rain which forced quarrying activities as well as air quality and noise level monitoring to be stopped.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (18-12-2022)				
S.No.	***Time(Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	10:00	29.6	63.9	2.3SE
2	11:00	29.6	53.8	2.7S
3	12:00	30	60.4	2.1W
4	13:00	30.9	55.8	3SE
5	14:00	33.4	51	2SE
6	15:00	32.4	54.1	1W
7	16:00	31.3	54	1.4W
8	17:00	30.9	54.5	1.2S
9	18:00	29.9	56.8	2W
10	12:00	30	60.4	2.1W

Weather: Quarrying day (19-12-2022)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	25.5	65.2	0.9S
2	07:00	25.1	67.4	0.6SE
3	08:00	27.5	65.8	0
4	09:00	29.2	62	0.9W
5	10:00	28	63.1	0.9SE
6	11:00	29.7	53	0.6SE
7	12:00	29.4	52.8	2.8SE
8	13:00	29.3	48.2	2.1E

9	14:00	29	48.6	0.5S
10	15:00	28.5	49.7	0.8SE
11	16:00	27.9	58	0.3W
12	17:00	29.2	62	0.9W

6.2 Particulate matters/dust

- Generally, PM10 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter.

- In 500m stations, increase of PM10 concentration on ambient day than blasting day can be attributed to local source of pollution like road dust. Influence of quarrying cannot be seen at all in these stations.

- In a few stations other than those at 500m, ambient day concentration is more than blasting day concentration of PM10. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations of PM10 higher which also points to an inference that the influence of dust generation in blasting is negligible in PM10 compared to general ground dust from overall quarry area including roads.

- The result in Sl.no (iii) has another explanation too. The average windspeed on ambient day was almost twice compared to blasting day which resulted in more emanation of ground dust. The average humidity of quarrying day is found more than that of ambient day which also contribute to the specified result. The high relative humidity finally ended up in a slight rain from 5 pm onwards.

- The results of PM2.5 shows that ambient day values are generally more than blasting day values. The explanations based on dust suppression, windspeed, humidity and local influence at far-off stations given for PM10 hold here also.

Table: PM10 & PM2.5 values in non-quarrying and quarrying day					
Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m³)*		PM 2.5 (microgram/m³)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	78.92416226	82.0337765	140.9440983	69.46127556
W100	100 m	71.27739985	45.81190849	97.78827853	56.15453729
W200	200 m	91.75022418	70.59610706	58.38078842	55.45670225
W500	500 m	90.42790906	64.51247166	80.31575566	66.08839323
NE50	50 m	78.54300582	80.97222222	73.0077904	55.44839321
NE100	100 m	50.98002844	54.16584381	45.96481923	24.35323599
NE200	200 m	79.2022792	71.34272916	74.87391411	87.39450949
NE500	500 m	84.42901235	67.96653797	56.54945507	111.1455108
SE50	50 m	116.7755991	139.2885563	160.710418	60.79963397
SE100	100 m	122.3674655	89.50496343	119.5182913	47.56860399
SE200	200 m	67.6727909	62.42307692	136.6478639	50.87927287
SE500	500 m	81.23931624	65.60606061	67.16561121	53.34306366

Fig.1: PM-10 values of Quarrying and Non-quarrying days

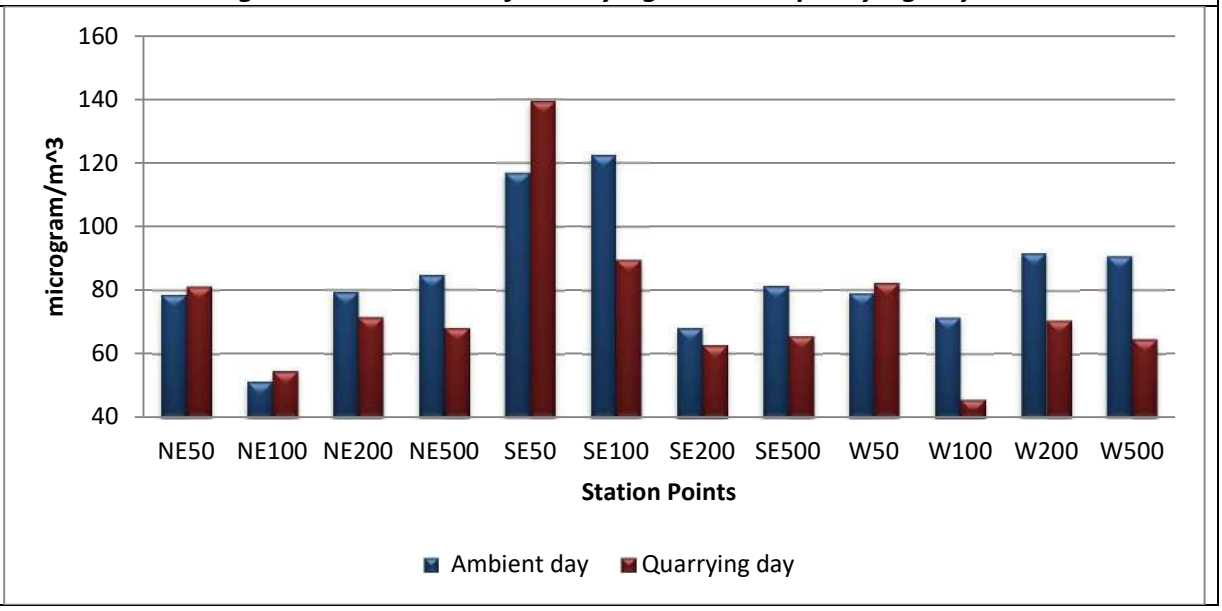
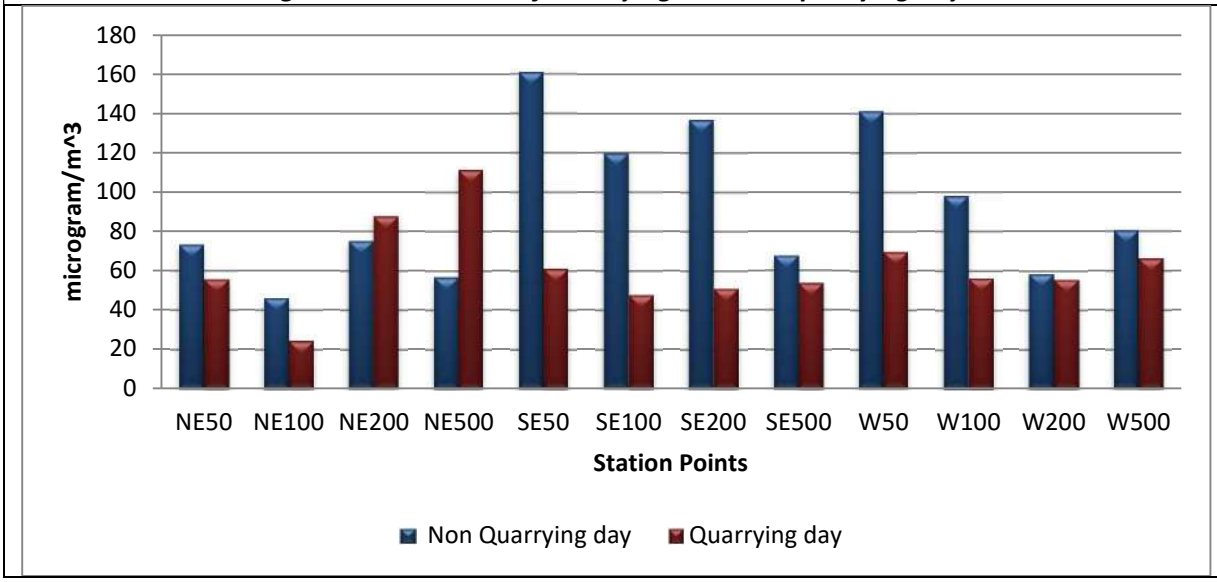


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below:

Leq= Equivalent noise level

dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level)

Observations:

- The equivalent noise level of the total day is higher on blasting day than ambient day at all stations generally.
- The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.
- The local influences at far-off stations where influence of quarrying is very megre, resulted in minor changes in trend.
- Peaks of hourly equivalent value can be seen during the first blasting time between 10 and 11 am; as well as during the second blasting between 1 pm and 2 pm.
- The slight rain on the quarrying day forced monitoring to be stopped at 5 pm on quarrying day.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.				
Station Points	**Non-quarrying Day Noise Levels**		**Quarrying Day Noise Levels**	
	L_{eq}	**L_{max}**	**L_{eq}**	**L_{max}**
W 50	54.29344707	87.7	61.88412714	97.1
W 100	55.5466646	76.6	75.0587176	102.3
W 200	53.38335616	76.7	54.13946653	88.1
W 500	58.99250481	94.6	53.18761785	87
NE 50	54.056252	98.3	62.98739564	105.1
NE 100	53.77288815	87.4	55.08860101	89.2
NE 200	56.16364337	87.3	57.32232136	88.5
NE 500	52.07046942	75.9	52.72569194	82.7
SE 50	60.22093328	87.9	69.14438369	108.8
SE 100	57.62129315	89.7	62.97071852	96.4
SE 200	52.36995282	82.3	50.52911622	75.9
SE 500	54.26444264	92.6	53.90914749	90.8

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

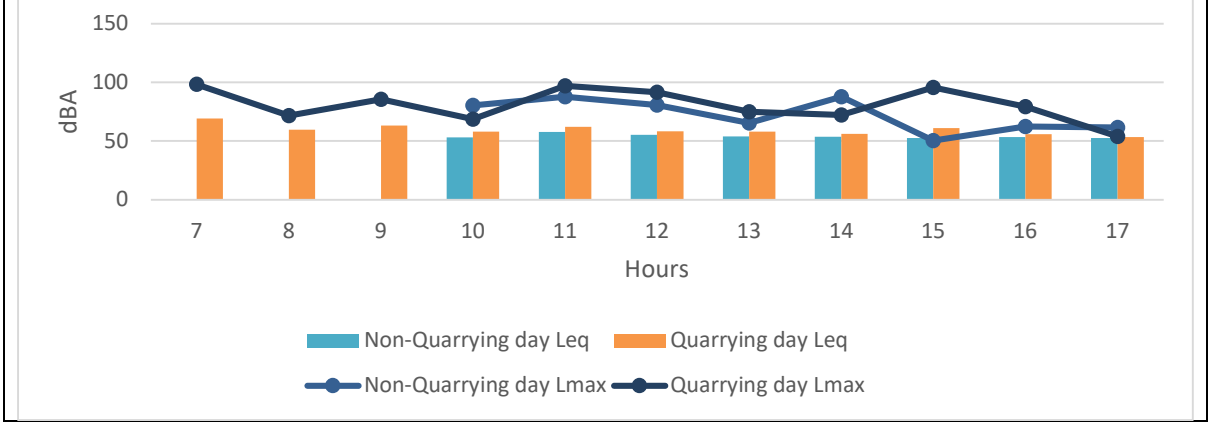


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

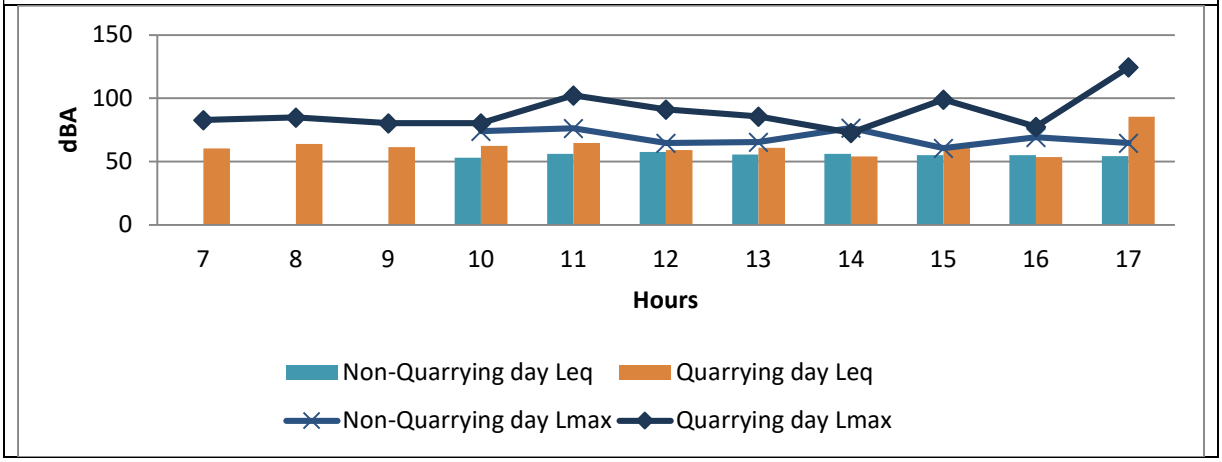


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

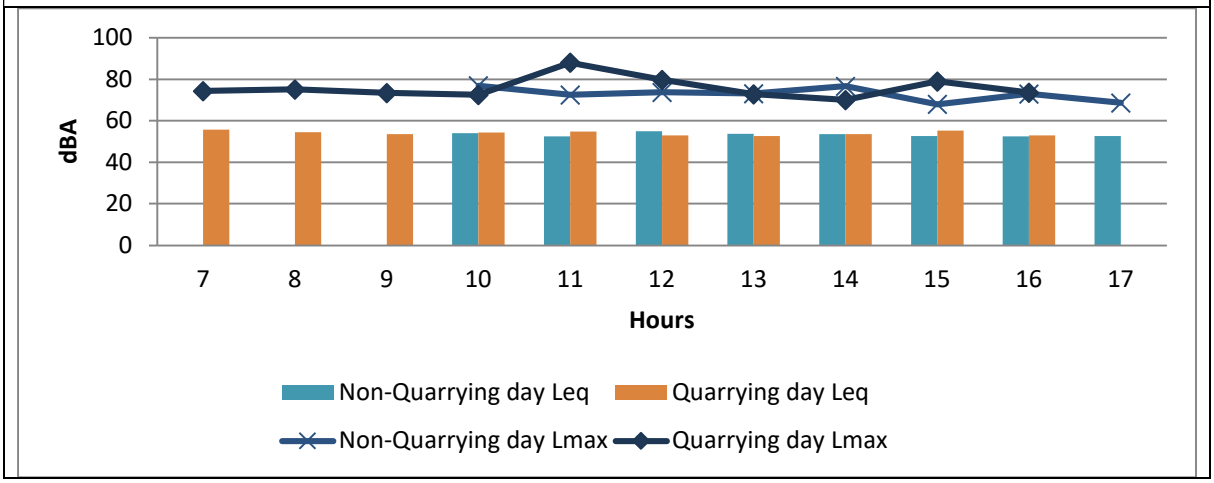


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 500m

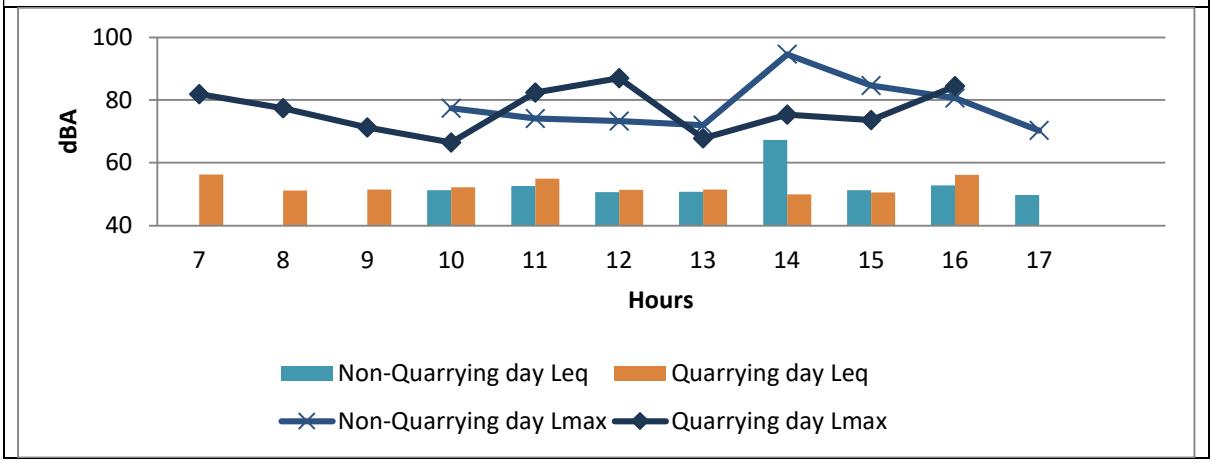


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

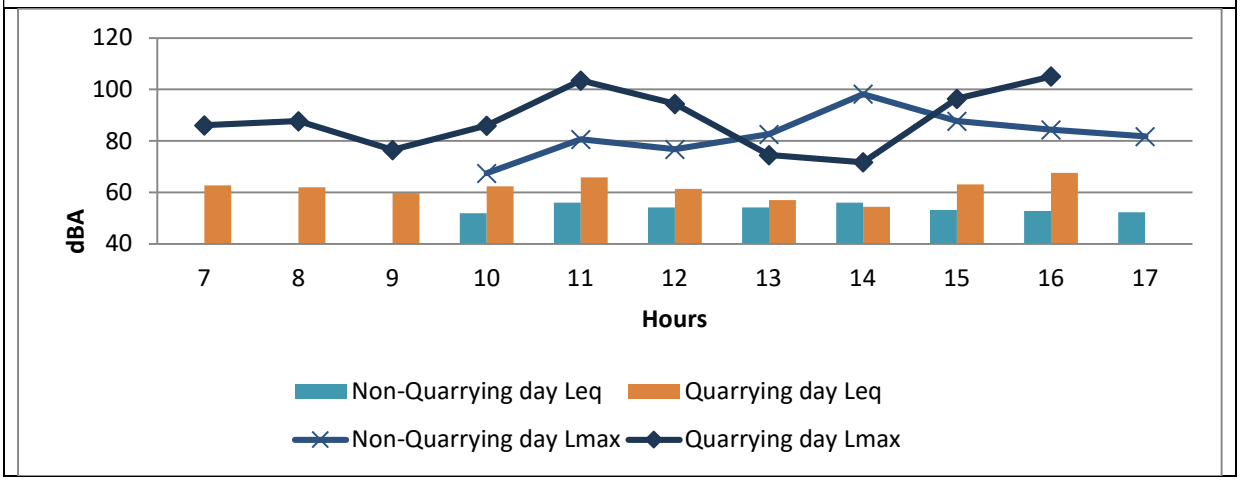


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

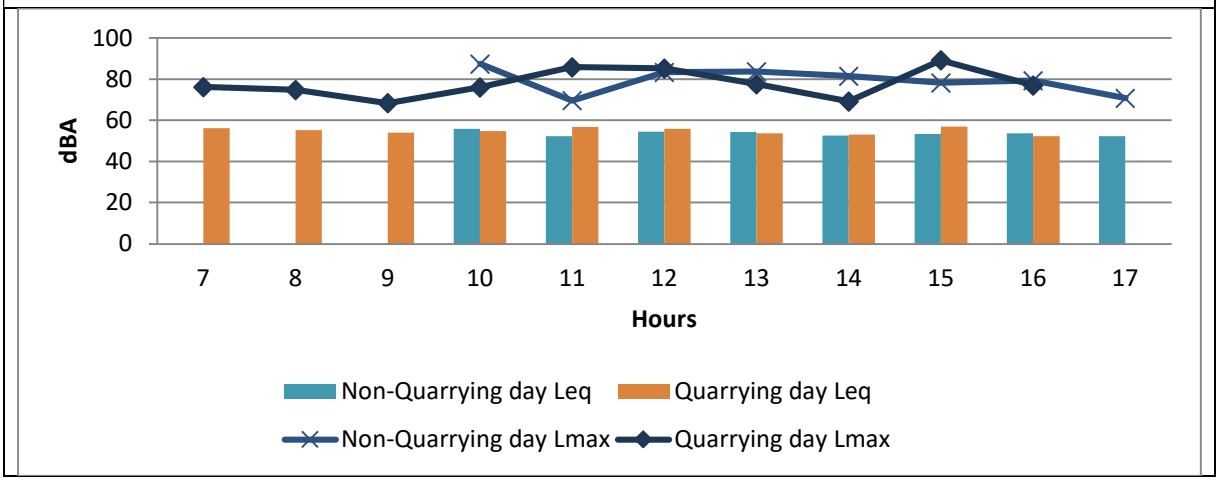


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

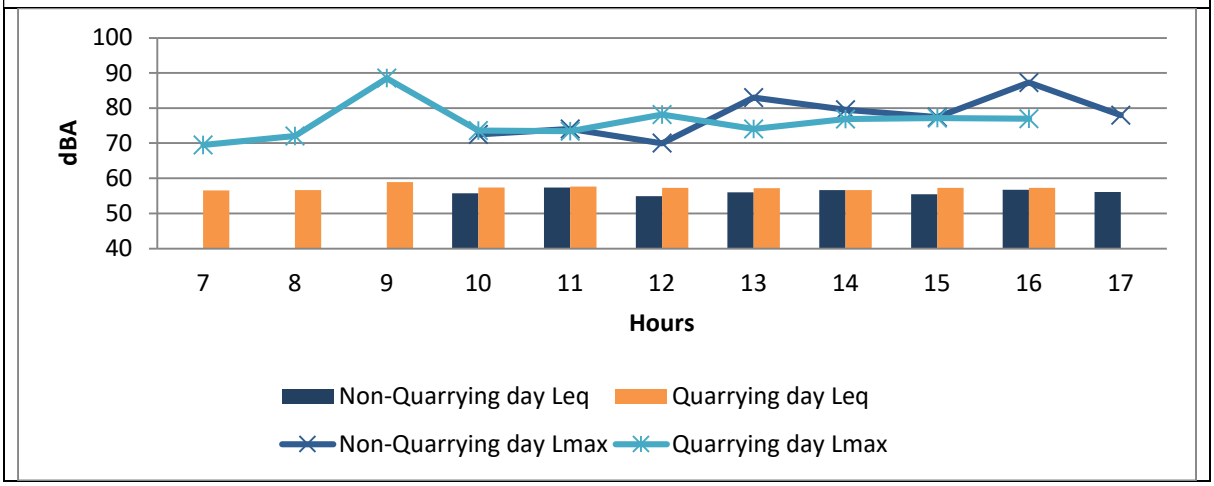


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

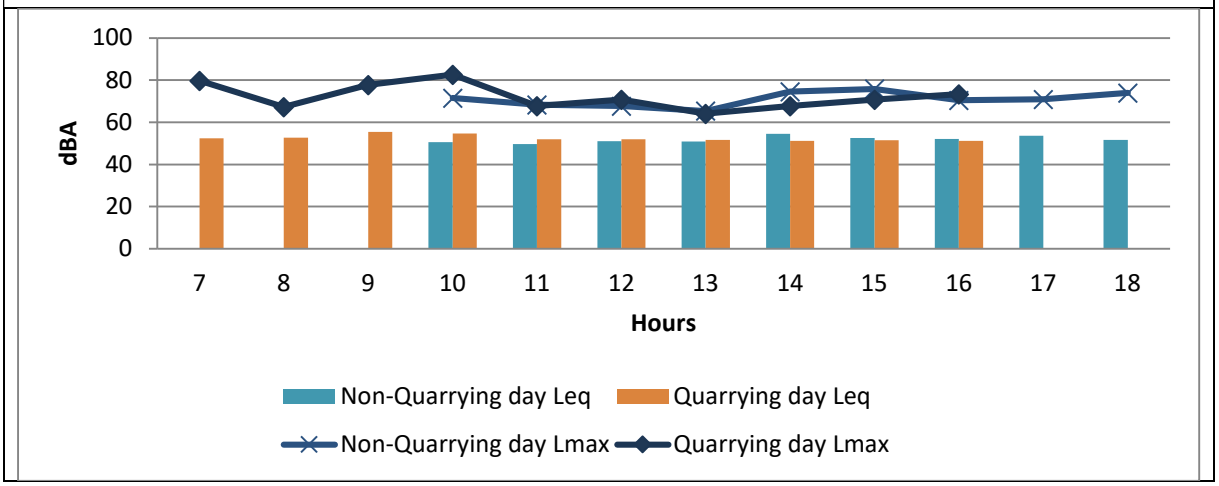


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

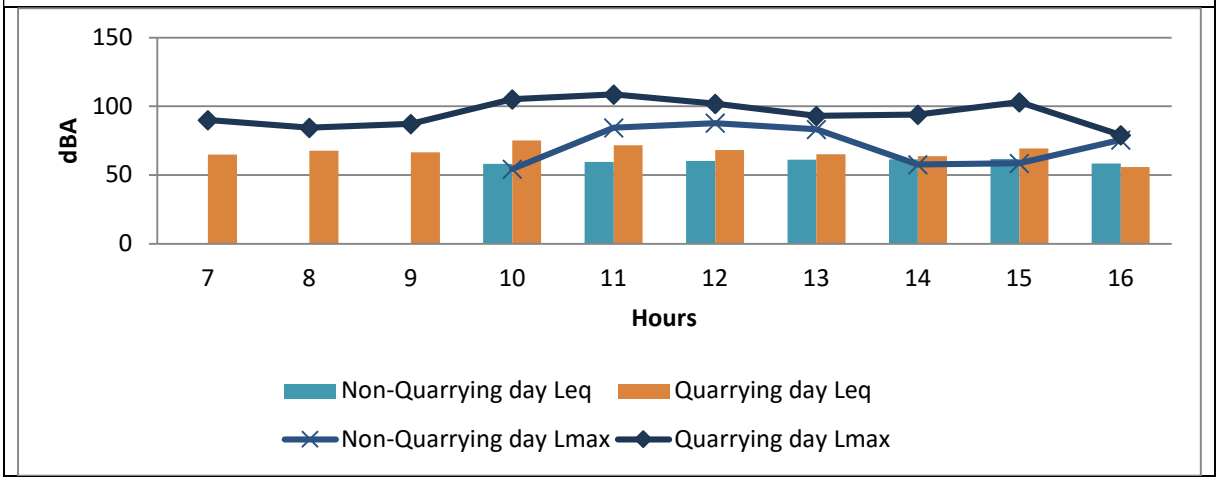


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

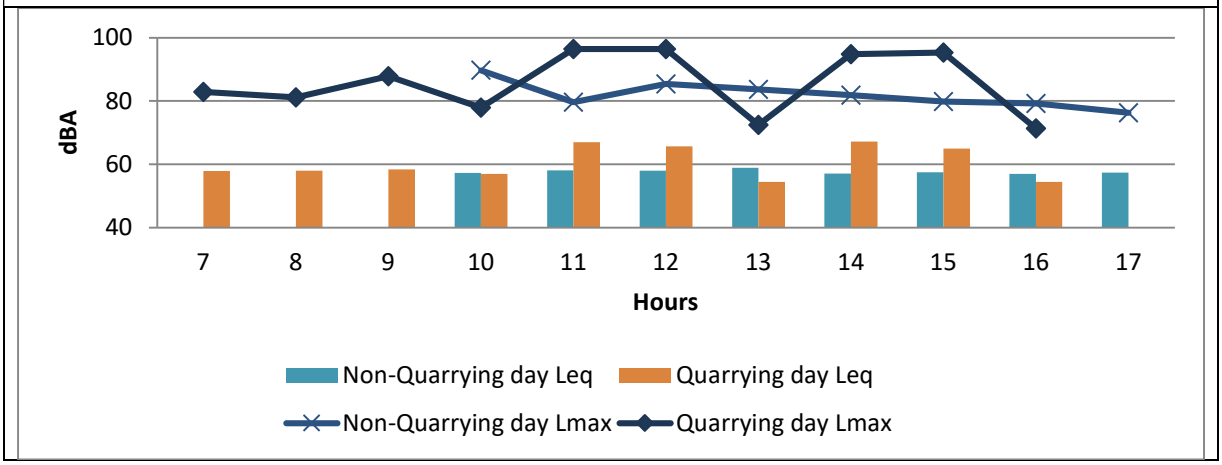


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

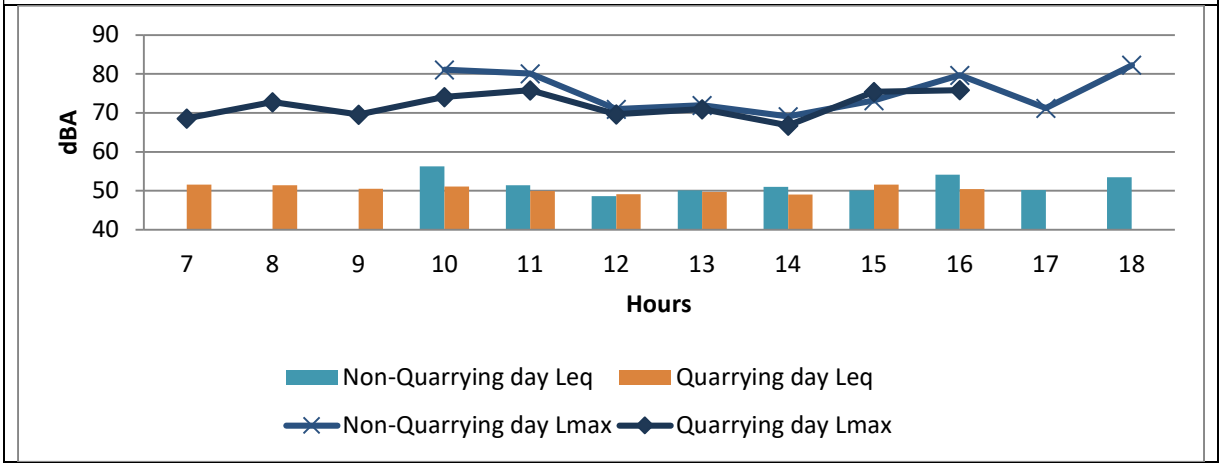


Fig.14: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

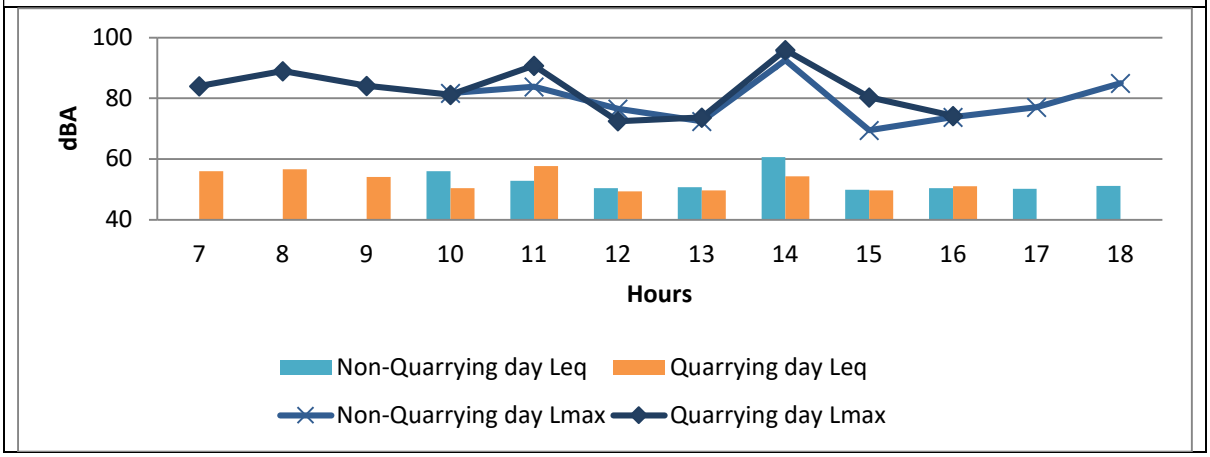
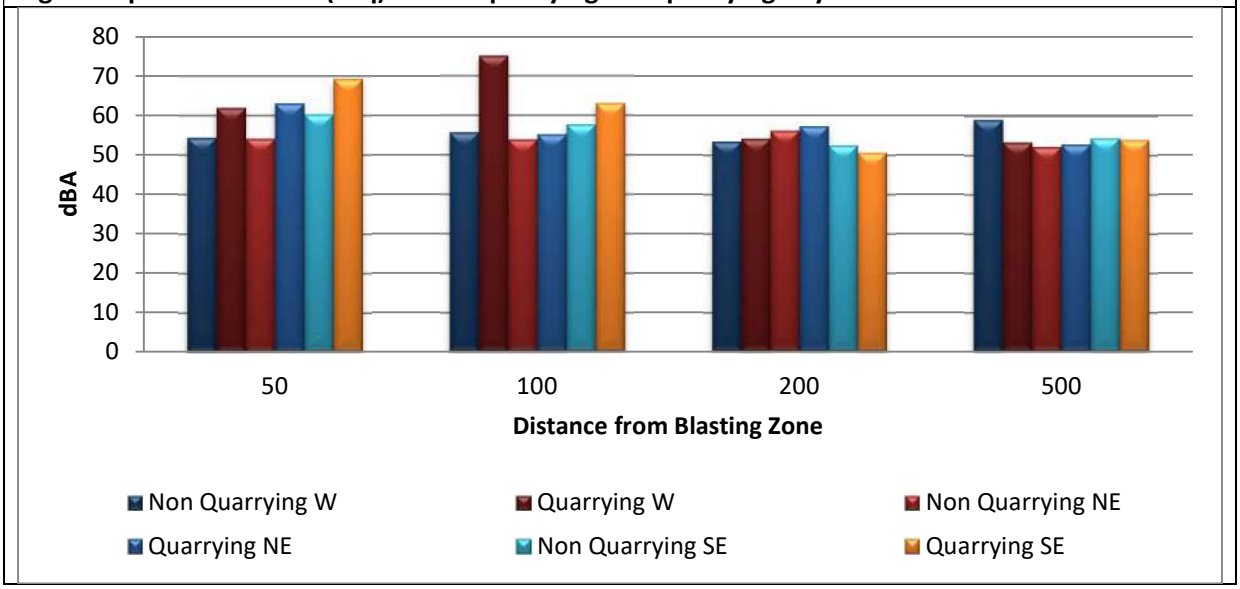


Fig.15: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: New Quarry Pond			
Date of Sample: 19/01/2023			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH	-	7.4
2	SS	mg/l	192.4
3	TDS	mg/l	345.7
4	CONDUCTIVITY	µS/cm	948.9
5	D.O	mg/l	8.1
6	SODIUM	mg/l	199.5
7	POTASSIUM	mg/l	160.32
8	CALCIUM	mg/l	63
9	MAGNESIUM	mg/l	34

7.0 Site specific observations made during the Visit

Good benching is provided, the surrounding ground is plain, with vegetation and habitations in various direction around the quarry. Buffer zones with 7.5 metres are maintained correctly. For dust suppression, a dedicated tanker vehicle is provided for water sprinkling Fencing is provided, boundary pillars are marked and fixed, sign boards are provided, PPEs like safety boots and helmets are provided as well as blasting shelter. There are no wildlife movements reported. CSR activities as mandated in the Environmental Clearance like helps for local schools and for medical camps are done by the proponent.

Photographs taken during the site assessment

Monitoring team

Quarry site

LOCATION: KOLLAM

Quarry site

Particulate matter monitoring

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 21-12-2022 to 24-12-2022

Name of the study site/ location	**M/s. Poabs Granites Pvt. Ltd. Kuthirakalam, Thiruvananthapuram**			
Address	**Kuthirakalam P.O, Vellanadu, Thiruvananthapuram, Kerala - 695543**			
District/ State	**Thirivananthapuram/ Kerala**			
Geo-coordinates	Latitude	08°52'54.00"N	Longitude	76°55'6.44"E

1.0 Study site description

1.1 General information

M/s. Poabs Granites Pvt. Ltd (PGBL), Kuthirakalam, Thiruvananthapuram owned by Shri. Aby Mathew is having the lithology of Garnet- Biotite Gneiss with Migmatite. As per the information provided by the stone quarry operator, the present stone quarrying lease commenced on 15.03.2018 and having validity of lease from 19-10-2022 to 18-10-2034. The Environmental Clearance issued by State Environmental Impact Assessment Authority (SEIAA) is having validity from 15-3-2018 to 14-3-2024. The stone quarry operator obtained Consent to Operate from Kerala State Pollution Control Board vide dated 11-10-2019 is having validity up to 31-10-2024. Area of mining is 5.9747 Ha, nearest residential area is 55 metres from the quarry. The proponent has a stone crusher which is located at 8 km distance from the stone quarry site. River Karamana is at 60 metres away from the boundary of the total area owned by the proponent. There are no forests within 10 km from the existing stone quarry.

1.2 Topography & Geology

As per the information provided by the stone quarry operator, the highest elevation of the mine area is 120 m above MSL and the lowest elevation is 35 m above MSL. The Archaean crystalline rocks comprise Khondalite group, Charnockite group and Migmatite group. Khondalite group is composed of garnetiferous biotite- sillimatite gneiss, with occasional bands of calc-granulite and quartzite, and constitutes the major rock type. Charnockites are acidic to intermediate in composition. Migmatites are evenly distributed in the central part of the district as narrow zones withingarnetiferous sillimanite gneiss. The surrounding ground is plain, with vegetationand habitations in various direction around the quarry. As per the lithological map, the rock type is Charnockite.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, hand shovels etc. followed by controlled blasting (NONEL TECHNOLOGY) using catridge slurry explosives. The rock breaking is done using pneumatic rock breaker and transported to the crusher site using trucks/ tippers of 15T. The quarry is developing by forming proper benches. Every day, blasting is carried out in 2 or 3 prefixed timings. Dust suppression activity is carried out in the mining area by means of water sprinkling using dedicated sprinkler tanker vehicles.

2.0 Location attributes			
2.1 Altitude (m)	35	2.2 Area (Ha)	5.9747
2.3 Terrain	Undulating	2.4 Lithology	Charnockite
2.5 Soil type	Laterite	2.6 Mineable reserve	19,12,631.25 MT
2.6 (a) Remaining Mineable reserve	31,95,815 MT	2.6 (b) Approximate mined quantity per annum	2,50,000 MT
2.7 Slope	Moderate	2.8 Fault	--
2.9 Distance from nearest forest (Km)	None near by	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	21-12-2022	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	22-12-2022	Air quality and noise monitoring carried out during the operation of quarry including drilling and blasting (06.00 to 18.00 Hrs.) as well as sampling of pond water for assessment of water quality
3	23-12-2022	Background monitoring of ambient air quality and noise levels without any activities in the quarry (06.00 to 18.00 Hrs.)
4	24-12-2022	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring plan and locations

The quarry area has slightly deep excavation. From the surrounding ground level, it is 05-08m deep. The present blasting zone is towards south of the quarry area which has more length in North South direction. Hence the 50m, 100m, 200m stations towards West, South West and North East are inside the open quarry land itself. Further stations like 500m were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-West line each at an angle of approximately 120° to each other. 9 locations were inside the quarry and 3 locations were outside the quarry premises. The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 11 blasts which consist of 319 holes, each hole having 32mm diameter and 5 ft – 8 ft depth. The explosive used was Ammonium Nitrate in the range of 375 to 550 gm per drill hole. The CIMFR team identified 8 locations for the seismic analysis which includes 4 locations inside the quarry and 4 locations outside the quarry. CIMFR team also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. Photographs taken during the site assessment of M/s. Poabs Granites Pvt. Ltd. Thiruvananthapuram is given as **Annexure-PGPL1.**

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations

Co-ordinate details of the selected monitoring locations is given in **Table 1** below:

Table 1. Geo-coordinates of selected sampling locations at M/s. Poabs Granites Pvt. Ltd. Kuthirakalam, Thiruvananthapuram

S.NO	Station Points	Latitude	Longitude
1	W50	8.5430970	77.0076580
2	W100	8.5431300	77.0071370
3	W200	8.5442220	77.0061050
4	W500	8.5445900	77.0050310
4	NE50	8.5387080	77.0058430
5	NE100	8.5412830	77.0077010
6	NE200	8.5409658	77.0076176
7	NE500	8.5387080	77.0077010
8	SW50	8.5432800	77.0083460
9	SW100	8.5435960	77.0085660
10	SW200	8.5444150	77.0087714
11	SW500	8.5457730	77.0098600

5.0 Monitoring Activities

5.1 Monitoring during quarry operation (22-12-2022)

The ambient air and noise monitoring started at 06 AM. The monitoring was continued without any interruption from beginning to end. Before blasting, drilling of blast holes using jack hammers was started from 6 am onwards and approximately 319 no. s of blast holes were drilled ranging from 5ft to 8 ft depth and while drilling necessary precautions such as covering the drilling hole with the wet gunny bag and sprinkling of water as dust suppression measure during drilling operation. Thereafter, filling of explosives into each hole were completed at 11am. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 8 locations by 10:20am and 1st set of blasting was completed by 11:25am and blasting were conducted by 12 noon. Immediately after the blasting activities were completed which includes vehicular movement, breaking of boulders using pneumatic rock breakers and hauling of the quarry product using haulers. These quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all 12 stations by 6 PM. Entire blasting activity were carried out under over all supervision of the CIMFR experts

5.2 Background monitoring (23-12-2022)

The ambient air and noise level monitoring started at 6:00am at all 12 monitoring stations. The quarry activities were kept completely idle during ambient air quality and noise monitoring. All the 12 monitoring stations ensured working properly. At each station, one AE / NAMP operator were deployed for the monitoring. The Noise data, air flow rates and total volume of sucked air were recorded every one hour. The weather data were recorded from a station inside the quarry and wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east. The monitoring was completed iat all 12 stations by 6 PM. Ambient air quality and Noise level monitoring were carried out during quarrying and non-quarrying day under overall supervision of Kerala State Pollution Control Board.

6.0 Results

6.1 Weather

The weather data were monitored every hour using Weather Tracker inside the quarry with respect to wind velocity, humidity and temperature and the details are given in **Table 2 & Table 3** below.

Table 2. Weather Details Observed during Quarrying Day (22-12-2022)

Sl. No.	Time (Hrs)	Temperature (Degree Celsius)	Humidity (Percentage)	Wind Speed & Direction (m/s)
1	06:00	24.7	86.3	0.3W
2	07:00	24.8	90	0.8SE
3	08:00	26.9	86.3	1W
4	09:00	29.9	76	1.5W
5	10:00	31.1	71.3	1.1SE
6	11:00	36.1	60.1	0.8SE

7	12:00	38.1	68	0.6S
8	13:00	33.7	61.4	0.3SE
9	14:00	31.6	73.3	0.4SE
10	15:00	30	68.9	0.6W
11	16:00	29.	66.9	0.9S
12	17:00	29.9	76.4	0.4NE
13	18:00	28.3	78.4	0.4NE

Table 3. Weather Details Observed during Non-quarrying day (23-12-2022)

Sl. No.	Time (Hrs)	Temperature (Degree Celsius)	Humidity (Percentage)	Wind Speed & Direction (m/s)
1	07:00	25	83.2	0.3E
2	08:00	26	75.9	0.8SE
3	09:00	30.2	71.3	1SE
4	10:00	31.1	69.5	1.5W
5	11:00	32.6	62	1.1SE
6	12:00	32.5	55.7	0.8NE
7	13:00	32.4	53.8	0.6W
8	14:00	33.9	56.6	0.3W
9	15:00	33	60.4	0.4SE
10	16:00	30.4	60	0.6SE

6.2 Particulate matters/ dust in terms of PM10 and PM2.5 values observed during Non-Quarrying day (23.12.2022) & Quarrying Day (22.12.20222)

Particulate matters/ dust in terms of PM10 and PM2.5 values observed during quarrying day (22.12.20222) and non-quarrying day (23.12.2022) are given in **Table 4 and Fig 1 to Fig 2** in subsequent paras

Table 4: PM10 and PM2.5 values observed during non-quarrying day (23.12.2022) & quarrying day (22.12.20222)

Station Points	Distance from blasting zone (metre)	PM 10 (microgram/m³)		PM 2.5 (microgram/m³)	
		Ambient day	Quarrying day	Ambient day	Quarrying day
W50	50 m	63.94871795	55.56612549	103.5820896	58.12459859
W100	100 m	48.55177408	65.06011609	52.39768592	65.99702235
W200	200 m	67.77184959	56.23400791	53.64455364	53.00713558
W500	500 m	35.21582734	54.48877289	33.70786517	36.09777244
NE50	50 m	229.7703071	108.9419137	81.60867826	57.45974477
NE100	100 m	62.68011527	73.27694236	49.26744705	58.247674999
NE200	200 m	44.29104478	46.46825397	49.5915986	51.41325536
NE500	500 m	91.54301817	98.6013986	87.21935504	93.93939394
SW50	50 m	66.24681934	64.7941981	59.49566588	39.48306595
SW100	100 m	59.52836201	64.88247863	56.23781676	62.05158038
SW200	200 m	84.4840386	62.47863248	155.0102249	61.50186884
SW500	500 m	64.2912471	68.87248554	48.92966361	53.59276327

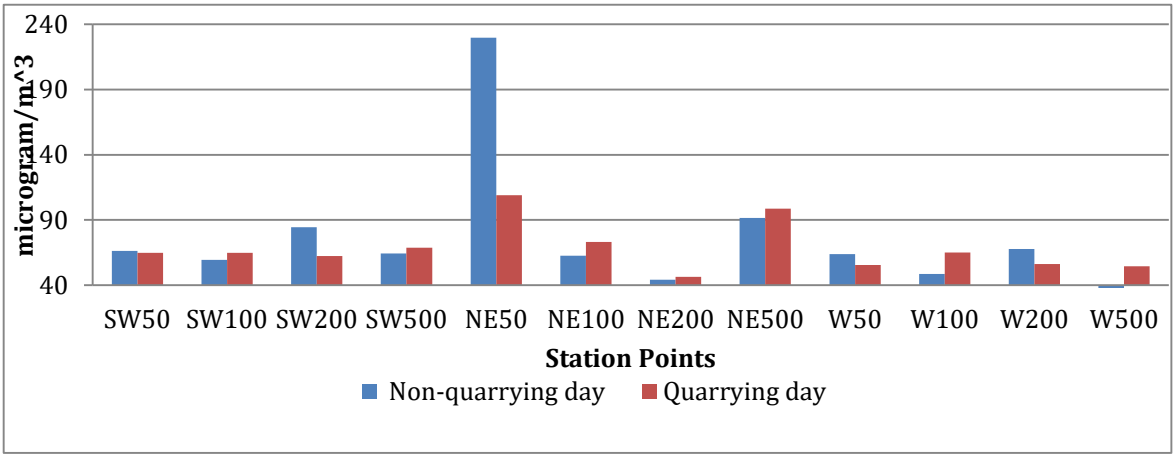


Fig.1: PM-10 values observed during Quarrying and Non-quarrying day

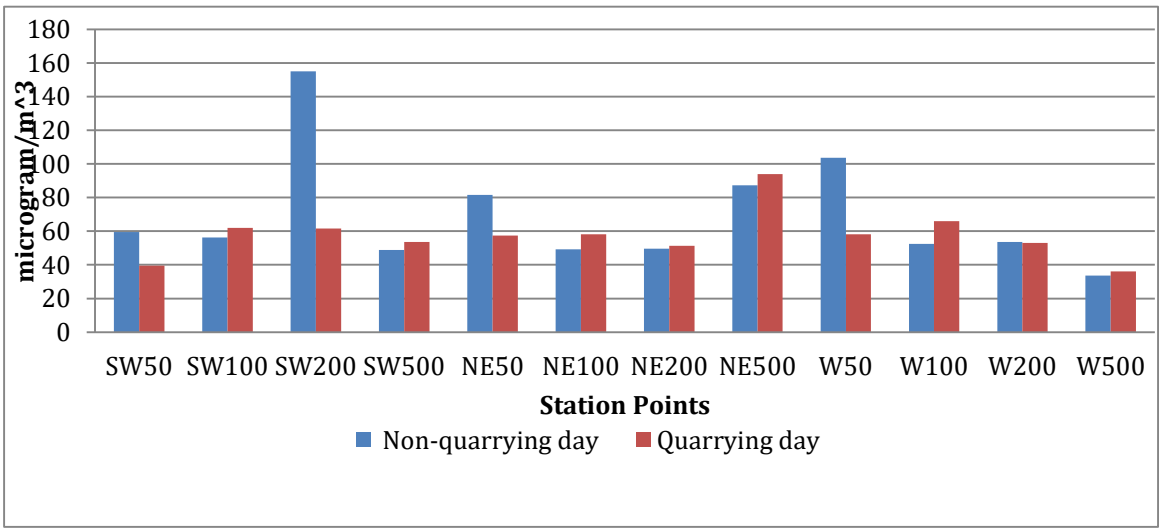


Fig.2: PM-2.5 values during Quarrying and Non-quarrying day

The analysis results of ambient air quality monitoring carried out during non-quarrying day (23.12.2022) & quarrying day (22.12.20222) reveal that

(i) PM10 and PM2.5 values of blasting day can be seen to be higher than those of ambient day. This can be seen in stations W100, W500, NE100, NE200, NE500, SW100 and SW500. This shows the influence of quarrying in increasing the concentration of particulate matter.

(II) In W50, W200, NE50, SW50, SW200 ambient day concentration is more than blasting day concentration of PM10 and PM2.5. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations of PM10 and PM2.5 higher which also points to an inference that the influence of dust generation in blasting is negligible compared to general ground dust from overall quarry area including roads.

6.3 Noise levels

Observed Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) during Non-quarrying day (23.12.2022) & Quarrying day (22.12.20222) are given in the **Table 5 and Fig.3 to Fig.15** below:

Table 5: Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) observed during Non-quarrying Day (23.12.2022) and Quarrying Day (22.12.2022)

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	58.10103272	88	60.35579001	85.7
W 100	60.23934074	113.1	60.35579001	113.3
W 200	51.92853845	82.1	52.49189013	85.3
W 500	64.55989243	86	66.25880987	92.8
NE 50	58.3871514	81	62.22410406	99.2
NE 100	56.40258189	75	56.30615294	93.2
NE 200	56.70712467	83.3	61.90459753	96.7
NE 500	44.86672029	87.5	56.64365701	116.1
SW 50	66.29737349	89.3	63.7793145	97.3
SW 100	56.10543712	76.9	65.35265828	89.9
SW 200	56.09726463	77.2	62.19810515	87.1
SW 500	54.37083537	79.2	69.8202551	82.6

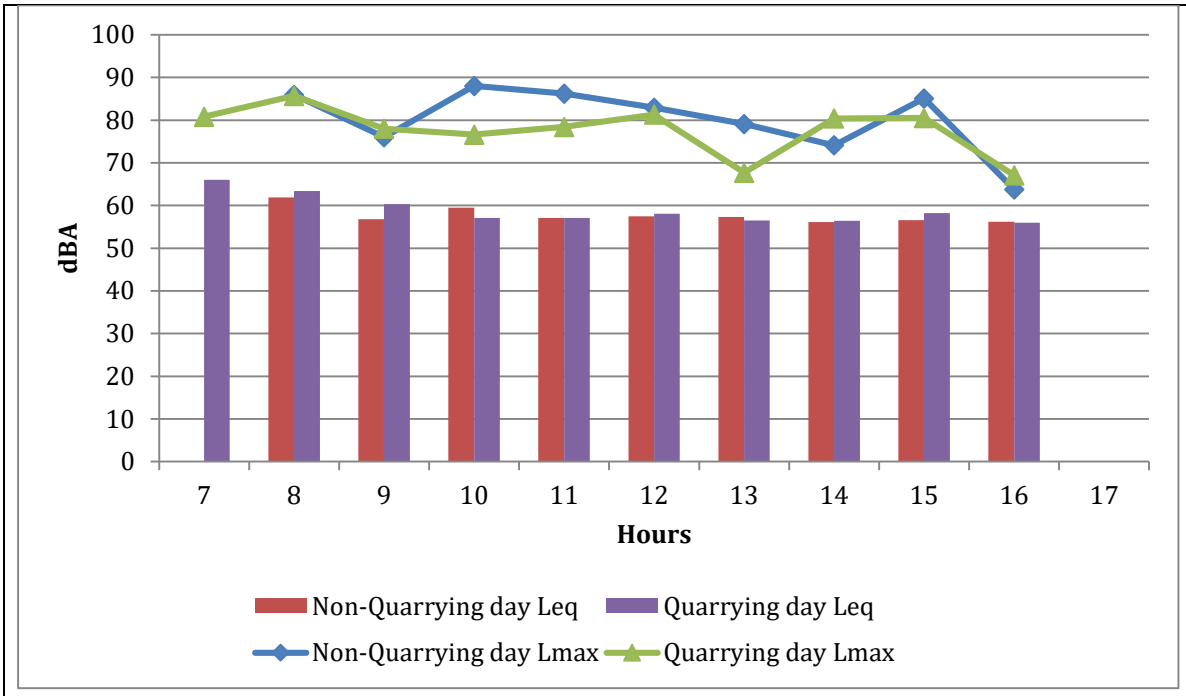


Fig.3: Equivalent values (Leq) and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

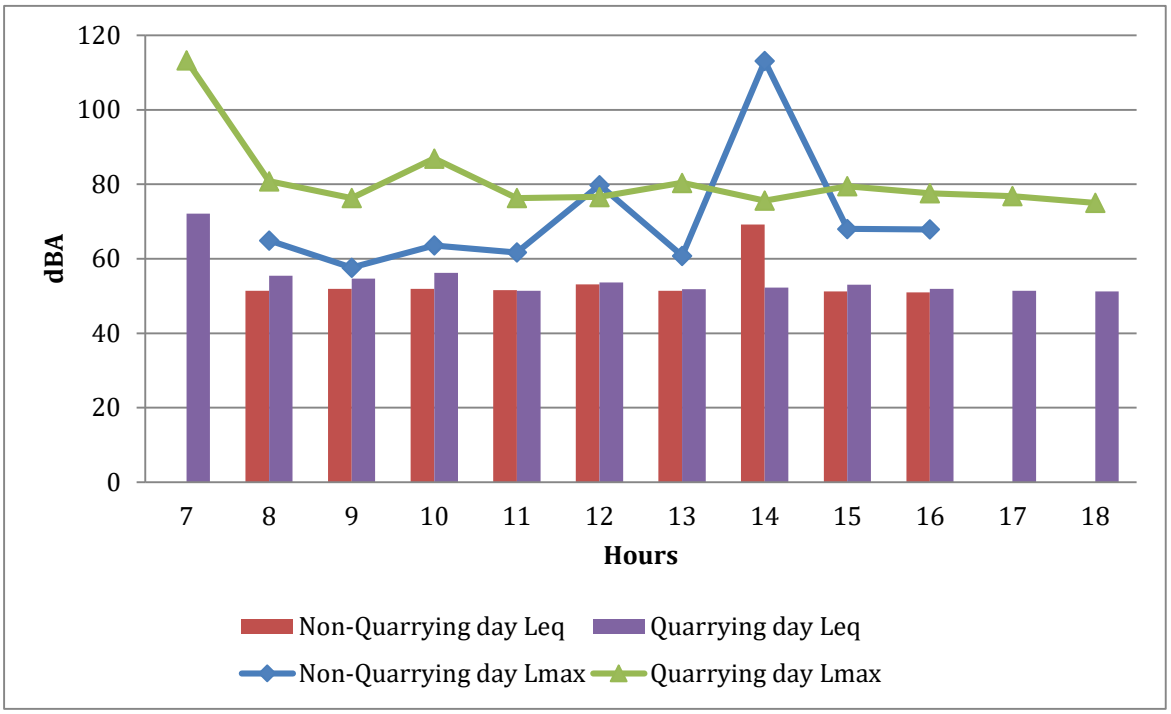


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

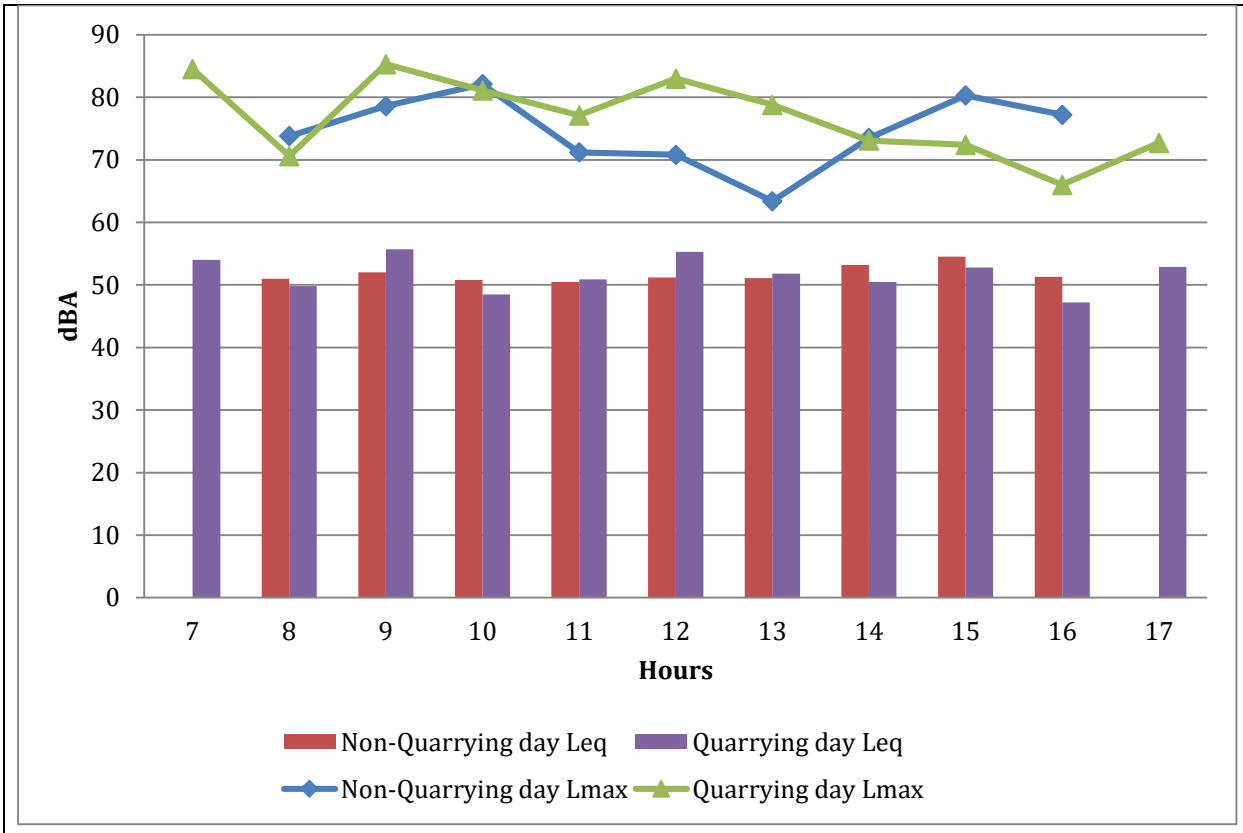


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 200m

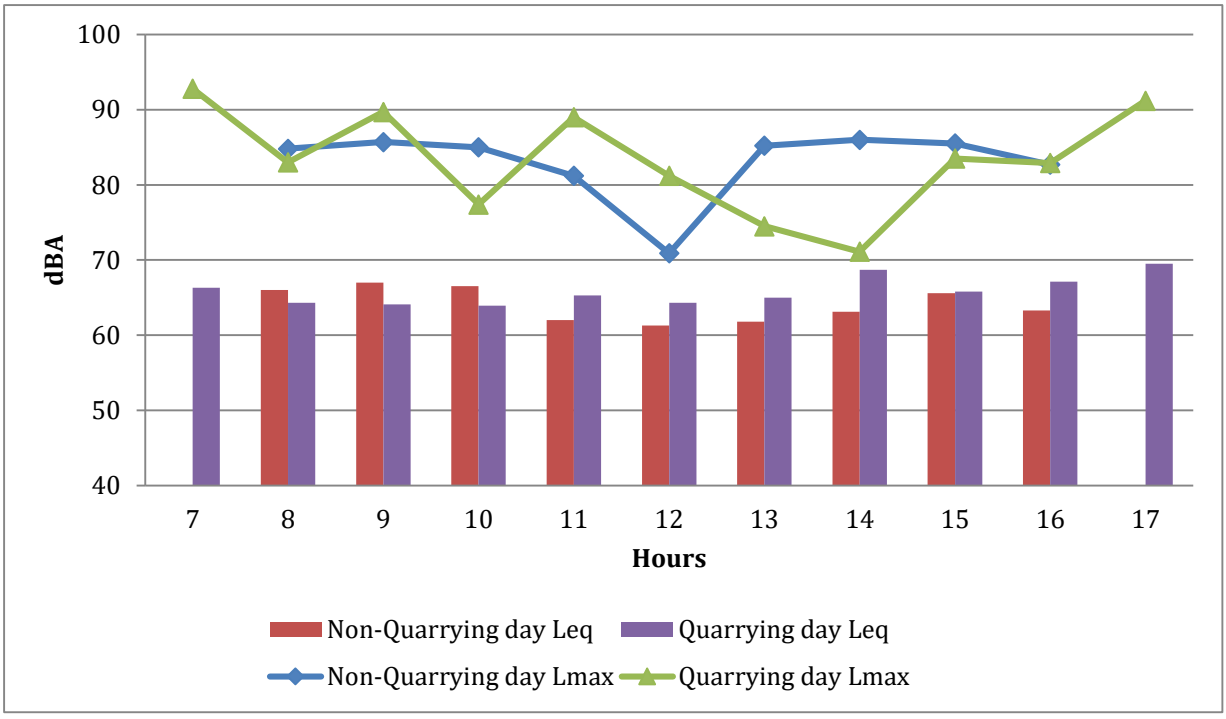


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 500m

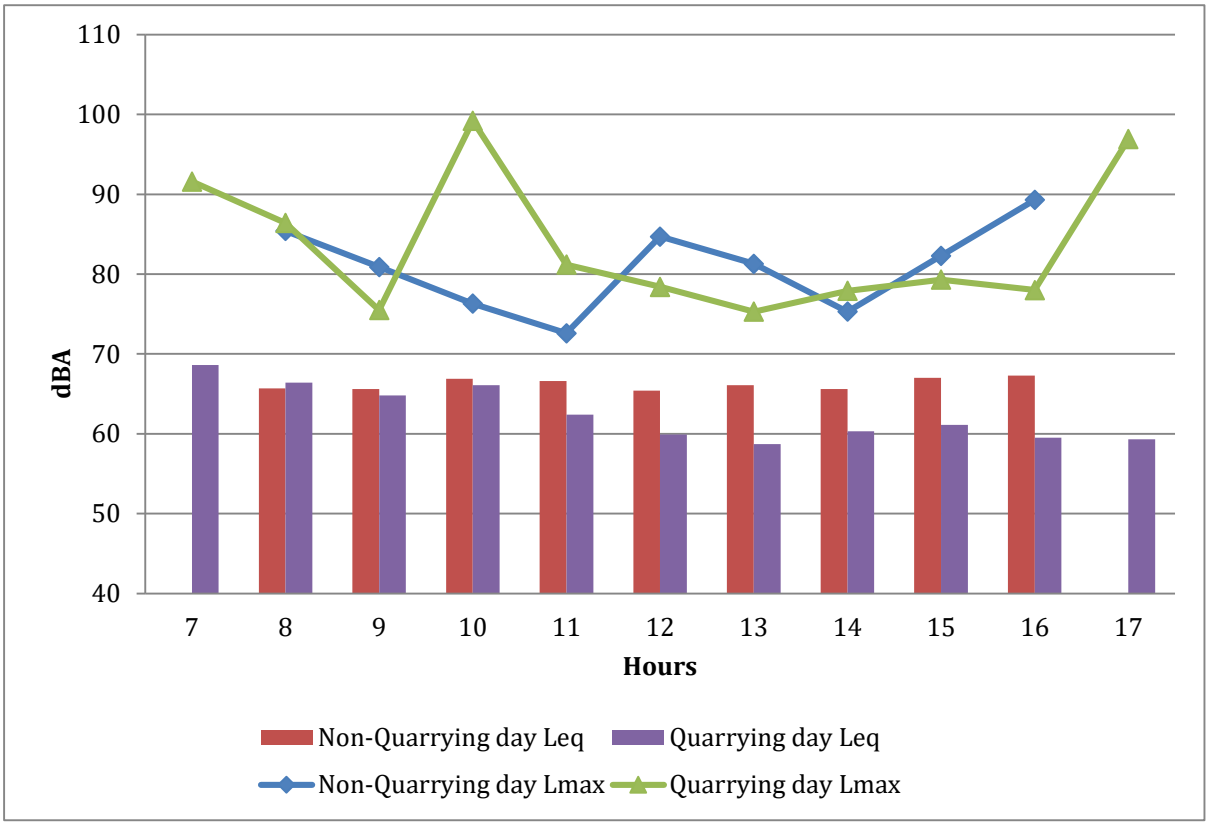


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in North East direction 50m

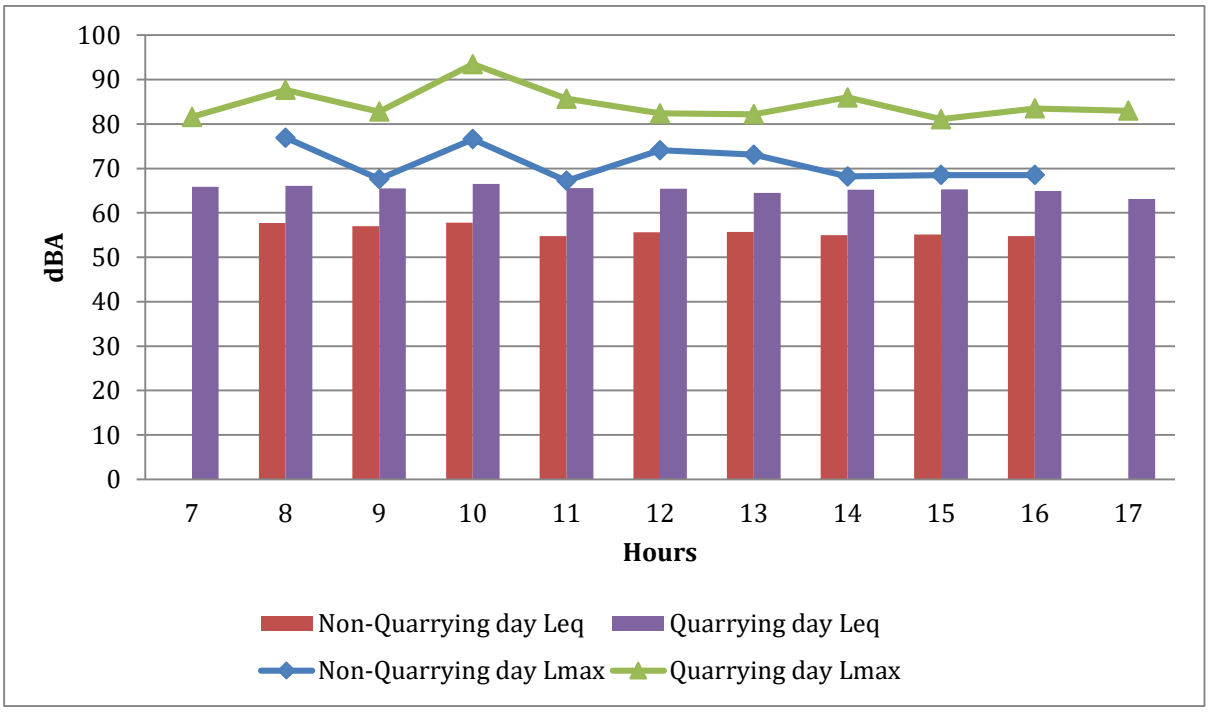


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in North East direction 100m

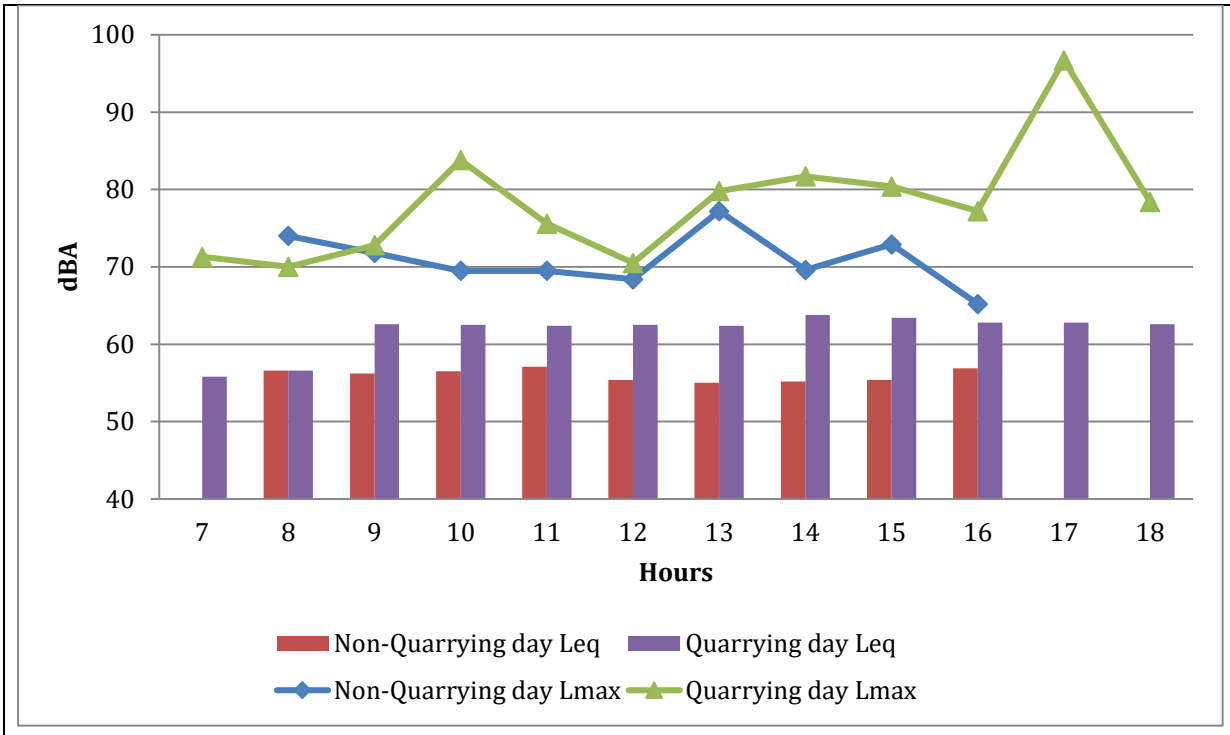


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in North East direction 200m

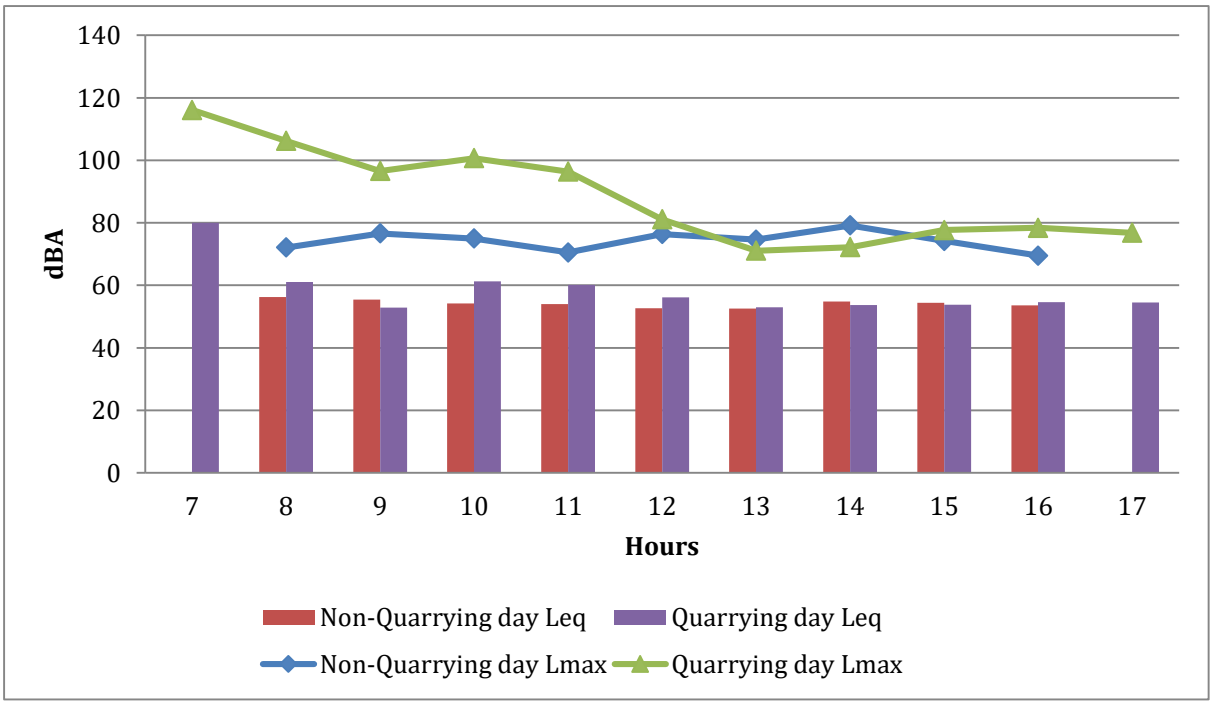


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in North East direction 500m

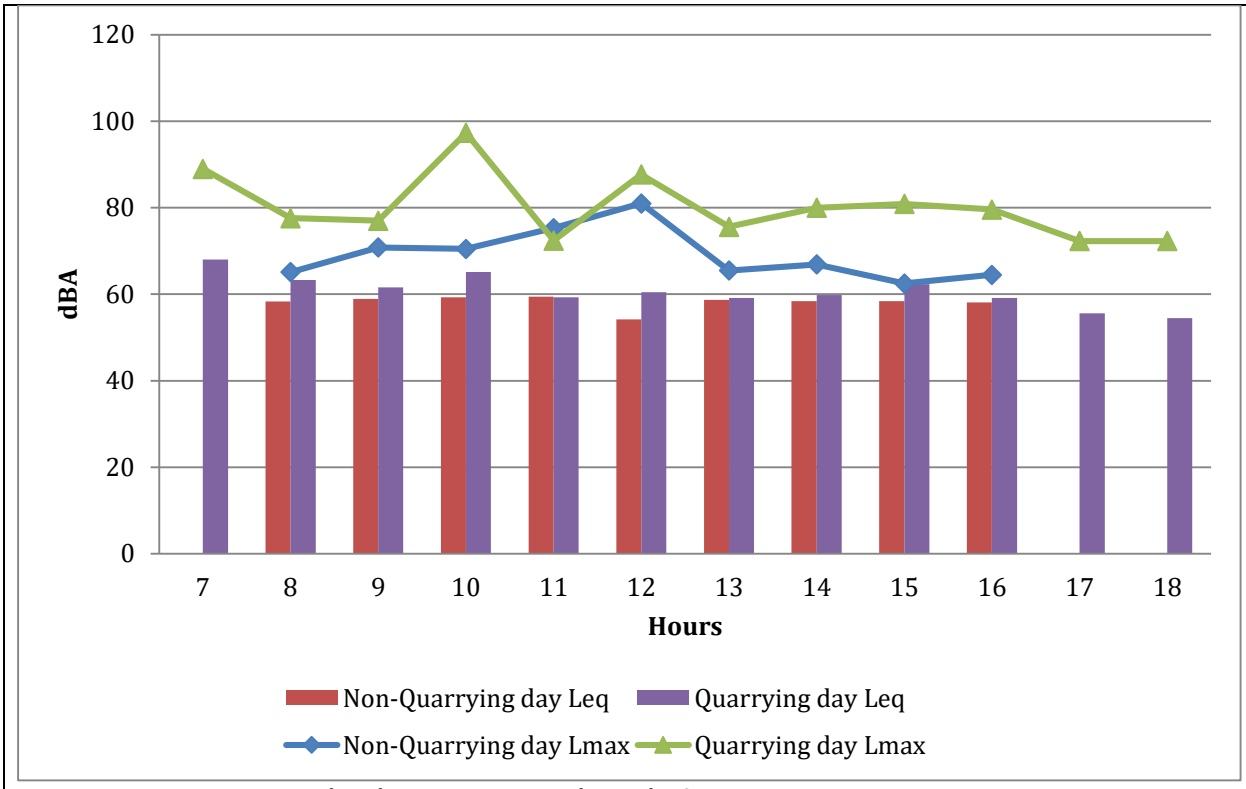


Fig.11: Equivalent values (Leq) and maximum (Lmax) of quarrying and non-quarrying day in South West direction 50m

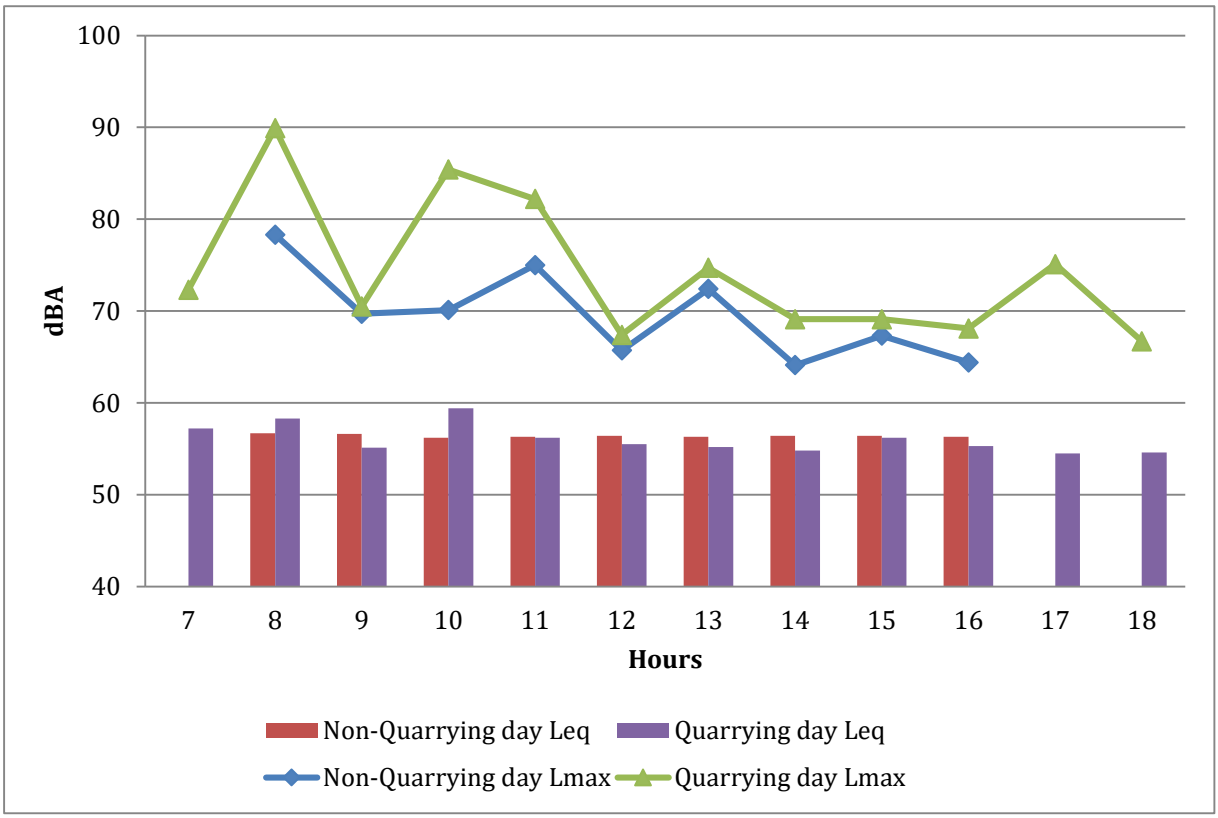


Fig.12: Equivalent values (Leq) and maximum (Lmax) of quarrying and non-quarrying day in South West direction 100m

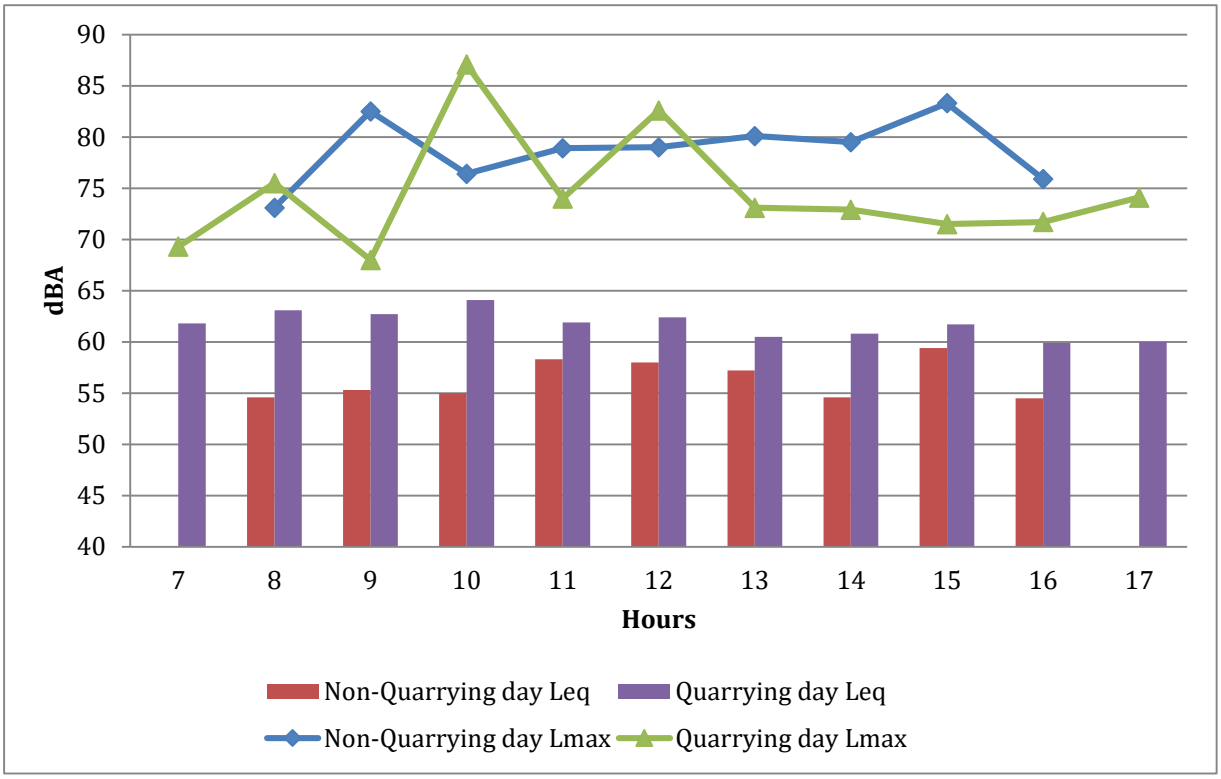


Fig.13: Equivalent values (Leq) and maximum (Lmax) of quarrying and non-quarrying day in South West direction 200m

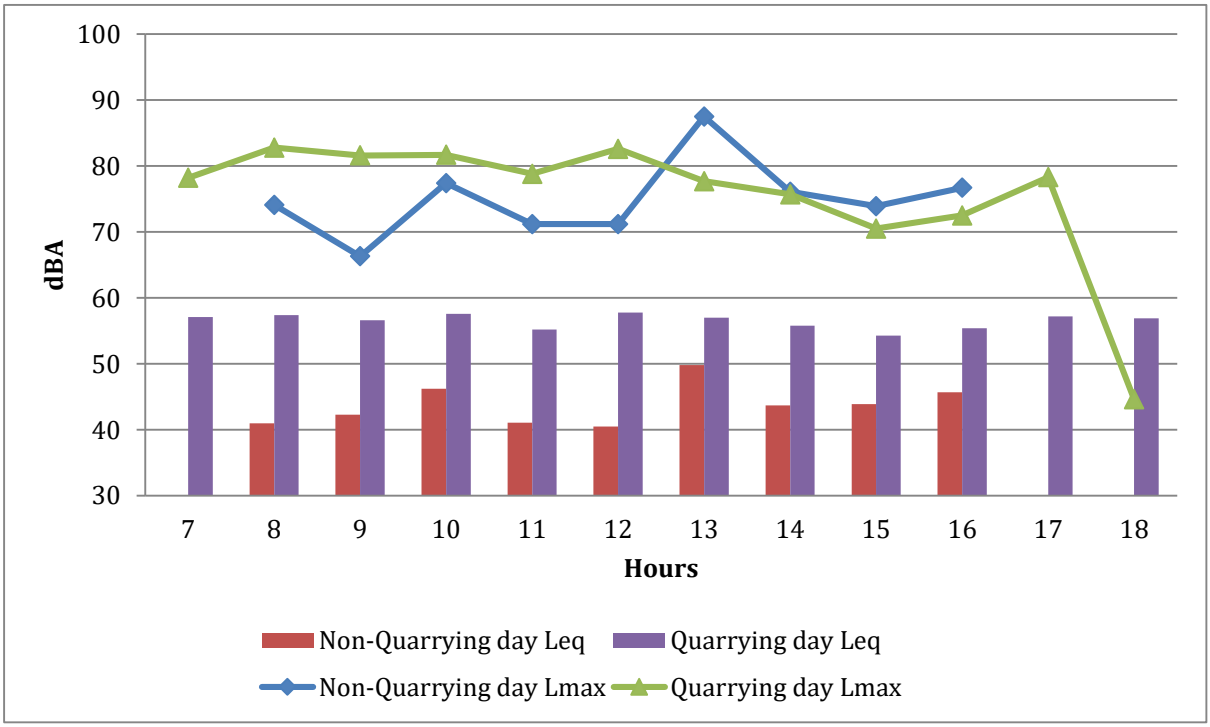


Fig.14: Equivalent values (Leq) and maximum (Lmax) of quarrying and non-quarrying day in South West direction 500m

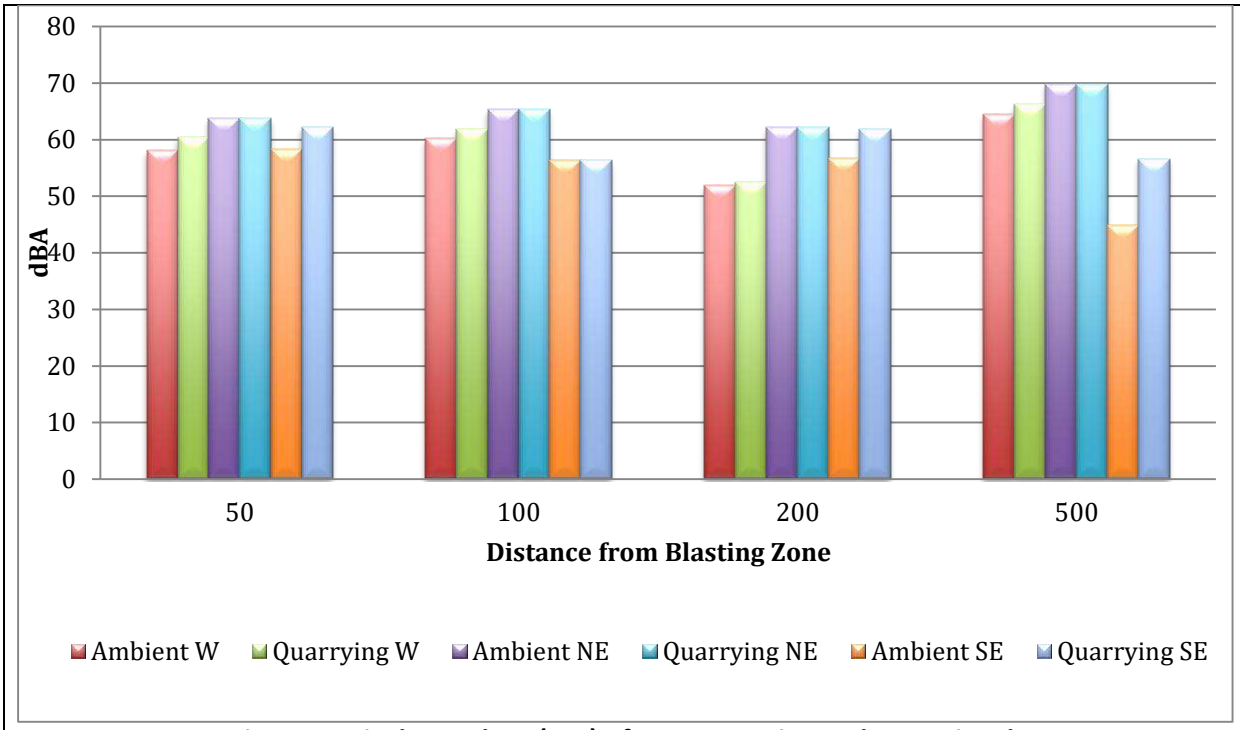


Fig.15: Equivalent values (Leq) of Non-quarrying and quarrying day

Leq= Equivalent noise level (12 hours) dB(A)= Decibel in 'A' scale (unit of sound pressure level)

Analysis results of the Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) levels observed during quarrying day (22.12.20222) & non-quarrying day (23.12.2022) reveal that

(i) The equivalent noise level of the total day is higher on blasting day than ambient day at all stations and observed difference is less than 10 dB(A) at most of the stations.

(ii) The noise levels on blasting day decreased with increase in distance from blasting zones at all directions except NE200, SW100 and W500. For NE200 and SW100, echoing and reverberation effects of nearby reflecting surfaces caused increase in noise compared to 50m stations in the same line.

(iii) The local influences at W500, where influence of quarrying is megre resulted in minor changes in trend.

(iv) Peak of hourly equivalent value can be seen at 12 th hour which corresponds to the blasting time.

6.4 Stone Quarry Pond Water Quality

Analysis results of the stone quarry pond water quality is given in the Table below:

Sample Point: Quarry Pond

Date of Sample: 23/01/2023

Sl. No.	Parameters	Unit	Value
1	pH	-	8.8
2	COD	mg/l	5
3	SS	mg/l	17
4	TDS	mg/l	192
5	Conductivity	µS/cm	314

6	D.O	mg/l	7.8
7	Sodium as Na	mg/l	9.4
8	Potassium as K	mg/l	2.6
9	Calcium as Ca	mg/l	24
10	Magnesium as Mg	mg/l	4.8

7.0 Site Specific Observations

Site specific observations made during the study area are as follows :-

- The quarry is having an extent of 5.9747 hectares and the roads inside the quarry are tarred.
- Approach road to the quarry from the tarred public road, which is about 200 metres long, is not tarred or concreted.
- Outside the quarry area, there is a human habitation within 200 metres of quarry site.
- Rubber plantation and other natural vegetation is available all around the quarry, however, green belt not been specifically planted by the quarry proponent.
- Proper benching at the quarry site is maintained or practised.
- The quarry practises dust suppression measures such as wet gunny bag covering and sprinkling of water while drilling a hole, sprinkler mounted tanker vehicle through a dedicated vehicle (specially designed with a canon like attachment mounted on a tanker).
- Quarry operator ensuing no moisture exists in the blast holes, before filling of blasting materials.
- PPEs provided to all the categories of workers at the time of drilling, blasting and quarrying.
- Blasting shelter made of iron sheet is provided at suitable distances to prevent any damage to the workers at the time of blasting or for hiding during any unexpected eventualities.
- Quarry site operator have provided a provision of collection-cum-settling tank provision with a floating matter trap before discharge of wastewater generated from the quarry site.
- The people residing around the quarry have very few complaints- regarding damages to houses as a result of blasting and vibration, instances of fly rock damages, damaged approach roads making people's vehicular movement and pedestrian traffic very difficult, etc.
- No fly rocks observed during the study period.

Annexure PGPL I

Photographs taken during the site assessment carried out during 21 to 24.12.2022 at M/s. Poabs Granites Pvt. Ltd. Kuthirakalam, Thiruvananthapuram District, Kerala

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 26-12-2022 to 29-12-2022

Name and Address of the Stone Quarry Site	**M/s. Parackal Granite Kerala, Private Limited, Enanalloor Post, Kalamboor Muvattupuzha, Ernakulam**			
Geo-coordinates	Latitude	10°00'46.98"N	Longitude	76°38'40.27"E

1.0. Stone Quarry Site Description

1.1 General information

M/s. Parackal Granite Kerala, Kalamboor, Muvattupuzha, Ernakulam had the lithology of Hornblende Gneiss, was of large size and has no public complaints. The present quarrying lease issued by Department of Mining and Geology, Government of Kerala, commenced on 12-02-2019and is valid up to 14-02-2029.

The quarry has obtained Environmental Clearance from State Environmental Impact Assessment Authority, Kerala on 27-02-2018 and valid up to 26-02-2023. It also holds valid Consent to Operate of Kerala State Pollution Control Board. It is owned by Shri. P. K. Prasad. Area of mining is 7.6606 Ha, nearest residential area is 54 metres from the quarry.

The quarry is attached to in-house crusher. The public road to the quarry from the nearest town is well tarred and wide enough for two heavy vehicles. The approach road in the proponent's property is also tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers and no forests or sanctuaries nearby.

1.2 Topography & Geology

The highest elevation of the mine area is 90 m above MSL in the South-West (SW) central part and 45 m above MSL in the North direction. Geologically two distinct litho units are discernible in this area, the eastern part is occupied by hard rocks representing Precambrian metamorphosed rocks while the coastal tract in the west is covered by soft rock. Major part of the district is occupied by charnockite and migmatite groups of rocks of Precambrian age.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, etc. followed by controlled blasting (NONEL) using class 2 and class 6 explosives.

The rock breaking is done using pneumatic breakers and transported to the crusher site using trucks/ tippers of 15 Tonnes carrying capacity for various products. Every day, blasting is carried out in 2 prefixed timings with maximum 60 no. of holes/blast.

2.0 Location attributes			
2.1 Altitude (m)	44	2.2 Area (Ha)	7.6606
2.3 Terrain	Undulating	2.4 Lithology	Hornblende Gneiss
2.5 Soil type	Laterite	2.6 Total Mineable reserve	3175218 MT
2.6 (a) Remaining Mineable reserve	2098385.375 MT	2.6 (b) Approximate mined quantity per annum	320000MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	19	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	26-12-2022	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	27-12-2022	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	28-12-2022	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
4	29-12-2022	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations

The quarry area is not very deep; the present excavation area is only 05-10 metre below the surrounding ground level. The present blasting zone is towards east of the quarry area which has more length in the east west direction than in the North South direction. Hence towards the West side the quarry is open to an extent of about 200m from the blast area. Hence the 50m, 100m and 200m stations towards West are inside the open quarry land itself.

The 50m stations in North East and South East directions are also within the quarry area. The other points are in the higher benches outside the present blasting area. Further stations like 200m and 500m were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other.

Seven locations were inside the quarry and 5 locations were outside the quarry premises. In the West line, beyond 350m, there were no structures/ houses/ other salient features. Also, since it is the upwind direction, this point was made the farthest point and marked as W 500. Photographs taken during the site assessment at M/s. Parackal Granite Kerala, Private Limited, Muvattupuzha, Ernakulam District, Kerala is given as Annexure-1.

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations			
S. No.	***Station Points***	***Latitude***	***Longitude***
1	W50	10.0137230	76.6430511
2	W100	10.0136744	76.6427000
3	W200	10.0135945	76.6419359
4	W500	10.013645	76.640641
5	NE50	10.0138497	76.6439365
6	NE100	10.0141301	76.644190
7	NE200	10.0154464	76.6446946
8	NE500	10.0178682	76.6454382
9	SE50	10.0132746	76.6440985
10	SE100	10.0130326	76.6443181
11	SE200	10.0123280	76.6450909
12	SE500	10.0085399	76.6455593

5.0 Monitoring activities

5.1 Background monitoring (27-12-2022)

The monitoring started at 6.00am at each 12 locations. The quarry activities were kept completely idle on 27th December to do ambient monitoring. The crusher was kept idle on both the ambient monitoring day and quarrying day. The Environmental Engineers in-charge ensured whether all stations are working properly. At each station, one AE / equipment operator was there for the monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. Weather data were also recorded at two station points (SE 50 and SE 100) inside the quarry. The monitoring was interrupted at stations W 50 (for 15 minutes from 12.00pm) and W 200 (from 12.00pm to 2.00pm) due to the power failure. The wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 269 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used is ammonium nitrate of 375 gm per hole.

The CIMFR team identified 8 locations for the seismic analysis. 5 locations were inside the quarry (NE 50, NE 100, N 130, N 200 and quarry office) and 3 locations were outside the quarry (NE 200, NE 500, and SE 200). They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 4.00pm. The monitoring was completed at all the 12 stations by 06PM. But some of the stations could get only 11 hour or 10 hour readings due various technical hitches during the monitoring.

5.2 Monitoring during Stone Quarry Operation (on 28-12-2022)

The monitoring started at 6.00am. At the stations NE 200 and NE 500, air monitoring was interrupted for 15 minutes to 1 hour due to the power failure. Also, at the station SE 50 and SE 100, the sound level meter had some problem and the noise monitoring was interrupted from 20 minutes to 1 hour. The weather data were recorded from the same two stations inside the quarry.

Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and approximately 300 no. s of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 11.45am. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 8 locations which had slight changes from the previously decided locations, due to site-specific practical reasons. That is, inside the quarry there were 4 locations except at the Office site. Outside the quarry, one additional point was identified at NE 200.

There is another operational quarry about 500m distant from the boundary of the quarry under study. Noise of blasting from that quarry was audible at the site but it was ensured that the blasting of either of the two quarries takes place at different timing so that effect of blasting of the quarry under study could be detected separately.

The crusher was kept idle on both the ambient monitoring day as well as the quarrying monitoring day since operating the crusher would have contributed to dust as well as vibration and noise. That would affect the measured values in which the effect of quarrying alone is to be found out. About 10 experimental blasts were conducted.

Immediately after the blasting was completed, vehicular movement, breaking of boulders using breakers and hauling of the quarry product using haulers were carried out. These quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all the 12 stations by 06PM.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (27-12-2022)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	09:00	26	79	6, E
2	10:00	28	66	6, SW
3	11:00	29	66	5, S
4	12:00	29	64	5, S
5	13:00	29	62	9, SW

6	14:00	28	61	10, SW
7	15:00	30	60	10, W
8	16:00	27	82	3, W
9	17:00	28	82	3, W
10	18:00	28	83	3, W

Weather: Quarrying day (28-12-2022)				
S.No.	***Time (Hrs)***	***Temperature (°C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	21	93	2, E
2	07:00	23	93	2, E
3	08:00	24	80	2, E
4	09:00	26	80	2, SE
5	10:00	27	63	1, SE
6	11:00	29	63	1, S
7	12:00	27	70	1, S
8	13:00	26	84	1, S
9	14:00	26	84	1, S
10	15:00	25	84	1, S
11	16:00	25	84	1, S
12	17:00	24	97	1, S

6.2 Particulate matters/dust

- Generally, PM10 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter.
- In a few stations other than those at 200m, 500m, ambient day concentration is more than blasting day concentration of PM10. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day

concentrations of PM10 higher which also points to an inference that the influence of dust generation in blasting is negligible in PM10 compared to general ground dust from overall quarry area including roads.

- The results of PM2.5 shows that ambient day values are generally more than blasting day values. The explanations based on dust suppression and local influence at far-off stations given for PM10 hold here also.

Table: PM10 & PM2.5 values in non-quarrying and quarrying day

Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m³)*		PM 2.5 (microgram/m³)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	28.16666667	55.09615385	59.70739423	36.17153309
W100	100 m	32.33525734	45.72649573	58.14187827	64.02561024
W200	200 m	20.76446281	61.86684362	83.48699037	64.45180358
W500	500 m	72.62820513	53.17307692	47.50593824	51.8408453
NE50	50 m	29.29383603	46.13095238	64.09501374	55.88044185
NE100	100 m	21.11631538	34.68992248	52.7013073	49.06225831
NE200	200 m	32.14814815	40.98883573	49.27536232	55.92366817
NE500	500 m	40.46153846	39.02777778	82.14801072	90.69943549
SE50	50 m	39.94535519	47.69283747	82.09109731	62.10966989
SE100	100 m	31.8359375	33.49236641	60.02868265	68.25735992
SE200	200 m	39.40104167	46.7769296	53.0257033	52.05205205
SE500	500 m	27.8314746	36.0479798	33.33333333	34.71220138

Fig.1: PM-10 values of Quarrying and Non-quarrying days

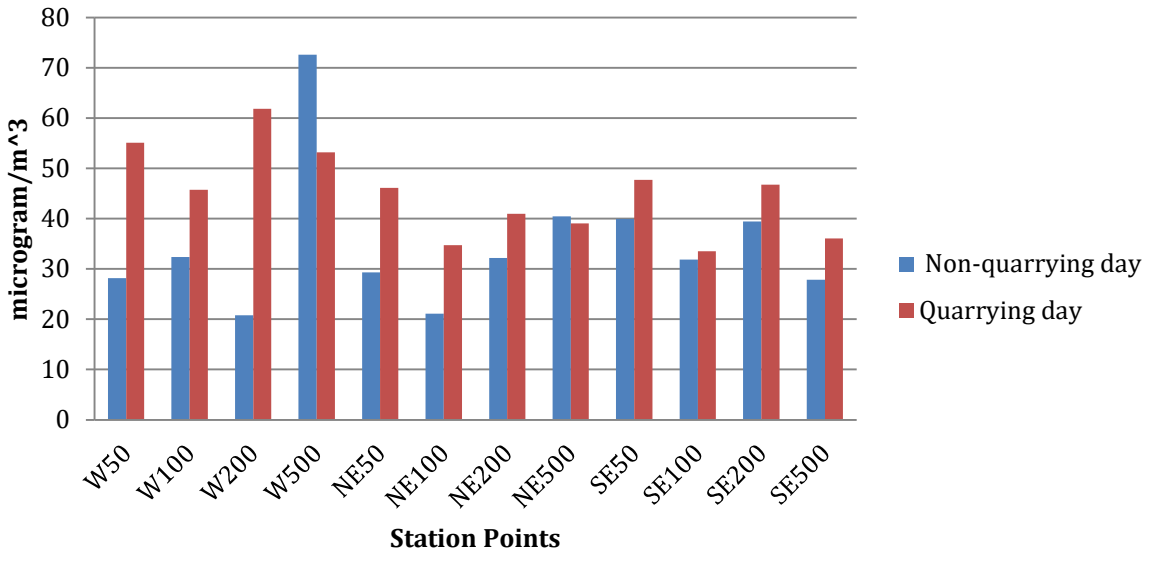
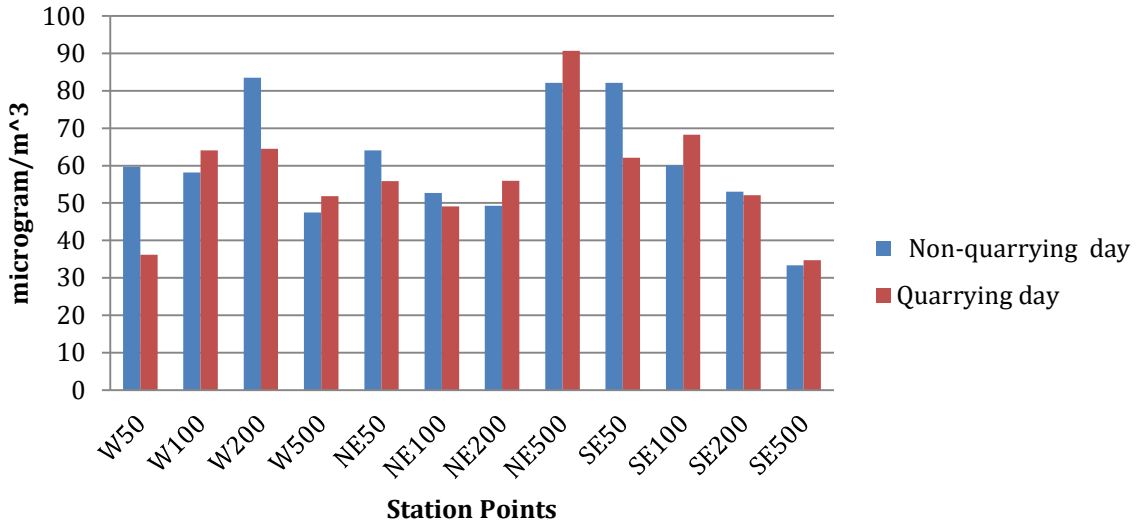


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below:

Leq= Equivalent noise level

dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level)

Observations:

- The equivalent noise level and Lmax of the total day are higher on blasting day than ambient day at all stations generally. Only at 500 metre stations, where quarrying seems to have no influence at all, the pattern is changed.
- The blasting time was 11.30 am. Blasting had not completed at 12 pm. Due to safety-related reasons, the hourly value of noise at 12 pm could not be taken. The next reading after 11 am was taken at 1 pm only. This caused gap of one reading on the quarrying day, as can be seen in the graphs. But it can be seen that the equivalent values as well as maximum values in each station are showing a peak between 11 am and 1 pm as a result of blasting.
- Except at one station W100, equivalent noise of the quarrying day is not increasing more than 10 dB(A) above corresponding non-quarrying day's value. The equivalent noise of the day of quarrying is not significantly more than that of non-quarrying.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	55.34133461	84.3	72.53712802	105.5
W 100	54.17711216	89.7	72.50287422	105.6
W 200	51.66358862	87.1	64.03603659	97.1
W 500	53.15292522	93.1	52.79026687	90.7

NE 50	53.86262289	79.7	64.46133569	94.7
NE 100	57.29962459	100.8	59.21900502	106.4
NE 200	57.23670039	80.9	58.60705616	82.4
NE 500	52.74386752	92.6	54.44627708	96.9
SE 50	49.1557154	83.2	65.96985642	104.2
SE 100	57.65018025	84.1	56.60367953	83.2
SE 200	58.43733462	90.3	59.21066189	83.1
SE 500	52.71788464	88.9	54.08484729	92.9

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

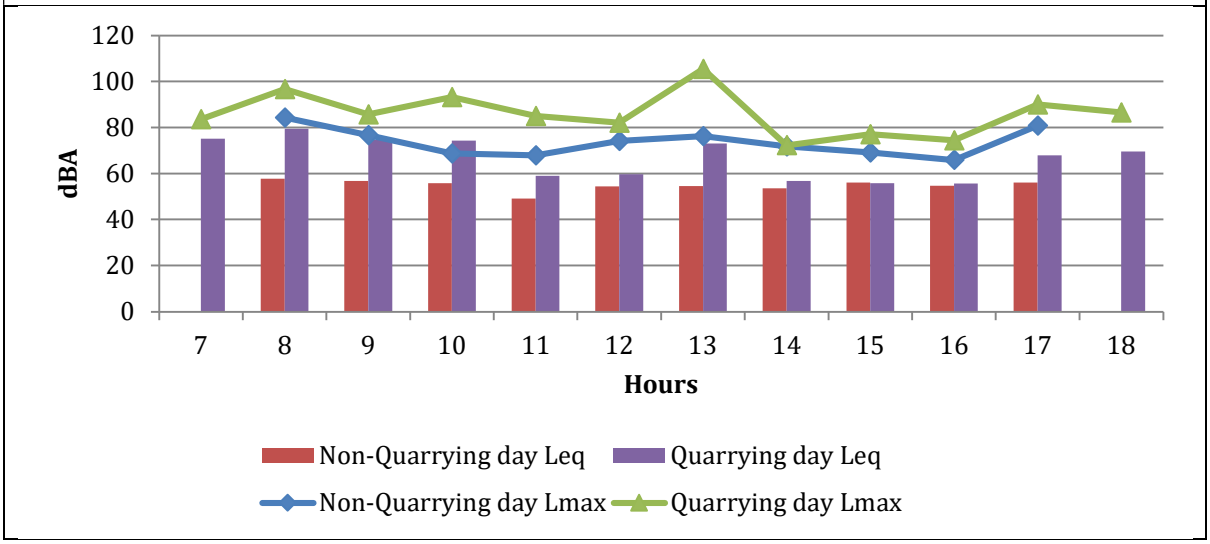


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

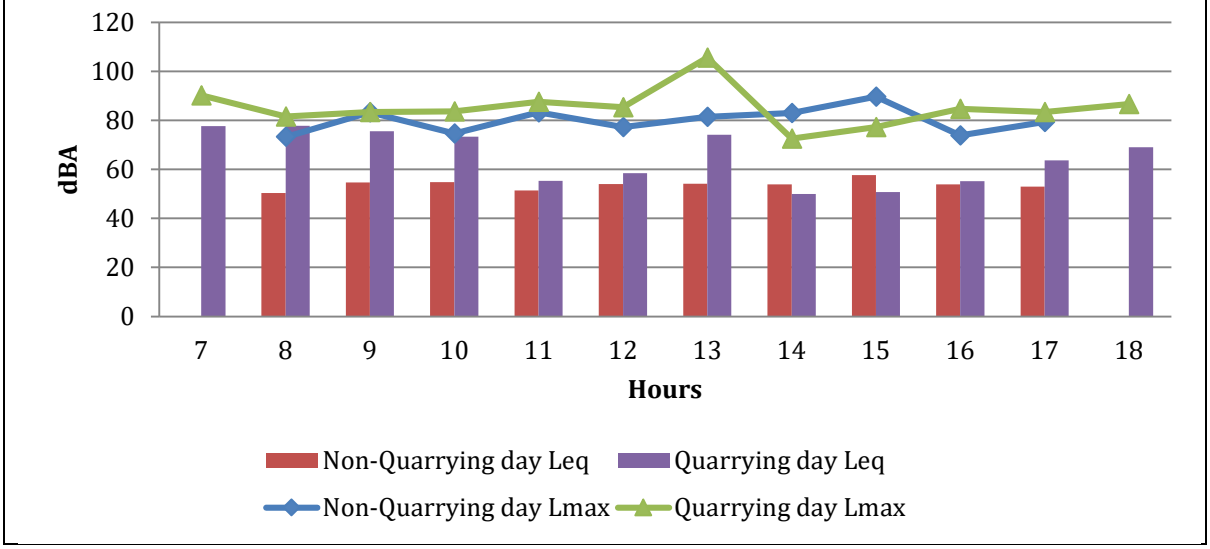


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

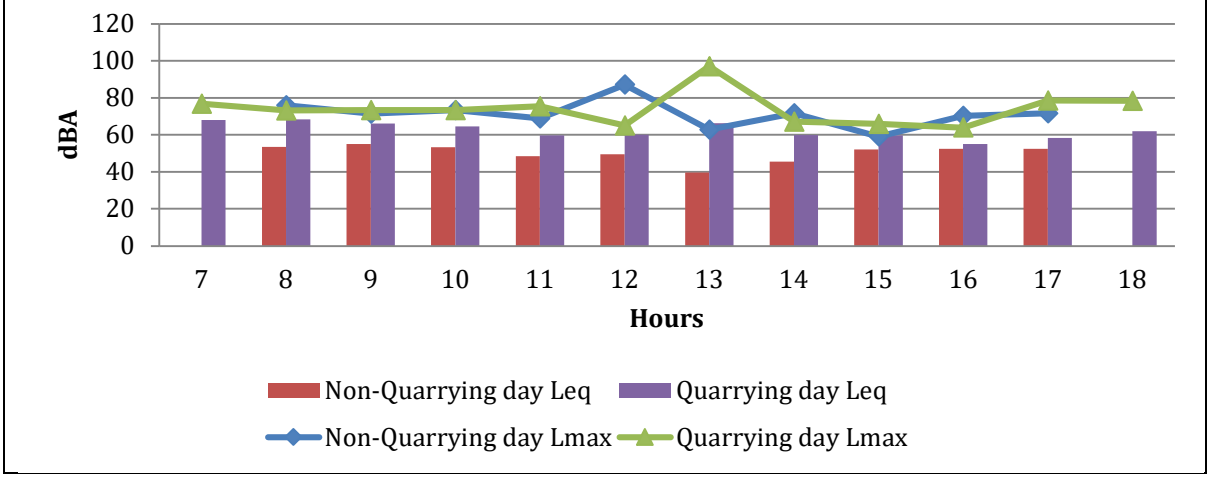


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 500m

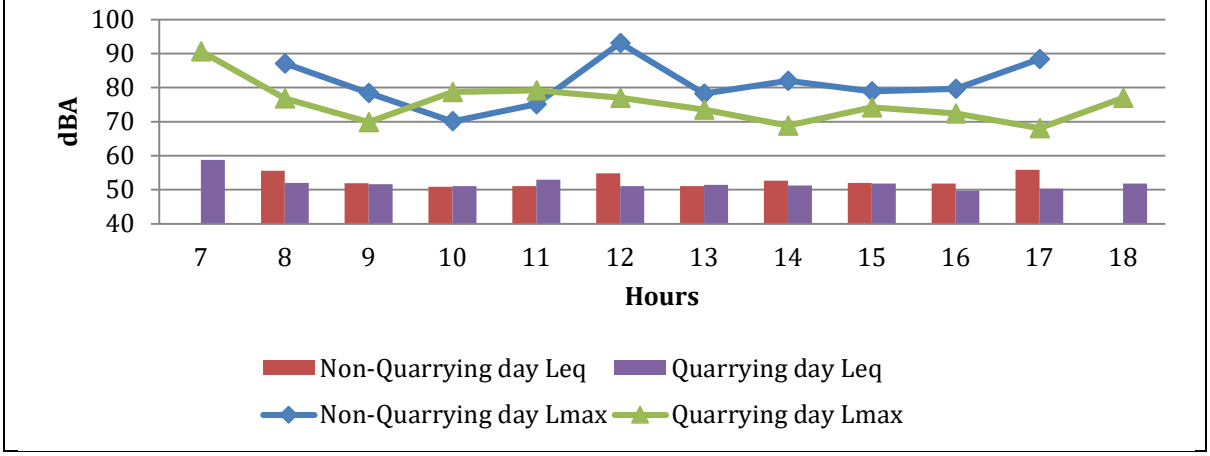


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

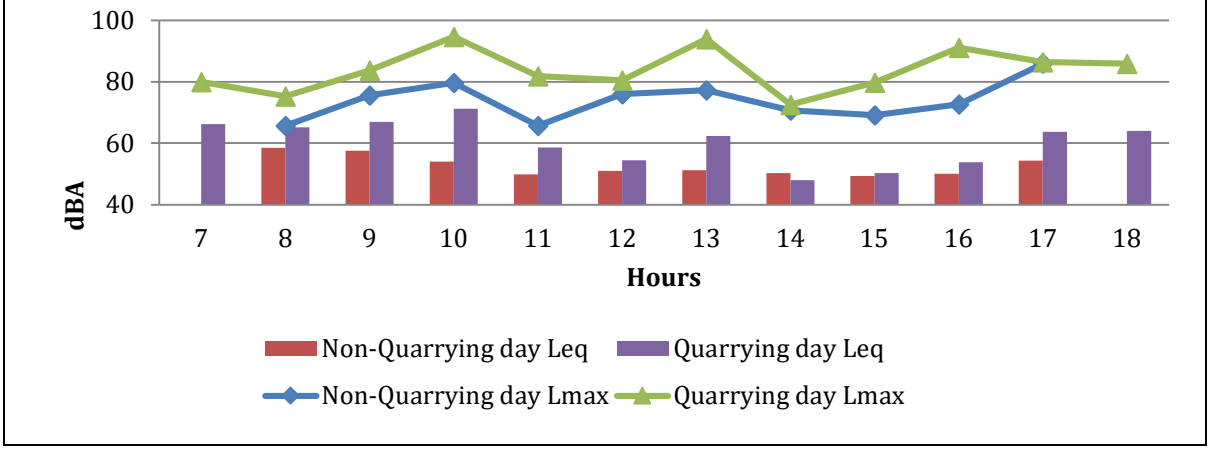


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

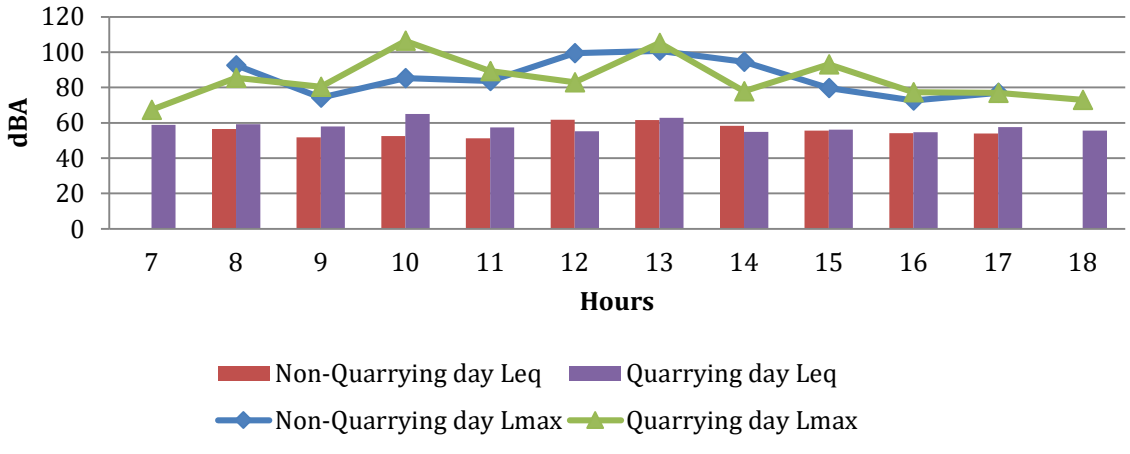


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

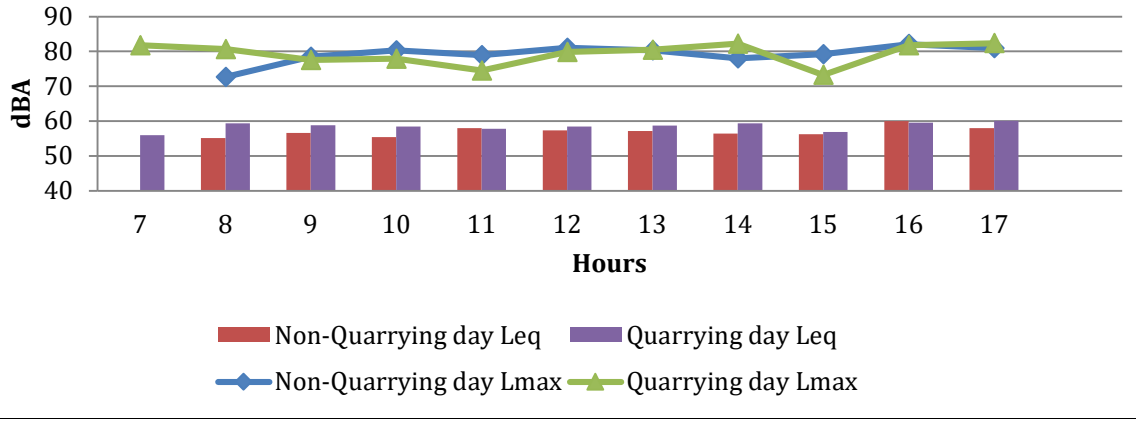


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

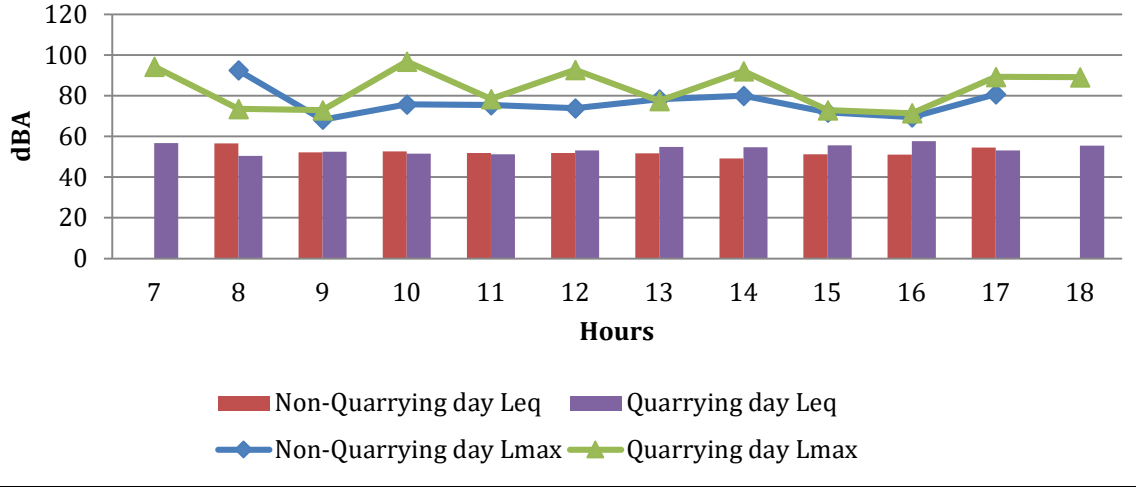


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

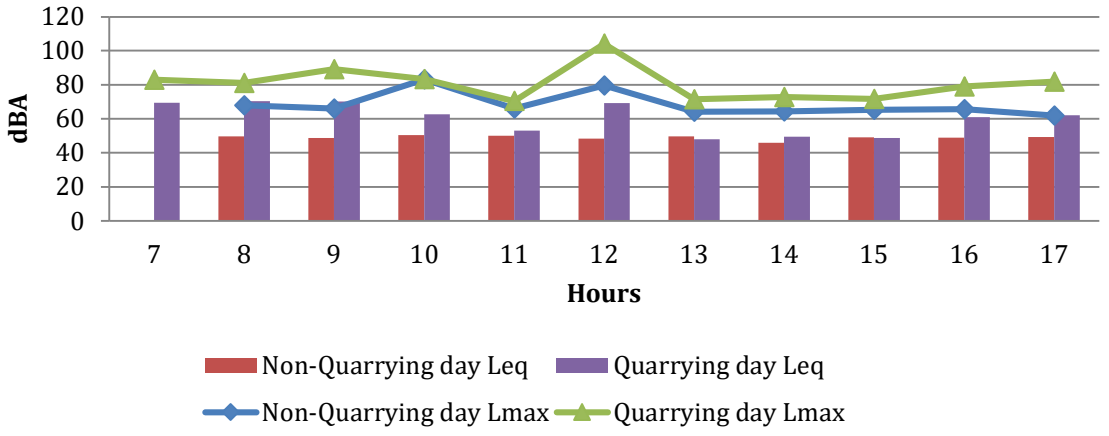


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

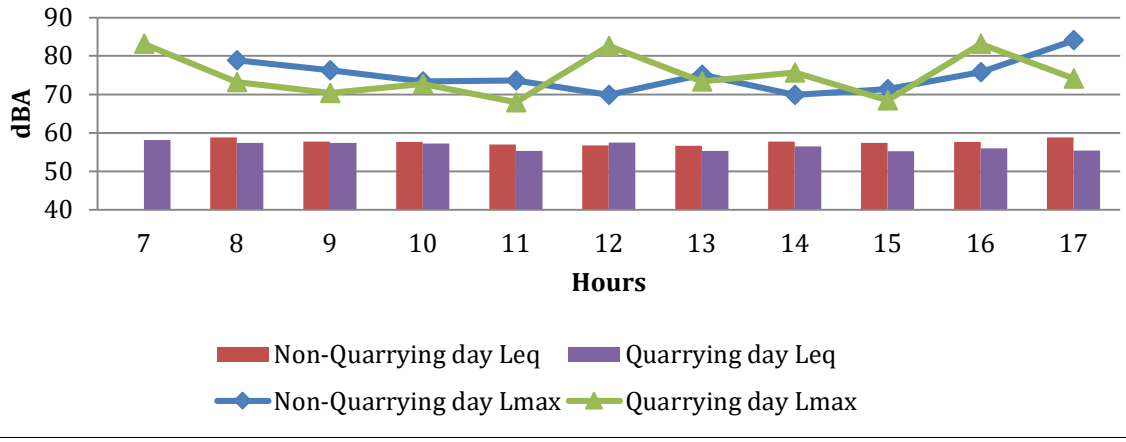


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

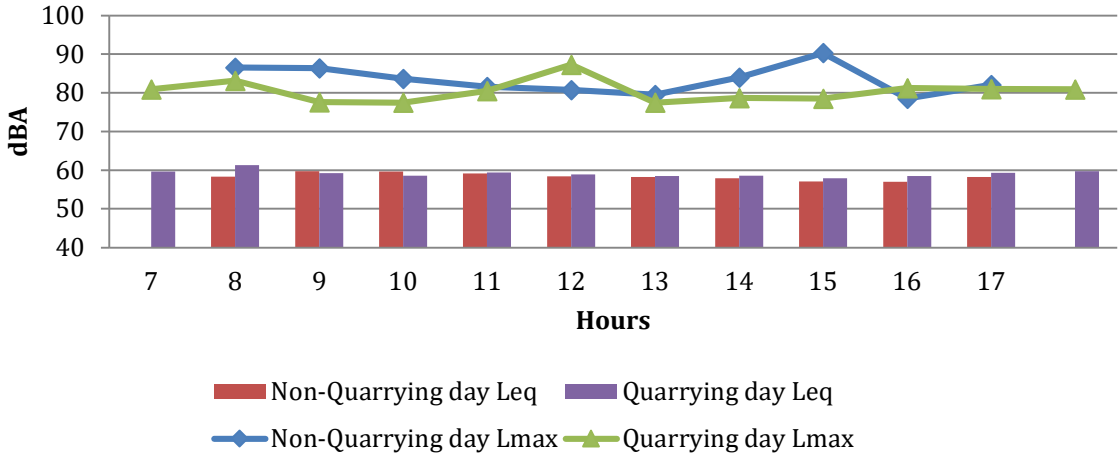


Fig.14: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

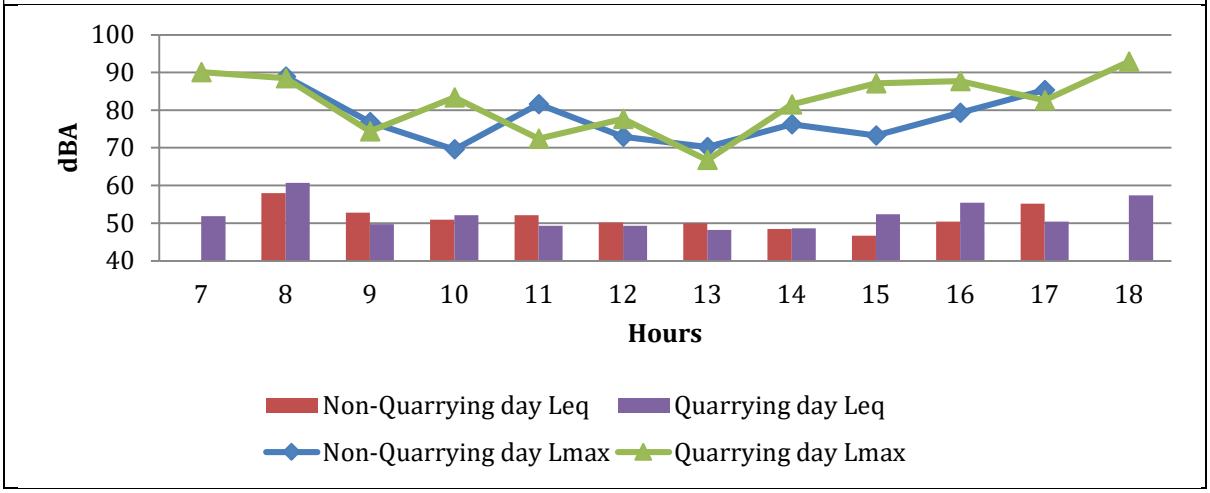
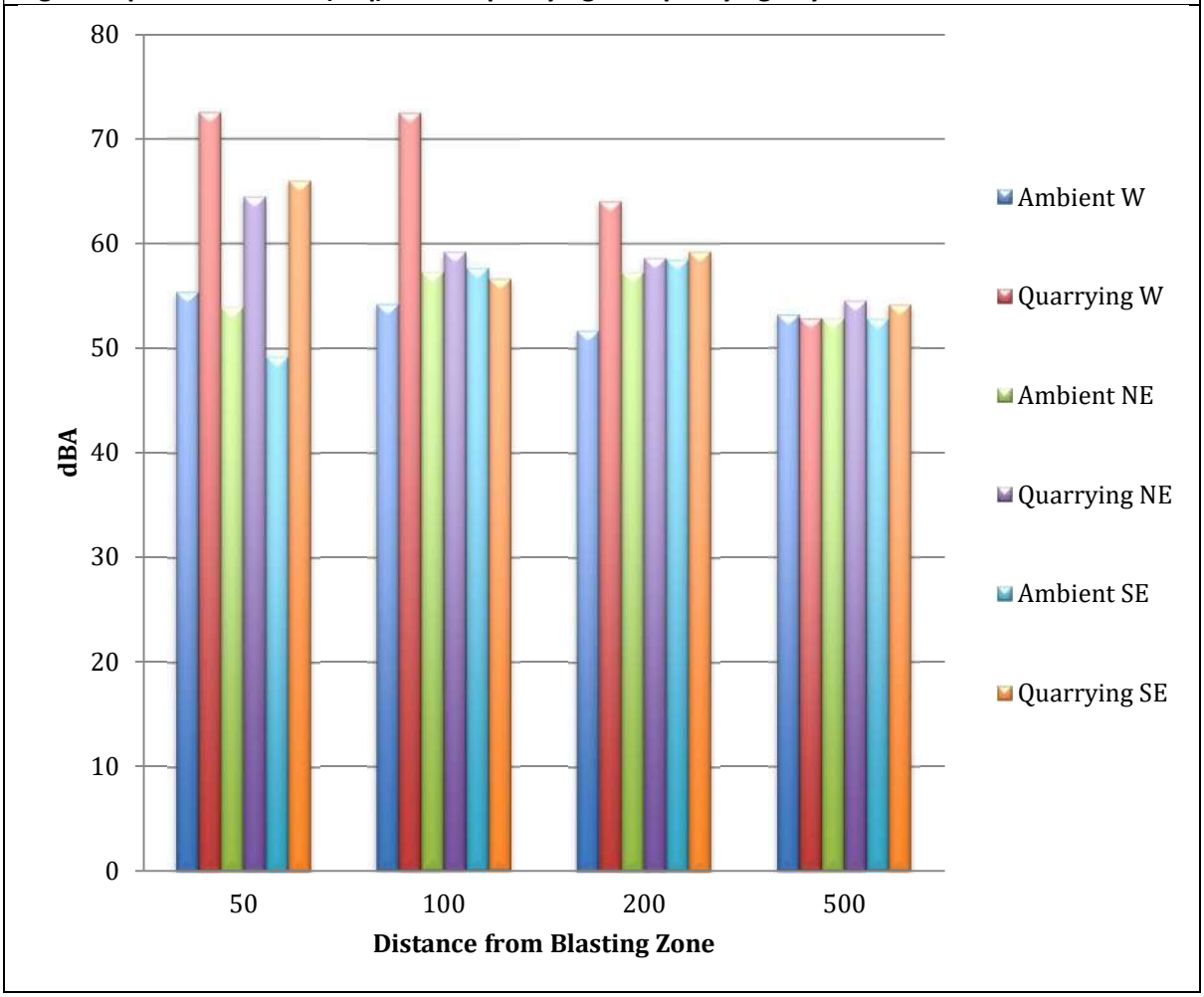


Fig.15: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: Old Quarry Pond			
Date of Sample: 28/12/2022			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH	-	7.55
2	COD	mg/l	16
3	BOD	mg/l	4.1
4	SS	mg/l	BDL
5	TDS	mg/l	114.4
6	CONDUCTIVITY	µS/cm	70.84
7	D.O	mg/l	8.6
8	SODIUM	mg/l	3.26
9	POTASSIUM	mg/l	2.9
10	CALCIUM	mg/l	31
11	MAGNESIUM	mg/l	20

7.0 Site specific observations made during the Visit

The quarry has a deep excavated area. High rock faces are there all around the excavation. Dust suppression is done by using dedicated tanker vehicles. A requisite personal protection equipment is given to all workers. Good shaped benches are formed and maintained. Boundary pillars are maintained intact with latitude and longitude inscribed on them. There is natural vegetation all around and green belt has not been developed artificially. The approach roads outside quarry premises are paved. Settling facility is provided to remove pollutants from surface runoff during rainy season, when water from quarry excavated area is pumped out. The land surrounding the quarry premises are thickly vegetated and many residences are in the proximity.

Photographs taken during the site assessment

Monitoring team

Quarry site

Particulate matter monitoring

Quarry pit

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 01-01-2023 to 04-01-2023

Name and Address of the Stone Quarry Site	**M/s. United Granites and Metals Limited or George Kochuparambil or Kochuparambil Granites located at Manakkad Village, Vazhithala, Thodupuzha, Idukki 685583**			
Geo-coordinates	Latitude	09°53'48.01"N	Longitude	76°38'21.51"E

1.0. Stone Quarry Site Description

1.1 General information

M/s. United Granites and Metals Limited or George Kochuparambil or Kochuparambil Granites located at Manakkad Village, Vazhithala, Thodupuzha, Idukki 685583 is attached with captive crusher unit. As per the information provided by the quarry operator, the present quarrying lease commenced on 17.03.2018 and permission is granted by Department of Mining and Geology, Government of Kerala which is valid for 5 years. The quarry operator has obtained Environmental Clearance dated 17.03.2018 from State Environmental Impact Assessment Authority (SEIAA) and is valid up to 16.03.2023. The quarry has obtained Consent to Operate dated 16.07.2018 with validity up to 15.07.2023 from Kerala State Pollution Control Board. Area of mining is 12.2987 Ha. Nearest residential area is more than 150 metres away from the boundary of the approved mining area. There are no forests or wildlife sanctuaries located nearby. There are no rivers or such other water bodies nearby. The approach roads to the quarry are well maintained, with a length of about 300 meters to nearest major road. This quarry cannot sell granite boulders outside crushing units except its captive crusher unit. The surrounding ground is plain, with vegetation, rubber plantation and habitations around the stone quarry.

1.2 Topography & Geology

As per the information provided by the quarry operator, the stone quarry site had the lithology of Hornblende Gneiss. Geologically, the district can be divided into three major belts in a north-south direction- (i) Peninsular Gneiss Complex in the north and (ii) Charnockite group of rocks in the south and (iii) Migmatitic complex in between. The oldest rock of the area belongs to Peninsular Gneissic Complex represented by granite gneiss. The charnockite group comprises of pyroxene granulite, magnetite quartzite and charnockite among which the charnockite is dominant and widespread. Central, northeast and southeast parts of the district are dominated by rocks of migmatitic complex composing of biotite gneiss and hornblende-biotitegneiss. The highest elevation of the mine area is 145 m above MSL and 35 m above MSL.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, hand shovels etc. followed by controlled blasting (NONEL TECHNOLOGY) using class 2 and class 6 explosives. The rock

braking is done using pneumatic rock breaker and transported to the captive crusher site using trucks/ tippers of 15T. Every day, blasting is carried out in 2 prefixed timings with maximum 40 no. of holes/blast.

2.0 Location attributes

2.1 Altitude (m)	44	2.2 Area (Ha)	12.2987
2.3 Terrain	Undulating	2.4 Lithology	Hornblende Gneiss
2.5 Soil type	Laterite	2.6 Total Mineable reserve	5980285 MT
2.6 (a) Remaining Mineable reserve	4472814 MT	2.6 (b) Approximate mined quantity per annum	400000 MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	None within study area	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment

Day	Date	Activities
1	01-01-2023	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point depending on the prevailing wind direction. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	02-01-2023	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	03-01-2023	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities and water sample collection (06.00 to 18.00 Hrs.)
4	04-01-2023	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next stone quarry site selected for assessment

4.0 Sampling/ Monitoring Plan and locations

The quarry area has a very deep excavation which has more length in the east west direction than in the North South direction. From the surrounding ground level, it is 40m-50m deep. The present blasting zone is towards west of the quarry area. 50m, 100m and 200m stations towards West, South East and North East are inside the excavated area or the surrounding un-mined area. Further stations like 500m were all outside the quarry premises, in private properties. In total, 12 co-ordinates were fixed with the actual blasting zone as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other. 9 locations were inside the quarry premises and 3 locations were outside the quarry premises. Photographs taken during the site assessment at Quarry of Mr. George Kochuparambil, Thodupuzha, Idukki District Kerala is given as **Annexure-UGML 1.**

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations

Co-ordinates of selected monitoring locations at the stone quarry site during the study is given in **Table 1** below

Table 1. Co-ordinates of selected monitoring locations at the stone quarry site

S.NO	Station Points	Latitude	Longitude
1	W50	9.8954959	76.6397201
2	W100	9.8954708	76.6392551
3	W200	9.8949294	76.6383807
4	W500	9.8941311	76.6368055
5	NE50	9.895914	76.641372
6	NE100	9.896201	76.641952
7	NE200	9.896585	76.642648
8	NE500	9.898985	76.644112
9	SE50	9.8949146	76.6407229
10	SE100	9.8945608	76.6410156
11	SE200	9.8939277	76.6412945
12	SE500	9.8904414	76.6413452

5.0 Monitoring activities

5.1 Background monitoring (02-01-2023)

The ambient air and noise monitoring started at 6:00am at all 12 selected stations in the quarry area. The quarry activities were kept completely idle on 2nd January 2023 to do ambient air quality and noise monitoring and all the 12 selected monitoring stations were ensured working properly. At each station, one Assistant Engineer / Instrument operator was stationed for the continuous monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. The weather data were recorded from a station inside the quarry at NE200 and wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east. Ambient Air Quality and Noise Monitoring were carried out under the overall supervision of Kerala State Pollution Control Board and waste water from the stone quarry pond was collected for further analysis for relevant parameters at Central Laboratory, Kerala State Pollution Control Board, Kochi.

The locations for drill holes for explosives were located by the CIMFR team. It was decided to conduct 10 blasts which consist of 281 holes, each hole having 32mm diameter and 6ft - 8ft depth. The explosive used is ammonium nitrate and maximum charge was in the order of 375 to 850 gm per hole. The CIMFR team identified 8 locations for the seismic analysis. 5 locations were inside the quarry and 3 locations were outside the quarry. They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 6.00pm. For study purpose, no. of holes to be drilled for each blast, filling of explosives and blasting activity were carried out under the overall supervision of CIMFR Expert Team.

5.2 Monitoring during Stone Quarry Operation (on 03-01-2023)

The air and noise monitoring was started at 06 AM. The monitoring was continued without any interruption from beginning to end. Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and 281 no. of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 12.30pm. Connections were also established for the blasting, under the overall supervision of CIMFR Team. The crusher was kept idle on quarrying monitoring day in view of the blasting activity. All the 10 blasts as planned were conducted. Immediately after the blasting was completed, regular activity such as vehicular movement, breaking of boulders using pneumatic rock breakers and hauling of the quarry product using haulers were carried out. These quarrying activities as well as ambient air, noise levels were continued full-fledged until the end of the day. The blasting activity carried out by the stone quarry operator under the overall guidance and supervision of CIMFR Experts.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

The weather data were monitored every hour using Weather Tracker inside the quarry with respect to wind velocity, humidity and temperature and the weather details observed during Non-quarrying (02.01.2023) and Quarrying Day (03.01.2023) are given in **Table 2 & Table 3** below.

Table 2. Weather details observed during non-quarrying (02.01.2023)

Sl. No	Time (Hrs)	Temperature (◦ C)	Humidity (%)	Wind Speed & Direction (m/s)
1	07:00	24.3	85	0
2	08:00	26.6	67.8	0.6 SE
3	09:00	29	50.5	1.4 S
4	10:00	29.8	50	1 SW
5	11:00	30	47.3	1 SE
6	12:00	30.6	44.1	1.3 S
7	13:00	31.2	40.7	1.6 S
8	14:00	31.2	36.3	1.3SE
9	15:00	33.3	41	0.4 E
10	16:00	32.6	44.3	0.8 S
11	17:00	30.2	61.5	0

Table 3. Observed Weather Details on the Quarrying Day at the Quarry Site (03.01.2023)

Sl. No	Time (Hrs)	Temperature (◦ C)	Humidity (%)	Wind Speed & Direction (m/s)
1	06:00	21.7	83.8	0
2	07:00	22.2	84.4	0
3	08:00	24.7	78.5	0.5 S
4	09:00	26.9	67.5	0.5 S
5	10:00	27.8	59.5	1.9 SE
6	11:00	29.9	56	0.7 SW
7	12:00	31.8	48.5	1.2 S
8	13:00	32	45.1	1 S
9	14:00	32.7	47	0
10	15:00	33.2	48.5	1 SE
11	16:00	32.4	48.9	0
12	17:00	31.3	49	0.8 S
13	18:00	31.1	60.9	0

6.2 Particulate matter/dust in terms of PM10 and PM2.5 values observed during Non-Quarrying day (02.01.2023) & Quarrying Day (03.01.2023)

Particulate matters/ dust in terms of PM10 and PM2.5 values observed during Non-quarrying day (02.01.2023) and Quarrying day (03.01.2023) are given in **Table 4 and Fig 1 to Fig 2** below:

Table 4: PM10 & PM2.5 values observed during Non-quarrying and Quarrying day

Station Points	Distance from blasting zone (metre)	PM 10 (microgram/m^3)		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	53.0952381	53.69585687	34.82124406	26.98788836
W100	100 m	112.519685	76.97944007	20.96998609	20.03125208
W200	200 m	46.91647151	49.35980903	21.31211943	18.43434343
W500	500m	33.79928315	38.27380952	7.174713981	6.660168941
NE50	50 m	38.22834646	74.17534722	22.56410256	41.20148857
NE100	100 m	47.88527624	47.9561879	39.29292929	10.15853983
NE200	200 m	58.21333333	51.34372177	43.30312185	26.68644704
NE500	500 m	51.80769231	62.37179487	2.81124498	22.71664328
SE50	50 m	35.91397849	56.22222222	18.36327345	15.82067679
SE100	100 m	59.06976744	59.00537634	22.37470167	8.785140562
SE200	200 m	38.42307692	48.56804479	15.72516026	44.58059374
SE500	500 m	33.75	39.81128075	6.021637069	4.08496732

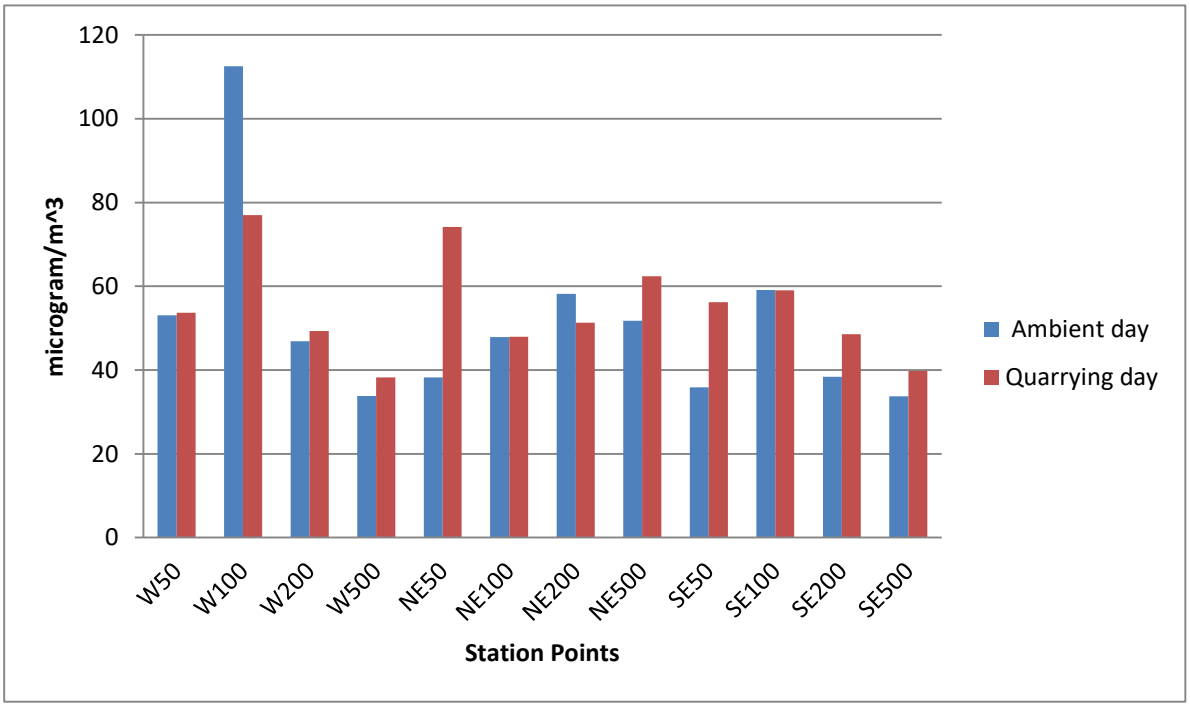


Fig.1: PM10 values observed during quarrying and non-quarrying day

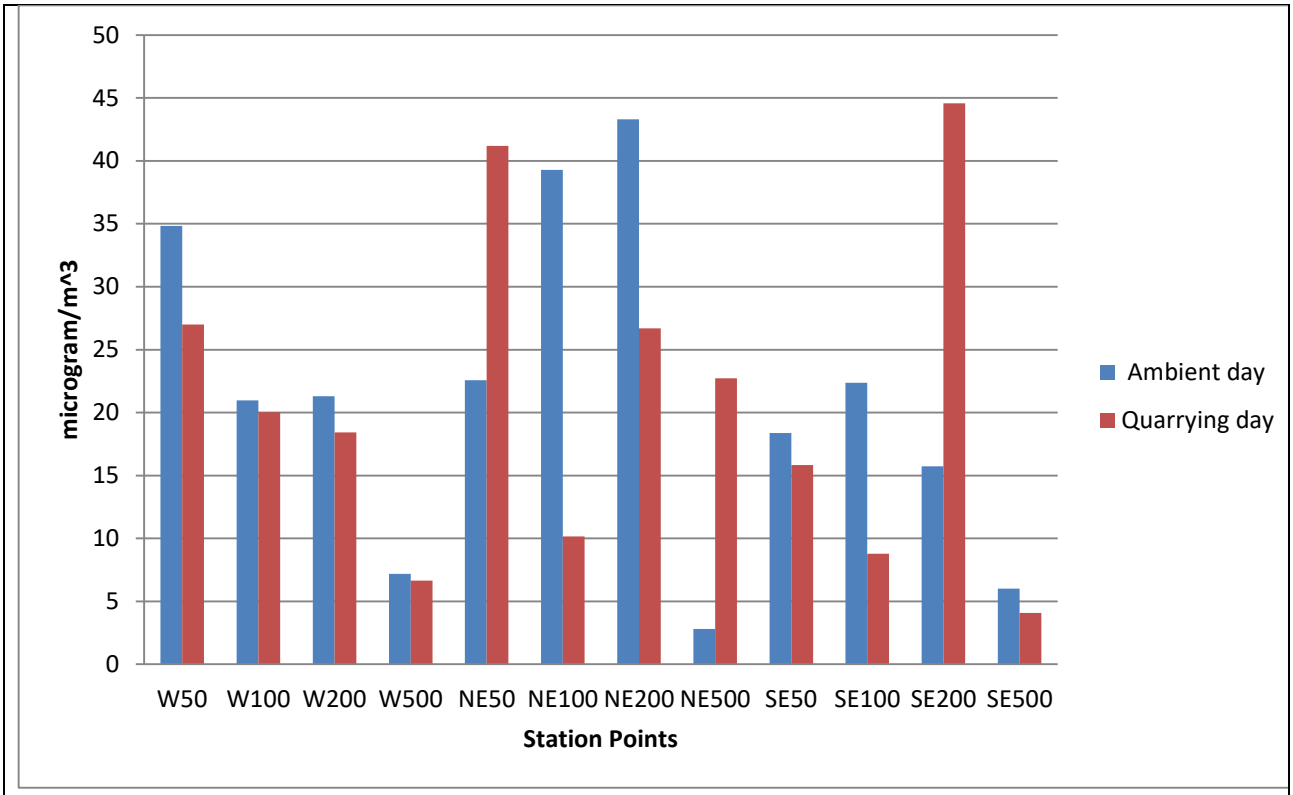


Fig.2: PM2.5 values observed during Quarrying and Non-quarrying day

The analysis results of ambient air quality during non-quarrying day (Ambient day) and quarrying day reveal that

(i) PM10 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter PM 10.

(ii) In West 100m station, increase of PM10 concentration on non-quarrying day than quarrying day can be attributed to the presence of a product storage area nearby, which might have emanated dust during non-quarrying day due to wind. Influence of quarrying is seen minimal in stations 200 m and 500 m, so the results are not like 50 m stations.

(iii) The results of PM2.5 shows that ambient day values are generally more than blasting day values. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations higher.

6.3 Noise Monitoring

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) on non-quarrying and quarrying day are given in the **Table 5 and Fig 3 to Fig 15** in subsequent paras:

Table 5: Observed Noise Levels in terms of Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) on Ambient Day and Quarrying Day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W50	60.18807653	66.1	64.2089918	109.5
W100	56.98689576	58.2	61.66202326	90.1
W200	57.06441643	97.2	57.20732863	83.9
W500	52.57283161	87.7	52.74585978	82.7
NE50	55.46514863	88.1	63.89980187	107.1
NE100	49.05278828	80.1	52.45398751	88.7
NE200	47.84672128	87.2	52.53416507	87.5
NE500	53.75160023	75.9	52.02780663	75.7
SE50	52.21035288	91.3	65.09020189	108.9
SE100	51.8989128	95.2	58.41955785	104.5
SE200	58.9643484	97.8	58.20870395	100.3
SE500	52.04640674	92.2	48.8404357	73.4

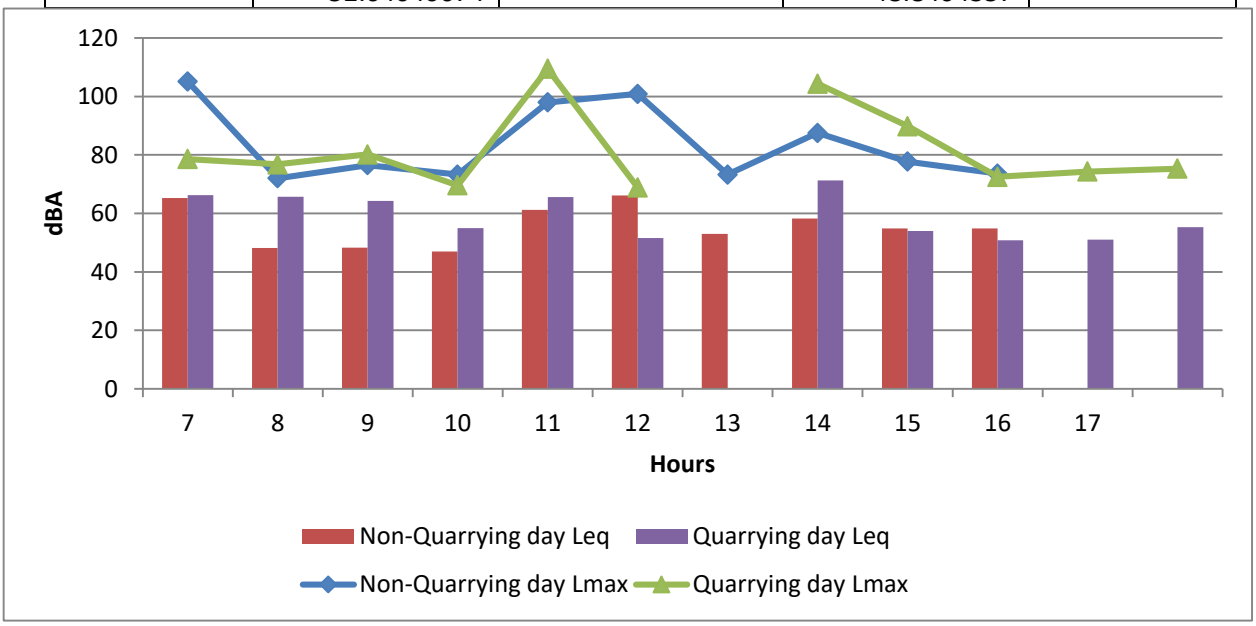


Fig.3: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at West Direction 50 m

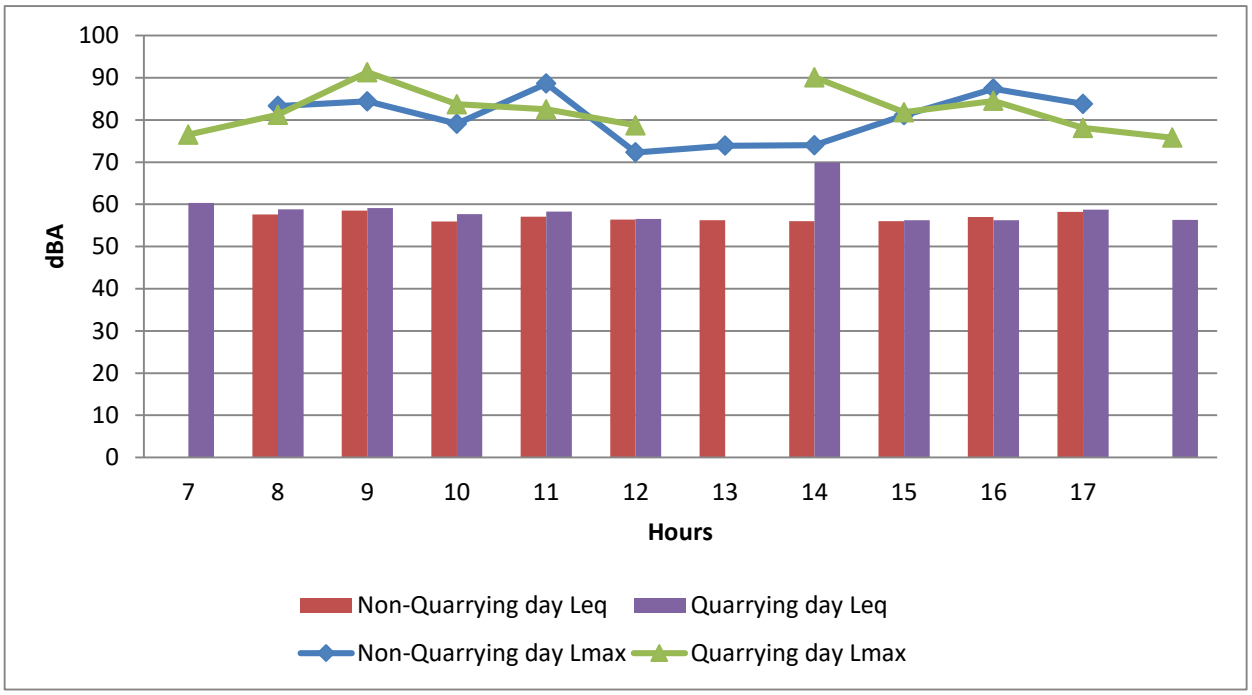


Fig.4: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at West Direction 100 m

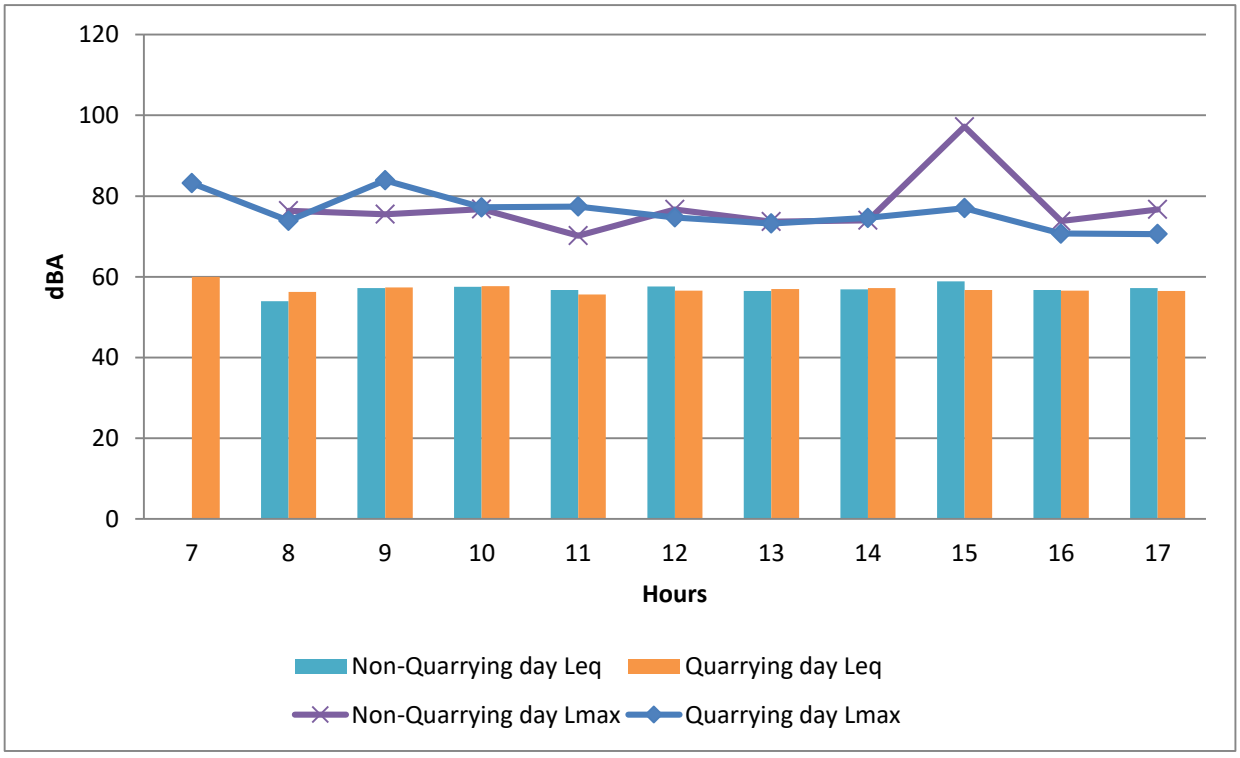


Fig.5: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at West Direction 200 m

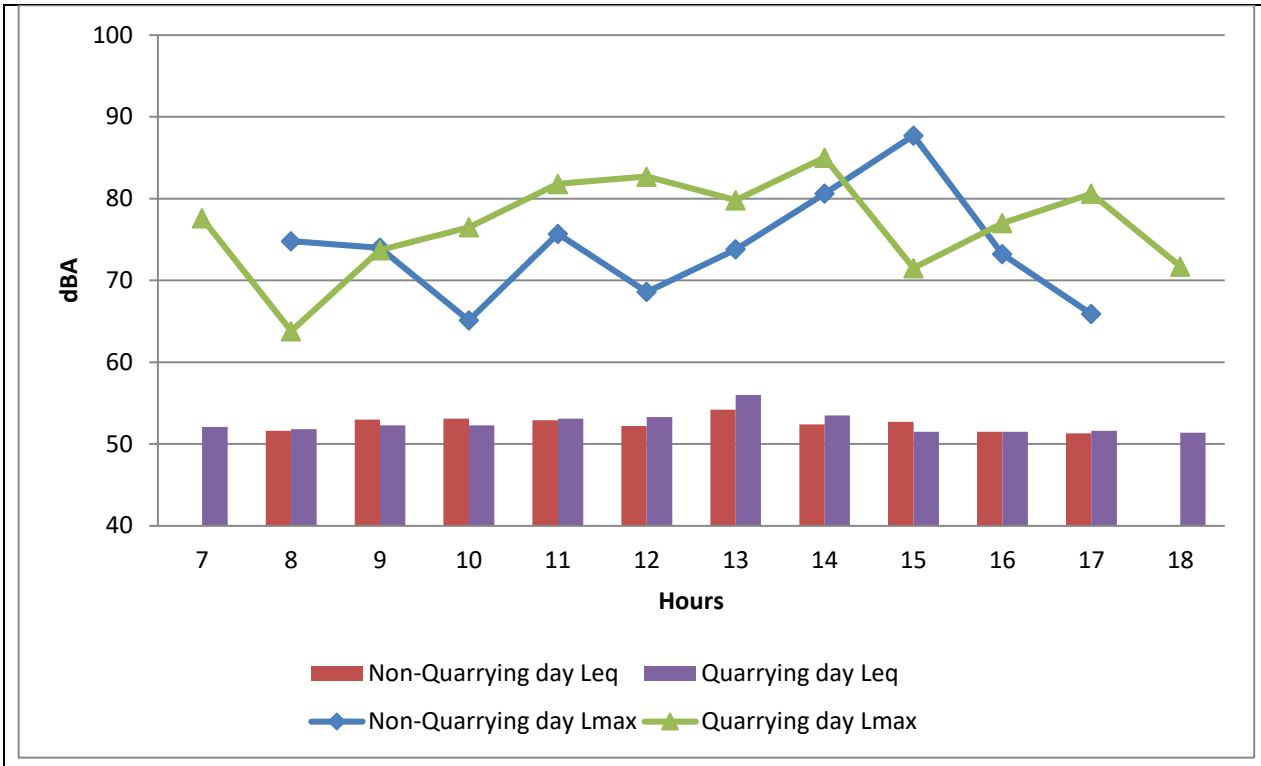


Fig.6: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at West Direction 200 m

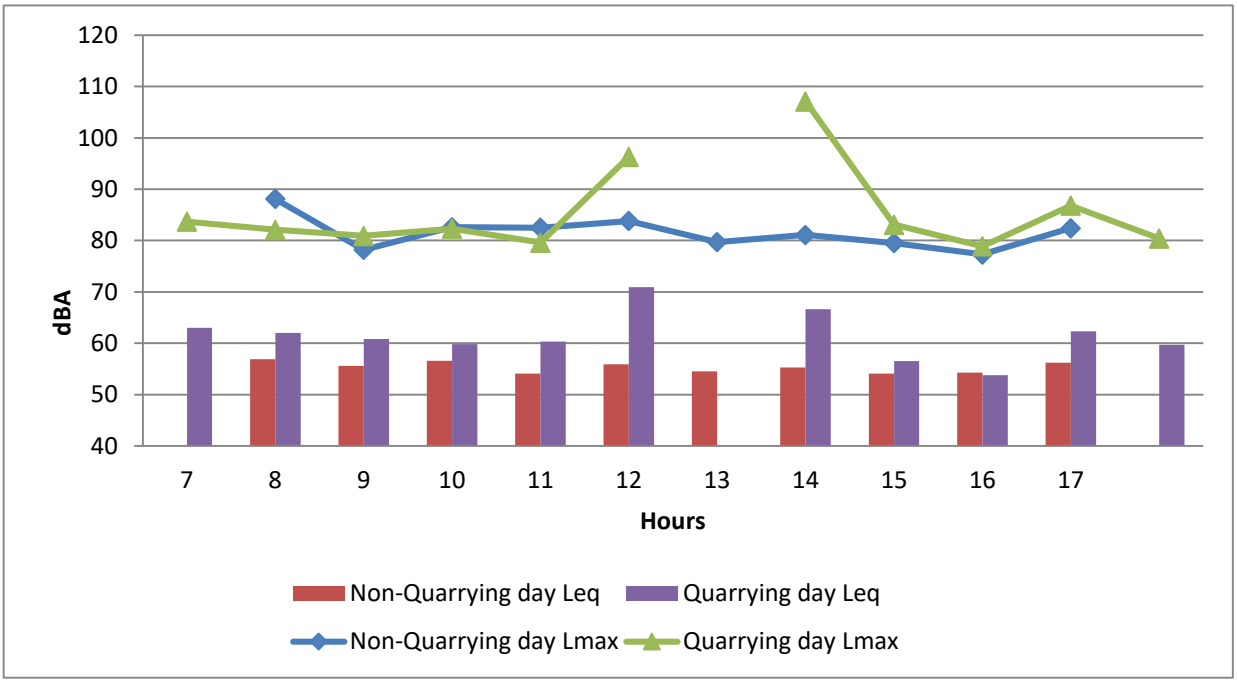


Fig.7: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at North East Direction 50 m

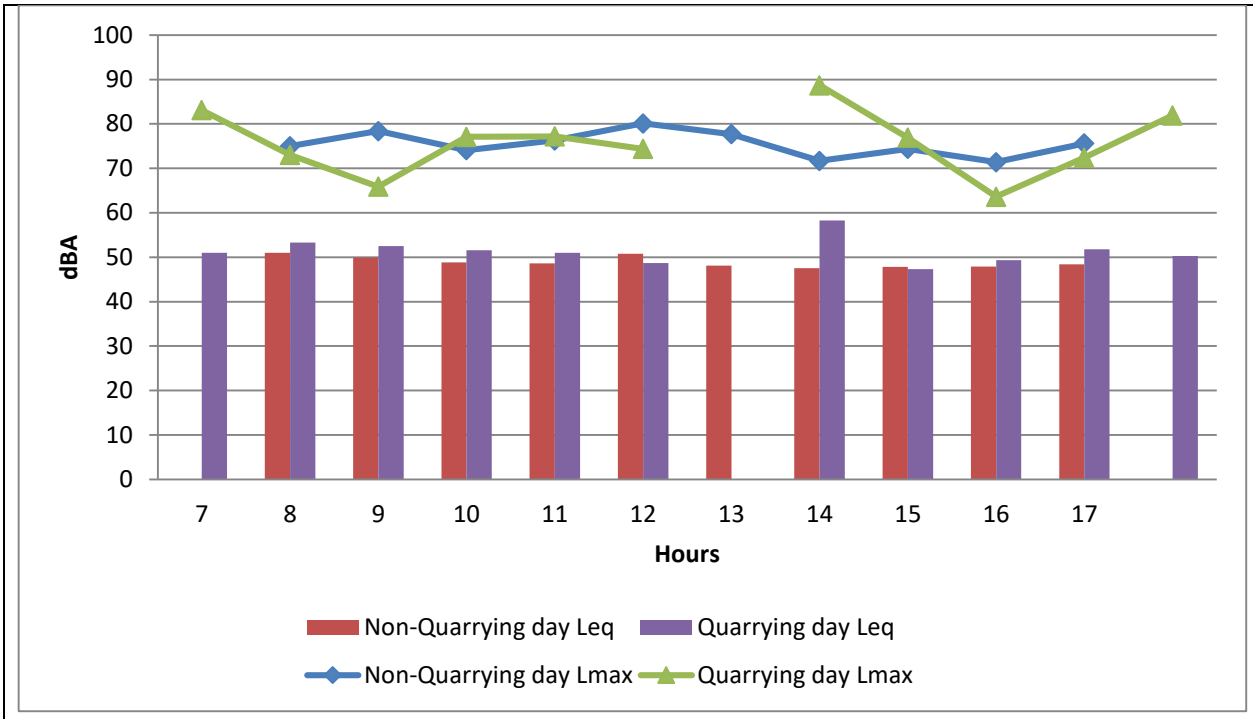


Fig.8: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at North East Direction 100 m

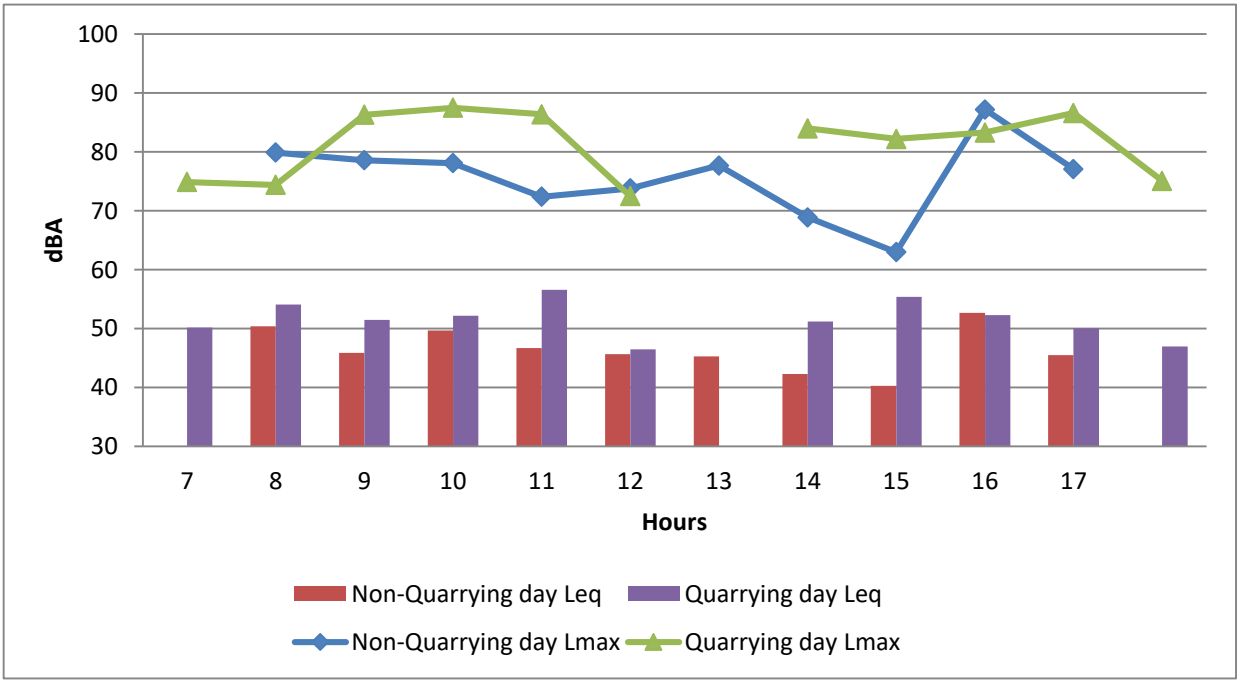


Fig.9: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at North East Direction 200 m

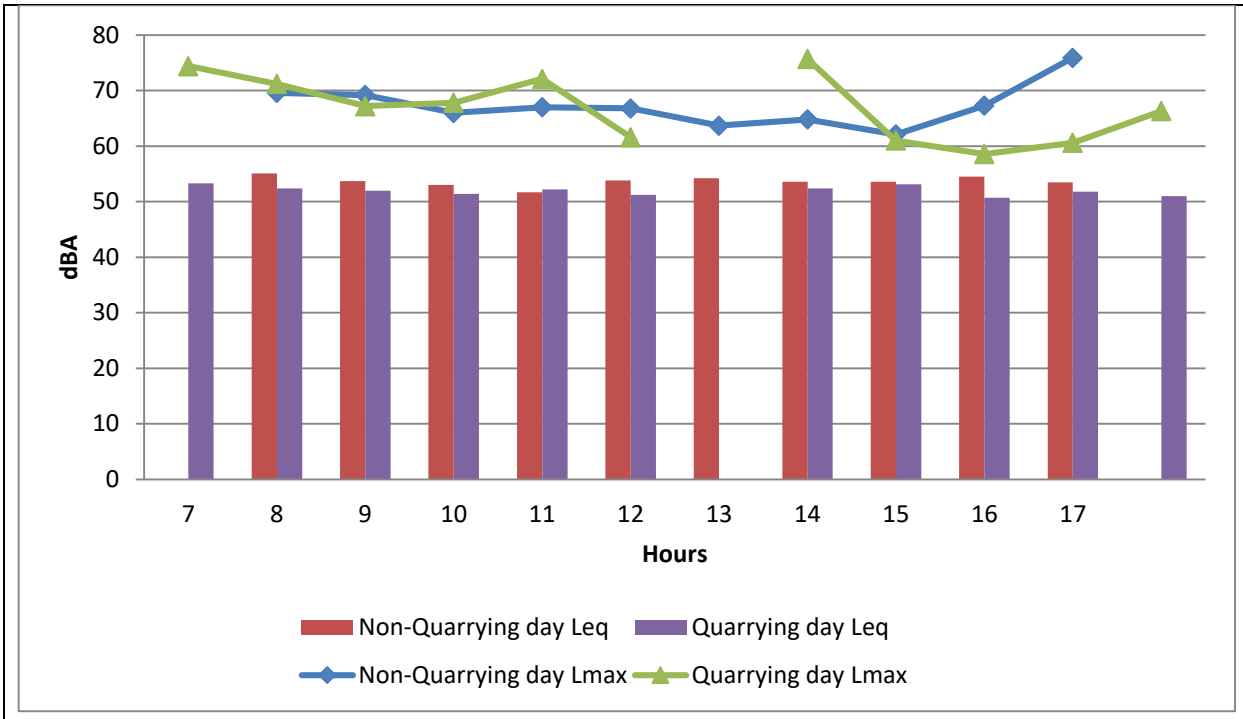


Fig.10: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at North East Direction 500 m

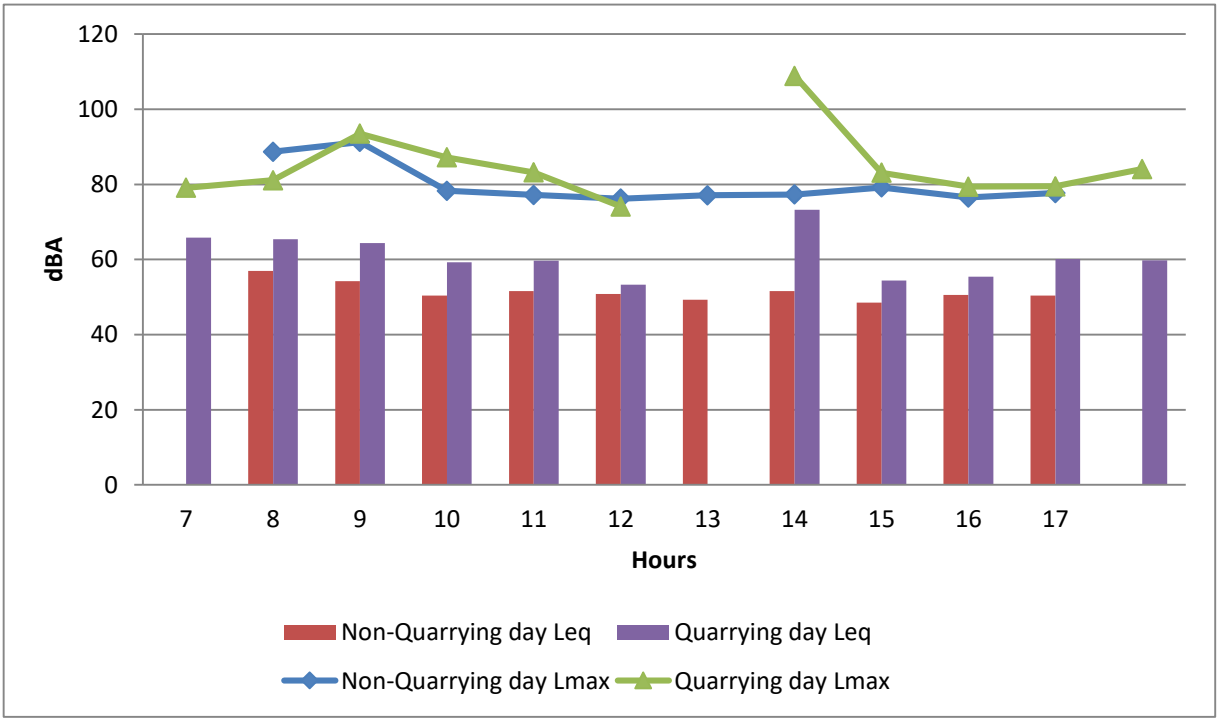


Fig.11: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at South East Direction 50 m

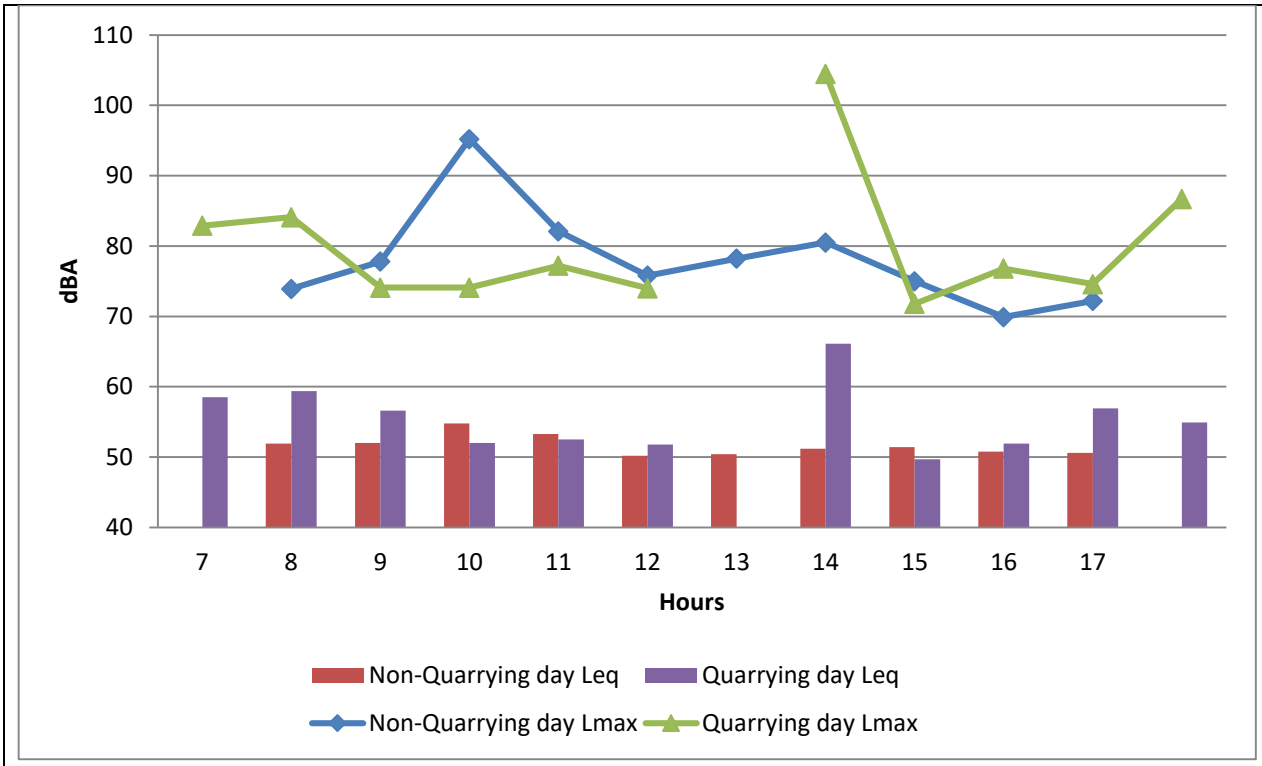


Fig.12: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at South East Direction 100 m

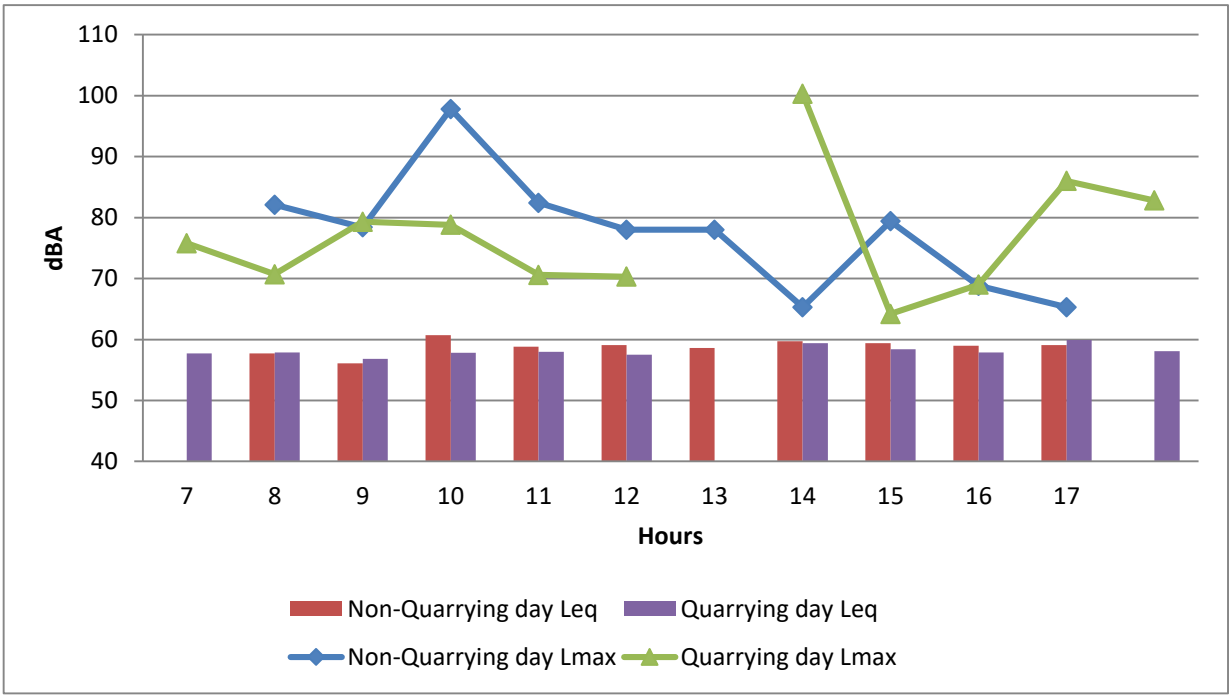


Fig.13: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at South East Direction 200 m

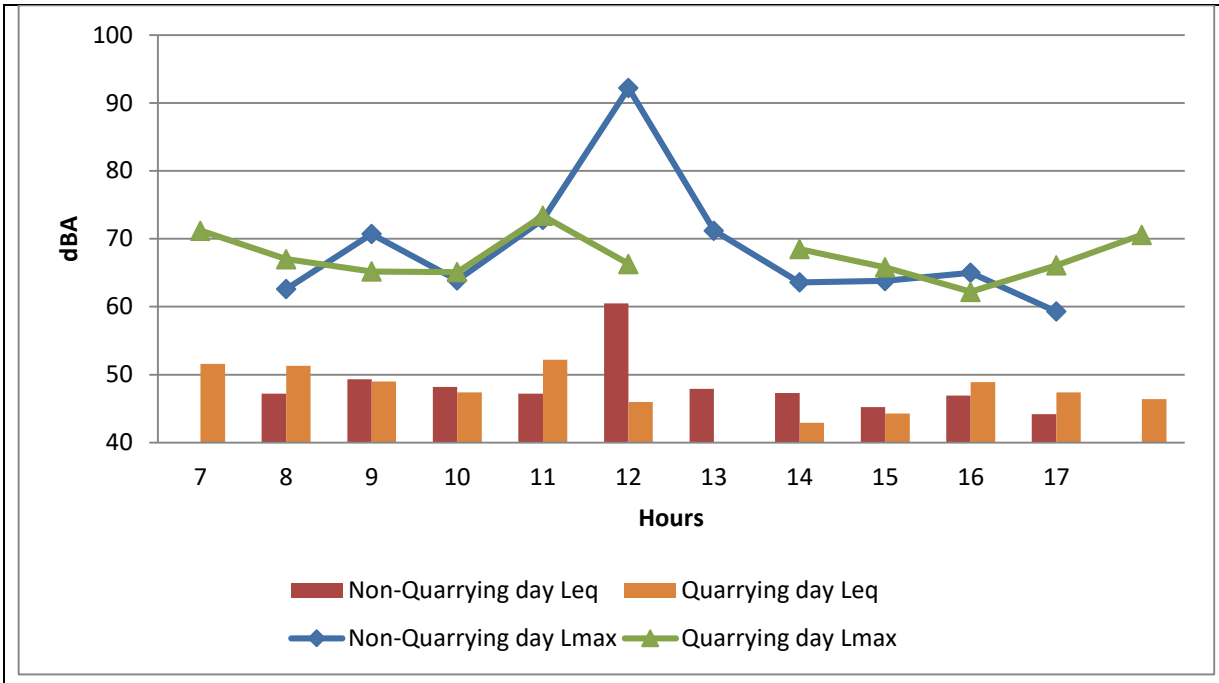


Fig.14: Noise Levels- Equivalent Values (Leq) and Maximum Values (L_{max}) observed on Quarrying and Non Quarrying Day at South East Direction 500 m

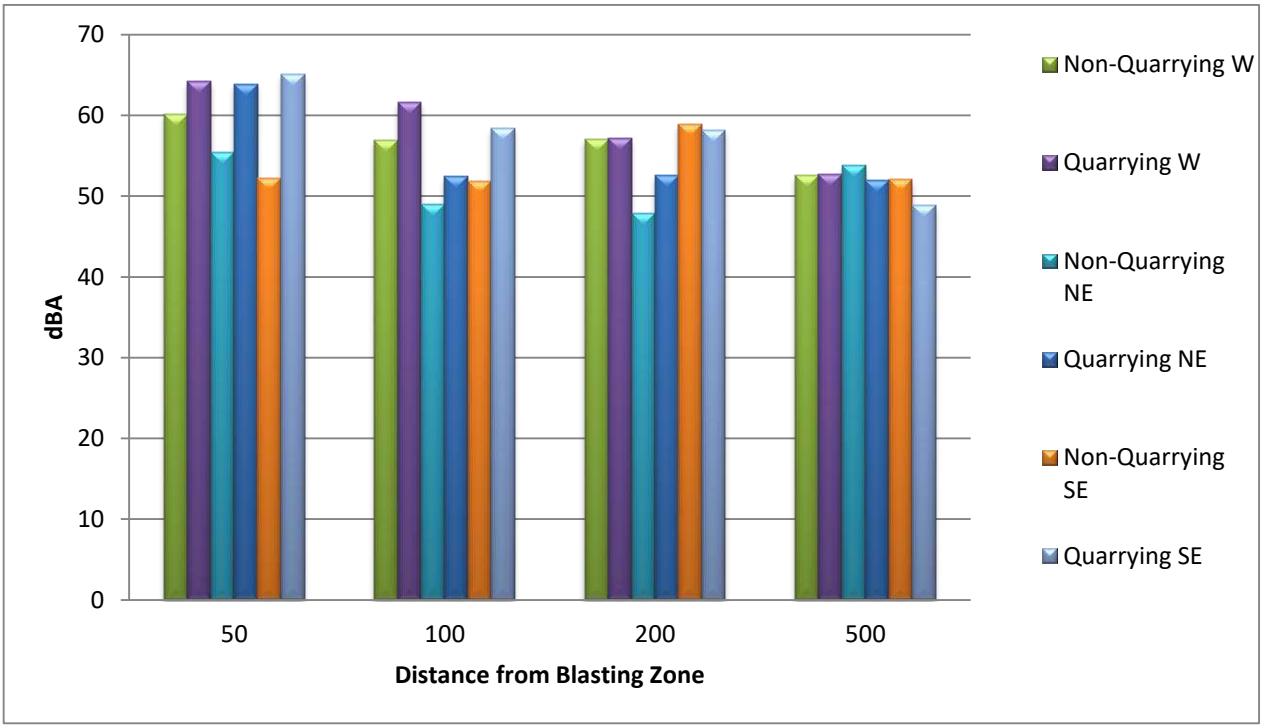


Fig.15: Equivalent values (Leq) of non quarrying and quarrying day

Leq= Equivalent noise level (12 hours)

dB(A)= Decibel in 'a' scale (unit of sound pressure level)

The Noise monitoring analysis results monitored at 11 monitoring stations reveal that

(i) The equivalent noise level are high on quarrying day than ambient day at all monitored stations except at SE200, SE500 and NE500, which can be attributed to local sources, than quarrying effects.
(ii) The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.
(iii) More than 10 dB(A) increase in Leq was observed in SE50
(iv) Peak of hourly equivalent value was observed between 12 hours and 14 hours, which corresponds to the blasting time.

6.4 Water Quality

Analysis results of the stone quarry pond water quality is given in the Table below:

Sample Point: Quarry Pond located within the quarry site

Date of Sample: 03/01/2023

Sl. No.	Parameters	Unit	Value
1	pH		7.2
2	BOD	mg/l	12
3	COD	mg/l	36
4	SS	mg/l	46.5
5	D.O	mg/l	5.2
6	SODIUM	mg/l	8.29
7	POTASSIUM	mg/l	4.06
8	CALCIUM	mg/l	17.2
9	MAGNESIUM	mg/l	4.13

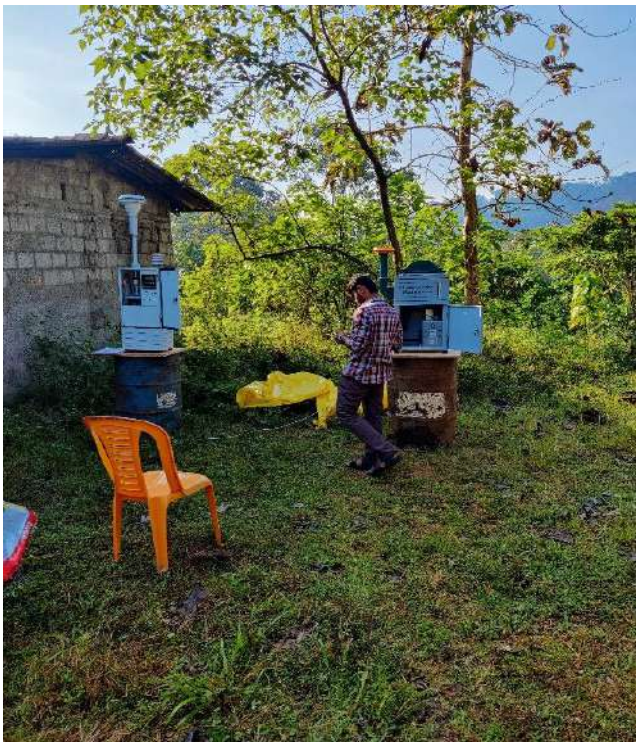
Note:- No effluent discharge standards prescribed by Kerala SPCB to the Stone Quarry Operator under the Consent to Operate issued under The Water (Prevention and Control of Pollution) Act, 1974.

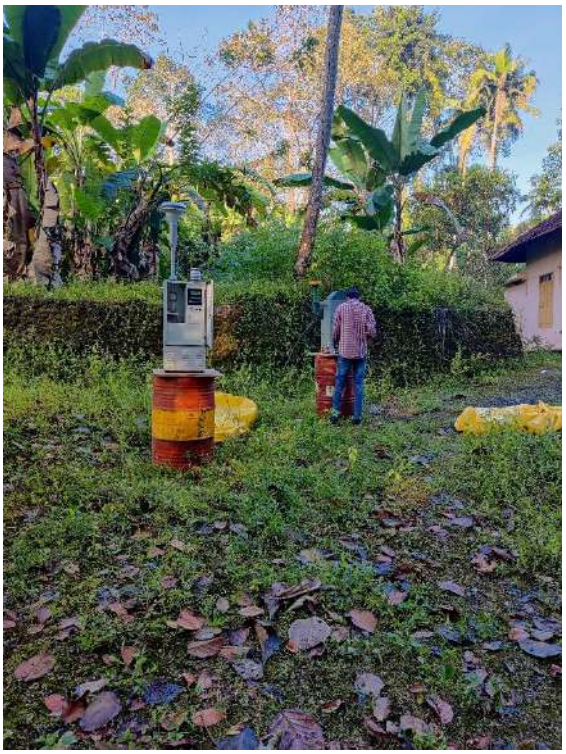
7.0 Site specific observations made during the Visit

- The quarry has a deep excavated area.
- The land surrounding the quarry premises are thickly vegetated and residences observed. High rock faces observed all around the excavation.
- Dust suppression is practiced by using dedicated tanker spray vehicle and cannons
- All requisite personal protection equipment is provided to all the workers.
- Good shaped benches are practiced and maintained.
- Boundary pillars are maintained intact with latitude and longitude painted
- There is a natural vegetation all around and green belt has been developed artificially.
- The Approach roads outside quarry premises are tarred and well maintained.
- Mist sprinkling all around the stone quarry and smog gun arrangements are made by the unit for control of dust from stone quarry site.
- Blasting shelter made of iron sheet is provided at suitable points to prevent any damage to the workers at the time of blasting or for hiding during any unexpected eventualities.
- Surface runoff during rainy season, water from quarry site is pumped out and discharged into the forest area, without imparting any treatment.
- No fly rocks observed during the study period.

Annexure UGML I

Photographs taken during the site assessment carried out during 01 to 04.01.2023 at Quarry of Mr. George Kochuparambil, Vazhithala, Idukki District, Kerala





LOCATION: IDUKKI

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 05-01-2023 to 08-01-2023

Name and Address of the Stone Quarry Site	**Cochin Blue Metal Industries Pvt Ltd., Choozhikkara, Methiri (PO), Ramapuram, Kottayam- 686576**			
Geo-coordinates	Latitude	09°50'43.25"N	Longitude	76°38'00.95"E

1.0. Stone Quarry Site Description

1.1 General information

M/s. Parackal Granite Kerala, Kalamboor, Muvattupuzha, Ernakulam had the lithology of Hornblende Gneiss, was of large size and has no public complaints. The present quarrying lease issued by Department of Mining and Geology, Government of Kerala, commenced on 12-02-2019and is valid up to 14-02-2029.

The quarry has obtained Environmental Clearance from State Environmental Impact Assessment Authority, Kerala on 27-02-2018 and valid up to 26-02-2023. It also holds valid Consent to Operate of Kerala State Pollution Control Board. It is owned by Shri. P. K. Prasad. Area of mining is 7.6606 Ha, nearest residential area is 54 metres from the quarry.

The quarry is attached to in-house crusher. The public road to the quarry from the nearest town is well tarred and wide enough for two heavy vehicles. The approach road in the proponent's property is also tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers and no forests or sanctuaries nearby.

1.2 Topography & Geology

The highest elevation of the mine area is 195 m MSL in the NW and the lowest is 130 m MSL in the SE direction. This area shows a very interesting correspondence between the major rock classes and their physiographic expression. The east comprises Precambrian metamorphic rocks and forms hilly ground. The central part is a low plateau, where tertiary sediments containing lignite ore. The charnockite group dominates in areal distribution with charnockite, charnockite gneiss and diopside gneiss occupying the major part.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, etc. followed by controlled blasting (NONEL) using class 2 and class 6 explosives.

The rock breaking is done using pneumatic breakers and transported to the crusher site using trucks/ tippers of 15 Tonnes carrying capacity for various products. Every day, blasting is carried out in 2 prefixed timings with maximum 60 no. of holes/blast.

2.0 Location attributes			
2.1 Altitude (m)	85	2.2 Area (Ha)	4.8910
2.3 Terrain	Undulating	2.4 Lithology	Charnockite
2.5 Soil type	Laterite	2.6 Total Mineable reserve	5980285 MT
2.6 (a) Remaining Mineable reserve	4472814 MT	2.6 (b) Approximate mined quantity per annum	400000 MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	None within 10 km	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	05-01-2023	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	06-01-2023	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
3	07-01-2023	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
4	08-01-2023	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations

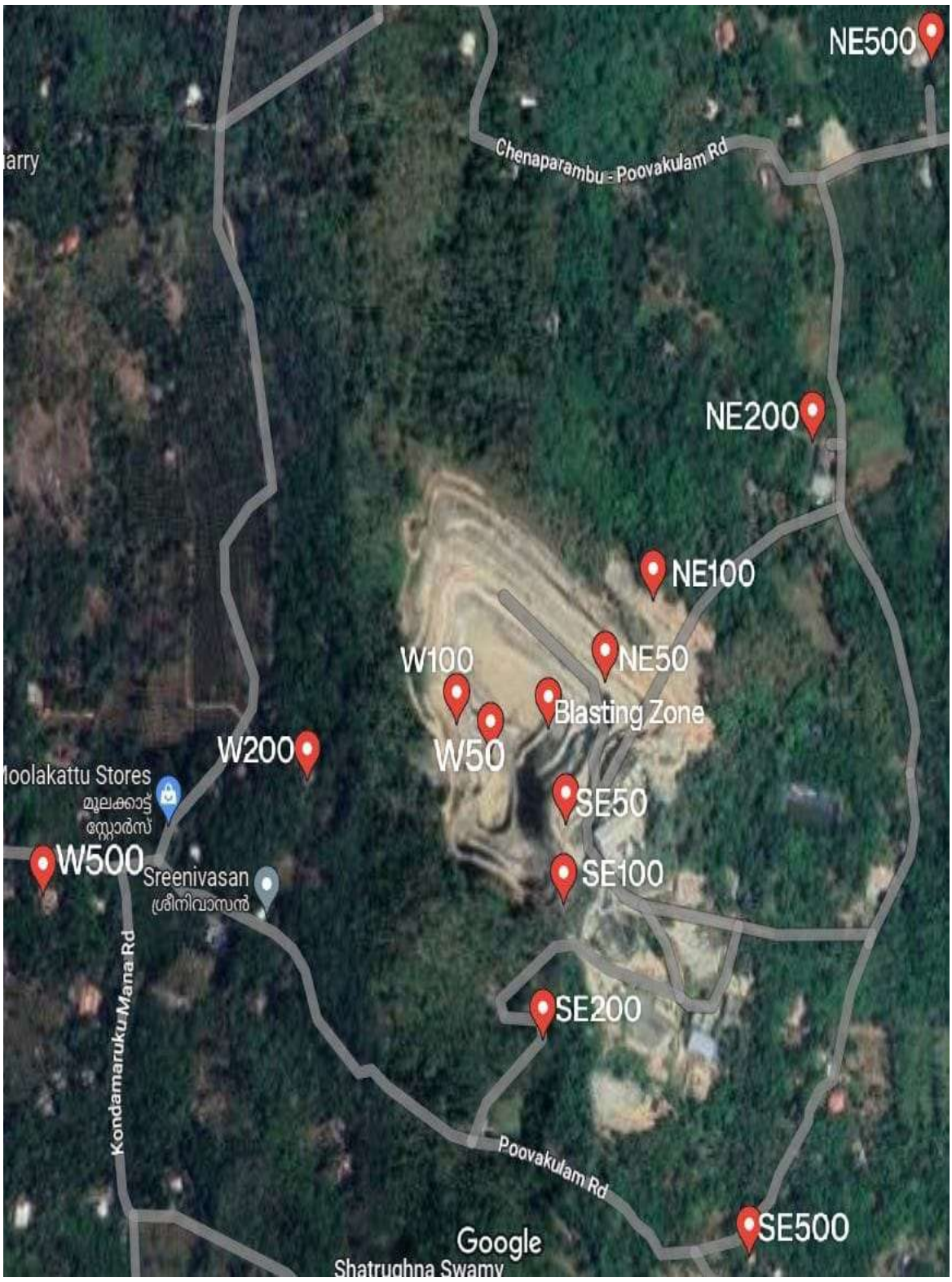
The quarry area has deep excavation. From the surrounding ground level, it is 30m- 40m deep. The present blasting zone is towards east of the quarry area which has more length in the east west direction than in the North South direction. Hence the 50m, 100m and stations towards West, North East and South East line are inside the open quarry land itself. Station Point SE200 is also inside the quarry premises. Further stations of 500m and NE200, W200 were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other. 7 locations were inside the quarry and 5 locations were outside the quarry premises.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 211 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used is ammonium nitrate of 250 gm per hole.

The CIMFR team identified 8 locations for the seismic analysis. 4 locations were inside the quarry and 4 locations were outside the quarry. They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location

identification and survey were completed by 5pm. Photographs taken during the site assessment at Cochin Blue Metal Industries Pvt. Ltd., Ramapuram, Kottayam District Kerala is given as Annexure-1.

4.1 Map showing sampling locations (Map)



LOCATION: KOTTAYAM

4.2 Geo-coordinates of sampling locations			
S. No.	***Station Points***	***Latitude***	***Longitude***
1	W50	9.8438463	76.6336519
2	W100	9.8439302	76.6332097
3	W200	9.8438817	76.6319826
4	W500	9.8436567	76.6298522
5	NE50	9.8443963	76.6346162
6	NE100	9.8446438	76.6349464
7	NE200	9.8458003	76.6364116
8	NE500	9.8467288	76.6382519
9	SE50	9.8435768	76.6344549
10	SE100	9.8430082	76.6344264
11	SE200	9.842008	76.6356358
12	SE500	9.840519	76.6362

5.0 Monitoring activities

5.1 Background monitoring (on 07-01-2023)

The monitoring started at 6.00am at all 12 stations. The air monitoring was interrupted at 7 stations inside the quarry (from 6AM to 7AM) due to voltage fluctuation and other electrical malfunctions. The quarry activities were kept completely idle to do ambient monitoring. The direction of the wind was mostly from west to east. The monitoring was completed at all 12 stations by 06PM. The crusher was in operation on this ambient monitoring day also, since it was operational on quarrying day.

5.2 Monitoring during Stone Quarry Operation (on 06-01-2023)

The monitoring started at 6.00am. At the stations NE 200 and NE 500, air monitoring was interrupted for 15 minutes to 1 hour due to the power failure. Also, at the station SE 50 and SE 100, the sound level meter had some problem and the noise monitoring was interrupted from 20 minutes to 1 hour. The weather data were recorded from the same two stations inside the quarry.

Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and approximately 300 no. s of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 11.45am. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 8 locations which had slight changes from the previously decided locations, due to site-specific practical reasons. That is, inside the quarry there were

4 locations except at the Office site. Outside the quarry, one additional point was identified at NE 200.

There is another operational quarry about 500m distant from the boundary of the quarry under study. Noise of blasting from that quarry was audible at the site but it was ensured that the blasting of either of the two quarries takes place at different timing so that effect of blasting of the quarry under study could be detected separately.

The crusher was kept idle on both the ambient monitoring day as well as the quarrying monitoring day since operating the crusher would have contributed to dust as well as vibration and noise. That would affect the measured values in which the effect of quarrying alone is to be found out. About 10 experimental blasts were conducted.
Immediately after the blasting was completed, vehicular movement, breaking of boulders using breakers and hauling of the quarry product using haulers were carried out. These quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all the 12 stations by 06PM.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (07-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	-	-	-
2	07:00	-	-	-
3	08:00	24.1	69.1	1.2, SE
4	09:00	25.8	64.6	1.1, S
5	10:00	27.5	60.8	1.5, W
6	11:00	29.1	55.7	0.7, SW
7	12:00	30.2	50.4	0
8	13:00	31.8	50.9	0
9	14:00	31	49.1	2.1, S

10	15:00	32.3	48.8	1.1, SE
11	16:00	32.1	54.7	1.2, NE
12	17:00	30.9	61.3	1.5, S
13	18:00	-	-	-

Weather: Quarrying day (06-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (°C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	22.6	70.2	0.6, SE
2	07:00	24	65.1	0.8, S
3	08:00	25.4	61.3	1.2, W
4	09:00	26.4	63.8	1.5, SE
5	10:00	28.2	54.6	0.7, SE
6	11:00	29.9	52.6	2, SW
7	12:00	30.7	50	0
8	13:00	32.6	53.4	0
9	14:00	31.6	50.6	1.2, S
10	15:00	31.5	48.4	2.8, S
11	16:00	31.8	54.8	1.1, SE
12	17:00	30.9	62.4	1.8, NE
13	18:00	30	65.6	1.5, SE

6.2 Particulate matters/dust

- The adjoining crusher had operated on both non-quarrying day and quarrying day.

- Generally, PM10 and PM2.5 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter. The variation in PM10 and PM2.5 on quarrying day than non-quarrying day are high compared to other quarry sites. This may be due to the dust-containment effect of the deep excavated area bound on all sides by high rock wall.

- In SE 500m station, increase of PM10 concentration on ambient day than blasting day can be attributed to local source of pollution like road dust. In SE50, SE100 and SE200 also PM 10 and 2.5 are more on non-quarrying day than quarrying day. These stations are within quarry premises but outside excavation. On non-quarrying day, other vehicular movement in the crusher premises was there even though there were no activities inside the excavation. The crusher plant's premises has dust-depositions which also contributed to ambient day's PM values.

Table: PM10 & PM2.5 values in non-quarrying and quarrying day

Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m^3)*		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	81.05555556	117.76028	18.06526807	71.90228621
W100	100 m	43.77333333	71.69312169	16.06425703	12.96854083
W200	200 m	49.0990991	60.15029725	18.07598039	65.3745973
W500	500 m	51.58615717	69.80251736	1.691542289	39.8953781
NE50	50 m	156.9260486	313.359682	33.84146341	45.65522777
NE100	100 m	59.08268734	126.5277778	29.986053	38.00272665
NE200	200 m	62.3715415	106.9899818	12.41987179	36.55859507
NE500	500 m	42.62254902	50.93573446	46.11451943	29.37797473
SE50	50 m	212.0576132	202.0921986	89.6969697	22.81144781
SE100	100 m	104.8907104	66.85897436	41.295306	6.923837784
SE200	200 m	87.92328042	56.77083333	23.00218124	19.39513478
SE500	500 m	61.41333333	54.3	20.68273092	1.00040016

Fig.1: PM-10 values of Quarrying and Non-quarrying days

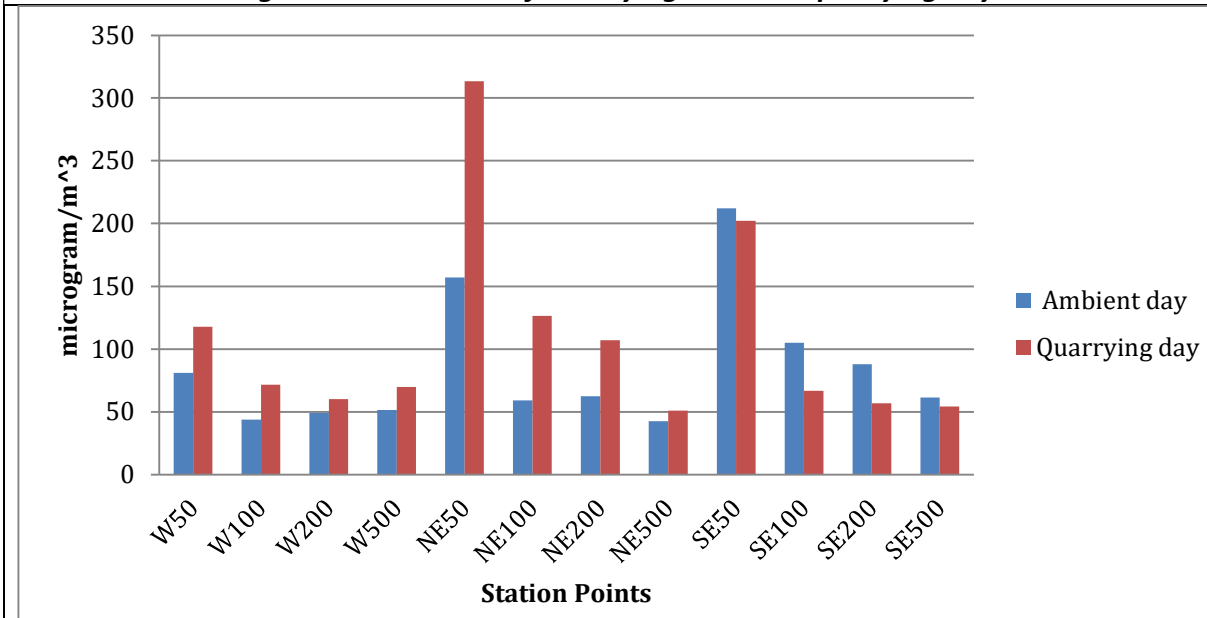
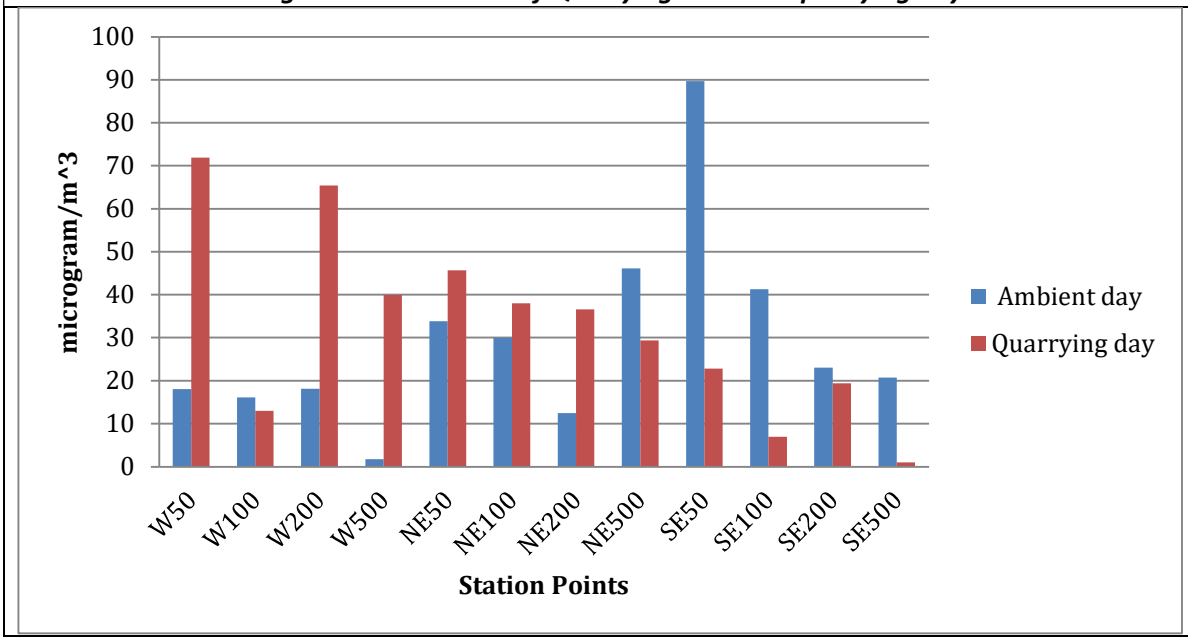


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below:

Leq= Equivalent noise level

dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level)

Observations:

- The adjoining crusher had operated on both ambient and quarrying monitoring days. This had affected the noise values of both days, especially SE direction where the crusher is located.
- The equivalent noise level of the total day is higher on blasting day than ambient day at all stations generally.
- The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.
- The local influences at far-off stations where influence of quarrying is very megre, resulted in minor changes in trend. Particularly in NE200 station, there was a dog farm nearby. Their barking caused higher Lmax and higher Leq on non-quarrying day compared to quarrying day.
- Peak of hourly equivalent value can be seen in the reading of 5 pm. It corresponds to blasting. Due to safety concerns, noise reading at 5 pm was not taken in stations very near to blast zone. In such stations, the peak of Lmax is seen at 6 pm.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	59.83952382	84.8	73.03866144	108.4
W 100	61.10748547	82.7	73.64087091	109.2
W 200	52.82427625	89.3	54.41208491	78.4
W 500	53.21203148	81.6	55.2814085	80.5
NE 50	65.03638879	84.4	67.56481128	103.4
NE 100	51.79030231	81.8	62.35934479	95.2
NE 200	53.44560396	86.1	49.93040149	73.8
NE 500	58.59939681	88.5	58.18463251	80
SE 50	70.20475244	81.3	72.92318102	101.5
SE 100	61.75307673	76.5	63.09596562	92.9
SE 200	61.40498275	85.2	63.0524531	90.6
SE 500	59.15523672	89.8	59.20886213	84

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

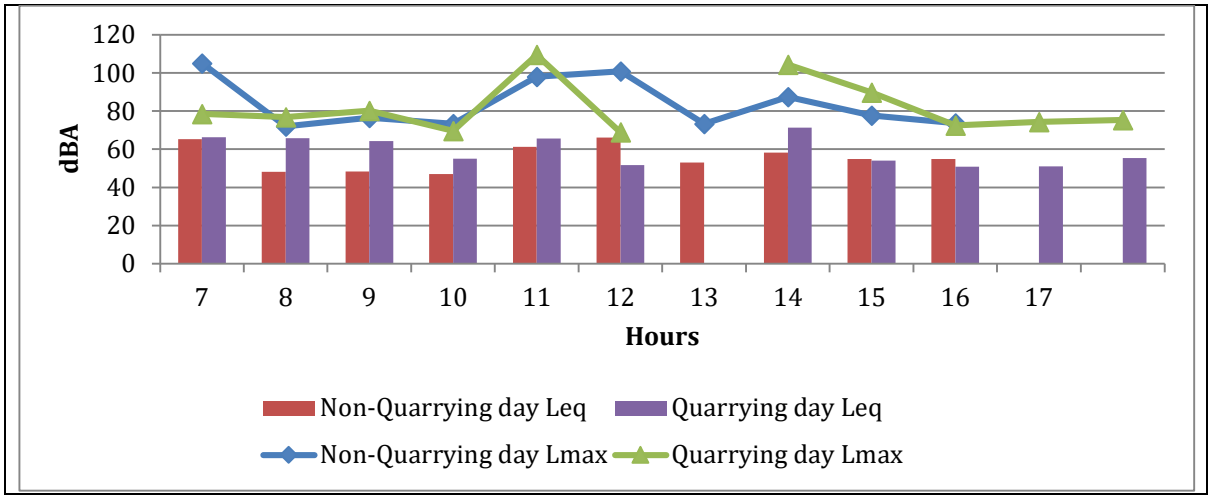


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

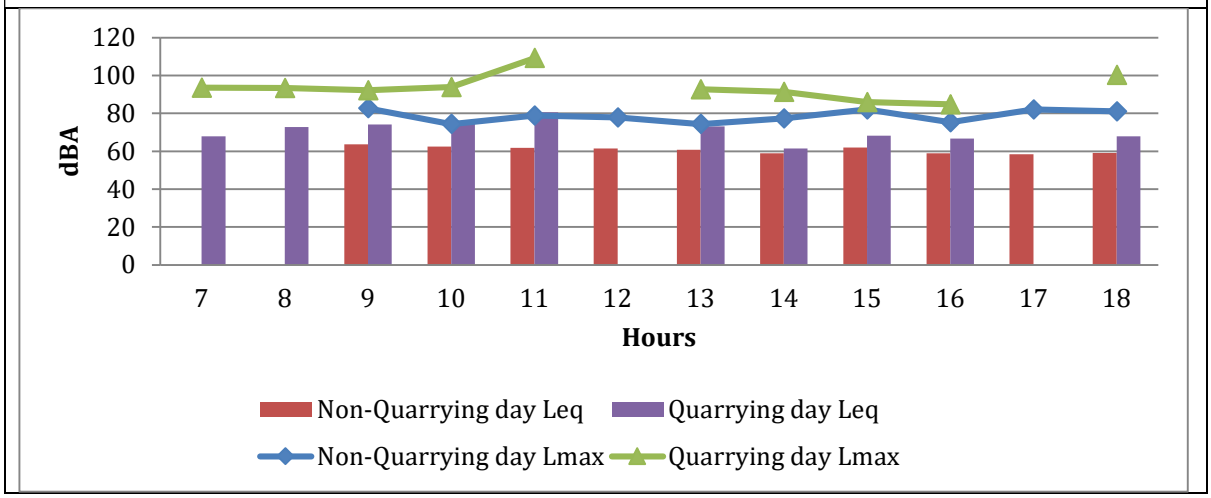


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

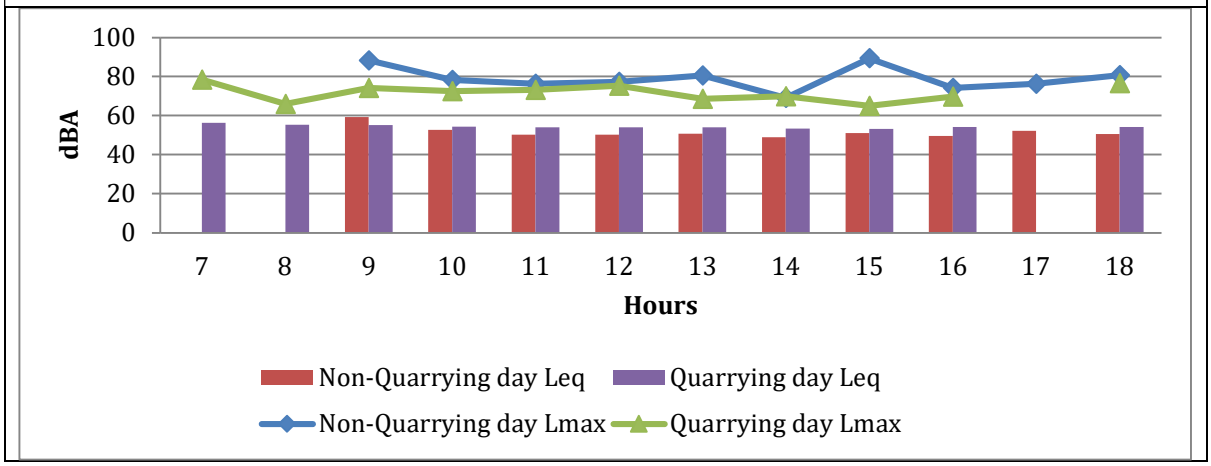


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 500m

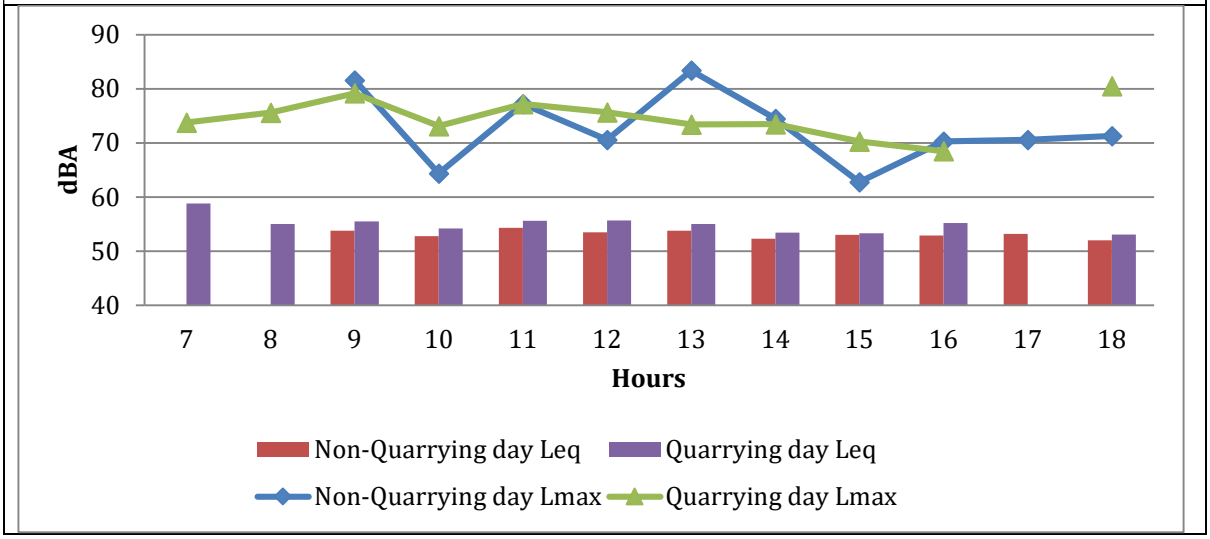


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

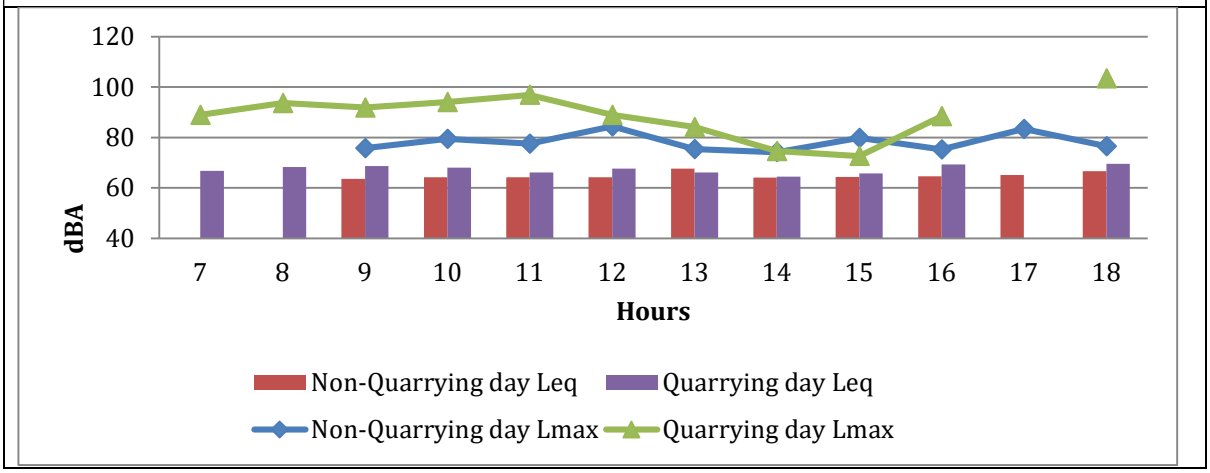


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

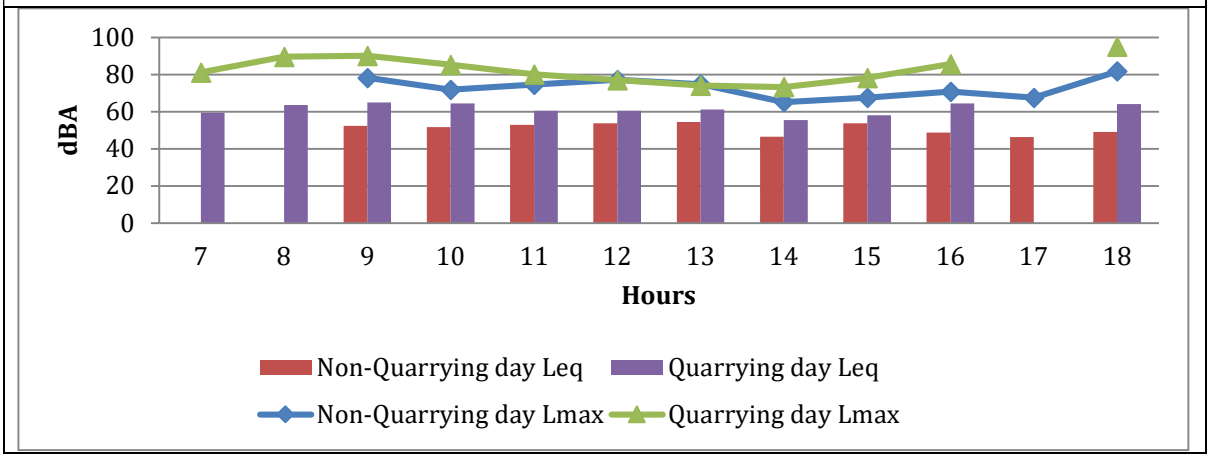


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

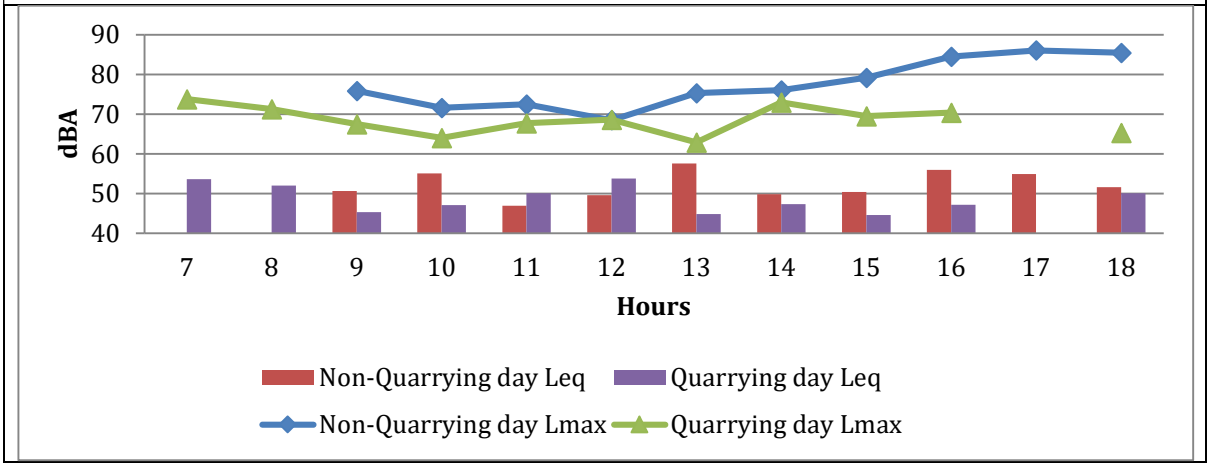


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

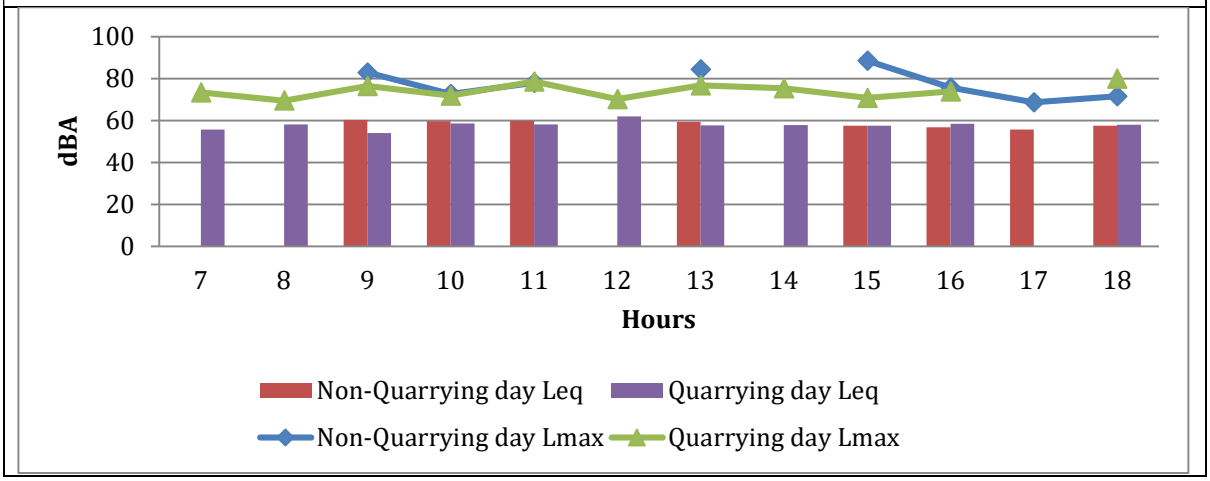


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

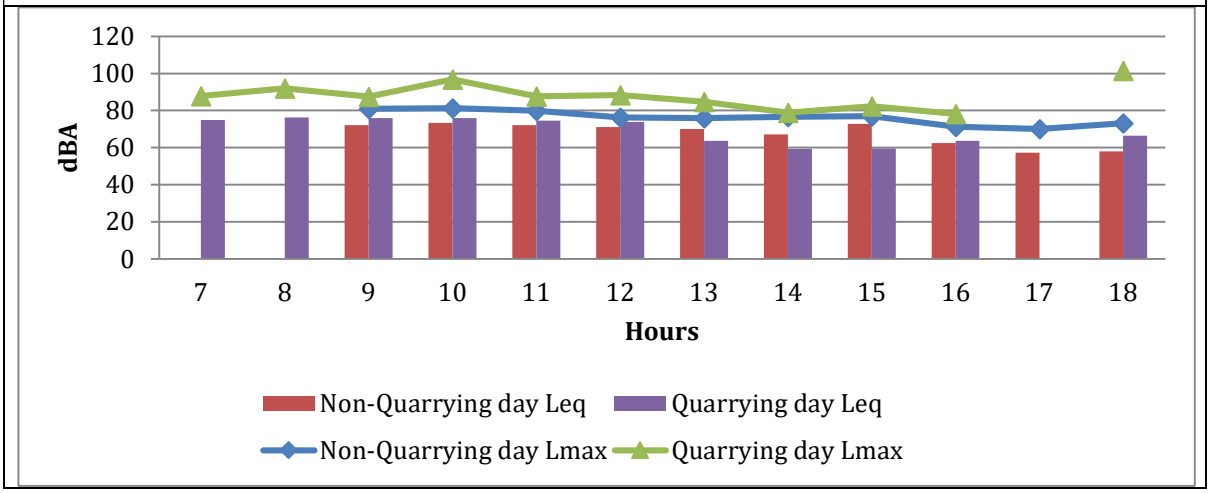


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

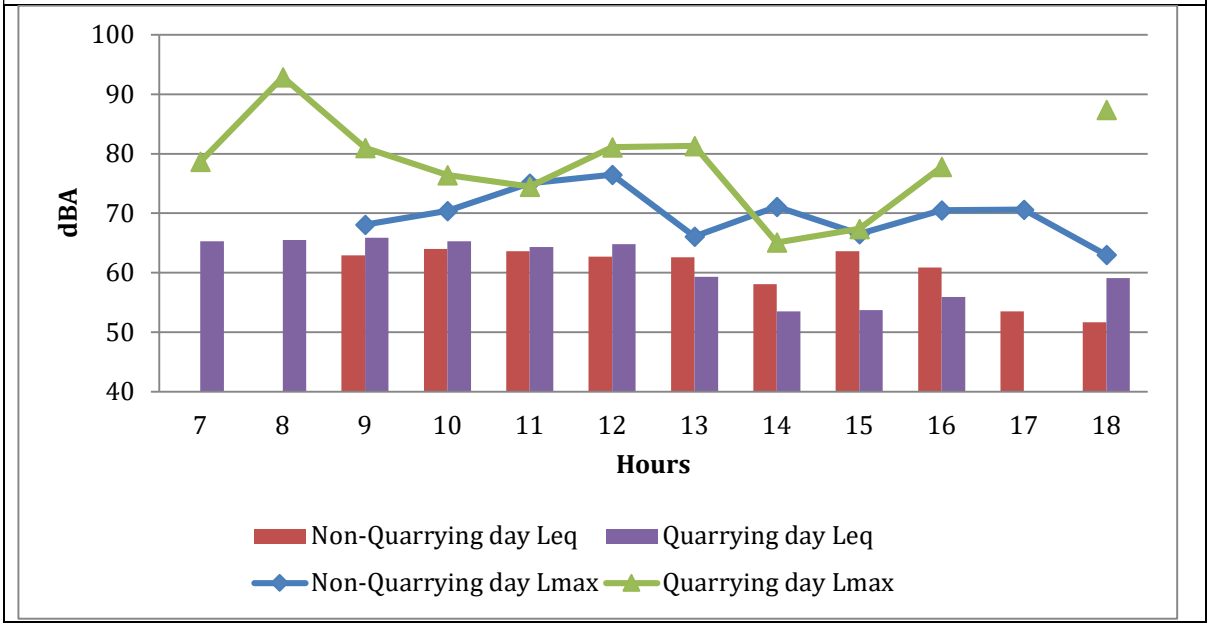


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

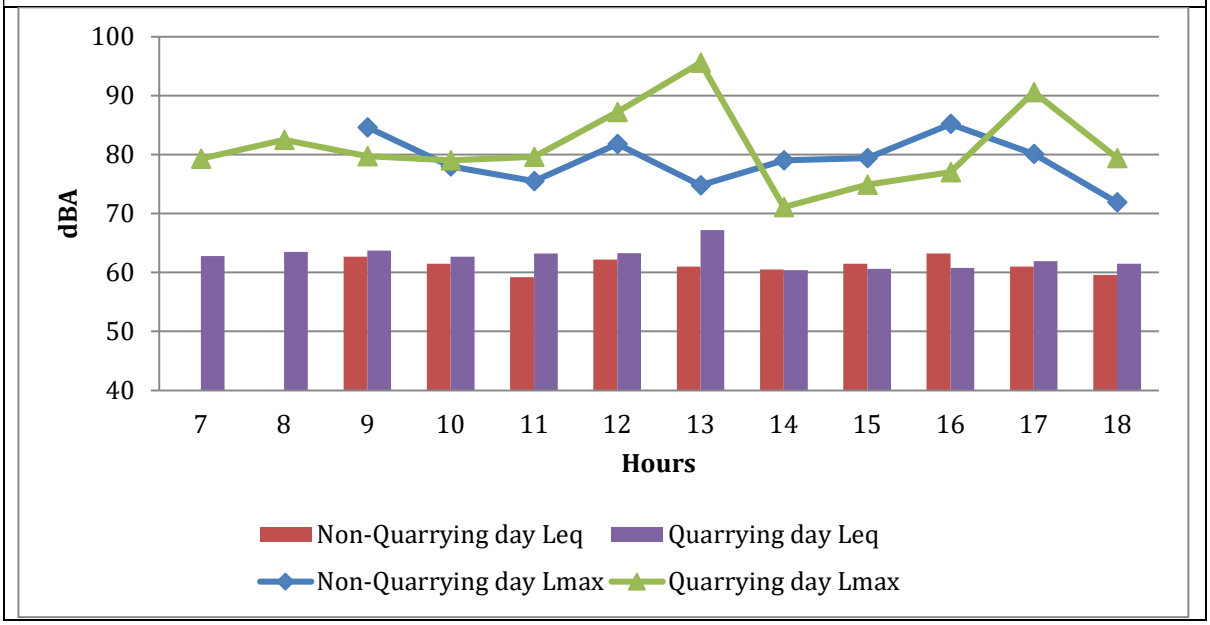


Fig.14: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

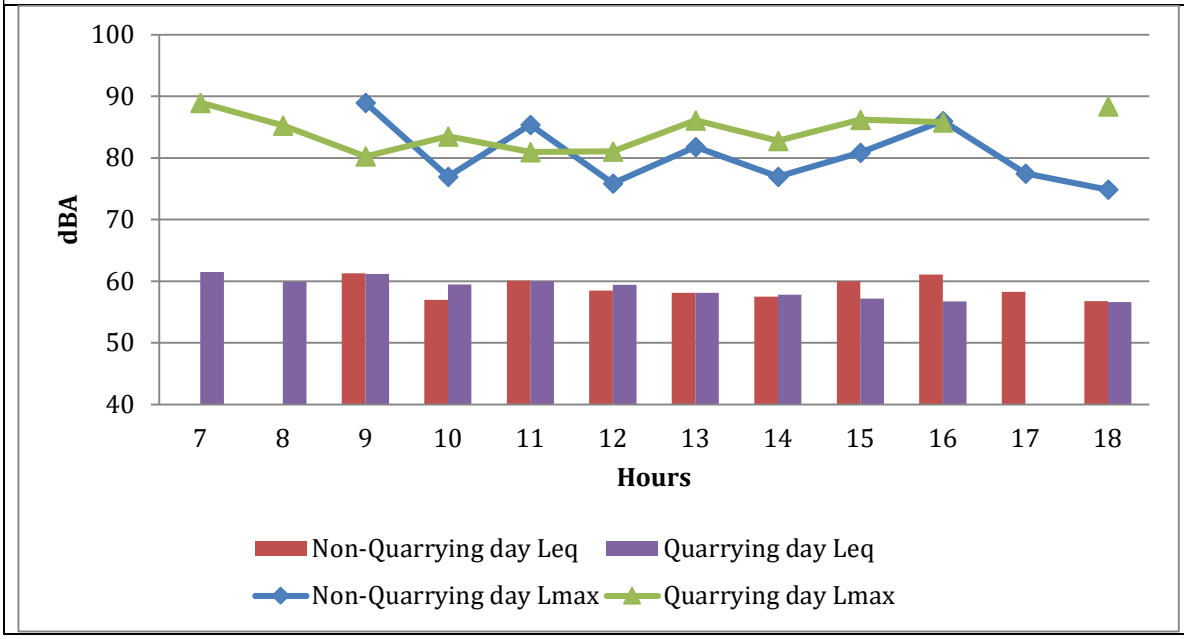
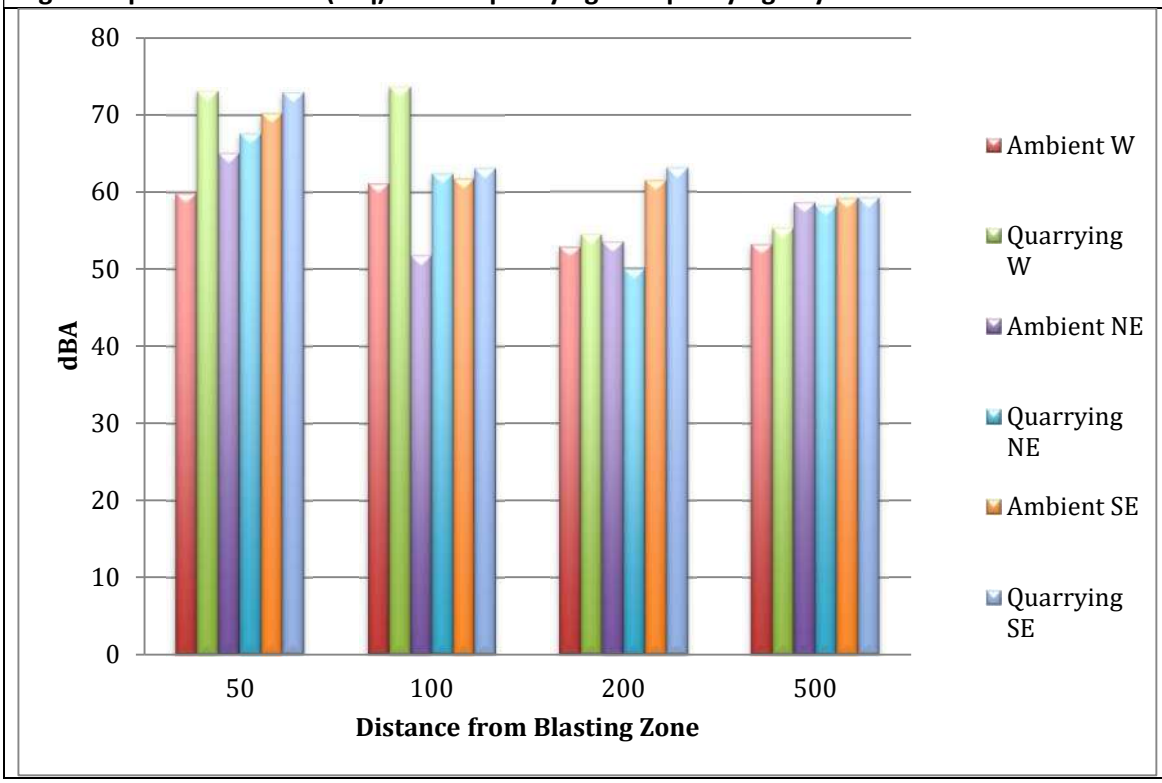


Fig.15: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: Old Quarry Pond			
Date of Sample: 28/12/2022			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH	-	7.8
2	COD	mg/l	4
3	BOD	mg/l	1
4	SS	mg/l	75
5	TDS	mg/l	220
6	CONDUCTIVITY	µS/cm	300
7	D.O	mg/l	7.1
8	SODIUM	mg/l	3.2
9	POTASSIUM	mg/l	6.4
10	CALCIUM	mg/l	4.6
11	MAGNESIUM	mg/l	2.2

7.0 Site specific observations made during the Visit

The quarry practises dust suppression using sprinkler-mounted tanker vehicle. The roads inside the quarry are tarred. Approach road to the quarry from the tarred public road, which is about 250 metres long, is also tarred. Good benching is practised. The depth of the present quarrying area with very high rock wall made the observed values different from other quarry sites. There are no recorded complaints about the quarry.

Photographs taken during the site assessment

Monitoring team

Quarry site

Particulate matter monitoring

Noise monitoring

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 09-01-2023 to 12-01-2023

Name and Address of the Stone Quarry Site	**M/s. Penta Granites, Elavampadam PO, Neethipuram, Palakkad 678706**			
Geo-coordinates	Latitude	10°31'18.66"N	Longitude	76°30'11.30"E

1.0. Stone Quarry Site Description
1.1 General information
M/s. Penta Granites, Elavampadam PO, Neethipuram, Palakkad had the lithology of Charnockite. It is attached with captive crusher unit. It is owned by Shri. Joshy PJ. As per the information provided by the stone quarry, the present quarrying lease commenced on 12.01.2017 and the validity of lease is up to 30.11.2029. The quarry has obtained Environmental Clearance dated 10.07.2017 and is valid upto15.12.2023. It also has Consent to Operate dated 12.09.2022 with validity up to 30.11.2027. Area of mining is 4.1371 Ha. Nearest residential area is 135 metres from the boundary of the approved mining area. The quarry is attached to in-house crusher. The public road to the quarry from the nearest town is well tarred and wide enough for two heavy vehicles. The approach road in the proponent's property is also tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers and no forests or sanctuaries nearby.
1.2 Topography & Geology
The highest elevation of the lease area is 180 m above MSL in the SW and the lowest is 120 m above MSL. The topography of the surrounding lease area is an elevated terrain with quarry land covered with native trees, shrubs, herbs, grass, climbers, bushes and habitations in various direction around the quarry.
1.3 Details of quarrying/ mining activities
The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, etc. followed by controlled blasting (NONEL) using class 2 and class 6 explosives. The rock breaking is done using pneumatic breakers and transported to the crusher site using trucks/ tippers of 15 Tonnes carrying capacity for various products. Every day, blasting is carried out in 2 prefixed timings with maximum 40 no. of holes/blast.

2.0 Location attributes			
2.1 Altitude (m)	110	2.2 Area (Ha)	4.1371
2.3 Terrain	Undulating	2.4 Lithology	Charnockite

2.5 Soil type	Laterite	2.6 Total Mineable reserve	2064248 MT
2.6 (a) Remaining Mineable reserve	1404843 MT	2.6 (b) Approximate mined quantity per annum	150000 MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	3.37	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	09-01-2023	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	10-01-2023	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	11-01-2023	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
4	12-01-2023	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations

The quarry area is deep, the present excavation area is only 30-40 metre below the surrounding ground level. The present blasting zone is towards east of the quarry area which has more length in the North South direction than in east west direction.

The 50m, 100m and 200m stations towards West and South East directions are inside the quarry land itself. The 200m stations in North East direction, further stations like 500m in all directions were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other. 8 locations were inside the quarry and 4 locations were outside the quarry premises. The photographs taken during the assessment at M/s. Penta Granites, Neethipuram, Palakkad District is attached as Annexure-I.

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations			
S. No.	***Station Points***	***Latitude***	***Longitude***
1	W50	10.5207641	76.504119
2	W100	10.5205941	76.5037985
3	W200	10.5211063	76.5027145
4	W500	10.5225982	76.5011776
5	NE50	10.521876	76.5044848
6	NE100	10.522452	76.5044694
7	NE200	10.521619	76.505147
8	NE500	10.52288	76.5078074
9	SE50	10.5203392	76.5050973
10	SE100	10.520179	76.5053065
11	SE200	10.5198019	76.5051604
12	SE500	10.5188805	76.5063171

5.0 Monitoring activities

5.1 Background monitoring (on 10-01-2023)

The monitoring started at 6.00am at each 12 locations. But at some stations, due to delay in supplying stabilised power supply, monitoring started at 8 am only. The quarry activities were kept completely idle to do ambient monitoring. The crusher was kept idle on both the ambient monitoring day and quarrying day. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. Weather data were also recorded at station points (NE 100) inside the quarry. The monitoring was interrupted at stations NE50 (for 1hour from 7 AM to 8AM) and W 200 (for 1 hour from 10AM to 11 pm) due to the voltage fluctuation issue. The wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 123 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used is ammonium nitrate of 250 gm per hole.

The CIMFR team identified 8 locations for the seismic analysis. 4 locations were inside the quarry and 4 locations were outside the quarry. They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 05.30pm. The monitoring was completed at all the 12 stations by 06PM.

5.2 Monitoring during Stone Quarry Operation (on 11-01-2023)

The monitoring started at 6.00am. At the station W200, the sound level meter had some problem and the noise monitoring was interrupted from 20 minutes to 1 hour. The weather data were recorded from the same stations inside the quarry.

Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 02PM. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points and installed the seismographs by 02:30 PM. The blasting was conducted by 03 PM. But the total blasting operation of 10 blasts took almost 45 minutes. It was not safe to be near monitoring stations at 3 pm as the blasting operation was going on, this forced 3 pm readings to be omitted in the noise level meters.

The crusher was kept idle on both the ambient monitoring day as well as the quarrying monitoring day since operating the crusher would have contributed to dust as well as vibration and noise. That would affect the measured values in which the effect of quarrying alone is to be found out. Immediately after the blasting was completed, vehicular movement, breaking of boulders using breakers and hauling of the quarry product using haulers were carried out. These quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all the 12 stations by 06PM.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (10-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	-	-	-
2	07:00	21.4	79.1	0
3	08:00	21.6	77.8	0
4	09:00	24.8	64.0	0.7, S
5	10:00	27.2	60.1	0.3, SE
6	11:00	29.0	55.6	1.2, W
7	12:00	29.5	56.5	1.3, SE

8	13:00	30.5	47.9	1, NE
9	14:00	30.3	43.9	2.1, SE
10	15:00	30.4	44.0	0.7, S
11	16:00	29.7	44.5	0.9, S
12	17:00	-	-	-

Weather: Quarrying day (11-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (°C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	20.1	75.9	0
2	07:00	20.4	69.9	0
3	08:00	21.1	75.3	0
4	09:00	21.9	72.0	0
5	10:00	27.5	61.0	0
6	11:00	27.9	53.9	2.3, SE
7	12:00	28.9	50.3	2.4, E
8	13:00	30.6	42.8	1.5, W
9	14:00	33.2	43.5	0
10	15:00	33.0	43.9	0.5, SE
11	16:00	32.7	43.6	1.1, S
12	17:00	30.1	43.8	0.4, NE

13	18:00	30.0	45.1	1.5, S

6.2 Particulate matters/dust

- Generally, PM10 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter. At SE 500, the PM10 values are very high even compared to 50 metre and 100 metre oints directly in quarrying zone. This is attributed to local reasons. There was thick vegetation in that station. Pollen from plants may e the reason for high PM10 values.

- In a few stations within active quarrying area itself, ambient day concentration is more than blasting day concentration of PM10. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations of PM10 higher. W200 was near a stock of quarry products inside the quarry premises. Wind effects on this stock on the ambient day led to higher PM0 values on ambient day.
- The results of PM2.5 shows that ambient day values are generally more than blasting day values. The explanations based on dust suppression and local influence at far-off stations given for PM10 hold here also.

Table: PM10 & PM2.5 values in non-quarrying and quarrying day

Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m^3)*		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	28.16666667	55.09615385	59.70739423	36.17153309
W100	100 m	32.33525734	45.72649573	58.14187827	64.02561024
W200	200 m	20.76446281	61.86684362	83.48699037	64.45180358
W500	500 m	72.62820513	53.17307692	47.50593824	51.8408453
NE50	50 m	29.29383603	46.13095238	64.09501374	55.88044185
NE100	100 m	21.11631538	34.68992248	52.7013073	49.06225831
NE200	200 m	32.14814815	40.98883573	49.27536232	55.92366817
NE500	500 m	40.46153846	39.02777778	82.14801072	90.69943549
SE50	50 m	39.94535519	47.69283747	82.09109731	62.10966989
SE100	100 m	31.8359375	33.49236641	60.02868265	68.25735992
SE200	200 m	39.40104167	46.7769296	53.0257033	52.05205205
SE500	500 m	27.8314746	36.0479798	33.33333333	34.71220138

Fig.1: PM-10 values of Quarrying and Non-quarrying days

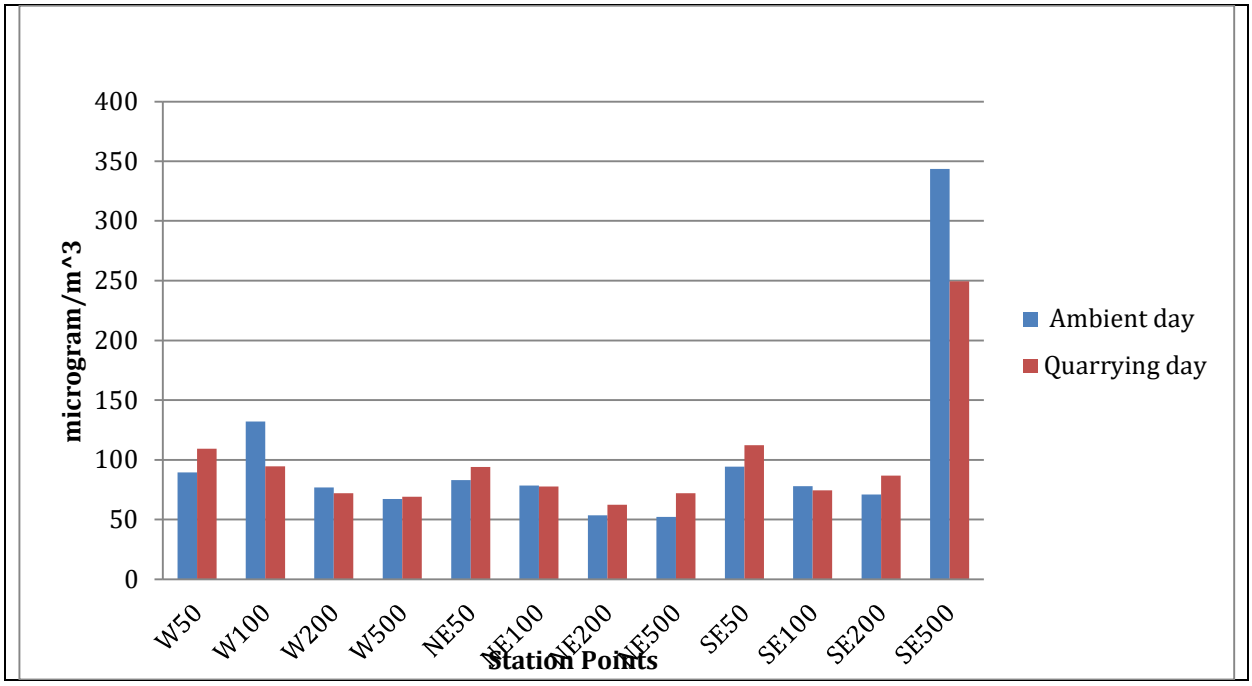
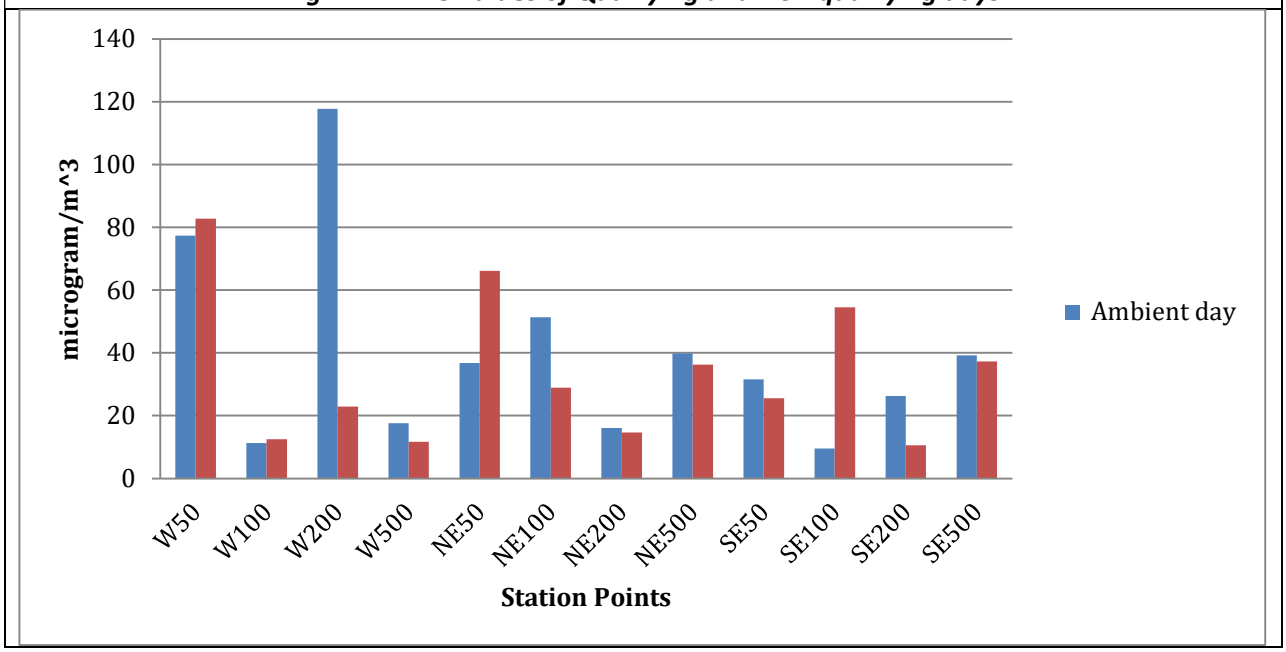


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level
Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below: Leq= Equivalent noise level dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level) Observations:

- The equivalent noise level of the total day is higher on blasting day than ambient day at all stations generally. In the 50 metre and 100 mere stations, the result is more prominent.
- The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.
- The noise equivalent of 15.00 hours (3 pm) could not be taken due to safety reasons, as the instruments were likely to be in the unsafe zone of blasting. Peak of L_{max} can be seen at 4 pm which corresponds to the blasting time which stretched for almost 45 minutes between 2 pm and 4 pm.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	58.08852877	87.9	74.49483131	110.7
W 100	52.75621481	81.3	71.25385117	90.8
W 200	50.77581035	77.7	60.92907478	101.2
W 500	53.14811263	84.5	53.17366443	80.3
NE 50	57.72518356	87.4	59.31911819	99.2
NE 100	52.79655956	78.7	67.36291335	109.9
NE 200	53.7215629	97.2	62.1635095	115.2
NE 500	57.24232125	83.1	53.36310698	84.4
SE 50	61.96108464	99.6	61.98692278	97.2
SE 100	59.43381425	94.2	59.6188626	95.9
SE 200	66.71537901	112.2	63.16613311	102
SE 500	66.71537901	92.5	59.98448765	94.2

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

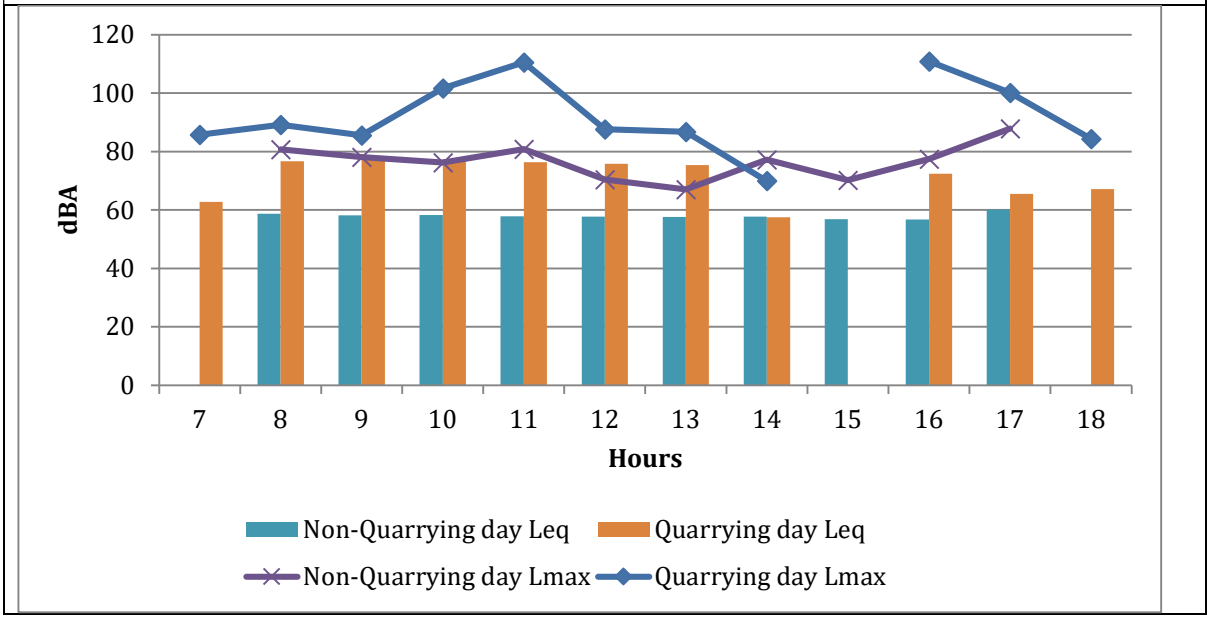


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

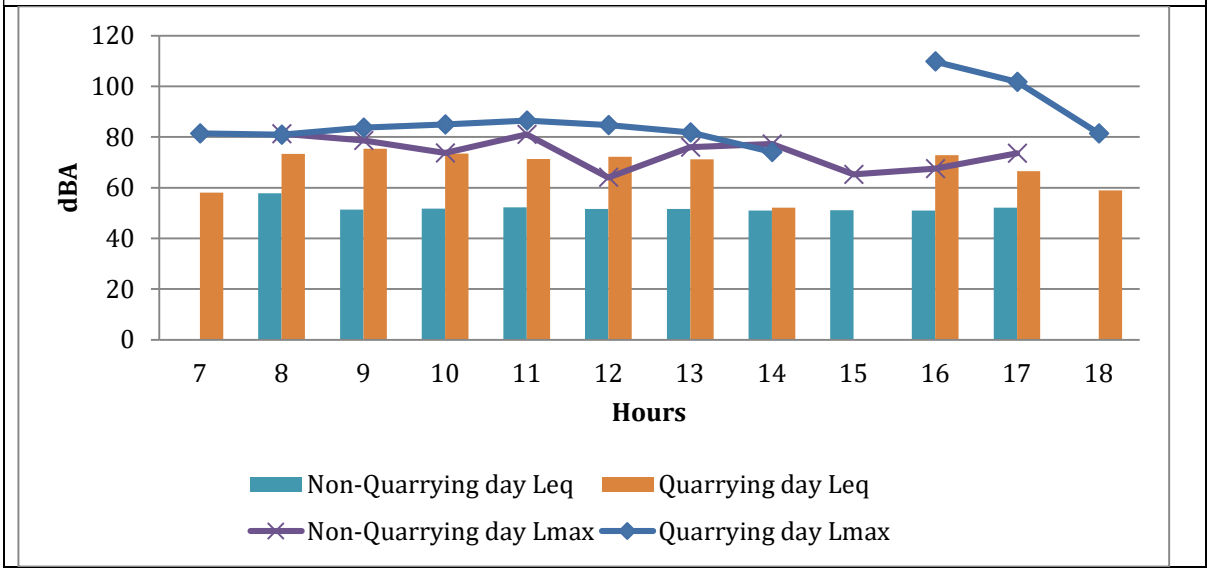


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

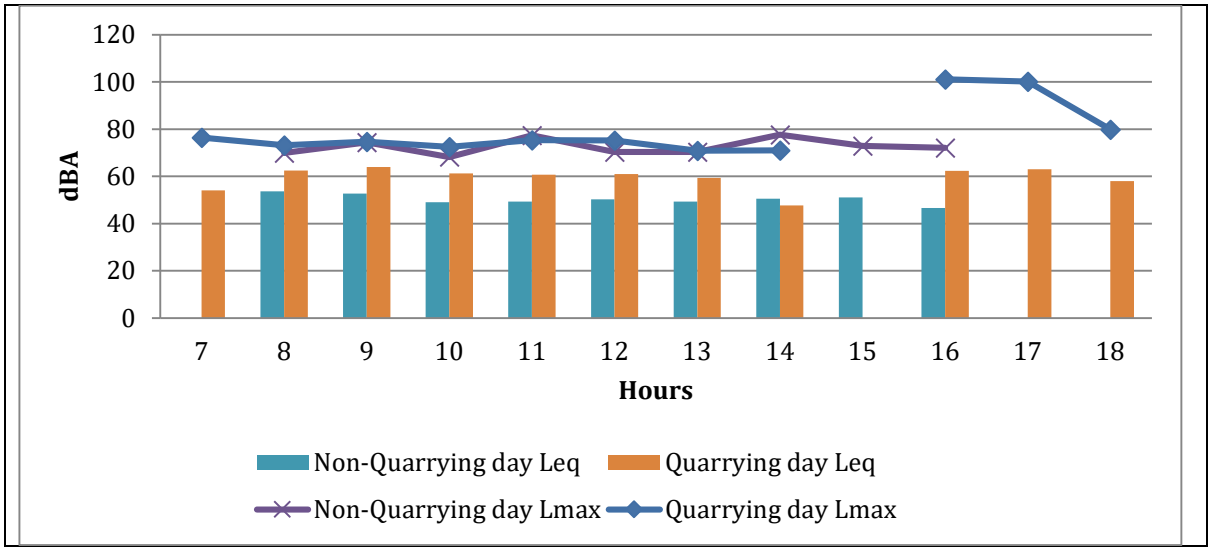


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 500m

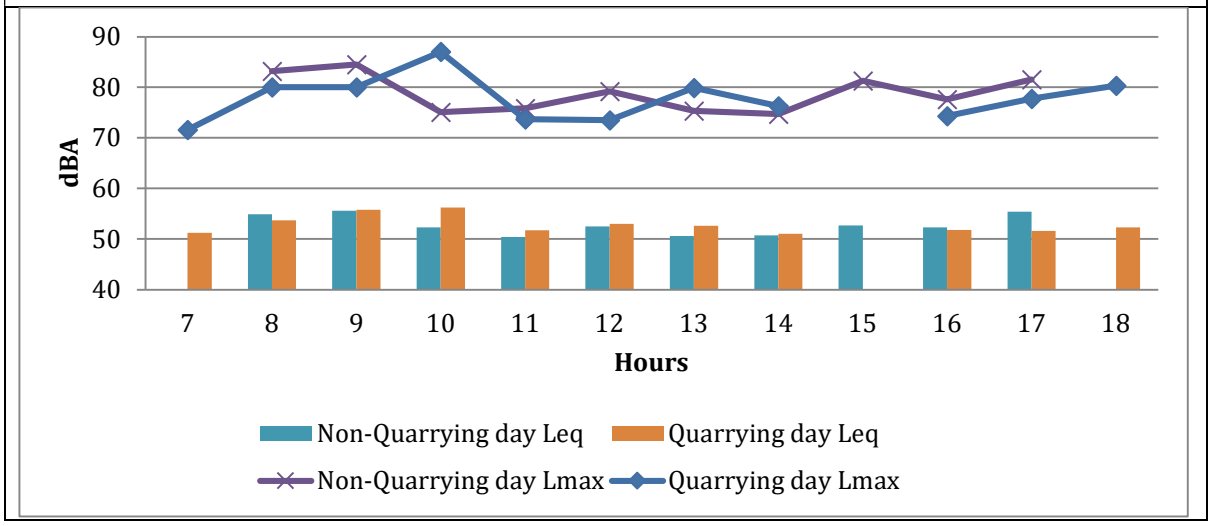


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

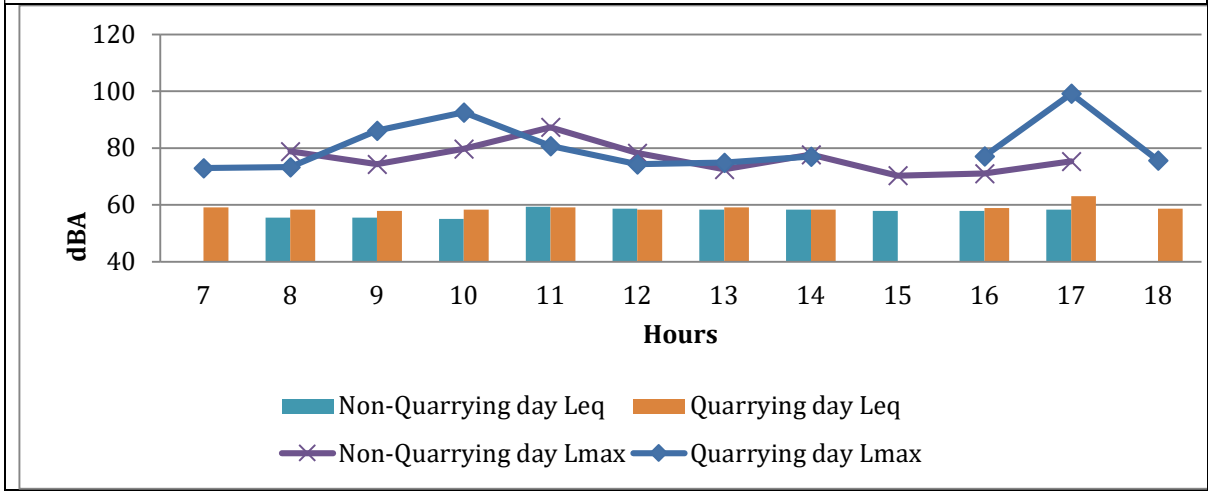


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

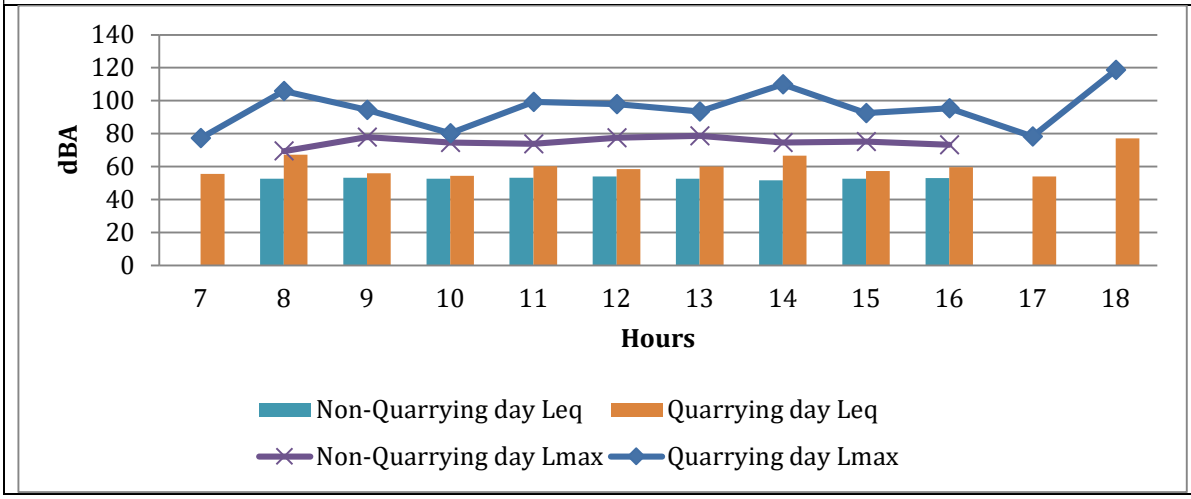


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

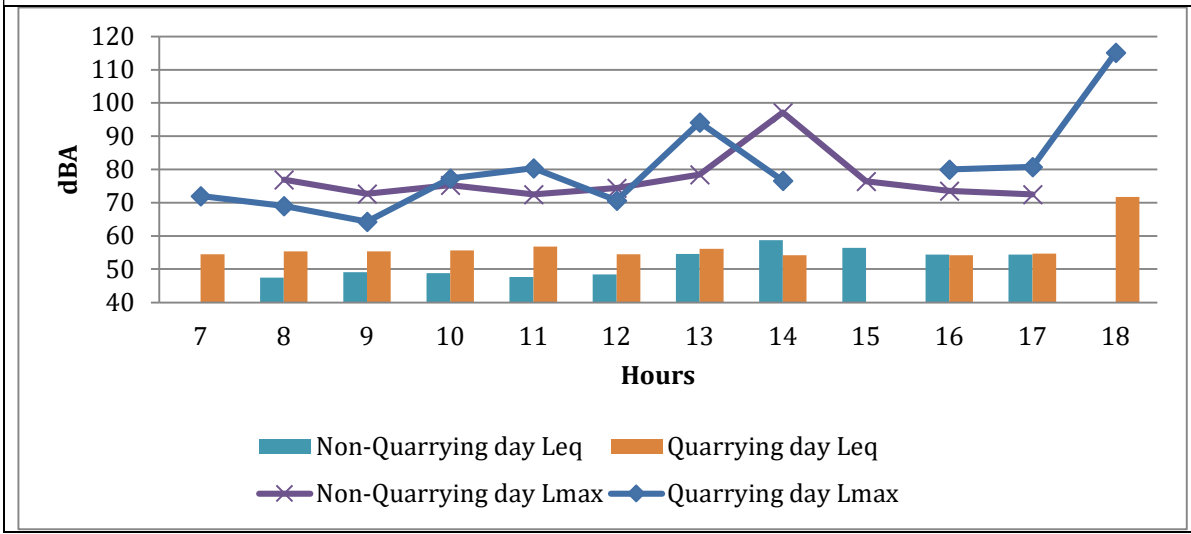


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

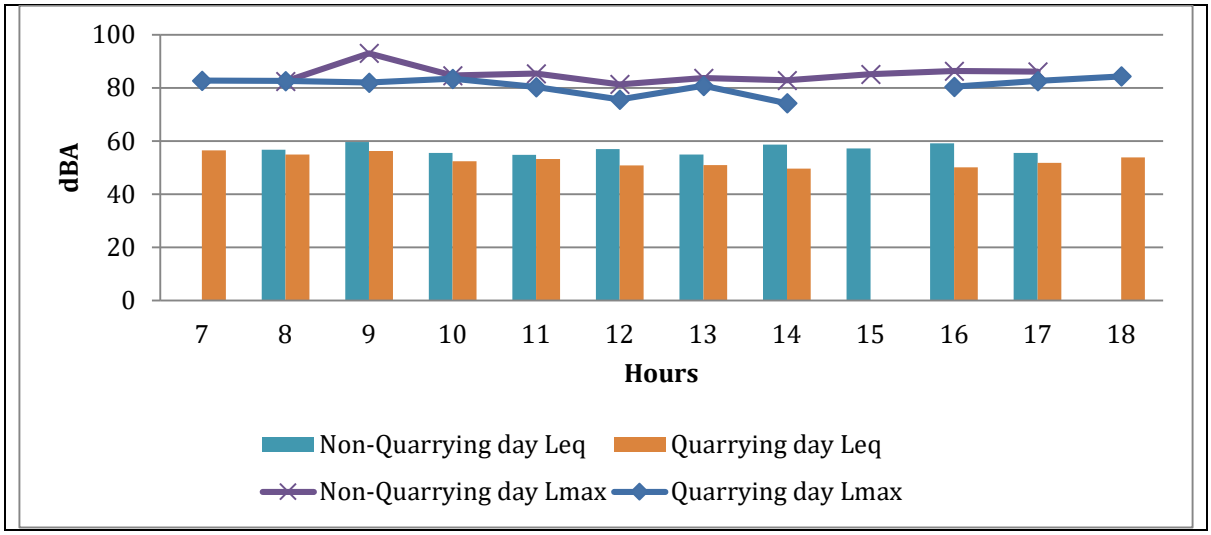


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

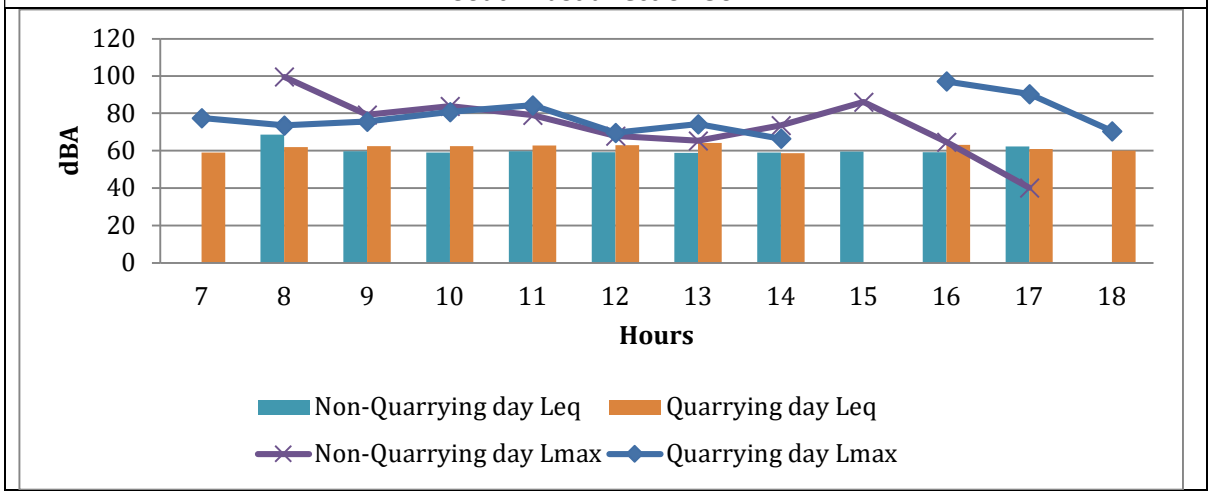


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

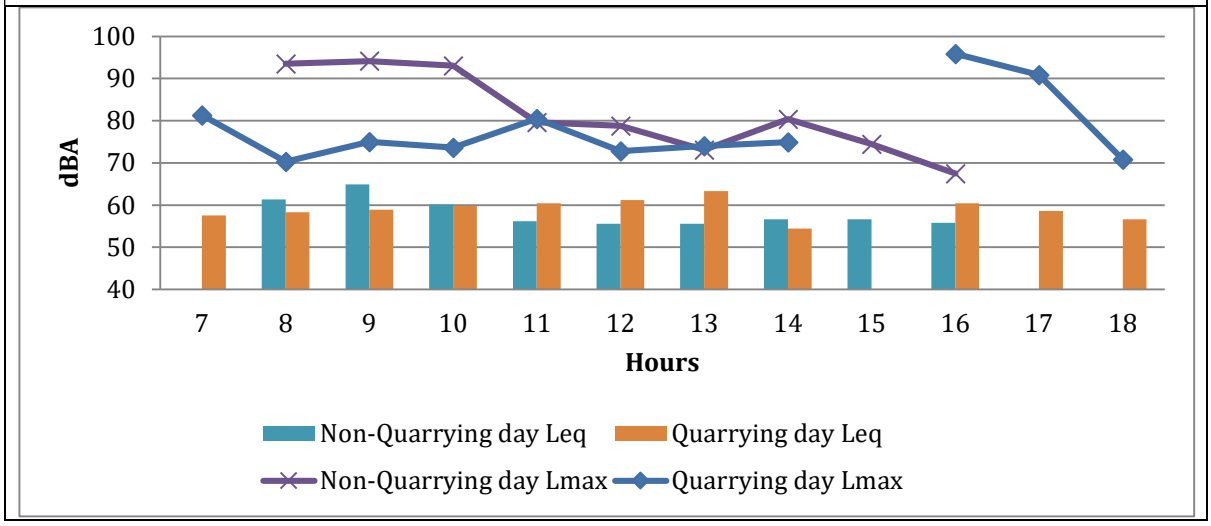


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

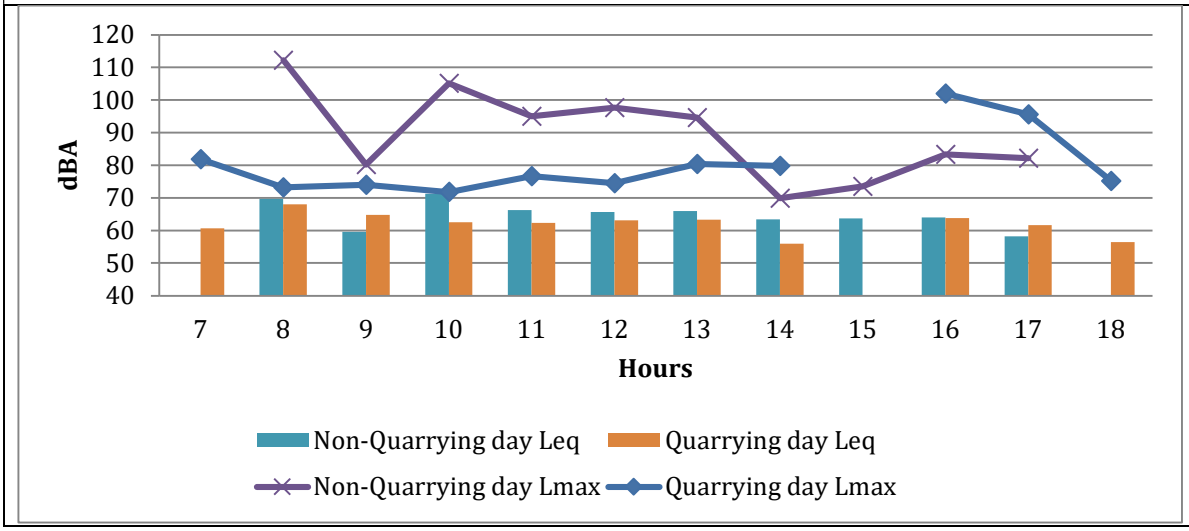


Fig.14: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

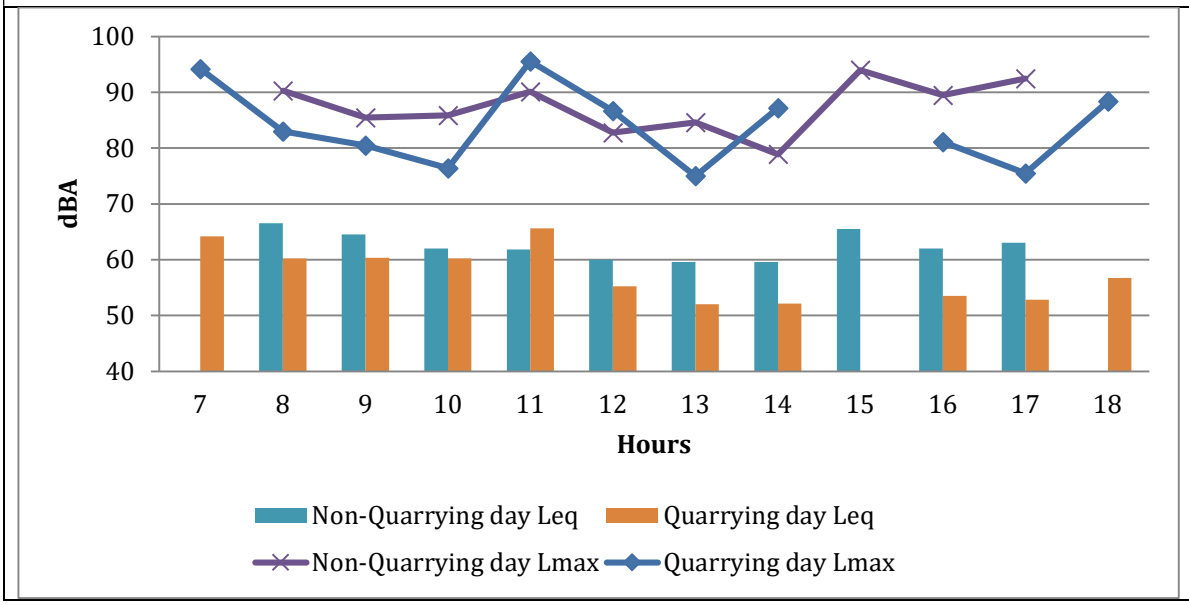
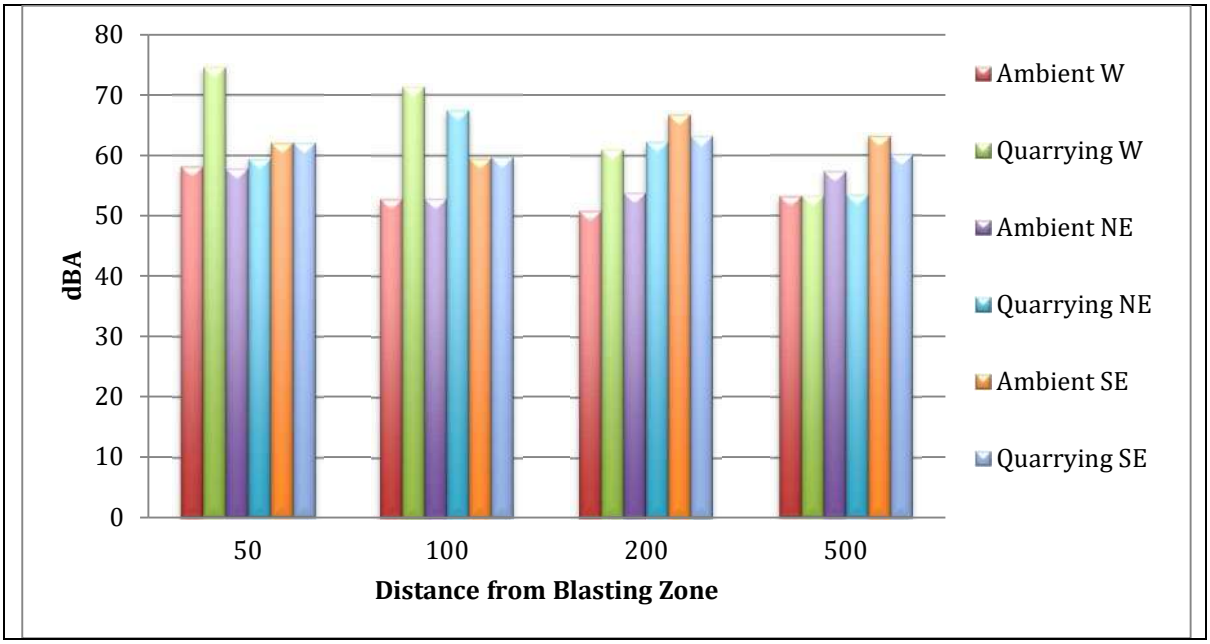


Fig.15: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: Old Quarry Pond			
Date of Sample: 28/12/2022			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH	-	7.76
2	COD	mg/l	12
3	BOD	mg/l	7.2
4	SS	mg/l	BDL
5	TDS	mg/l	248.9
6	CONDUCTIVITY	µS/cm	383
7	D.O	mg/l	7.2
8	SODIUM	mg/l	39.4
9	POTASSIUM	mg/l	10.5
10	CALCIUM	mg/l	78
11	MAGNESIUM	mg/l	48

7.0 Site specific observations made during the Visit

The quarry has a deep excavated area. High rock faces are there all around the excavation. Dust suppression is done by using dedicated tanker vehicles. All requisite personal protection equipments are given to workers. Good shaped benches are formed and maintained. Boundary pillars are maintained intact with latitude and longitude painted on them. There is natural vegetation all around; green belt has not been developed artificially. The approach roads outside quarry premises are tarred. The interior roads which serve for the crusher also are tarred too. A large quarry pond is kept in the quarry excavated area, which is filled with water. This water is used for dust suppression. At higher altitude than the quarry, on the east side, there are rubber plantations. There are complaints that these plantations are affected adversely by the quarrying, which depleted ground water, as well as caused air pollution, alleges the complainant. The land surrounding the quarry premises, up to 500 metres, is thickly vegetated, residences and other buildings are situated in-between vegetation

Photographs taken during the site assessment

Monitoring team

Quarry site

Particulate matter monitoring

Quarry pit

LOCATION: PALAKKAD

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 13-01-2023 to 16-01-2023

Name and Address of the Stone Quarry Site	**Quarry owned by Sudheesh AT, Vengappally village, Vythiri Taluk, Wayanad 67121**			
Geo-coordinates	Latitude	11°37'37.81"N	Longitude	76°02'38.36"E

1.0. Stone Quarry Site Description
1.1 General information
Quarry owned by Sudheesh AT, Vengappally village, Wayanad which had the lithology of Hornblende Gneiss. As per the information provided by the stone quarry, the present quarrying lease commenced on 15.02.2022. The lease is granted by Department of Mining and Geology, Government of Kerala which is valid upto14.02.2032. The quarry has obtained Environmental Clearance dated 01.01.2020 from State Environmental Impact Assessment Authority (SEIAA) and is valid up to 31.12.2025. It also has Consent to Operate dated 16.07.2018 with validity up to 15.07.2023 from Kerala State Pollution Control Board. Area of mining is 2.7513 Ha. Nearest residential area is 52.7 metres away from the boundary of the approved mining area The quarry is not attached to in-house crusher. The public road to the quarry from the nearest town is tarred and wide enough for two heavy vehicles. The approach road in the proponent's property is not tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers and no forests or sanctuaries nearby.
1.2 Topography & Geology
The highest elevation of the mine area is 780 m above MSL part and the lowest is750 m above MSL. This area can be broadly divided into four geological domains viz, the Peninsula Gneissie Complex in the north and central part, the migmatite complex in the southcentral part, the Charnockite group in the south and the Wayanad group in the North..
1.3 Details of quarrying/ mining activities
The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, etc. followed by controlled blasting (NONEL) using class 2 and class 6 explosives. The rock breaking is done using pneumatic breakers and transported to the crusher site using trucks/ tippers of 15 Tonnes carrying capacity for various products. Every day, blasting is carried out in 2 prefixed timings with maximum 30 no. of holes/blast.

2.0 Location attributes			
2.1 Altitude (m)	780	2.2 Area (Ha)	2.7513

2.3 Terrain	Undulating	2.4 Lithology	Hornblende Gneiss
2.5 Soil type	Laterite	2.6 Total Mineable reserve	1201181 MT
2.6 (a) Remaining Mineable reserve	4472814 MT	2.6 (b) Approximate mined quantity per annum	120118.1 MT
2.7 Slope	Moderate	2.8 Fault	---
2.9 Distance from nearest forest (Km)	None within 10km	2.10 Wildlife movement (Yes/ No)	No

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	13-01-2023	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	14-01-2023	Air quality and noise monitoring during the operation of quarry including drilling, blasting and all other quarry activities (06.00 to 18.00 Hrs.)
3	15-01-2023	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
4	16-01-2023	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring Plan and locations

The quarry area is not very deep, the present excavation area is only 05-10 metre below the surrounding ground level. The present blasting zone is towards North-East of the quarry area which has more length in the east west direction than in the North South direction.

The 50m stations in West, North East and South East directions are inside the open quarry land itself. The 50m stations in West, North East and South East directions are within the quarry area. Stations like W100, W200, SE100 are also within the quarry premises. Further stations like W500, SE200, SE500, NE100, NE200, NE500 were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other. 6 locations were inside the quarry and 6 locations were outside the quarry premises.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 114 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used is ammonium nitrate of 250 gm per hole.

The CIMFR team identified 7 locations for the seismic analysis. 2 locations were inside the quarry and 5 locations were outside the quarry. They also conducted a social survey on the

response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 6.00pm. The monitoring was completed at all the 12 stations by 06PM. Photographs taken during the site assessment at Quarry of Sudheesh AT, Vengappally, Wayanad District Kerala is given as Annexure-1.

4.1 Map showing sampling locations (Map)

4.2 Geo-coordinates of sampling locations			
S. No.	***Station Points***	***Latitude***	***Longitude***
1	W50	11.6282364	76.0447367
2	W100	11.6287746	76.0442717
3	W200	11.628428	76.042895
4	W500	11.6271313	76.0402822
5	NE50	11.6282731	76.0458006
6	NE100	11.628125	76.0403347
7	NE200	11.6300218	76.045013
8	NE500	11.6322116	76.0472228
9	SE50	11.6273921	76.0455491
10	SE100	11.6270387	76.0457131
11	SE200	11.6259238	76.0463286
12	SE500	11.6240818	76.0460745

5.0 Monitoring activities

5.1 Background monitoring (on 15-01-2023)

The monitoring started at 6.00am at each 12 locations. The quarry activities were kept completely idle to do ambient monitoring. The Environmental Engineers in-charge ensured whether all stations are working properly. At each station, one AE / equipment operator was there for the monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. Weather data were also recorded at station point SE50 inside the quarry. The monitoring was interrupted at station SE200(for 1 hour from 07 AM to 08 AM) due to the power failure. The wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east. The monitoring was completed at all 12 stations by 06PM.

5.2 Monitoring during Stone Quarry Operation (on 14-01-2023)

The monitoring started at 6.00am and continued without any interruption. The weather data were recorded from the same station inside the quarry.

Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and approximately 300 no. s of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 0115PM. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 7 locations by 01.45 PM. Blasting was conducted by 02PM.

Immediately after the blasting was completed, vehicular movement, breaking of boulders using breakers and hauling of the quarry product using haulers were carried out. These

quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all the 12 stations by 06PM.

6.0 Monitoring Results-Ambient Air Quality and Noise Levels

6.1 Weather

Weather: Non-quarrying day (15-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***
1	06:00	17	90.2	0.5SE
2	07:00	17	90.6	0.7SE
3	08:00	16.4	94.7	0
4	09:00	17	96.6	0
5	10:00	17.7	95.7	0
6	11:00	18.5	92.1	0.7SE
7	12:00	25.1	65.4	0.8S
8	13:00	25.8	50.6	0.5SW
9	14:00	26.7	40.4	0.8S
10	15:00	27	40.4	0.7S
11	16:00	28.1	37.7	1.8SE
12	17:00	25.7	58.7	0

Weather: Quarrying day (14-01-2023)				
S.No.	***Time (Hrs)***	***Temperature (◦C)***	***Humidity (%)***	***Wind (m/s) & Direction***

1	06:00	18.7	84	0
2	07:00	19.9	83.1	0
3	08:00	15.6	85.8	0.6 SW
4	09:00	17.1	95.2	0
5	10:00	19	91.3	2 SE
6	11:00	23	82.1	0.7 SE
7	12:00	25.3	57.1	3.1 SE
8	13:00	27.4	43.7	0
9	14:00	26.8	41.4	1.2 S
10	15:00	28.3	37.1	1.9 SE
11	16:00	27.5	60.2	0.4SE
12	17:00	26.2	69.3	0
13	18:00	22.7	78.6	0

6.2 Particulate matters/dust

- Generally, PM10 values of blasting day in stations inside the quarry can be seen to be higher than those of ambient day. This shows the influence of quarrying in increasing the concentration of particulate matter. The very high value of PM10 at W500 compared to closer stations is attributed to local influence.

- In a few stations other than those at 200m, 500m, ambient day concentration is more than blasting day concentration of PM10. The reason is inferred as follows. Efficient dust suppression using water spray and sprinkling was carried out on blasting day whereas dust suppression was nil on ambient day. This made the ambient day concentrations of PM10 higher.

- The results of PM2.5 shows that ambient day values are generally more than blasting day values. The explanations based on dust suppression and local influence at far-off stations given for PM10 hold here also. Similar to PM10, an unusual peak is found in PM 2.5 values at W500 also, which can be attributed to local reasons.

Table: PM10 & PM2.5 values in non-quarrying and quarrying day

Station Points	*Distance from blasting zone (metre)*	*PM 10 (microgram/m^3)*		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	64.52380952	73.48790323	51.06863954	49.95693368
W100	100 m	53.91025641	67.95634921	50	52.22430425
W200	200 m	57.63565891	55.13204761	36.13199666	50.52083333
W500	500 m	43.55889724	63.63247863	55.89307412	98.83130081
NE50	50 m	38.62820513	41.70940171	39.98368013	32.54664439
NE100	100 m	36.73611111	44.08861341	38.72157345	44.33891612
NE200	200 m	47.35142119	51.17361657	49.89775051	44.62156823
NE500	500 m	142.7380952	221.7628205	53.30804888	54.46792349
SE50	50 m	56.82414698	79.2166267	48.76807168	68.62030675
SE100	100 m	41.37741047	42.51302083	32.9566855	28.20121951
SE200	200 m	64.58333333	51.79673721	23.47266881	23.65591398
SE500	500 m	58.39646465	56.55982906	43.76292212	54.93576741

Fig.1: PM-10 values of Quarrying and Non-quarrying days

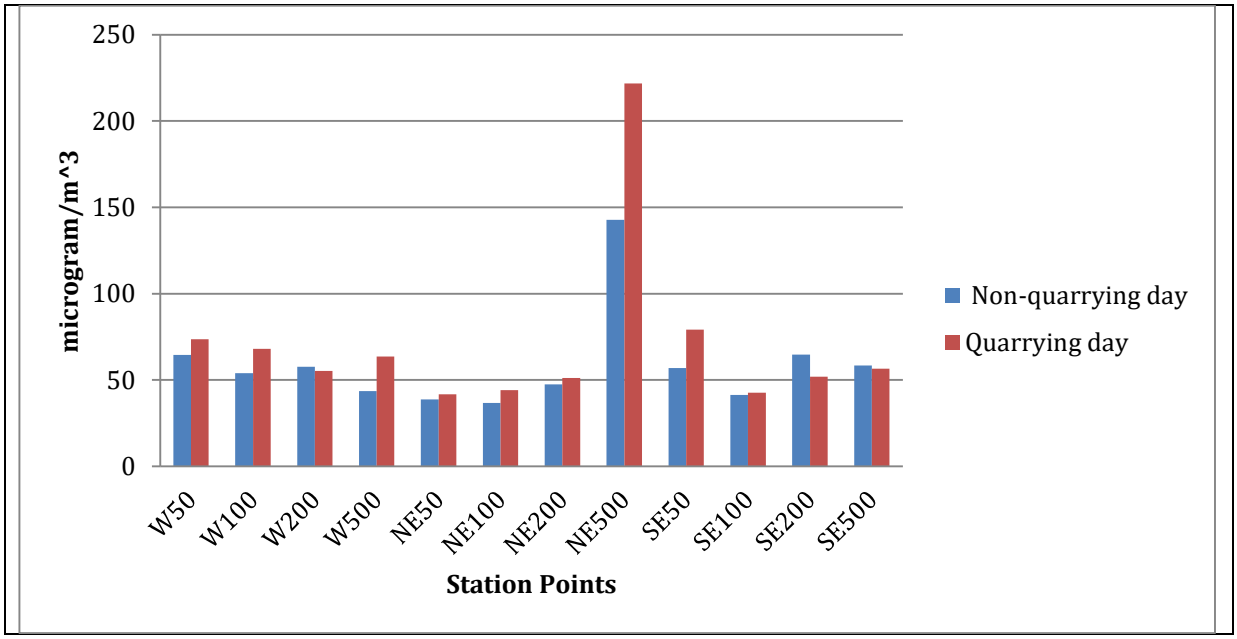
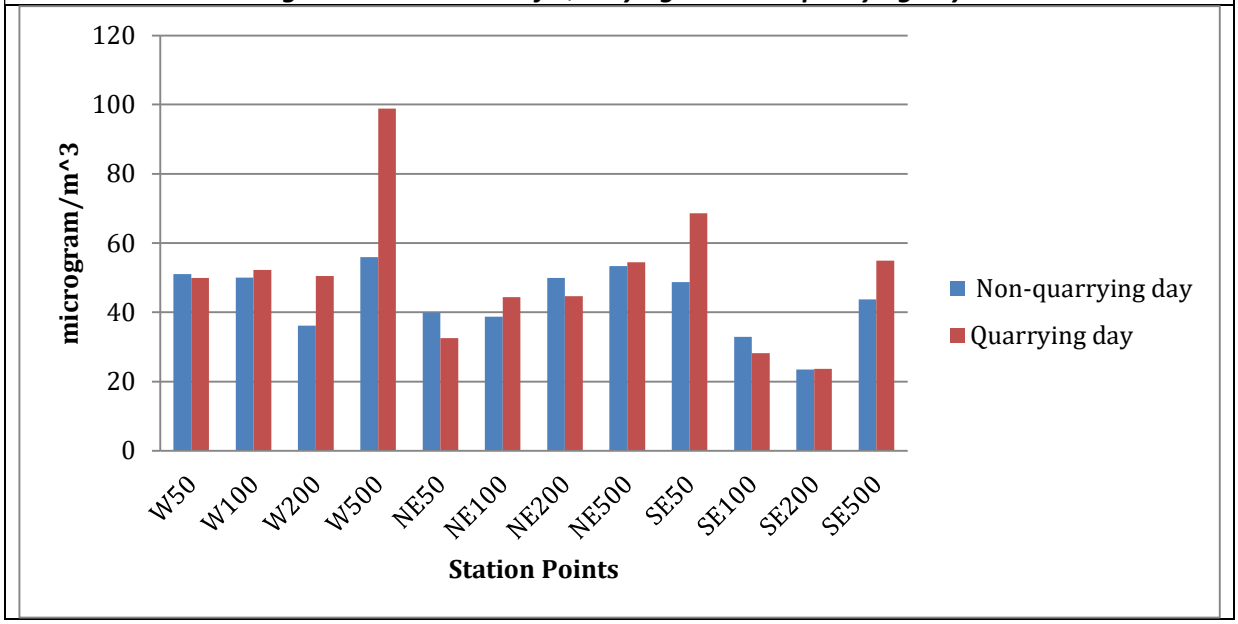


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days



6.3 Noise level

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) on non-quarrying and quarrying day are given in the table below:

Leq= Equivalent noise level

dB(A)= Decibel in 'A' weighted frequency scale (unit of sound pressure level)

Observations:

- The equivalent noise level of the total day is higher on blasting day than ambient day at all stations generally.
- The noise levels on blasting day decreases with increase in distance from blasting zones in all directions.

- Peak of hourly equivalent value can be seen at 3 pm, since the blasting happened between 1 pm and 3 pm. At 2 pm, the noise level readings could not be taken due to safety reasons as blasting was taking place.

Table: Observed Noise in terms of Equivalent Noise (L_{eq}) & L max on non-quarrying and quarrying day.

Station Points	Non-quarrying Day Noise Levels		Quarrying Day Noise Levels	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	56.1567279	105.4	61.558765	106
W 100	56.45239434	80.3	58.63269261	88.4
W 200	53.72660965	85.8	53.62162385	93.4
W 500	53.49196625	89.1	53.85003256	75
NE 50	53.70787212	76.4	52.18554586	82.8
NE 100	56.30936964	83.9	52.96608579	58.2
NE 200	52.65150438	80.7	52.90434738	88.6
NE 500	66.95570307	82.9	58.60783462	74.3
SE 50	59.35061871	88.2	60.31628072	96.5
SE 100	51.30079949	88.3	53.27375626	92.2
SE 200	54.89175644	90	56.57691252	85.6
SE 500	54.47894954	89.8	54.48843931	81.5

Fig.3: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 50m

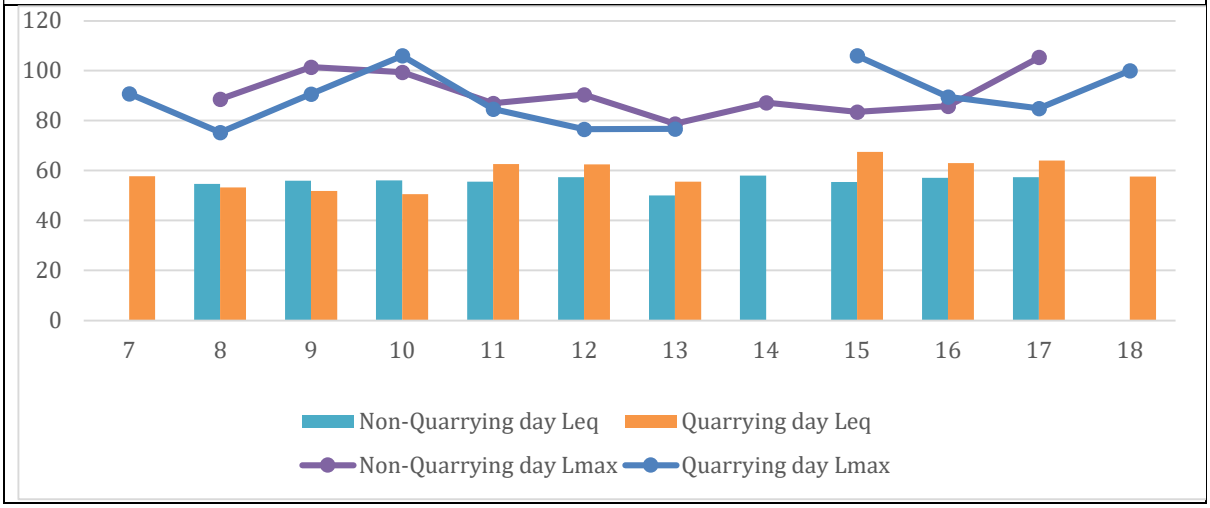


Fig.4: Equivalent values (Leq)and maximum (Lmax)of quarrying and non-quarrying day in West direction 100m

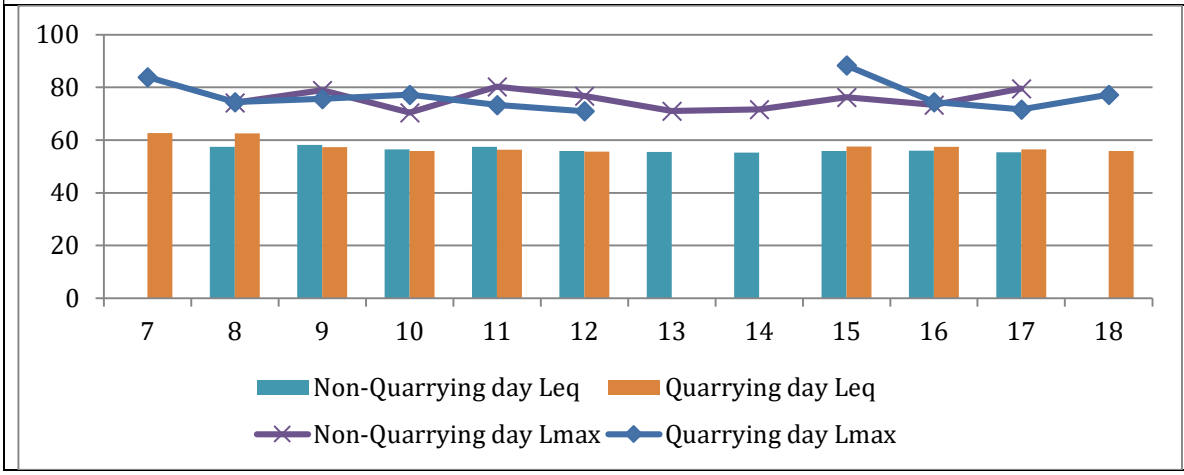


Fig.5: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 200m

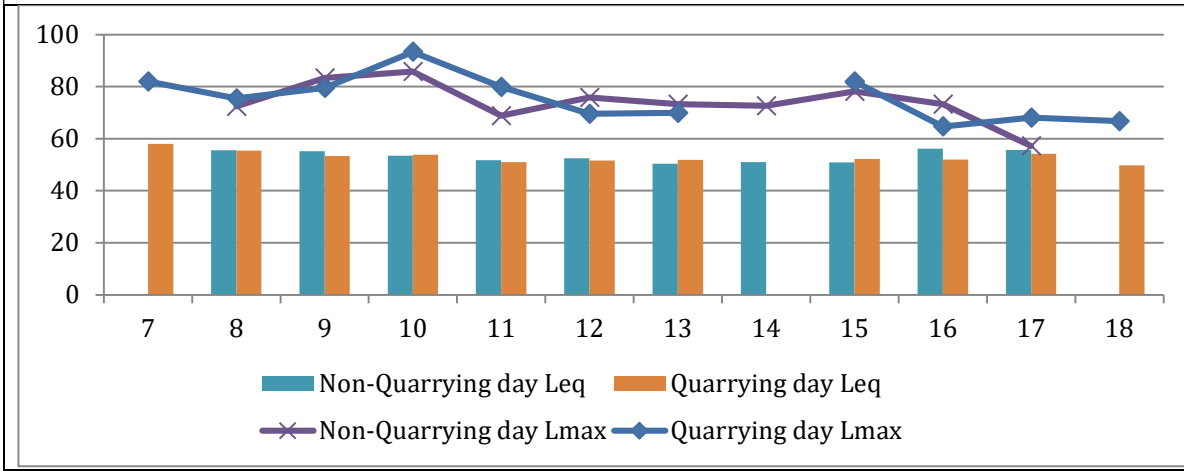


Fig.6: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in West direction 500m

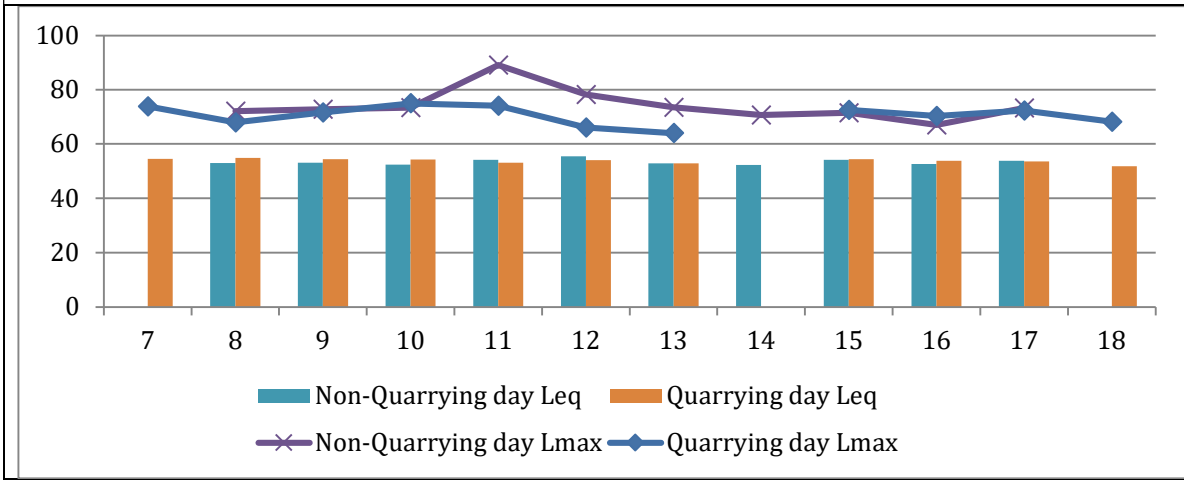


Fig.7: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 50m

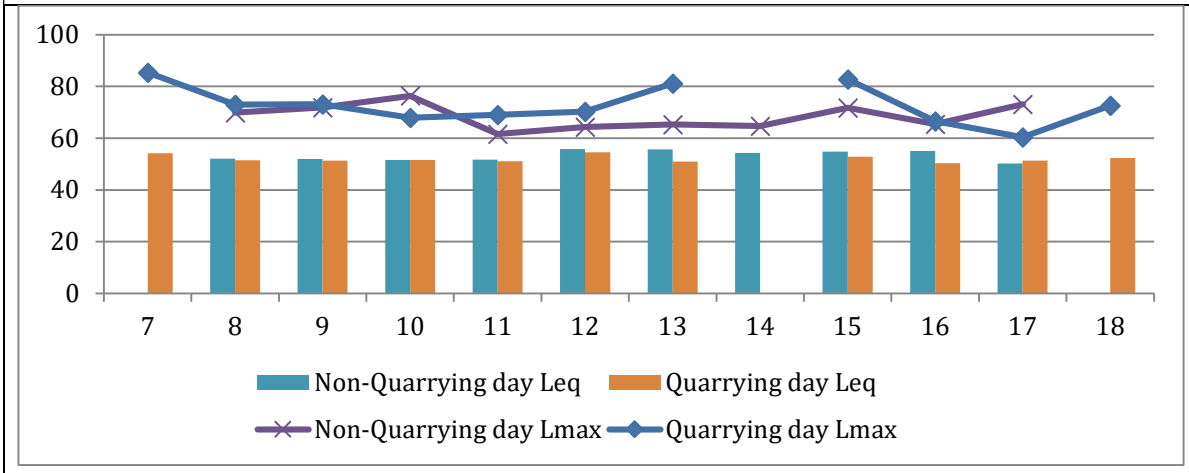


Fig.8: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 100m

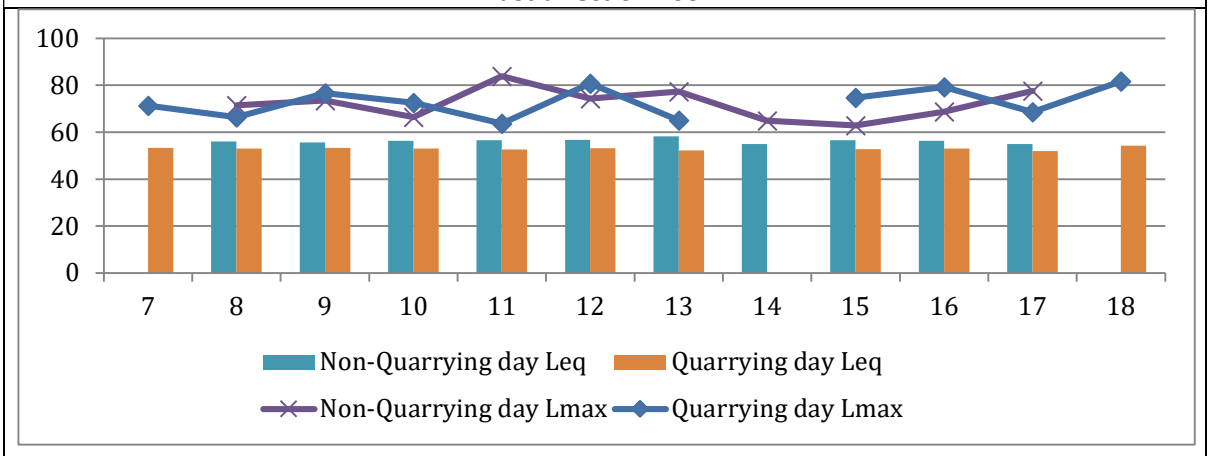


Fig.9: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 200m

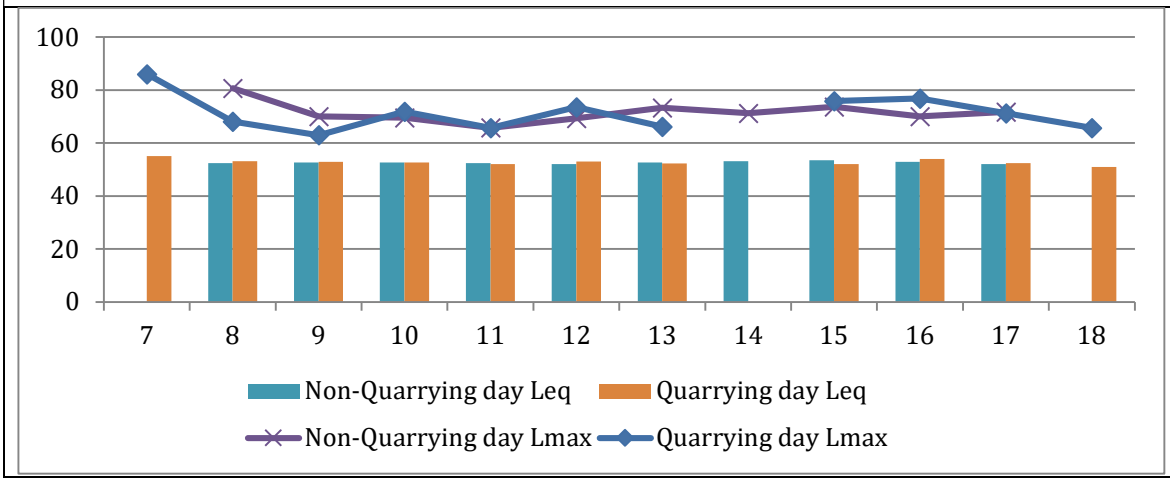


Fig.10: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in North-East direction 500m

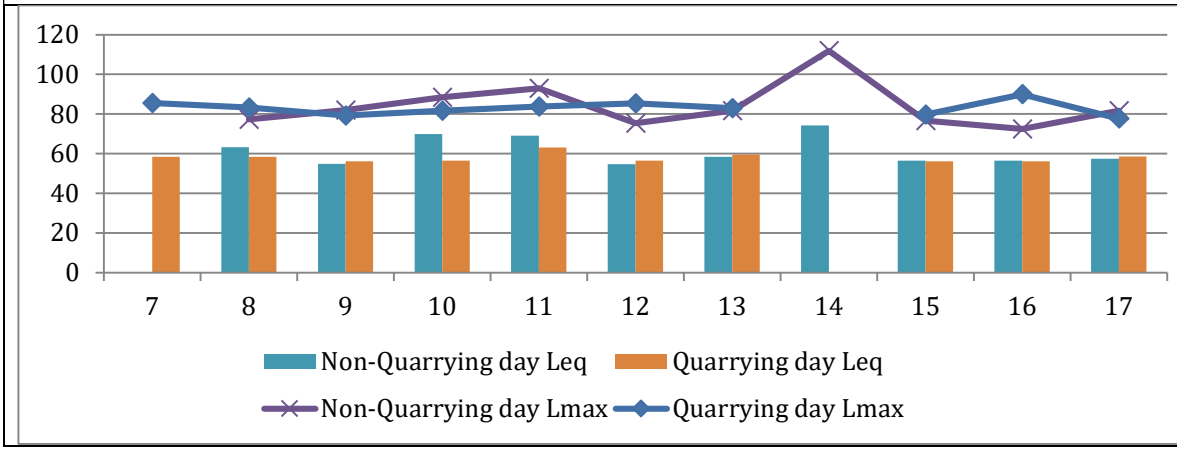


Fig.11: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 50m

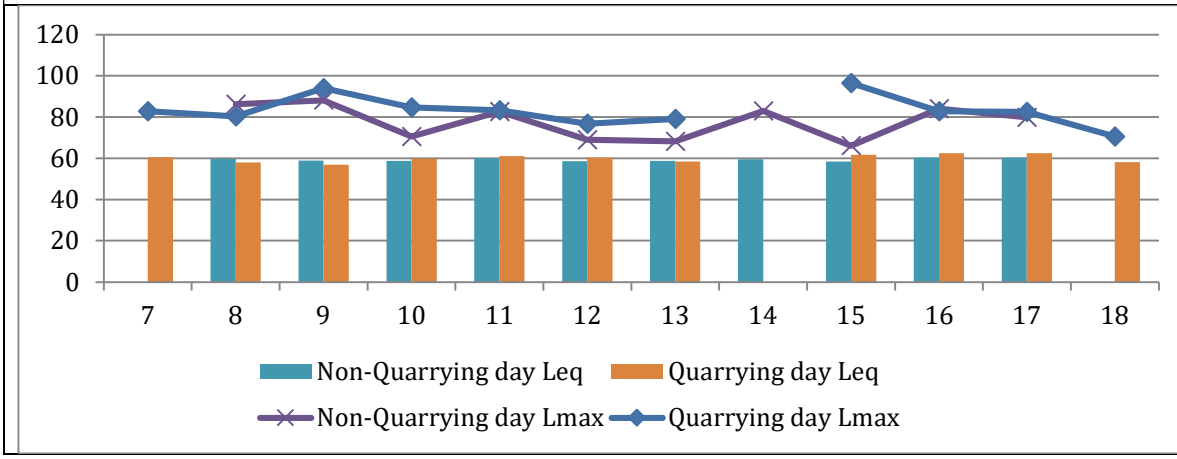


Fig.12: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 100m

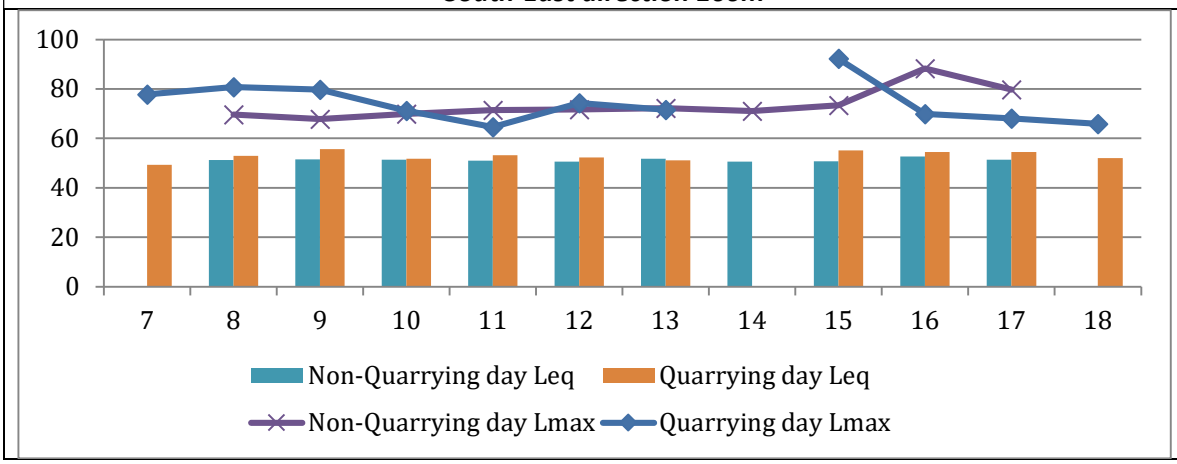


Fig.13: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 200m

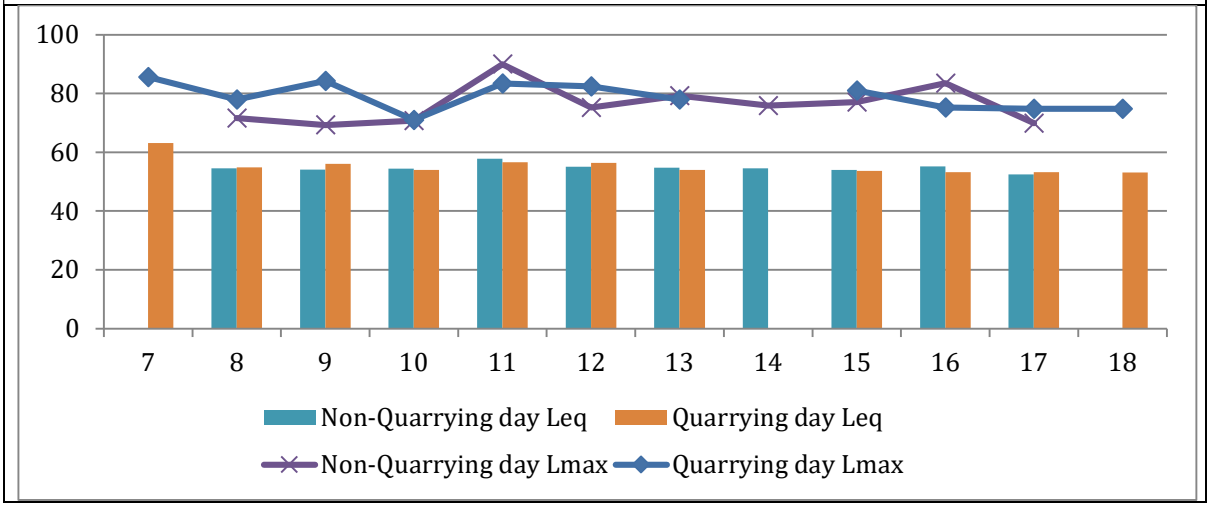


Fig.14: Equivalent values (Leq)and maximum (Lmax)of quarrying day and non-quarrying in South-East direction 500m

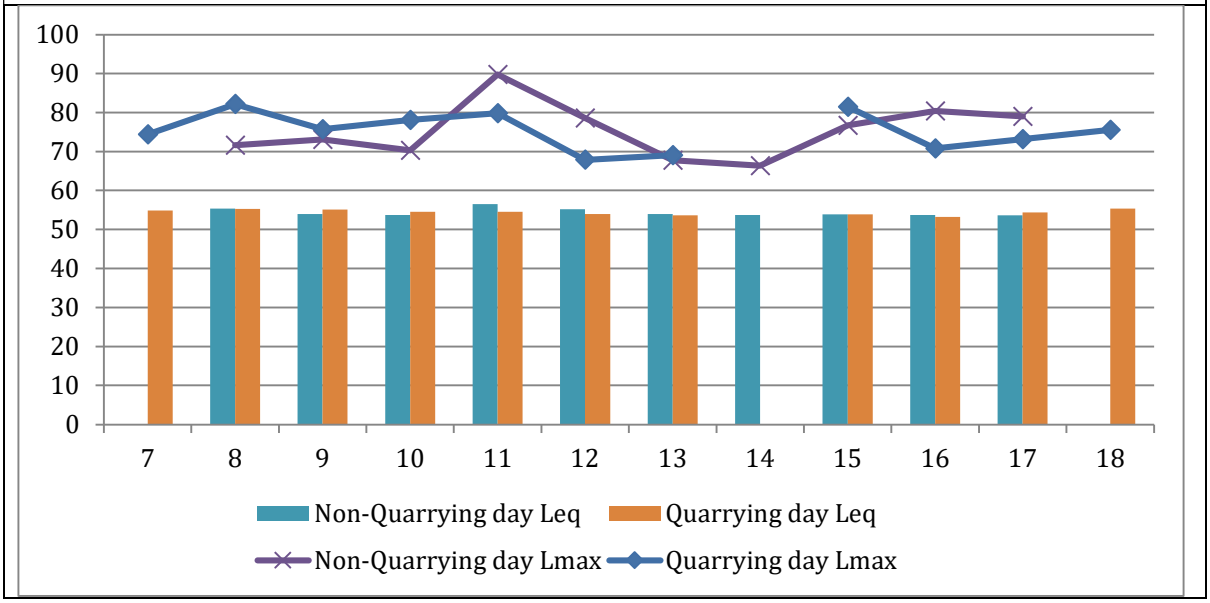
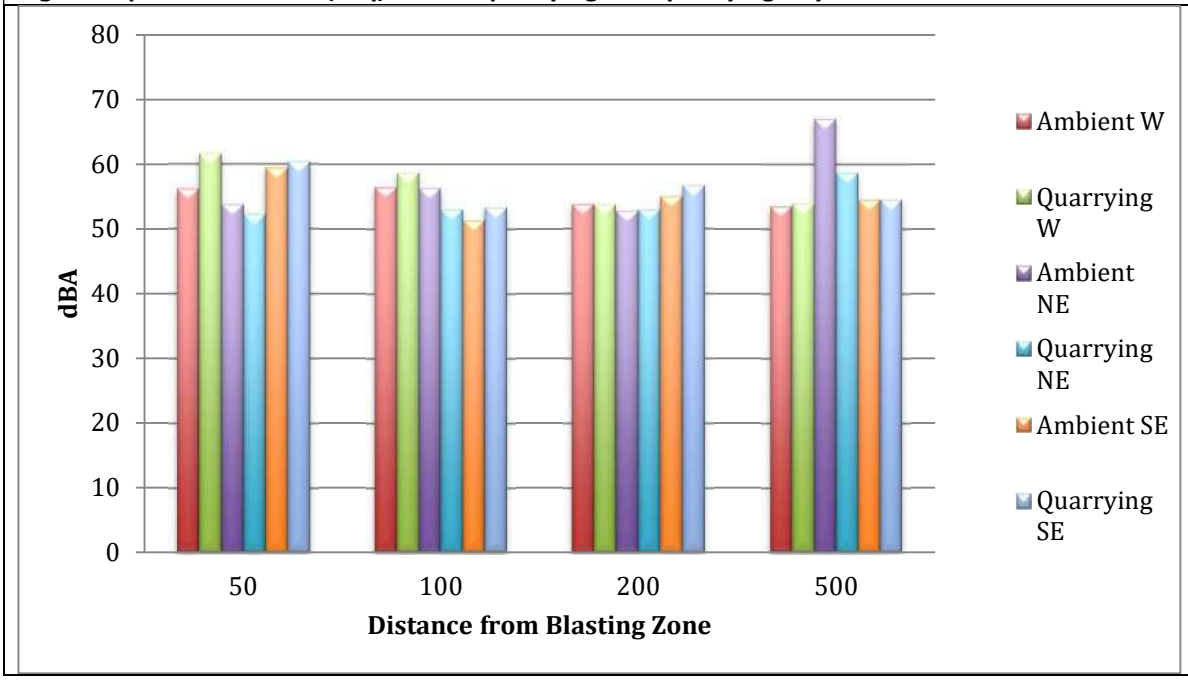


Fig.15: Equivalent values (Leq) of non-quarrying and quarrying day



6.4 Water Quality			
Sample Point: Old Quarry Pond			
Date of Sample: 28/12/2022			
Sl. No.	**Parameters**	**Unit**	**Value**
1	pH	-	7.5
2	COD	mg/l	16
3	BOD	mg/l	1
4	SS	mg/l	120
5	TDS	mg/l	210
6	CONDUCTIVITY	µS/cm	300
7	D.O	mg/l	7.1
8	SODIUM	mg/l	40
9	POTASSIUM	mg/l	13
10	CALCIUM	mg/l	80
11	MAGNESIUM	mg/l	55

7.0 Site specific observations made during the Visit
The surrounding ground is plain, with vegetation and habitations in various direction around the quarry. For dust suppression, a dedicated tanker vehicle is provided for water sprinkling. Fencing is provided, boundary pillars are marked and fixed, sign boards are provided, PPEs like safety boots, helmets are provided, there are no wildlife movements reported. CSR activities like infrastructure development, social welfare was provided by the quarry. There was considerable loosened overburden at the quarry site.

Photographs taken during the site assessment

Monitoring team

Quarry site

Particulate matter monitoring

Noise monitoring

WEATHER

Assessment Report on Ambient Air Quality, Noise Levels and Mine Pit Wastewater Quality carried out during 17-01-2023 to 20-01-2023

Name and Address of the Stone Quarry Site	**M/s. National Granite Stone Quarry owned by Sh. P. M. Abdul Rahiman located at Thayannur Village, Vellarikundu Taluk, Kasaragod, Kerala 671319**			
Geo-coordinates	Latitude	12°22'03.71"N	Longitude	75°12'18.61"E

1.0 Study site description

1.1 General information

The lithology of M/s. National Granite Stone Quarry owned by Sh.P. M. Abdul Rahiman located at Thayannur Village, Vellarikundu Taluk, Kasaragod, Kerala 671319 is Garnet-Sillimanite Kyanite Gneiss.As per the information provided by the stone quarry operator, the present quarrying lease issued by Department of Mining and Geology, Government of Kerala, commenced on 16.10.2018 and is valid up to 15.10.2030. The quarry has obtained Environmental Clearance from State Environmental Impact Assessment Authority, Kerala. It also holds valid Consent to Operate issued by Kerala State Pollution Control Board. Area of mining is 3.2420 Ha, nearest residential area is 52.7 metres from the quarry. The quarry is not attached to any captive stone crusher unit. The public road to the quarry from the nearest town is well tarred and wide enough for two heavy vehicles. The approach road in the proponent's property is not tarred, but kept well moist by water sprinkling. There are no major water bodies like rivers and no forests or sanctuaries nearby.

1.2 Topography & Geology

As per the information provided by the stone quarry operator, the highest elevation of the mine area is 380 m above MSL part and the lowest is315 m above MSL. The district of Kasargode can be broadly divided into five geological belts viz. the southern charnockitic rocks which extends further south, northern gneiss, a syenite pluton in central part, isolated cappings of sedimentary rocks confined to the coastal tract and quartenary sediments of coastal plain. As per the lithological map, the rock type in the quarry is Garnet-Sillimanite Kyanite Gneiss. Loose top soil was present in the entire quarry area where rocks have not been exposed.

1.3 Details of quarrying/ mining activities

The method of mining is semi-mechanized open cast mining. The mining operations are carried out using jack hammers, compressors, drills, excavators, etc. followed by controlled blasting (NONEL) using class 2 and class 6 explosives. The rock breaking is done using pneumatic breakers and transported to the crusher site using trucks/ tippers of 15Tonnescarrying capacity for various products.

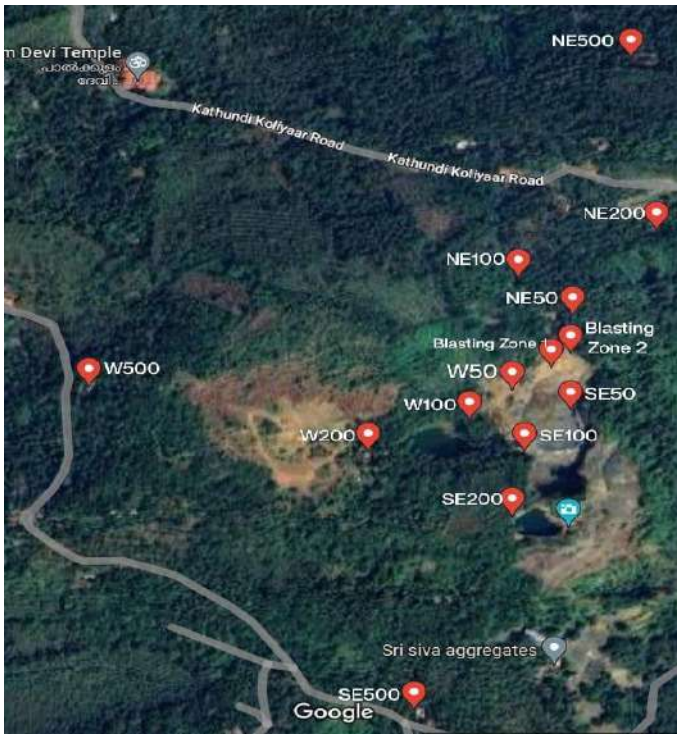
2.0 Location attributes			
2.1 Altitude (m)	315	2.2 Area (Ha)	3.2420
2.3 Terrain	Undulating	2.4 Lithology	Garnet-Sillimanite Kyanite Gneiss
2.5 Soil type	Laterite	2.6 Mineable reserve	923170 MT
2.6 (a) Remaining Mineable reserve	185685 MT	2.6 (b) Approximate mined quantity per annum	218375 MT
2.7 Slope	Sloping	2.8 Fault	--
2.9 Distance from nearest forest (Km)	None within 1 km	2.10 Wildlife movement (Yes/ No)	No

Source: Mining Plan

3.0 Schedule of the Study/ Assessment		
Day	Date	Activities
1	17-01-2023	Site reconnaissance, fixing of monitoring points within 50m, 100m, 200m and 500m from the blast point. Setting up a field office, arranging power supply for operating monitoring instruments/ equipment. Checking of instruments, deployment and conducting test runs.
2	18-01-2023	Background monitoring of ambient air quality and noise without any activities in the quarry. (06.00 to 18.00 Hrs.)
3	19-01-2023	Air quality and noise monitoring during the operation of quarry including drilling and blasting and sampling of quarry-pond water (06.00 to 18.00 Hrs.)
4	20-01-2023	Maintenance check of instruments used, safe packing for transportation and transporting monitoring gear to the next station.

4.0 Sampling/ Monitoring plan and locations
The quarry area is slightly deep, the present excavation area is only 10-20 metre below the surrounding ground level. The present blasting zone is towards North-East of the quarry area which has more length in the east west direction than in the North South direction. The station points were fixed based on the wind direction data. The 50m, 100m stations in West, North East and South East directions are inside the open quarry land itself. Stations like W200, SE200 are also within the quarry premises. Further stations like W500, SE500, NE200, NE500 were all outside the quarry premises, in private properties. Hence in total, 12 coordinates were fixed with the actual blasting point as centre in North-East line, West line and South-East line each at an angle of approximately 120° to each other. 8 locations were inside the quarry and 4 locations were outside the quarry premises. The photographs of monitoring activities is attached as **Annexure 1.**

4.1 Map showing sampling locations (Map)



4.2 Geo-coordinates of sampling locations

Co-ordinate details of selected monitoring locations at the stone quarry site is given in the **Table 1** below:

Table 1. Co-ordinate details of selected monitoring locations at the stoner quarry site

Sl.No.	Station Points	Latitude	Longitude
1	W 50	12.3694317	75.2058873
2	W 100	12.3690702	75.2054658
3	W 200	12.3686926	75.2044503
4	W 500	12.3694697	75.2016645
5	NE 50	12.3703326	75.2064934
6	NE 100	12.3707820	75.2059563
7	NE 200	12.3713502	75.2073346
8	NE 500	12.3734261	75.2070735
9	SE 50	12.3691979	75.2064740
10	SE 100	12.3686906	75.2060090
11	SE 200	12.3679197	75.2058950
12	SE 500	12.3655869	75.2049062

5.0 Monitoring activities

5.1 Background monitoring (18-01-2023)

The monitoring started at 6.00am at each 12 locations. In some stations, delay in setting stable power supply, as it was the first day, made monitoring to start by 8 am only. The quarry activities were kept completely idle to do ambient monitoring. The air monitoring was interrupted at station W200 for 4 hours (from 6AM to 10AM) due to voltage fluctuation issue and started back by 10AM. The Environmental Engineers in-charge ensured whether all stations are working properly. At each station, one AE / equipment operator was there for the monitoring. The Noise data, Air flow rates and Total volume of sucked air were recorded every one hour. Weather data were also recorded at station point SE100 inside the quarry. The wind velocity, humidity and temperature were monitored every hour using Weather Tracker. The direction of the wind was mostly from west to east.

The locations for drill holes for explosives were located by the CIMFR blasting team. It was decided to conduct 10 blasts which consist of 137 holes, each hole having 32mm diameter and 5ft - 6ft depth. The explosive used is ammonium nitrate and in the range of 250 gm to 375 gm per hole.

The CIMFR team identified 7 locations for the seismic analysis. 4 locations were inside the quarry and 3 locations were outside the quarry. They also conducted a social survey on the response of the public about quarrying activities, through a questionnaire. The location identification and survey were completed by 6.00pm. The monitoring was completed at all the 12 stations by 06PM. Ambient air quality and noise level monitoring were carried out at the stone quarry site under overall supervision of Kerala State Pollution Control Board and water sample collected from stone quarry pond analysed at Central Laboratory of Kerala State Pollution Control Board at Kochi.

5.2 Monitoring during quarrying operation (19-01-2023)

The monitoring started at 6.00am and continued without any interruption. The weather data were recorded from the same station inside the quarry. Before blasting, drilling of blast holes using jack hammers was started from 6.am onwards and approximately 128 no. s of blast holes were drilled. The drilling of holes (5ft to 6ft depth) and filling of explosives into each hole were completed at 11AM. Connections were also established for the blasting. The CIMFR team checked all the drilled holes of blast points. The team also installed Seismograph at 7 locations by 11.20 AM. Blasting was conducted by 11.30 AM. 10 experimental blasts were conducted. Immediately after the blasting was completed, vehicular movement, breaking of boulders using breakers and hauling of the quarry product using haulers were carried out. These quarrying activities continued full-fledged until the end of the day. The monitoring was completed at all the 12 stations by 06PM. During the assessment, no. of holes to be drilled per hole, quantity of explosives to be charged per hole, blasting activity were carried out under over all supervision of the CIMFR Expert Team

6.0 Results

6.1 Weather records

The weather data were monitored every hour using Weather Tracker inside the quarry with respect to wind velocity, humidity and temperature and the weather details observed during Non-quarrying (18.01.2023) and Quarrying Day (19.01.2023) are given in **Table 2 & Table 3** below.

Table 2. Weather details observed during non-quarrying day (18.01.2023)

SL. NO.	Time (Hrs)	Temperature ◦C	Humidity (%)	Wind Speed & Direction (m/s)
1	06:00	23.5	82.1	1.2 S
2	07:00	23.7	81.8	1.0SE
3	08:00	24.1	78.7	3.0SE
4	09:00	25.6	76.2	0.6SE
5	10:00	27.6	69.7	0.7SE
6	11:00	26.9	70.4	3.1SE
7	12:00	29.9	57.2	0.7SE
8	13:00	30.1	51.8	2.4SE
9	14:00	32.3	49.1	0.6SE
10	15:00	30.1	65.0	1.2E
11	16:00	29.6	68.0	0.0
12	17:00	27.9	67.8	0.0

Table 3. Weather details observed during Quarrying day (19.01.2023)

SL. NO.	Time (Hrs)	Temperature ◦C	Humidity (%)	Wind Speed & Direction (m/s)
1	06:00	23.8	61.5	1.5 SE
2	07:00	22.1	69.1	0.8 SE
3	08:00	26.4	71.9	0.0
4	09:00	28.1	59.9	0.7 SE
5	10:00	29.3	57.3	0.0
6	11:00	29.8	53.7	0.5 SE
7	12:00	30.4	50.9	0
8	13:00	31.7	47.1	0.6 W
9	14:00	32.4	45.2	0
10	15:00	30.4	49.6	0
11	16:00	30.4	49.3	0
12	17:00	26.9	60.1	0
13	18:00	32.4	45.2	0

6.2 Particulate matters/ dust in terms of PM10 and PM2.5 values observed during Non-Quarrying day (18.01.2023) & Quarrying Day (19.01.2023)

Particulate matters/ dust in terms of PM10 and PM2.5 values observed during Non-quarrying day (18.01.2023) and Quarrying day (19.01.2023) are given in **Table 4 and Fig 1 to Fig 2** below:

Table 4: PM10 and PM2.5 values observed during Non-quarrying and quarrying day

Station Points	Distance from blasting zone (metre)	PM 10 (microgram/m^3)		PM 2.5 (microgram/m^3)	
		Non-quarrying day	Quarrying day	Non-quarrying day	Quarrying day
W50	50 m	161.1881457	144.4791667	69.23387912	42.62138571
W100	100 m	94.26923077	104.8254083	67.2965058	44.31564691
W200	200 m	59.76190476	51.39708292	117.9446219	53.37069282
W500	500 m	55.33769063	75.2037752	82.62724596	56.15755074
NE50	50 m	76.13693153	72.55934075	64.94828569	64.28248806
NE100	100 m	92.77398127	76.57846424	104.1919806	68.67717201
NE200	200 m	60.86038533	46.05769231	56.97120365	55.07804782
NE500	500 m	103.7617955	110.8226496	86.11774065	63.15303262
SE50	50 m	76.6802168	95.11418533	64.92313346	48.780959
SE100	100 m	60.19230769	63.09151204	84.39073515	61.44445747
SE200	200 m	63.55078229	82.26246106	87.5055833	58.83341738
SE500	500 m	109.4761905	64.39489376	100.998004	67.55128735

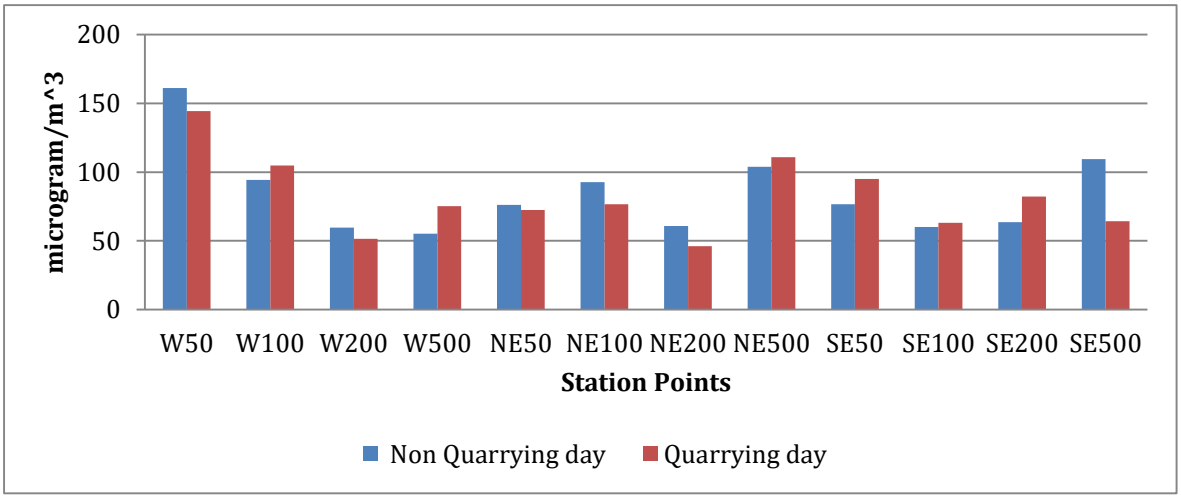


Fig.1: PM-10 values of Quarrying and Non-quarrying days

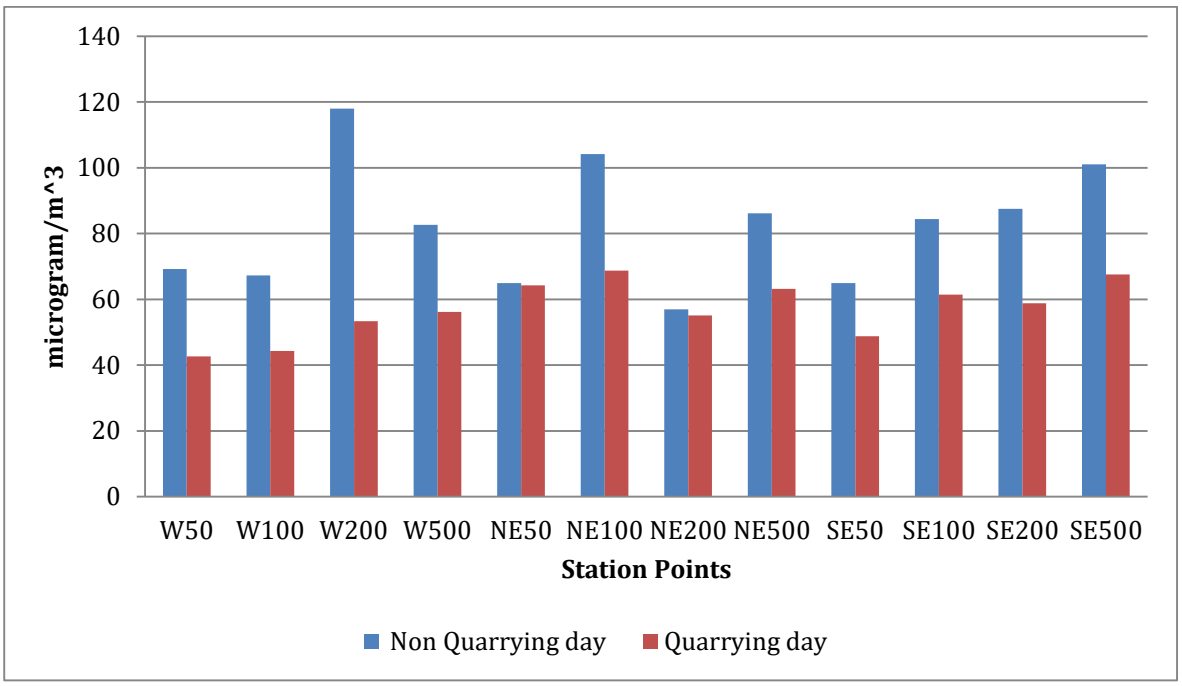


Fig.2: PM-2.5 values of Quarrying and Non-quarrying days

The analysis results of ambient air quality during non-quarrying day (Ambient day) and quarrying day reveal that

(i) The PM10 and PM2.5 values are varying erratically between non-quarrying and quarrying days. At some stations, PM10 values have increased, but corresponding PM2.5 values shows decrease and viceversa. The reason is the loose top soil quarry area other than exposed rocks. The soil was getting airborne in the non-quarrying day. The wind velocity was also comparatively higher on non-quarrying day than quarrying day. There was no dust suppression on non-quarrying day but good dust suppression was there on quarrying day. This caused higher ground dust at all the stations within quarry premises on the non-quarrying day.

(ii) In stations, NE200 and NE500; W200 and W500; and, SE200 and SE500, which were all away from quarrying area, local influences, not that of quarrying, caused the pattern of particulate mater values.

6.3 Noise levels

Observed Noise Levels in terms of Equivalent Noise (L_{eq}) and Maximum Noise Level (L_{max}) on non-quarrying and quarrying days are given in the **Table 5 and Fig 3 to Fig 15** in subsequent paras:

Table 5: Observed Noise Levels in terms of Equivalent Noise (L_{eq}) and Maximum Noise Levels (L_{max}) on Ambient Day and Quarrying Day.

Station Points	Non-quarrying		Quarrying	
	L_{eq}	L_{max}	L_{eq}	L_{max}
W 50	54.53776776	89	71.09626081	101.3
W 100	50.70924363	84.6	67.23217658	104.2
W 200	50.38809037	85.6	51.53325512	8.7
W 500	52.02469306	78.5	51.28390147	88
NE 50	56.53269591	77.6	64.12151425	118.9
NE 100	57.75010755	98.1	64.00207669	92.6
NE 200	57.9938271	77.4	57.93862208	87.4
NE 500	54.31729554	85.9	54.00017463	89.9
SE 50	48.35042325	78.4	65.84128917	104.9
SE 100	52.40926456	79.9	69.29160249	106.9
SE 200	45.8554891	74.4	55.78058959	96.9
SE 500	62.09271181	86.3	60.8456985	85.6

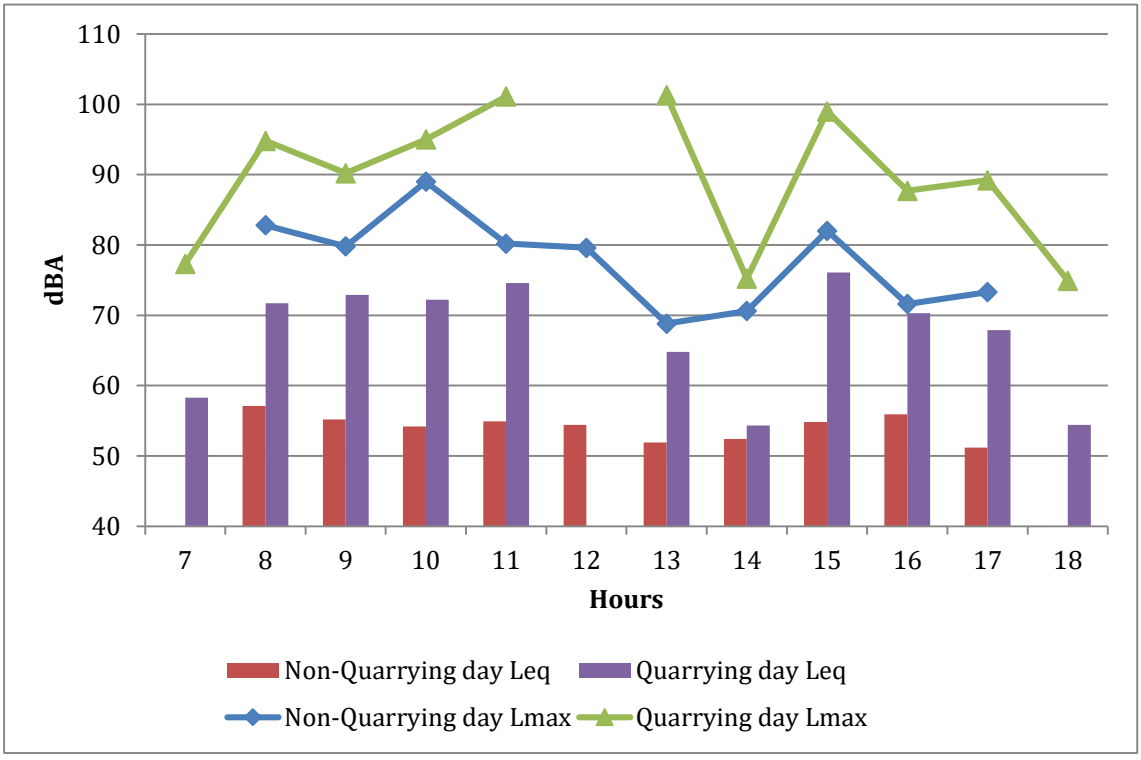


Fig.3: Equivalent values (Leq)and maximum (Lmax) Noise levels observed on quarrying and non-quarrying day in West direction 50m

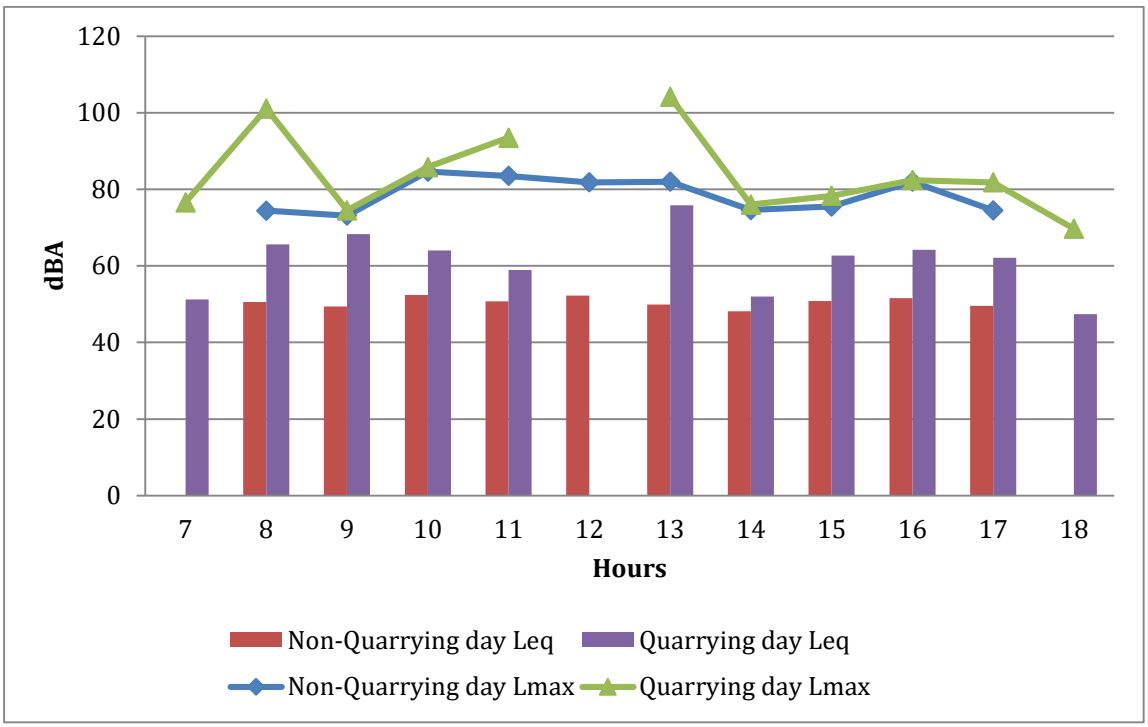


Fig.4: Equivalent values (Leq)and maximum (Lmax) observed on quarrying and non-quarrying day in West direction 100m

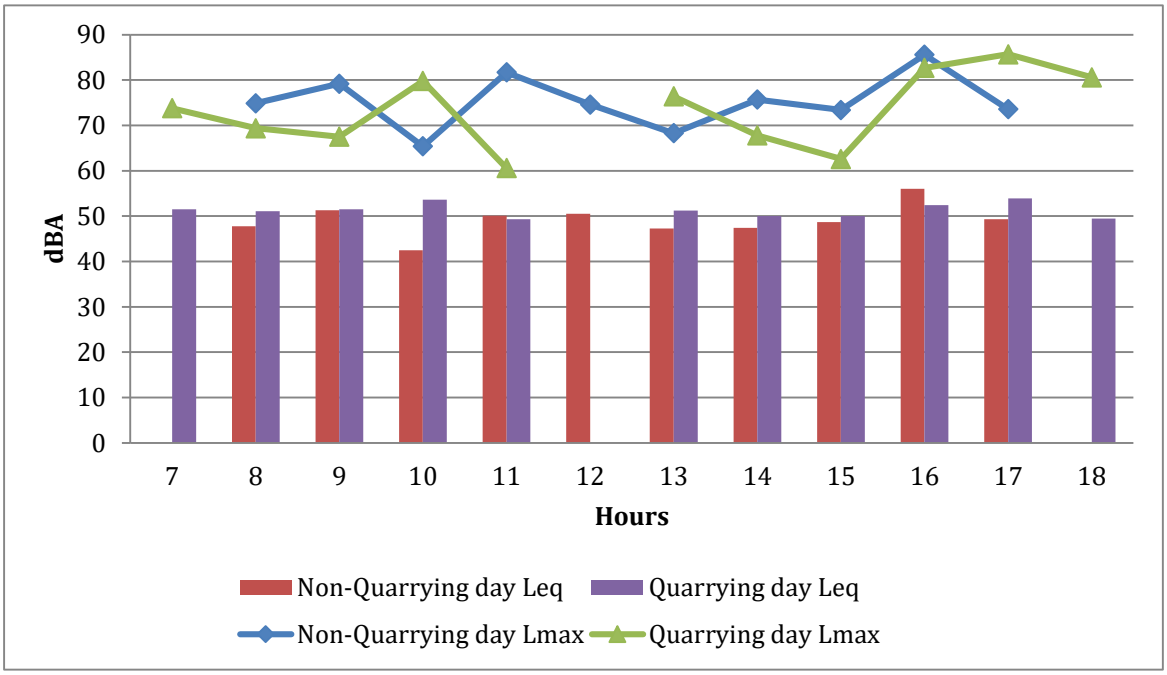


Fig.5: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in West direction 200m

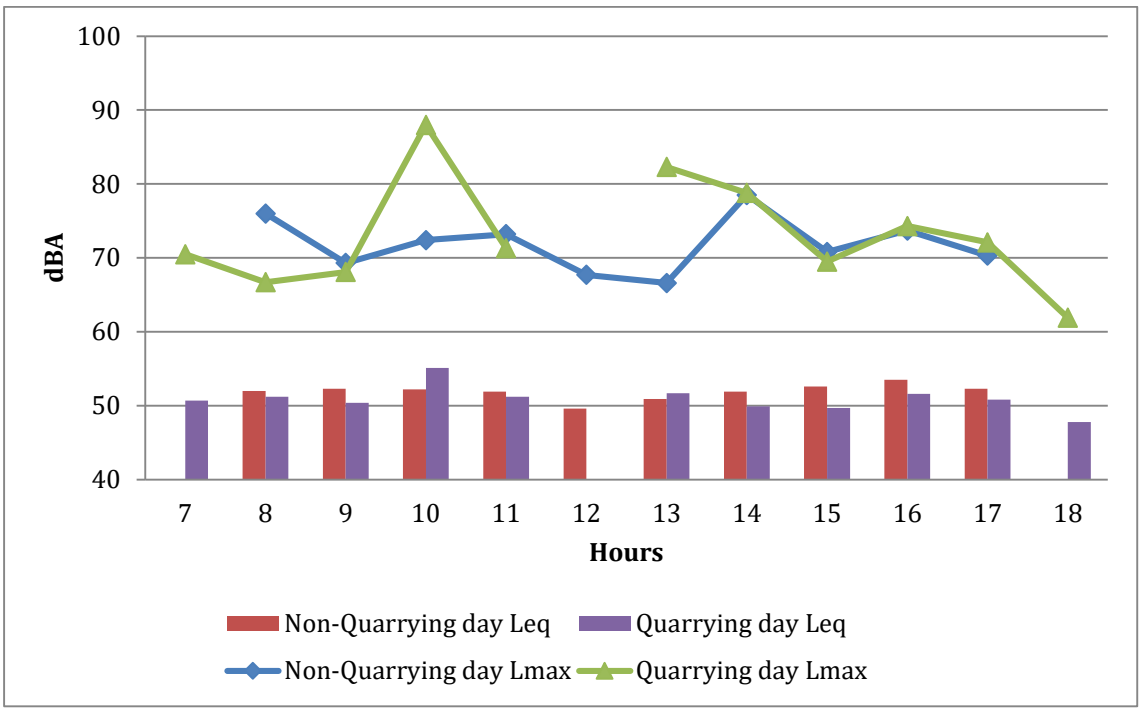


Fig.6: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in West direction 500m

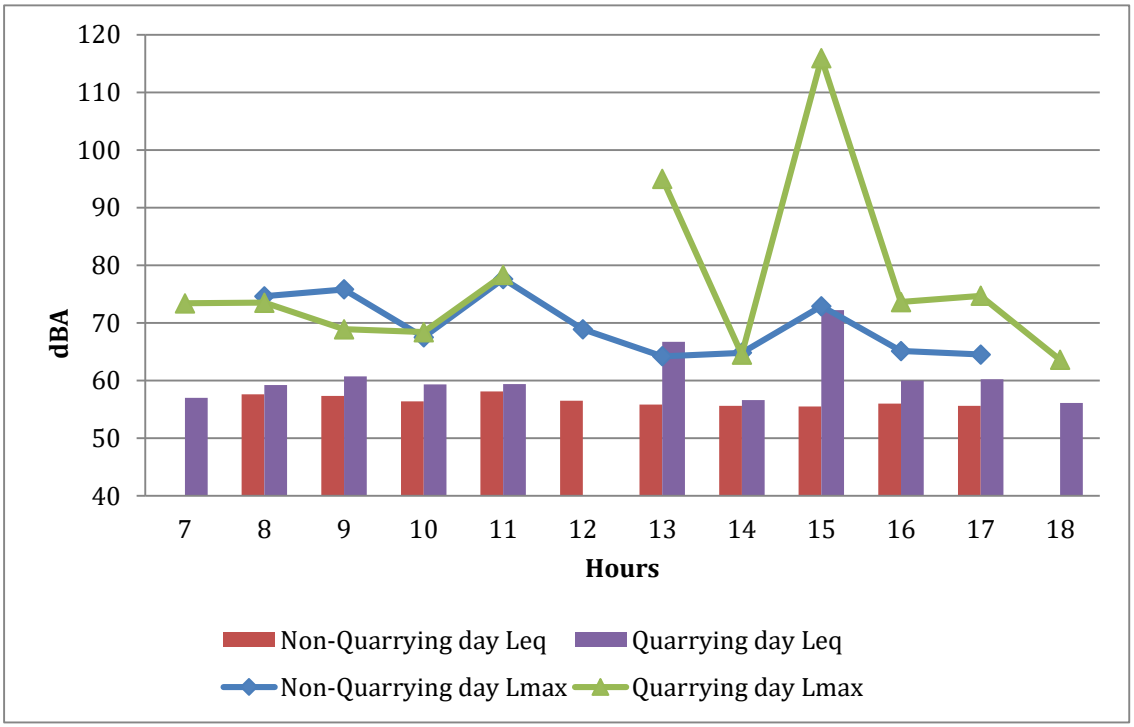


Fig.7: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in North-East direction 50m

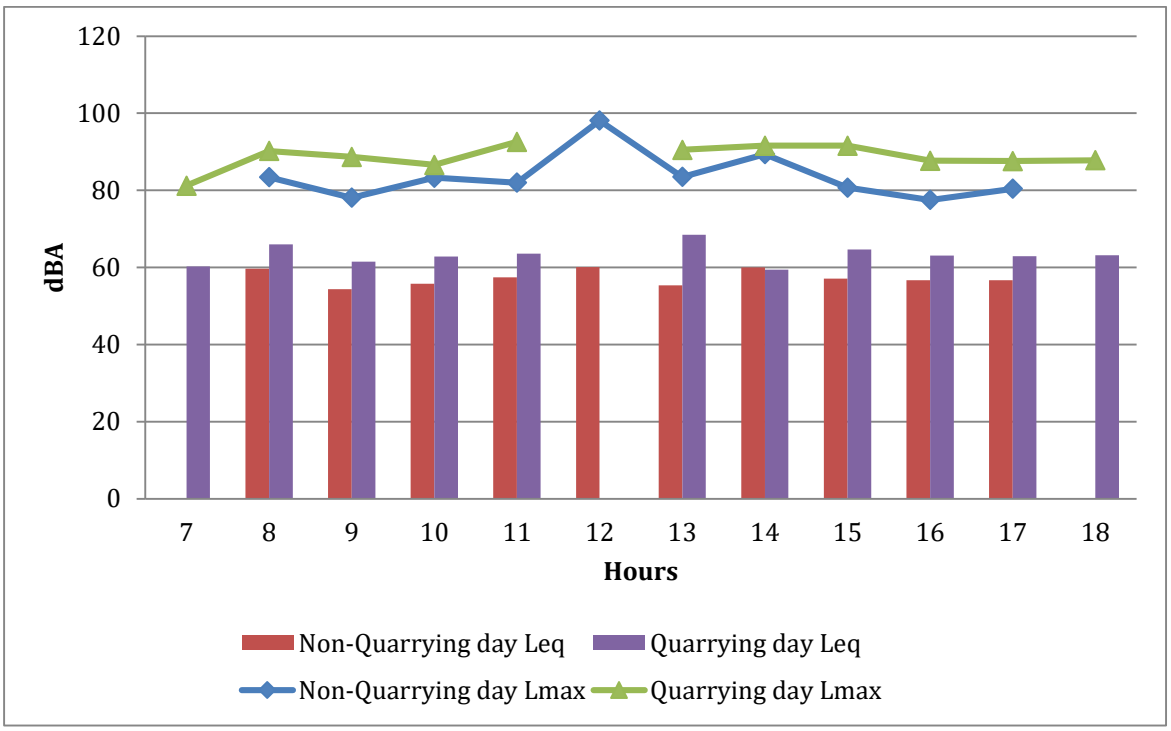


Fig.8: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in North-East direction 100m

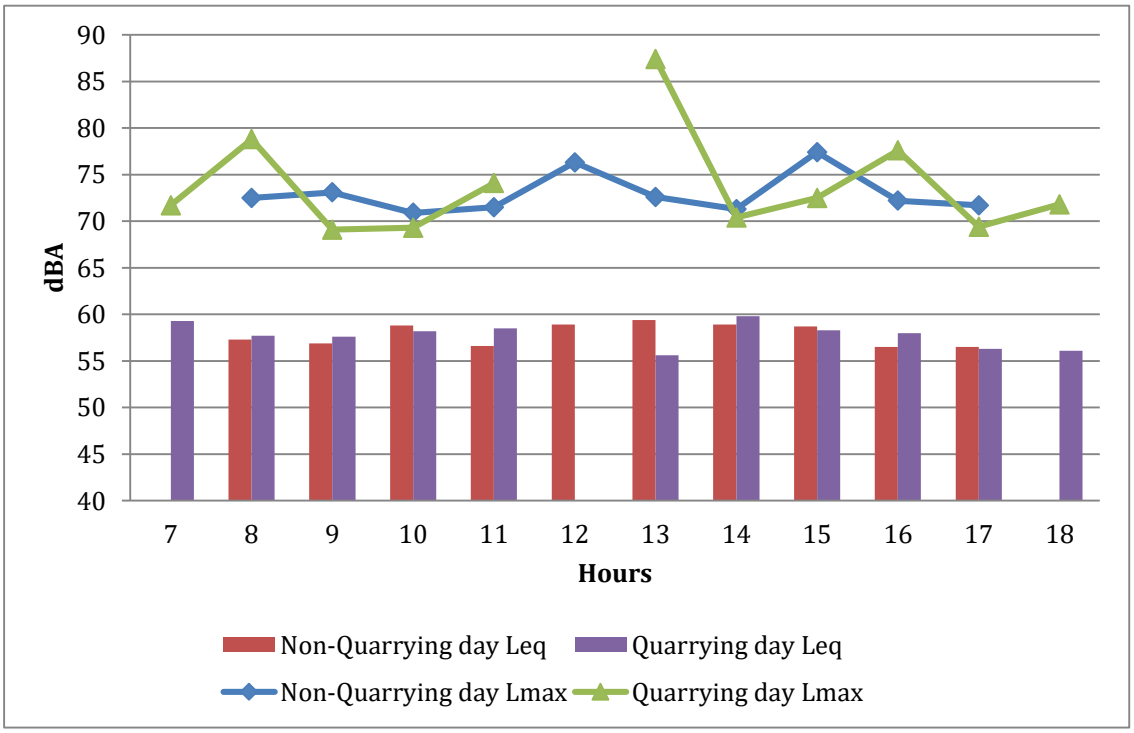


Fig.9: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in North-East direction 200m

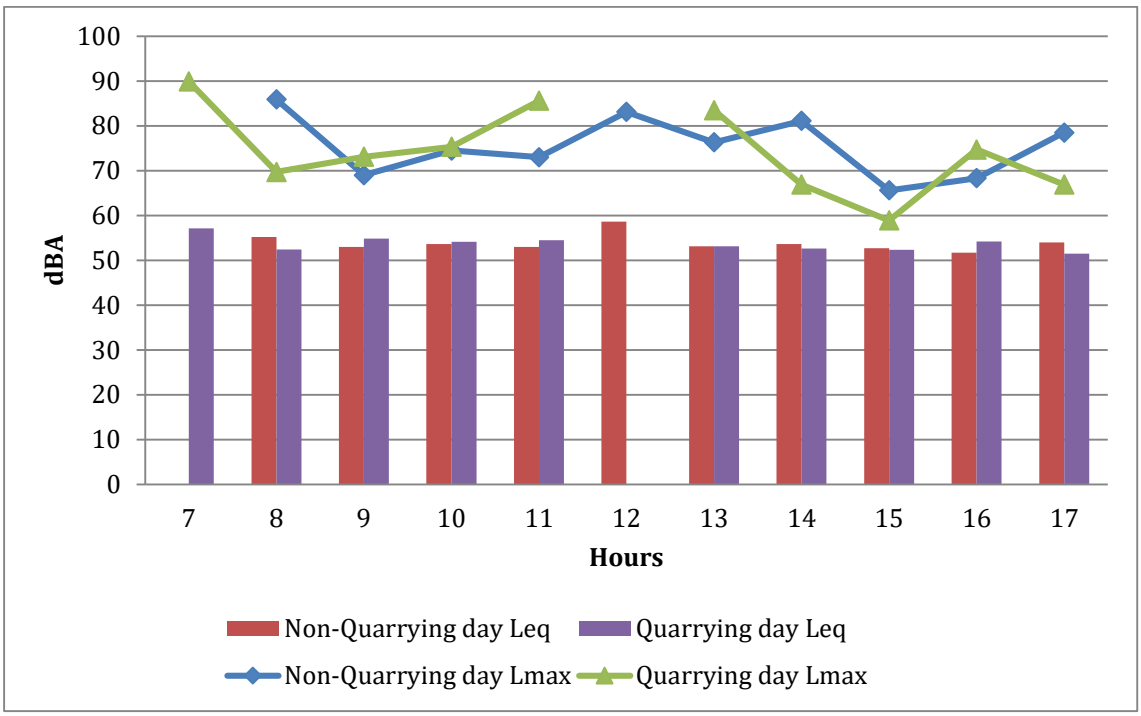


Fig.10: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in North-East direction 500m

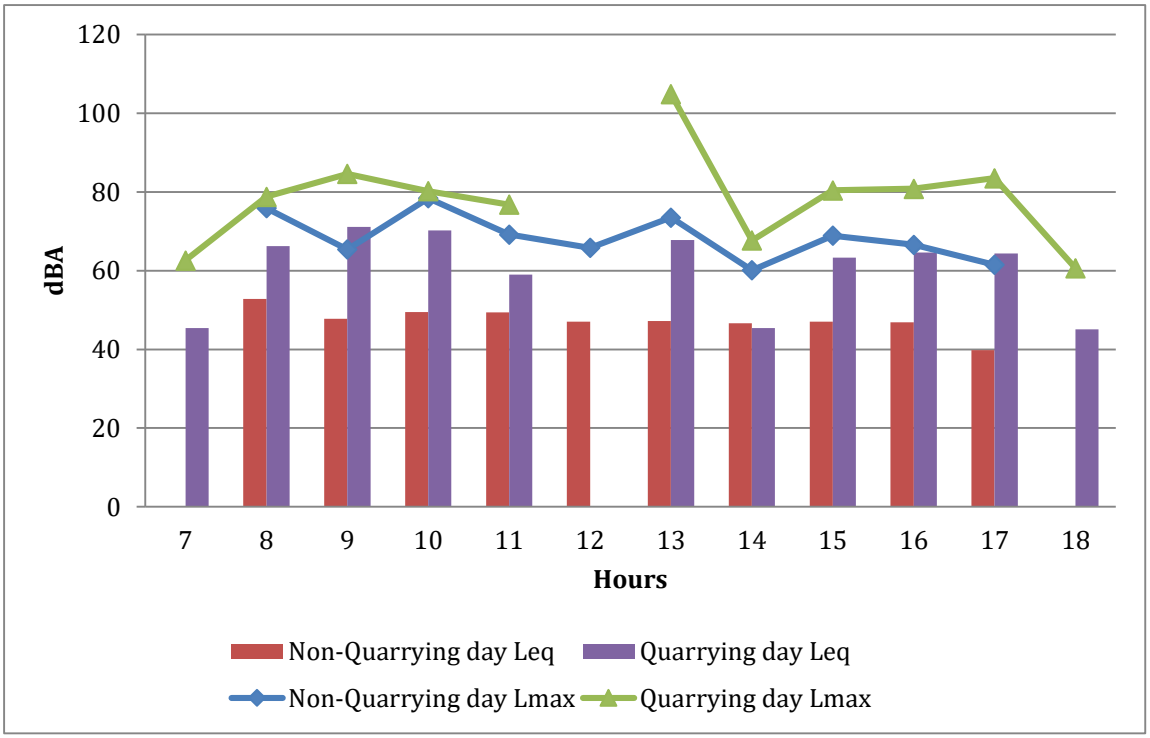


Fig.11: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in South-East direction 50m

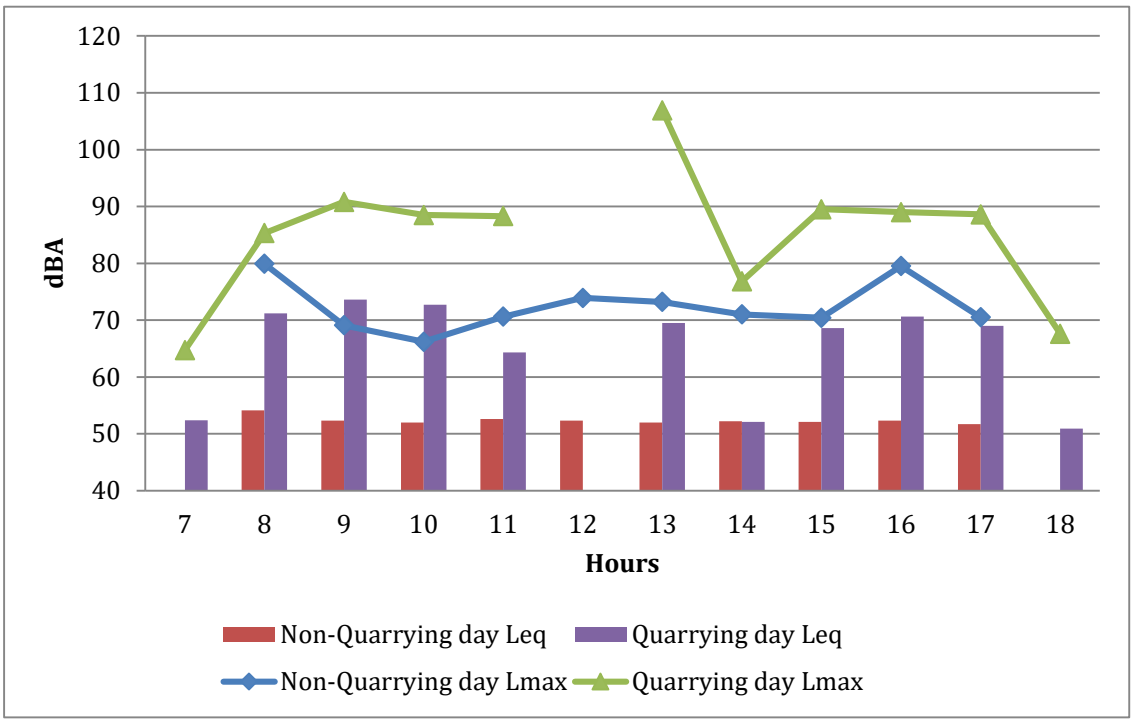


Fig.12: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in South-East direction 100m

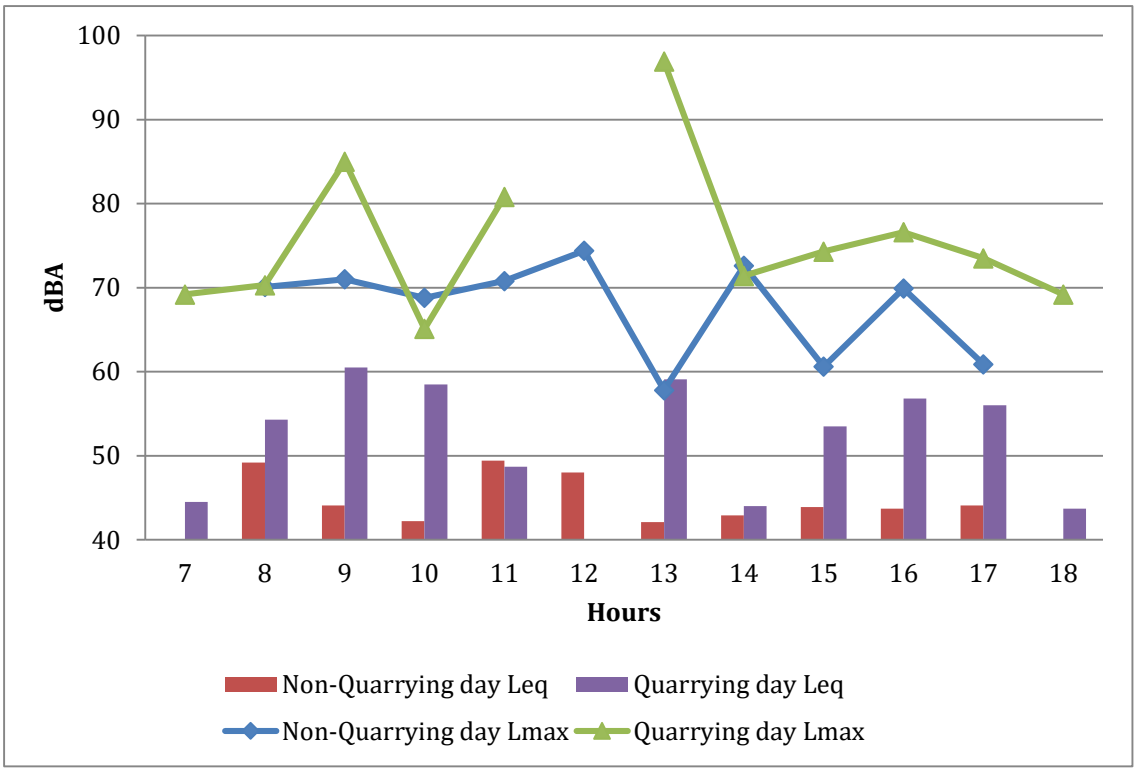


Fig.13: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in South-East direction 200m

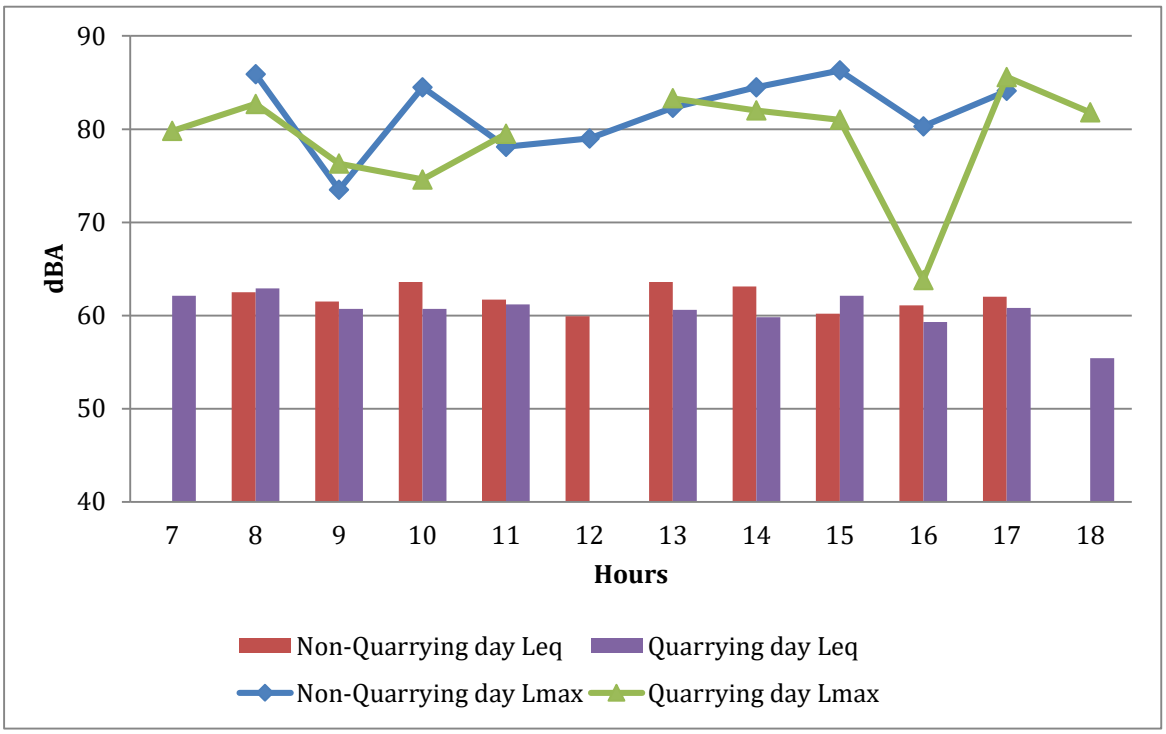


Fig.14: Equivalent values (Leq)and maximum (Lmax) observed on quarrying day and non-quarrying in South-East direction 500m

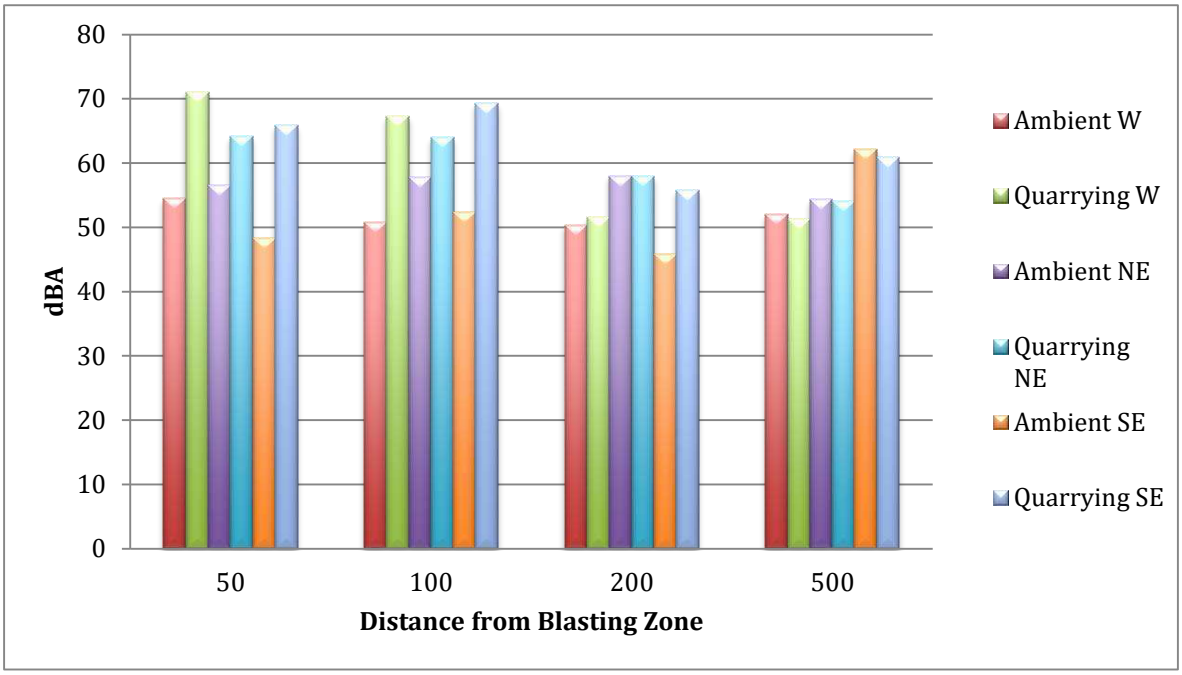


Fig.15: Equivalent values (Leq) observed on non-quarrying and quarrying day

Leq= Equivalent noise level (12 hours)
dB(A)= Decibel in 'a' scale (unit of sound pressure level)

The Noise monitoring analysis results monitored at monitoring stations reveal that

- The equivalent noise level and Lmax of the total day are higher on blasting day than ambient day at all stations generally. Only at 500 metre stations, where quarrying seems to have no influence at all, the pattern is changed.
- The blasting time time was 11.30 am. Blasting had not completed at 12 pm. Due to safety-related reasons, the hourly value of noise at 12 pm could not be taken. The next reading after 11 am was taken at 1 pm only. This caused gap of one reading on the quarrying day, as can be seen in the graphs. But it can be seen that the equivalent values as well as maximum values in each station are showing a peak between 11 am and 1 pm as a result of blasting.
- Except at one station W100, equivalent noise of the quarrying day is not increasing more than 10 dB(A) above corresponding non-quarrying day's value. The equivalent noise of the day of quarrying is not significantly more than that of non-quarrying.

6.4 Water Quality

Analysis results of the stone quarry pond water quality is given in the Table below:

Sample Point: Old Quarry Pond			
Date of Sample: 19/01/2023			
Sl. No.	**Parameters**	**Unit**	**Observed Value**
1	pH	-	6.72
2	COD	mg/l	1.6
3	SS	mg/l	1.6
4	TDS	mg/l	15
5	Conductivity	µS/cm	24.06
6	D.O	mg/l	7.9
7	Sodium as Na	mg/l	3.66
8	Potassium as K	mg/l	0.21
9	Calcium as Ca	mg/l	4
10	Magnesium as Mg	mg/l	0.486

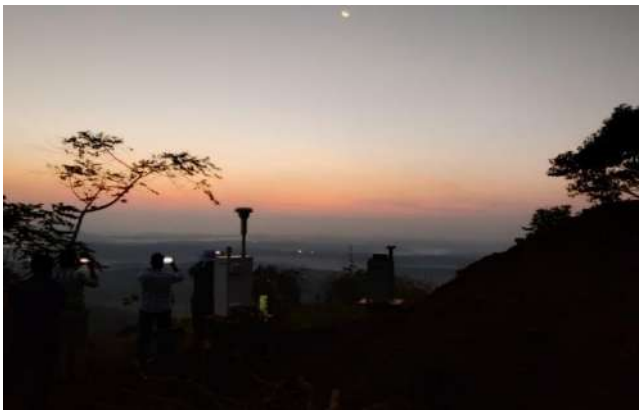
Note:- No effluent discharge standards prescribed by Kerala SPCB to the Stone Quarry Operator under the Consent to Operate issued under The Water (Prevention and Control of Pollution) Act, 1974.

7.0 Site specific observations

- The surrounding ground is sloping, with vegetation and habitations in various direction around the quarry.
- Fencing is provided, boundary pillars are marked and fixed, sign boards are provided
- For dust suppression, a dedicated tanker vehicle is provided for water sprinkling. However, while drilling, filling of explosives scientific method is not followed
- PPEs like safety boots, helmets are provided to the workers
- There are no wildlife movements reported in the stone quarry area
- CSR activities like infrastructure development, social welfare were provided by the quarry.
- Outside the excavated area of the quarry heavy vegetation, naturally developed.
- The 200 m and 500 m monitoring stations, which were in private properties, residences, were in clearings surrounded all around by vegetation.
- The public roads around the quarry are well maintained and have enough 2-lane width.
- The people had complaints about effects on their buildings due to blasting, not about air or noise pollution.
- Surface runoff during rainy season, water from quarry site is pumped out and discharged into the surrounding areas without imparting any treatment.
- Fly rocks observed during the study at the stone quarry site

Annexure I

Photographs taken during the site assessment carried out during 17 to 20.01.2023 at Quarry owned by P. M. Abdul Rahiman, Thayannur village, Kasaragod District, Kerala.



LOCATION: KASARAGOD