

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
NEW DELHI

O.A.No.304 OF 2019

M. Haridasan ... Applicant in the O.A.

Versus

State of Kerala & Ors. ... Respondents in the O.A.

AND

IN THE MATTER OF:-

M.A.No.81 OF 2021

Poabs Granites Ltd. & Anr. Applicants/Respondents

ADDITIONAL DOCUMENTS FILED BY POABS GRANTIES PVT. LTD.

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ADVOCATE FOR THE RESPONDENTS: MR.E.M.S.ANAM AND
MR.M.S.VISHNU SHANKAR

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4297

A P M MOHAMMED HANISH IAS
PRINCIPAL SECRETARY TO GOVERNMENT



INDUSTRIES & REV. (WAQF)
DEPARTMENTS
Government Secretariat
Thiruvananthapuram

Dated: 10.10.2024

No.A3/292/2020-IND

The Secretary,
Ministry of Mines
Shastri Bhavan
Government of India
New Delhi-110001

Sir,

Sub: Industries Department- Mining and Geology - Mines & Minerals –
Hon'ble National Green Tribunal – OA 304/2019 - Mining
locations to be placed 200 mts away from dwellings – request
forwarding of - reg.

- Ref: 1. Order Dated 21.07.2020 in Original Application 304/2019 filed
before the Hon'ble National Green Tribunal
2. Order Dated 25.10.2021 in Civil Appeal Nos. 12122 –
12123/2018 filed before the Hon'ble Supreme Court of India.

Kind attention is invited to the captioned subject and to inform you that while considering the Application cited (1) above, the Hon'ble National Green Tribunal ordered to observe minimum distance of 200m from Residential/Public buildings, Inhabited sites, locations to be considered by States, if blasting is involved and to observe 100m, if blasting is not involved. Later, the Hon'ble Supreme Court while considering the appeals cited (2) above, ordered 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.” Accordingly the parties concerned including State of Kerala approached the Hon’ble Tribunal and after hearing the arguments raised by the parties concerned, the Hon’ble Tribunal vide Order Dated 09.12.2021 has constituted a Joint Committee composed of the experts from (1) Indian Institute of Mines/ Indian Institute of Technology (IIT), Dhanbad, (2) CSIR- Central Institute of Mining & Fuel Research (CIMFR), Dhanbad, (3) CSIR- Central Building Research Institute (CBRI), Roorkee, (4) Indian Institute of Technology (IIT), Roorkee, (5) Wadia Institute of Himalayan Geology, Dehradun, (6) Directorate General of Mine Safety and (7) Central Pollution Control Board (CPCB) and this joint committee was entrusted with the task of an expert study on the subject of safe distance for stone quarry from habitations.

The Joint Committee has visited 9 stone quarries in Kerala and done certain experiments and submitted the report dated 02.03.2023 before the Hon’ble Tribunal. Once the report has been submitted the Hon’ble Tribunal has sought opinion of the parties concerned. While going through the report, the State has observed many anomalies narrated as given below. The report of the Joint Committee (of Experts) has many inaccuracies and lack of application of standard scientific methodology, which reflected in the result drawn from these experiments. The report of the Joint Committee is composed of two parts. The first part, which deals with physical hearing and online survey and the second part consisted of the result of the experiments undertaken. The interpretation of the observation made under the first part – physical hearing and online survey – clearly indicates that there is no need to impose more stringent regulations including the extension of existing distance criteria. The online survey clearly indicates that out of the 6734 responses

received by the Joint Committee, 65.3% are living near to the stone quarries and 74.7% have no grievances related to stone quarry.

The second part – the Result of the live experiments conducted by the Joint Committee has many anomalies which reflects lack of proper methodology as well as design. There were 497 granite (building stone) quarries functioning in Kerala during the year 2022 – 2023. The sample set was composed of only 9 quarries (1.8%) to interpret the whole scenario in India. Standard sampling with an acceptable margin of error of $\pm 20\%$ requires a minimum of 23 samples (<https://www.researchgate.net/publication/324571619>) to represent the data set of 497 quarries. Besides, the reason for site selection was not given. Only criterion used is dividing the State into 3 zones with 3 quarries in each zone. No geographical attributes are given, whether located in midland, highland or high ranges of Western Ghats. The lithology of the quarries selected clearly shows (Figure 2, Page No. 16) that 4 quarries are with Charnockite of Granulite facies of metamorphism and 5 are with Gneissic rocks representing Amphibolite facies of metamorphism. Rocks of igneous origin, intrusives and prominent metamorphic rock types of southern Kerala like Khondalite and Leptinite are omitted. From the above, it is clear that the representation of the sampling locations did not justify not even the whole scenario of Kerala.

Another disagreement of the State is regarding the vibration study conducted by the Joint Committee. There is no structural interpretation of the quarries kept for vibration studies. There is no mention whether the rock strata is massif or jointed. And there is no observation regarding the propagation of waves through massif Charnockite and fractured Charnockite. And it has failed to interpret whether any propagation distinction exists between

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Metamorphic rocks and Igneous rocks due to lack of sampling. Besides, the records attached to the report pertaining to the nature and timing of blasting conducted in quarries (Eg. Page No. 1037 with respect to M/s. Parackal Granites) show that the blasting is carried out every day in 2 prefixed timings with maximum 60 holes. It is rarely that quarry in Kerala functions with blasting of 60 holes at a time. The Committee has erroneously created a circumstance to project maximum ground vibration in each case, which is found to be unfair.

The suggestions and recommendation of the Joint Committee (Page No. 41, Item 8.0.: Suggestions and Recommendation) with respect to blasting experiment that as per the assessment study, the influence zone of ground vibration is 50-100 m from the blasting zone and the fly rock ejections were noticed in two instances and it were less than 25 m from the blast zone. The result was obtained when the blasting is carried out every day in 2 prefixed timings with maximum 60 holes. Hence the result is not in conformity with the result based on normal practice of blasting. It is most humbly requested to refer Table 5 of the Page 33 of the Report. It has been reported that the maximum value of Peak Particle Velocity (PPV) recorded at a Distance of 50m from the blasting face is 8.21mm/s (Trivandrum District), which is below the permissible level of 10mm/s as stipulated by the DGMS. Hence there is no reason to enhance the distance limit from 50m.

Regarding the result of the propagation of suspended particulate matter (SPM) and respiratory particulate matter (RPM) (in report it is mentioned as Particulate Matter) has no unique interpretation. 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. There are huge errors in result. In

some cases, the result shows the level of particulate matter is higher during non-blasting days rather than the blasting days (Page 994, 1011, 1026, 1043, 1057 etc). Similarly concentration of particulate matter is higher at far away locations than the locations nearby to blasting face (Page 994, 1011, 1026, 1043 etc). No specific reason is pointed out by the Joint Committee for this anomaly. Rather they have suggested to have enhanced distance criteria, which is unjustifiable.

The report of the Joint Committee has flaws in many aspects. There are extrapolations in different aspects to draw a conclusion that there is necessity to enhance the safe distance of quarrying. But the results are self explanatory to remind us that there is no need to enhance the distance of quarrying. It is evident from the report that there are two sets of impacts, either by Peak Particle Velocity or by Particulate Matter. In the first case, there is possibility to reduce the PPV by reducing the quantity of explosives used for blasting and also reducing number of holes. In the second case, there are well advanced modern equipments to reduce the level of pollutants. The report never attempted to find a possible solution to reduce the level of pollutants and vibration.

Section 15 of the Mines and Minerals (Development and Regulation) Act authorizes State Government to formulate the Rules. The Kerala Minor Mineral Concession Rules, 2015 came into existence in supersession of the then prevailed Kerala Minor Mineral Concession Rules, 1967. The 2015 rules were framed in consideration of the sustainable mining frame work suggested by the Hon'ble Supreme Court in Deepakkumar's case. Para 11 of the judgment emphasized that the Union Ministry of Mines along with Indian Bureau of Mines and respective State Governments should therefore make

necessary provisions in this regard (sustainability) under the Mines and Minerals (Development and Regulation) Act, 1957, Mineral Concession Rules, 1960 and adopt model guidelines to be followed by all States. Accordingly there have been amendments in MM (D&R) Act, redrafting in Mineral Concession Rules and supersession in KMMCR. The Hon'ble Supreme Court arrived into a conclusion by interacting with the proceedings of the Ministry of Mines, Indian Bureau of Mines and Ministry of Environment, Forest and Climate change. As stated above, there have been modifications in the Central Act and Rules. In 2016, the Government of India enacted Minerals (*Other than Atomic and Hydro Carbons Energy Minerals*) Concession Rules and Atomic Mineral Concession Rules. Even then the stipulations regarding distance criteria remained the same in the Central Rules. Rule 12 (1)(d) of the Minerals (*Other than Atomic and Hydro Carbons Energy Minerals*) Concession Rules and Rule 10 (1)(j) of the Atomic Mineral Concession Rules stipulate that " the lessee shall not carry on, or allow to be carried on, any mining operations at any point within a distance of fifty metres from any railway line, except under and in accordance with the written permission of the railway administration concerned, or under or beneath any ropeway or ropeway trestle or station, except under and in accordance with the written permission of the authority owning the ropeway, or from any reservoir, canal or other public works, or buildings, except under and in accordance with the prior permission of the State Government".

It may be kindly noted that the State of Kerala has placed on record before Hon'ble National Green Tribunal regarding the above described limitations and drawbacks of the observations of the Joint Committee and insisted to fix the distance criteria as 50m. State of Kerala has limitations on the availability of congenial land and high population density as far as the

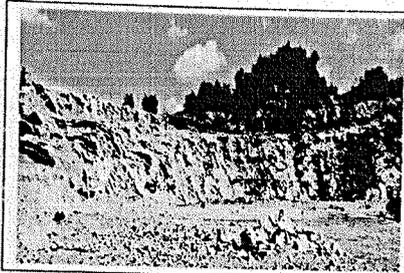
development of mines and minerals is concerned. Hence increasing the distance criteria above 50m may jeopardize the mining sector of Kerala. It may be noted that the Hon'ble National Green Tribunal, by its order dated 03.01.2024, appointed Mr. Raj Panjwani, Senior Advocate as Amicus in the matter and the matter is still remaining unresolved. In the above circumstances, it is requested that the Ministry of Mines may make the appropriate intervention in this regard and take necessary efforts so as to fix the distance criteria as 50m, since this matter is not confined to the State of Kerala alone, but for other States in the country as well.

Yours Faithfully,

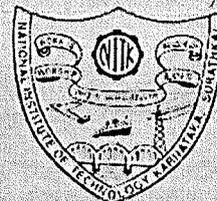
A P M MOHAMMED HANISH



A REPORT
ON
MONITORING OF GROUND VIBRATIONS GENERATED DUE TO
BLASTING OPERATIONS IN PEROORKADA STONE QUARRY OF
M/s. POABS GRANITES (P) LIMITED IN PEROORKADA VILLAGE
THIRUVANANTHAPURAM – TALUK & DISTRICT, KERALA
(Project Code: NITK/MN/2024-25/0046)



SUBMITTED TO:
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The Principal Investigator is grateful to the Director, National Institute of Technology Karnataka, Surathkal (Govt. of India) for permitting to take up the project.

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Help rendered by Mr. Shrishail R.K. Project Assistant in Dept. of Mining Engineering – NITK, Surathkal in field monitoring and preparation of the report is acknowledged.

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Jan 16, 2025

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MGMI Engineering Gold Medal
MEAI-SRG IT Award,

ISTE –SGSITS Young Teacher Award,
IE-NDRF-National Design Award
MEAI- Smt. Kiran Devi Singh Memorial Award

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ABSTRACT

M/s Poabs Granites Pvt. Ltd. is operating Peroorkada stone quarry over an area of 5.9747 Ha in Re-Sy Block No: 23, Re-Sy Nos. 460/2-1pt, 460/2-2, 460/10, 448/2, 461/1, 446/4pt, 461/2, 461/3, 461/4, 462/1, 462/2, 462/3, 462/5 & 446/8pt in Peroorkada Village, Thiruvananthapuram Taluk, & District of Kerala. The quarry management requested the Principal Investigator from National Institute of Technology Karnataka (NITK – Govt. of India) – Surathkal to monitor the ground vibrations generated due to blasting operations for one week duration.

Blasts are conducted in different locations of the quarry. 32mm diameter holes are drilled with Jack Hammer drill for a depth of 1.82 to 1.98m. Burden x spacing are 0.91x1.21m. 125gm cartridge explosives are used as base charge along with initiation system and Ammonium Nitrate & Fuel Oil (ANFO) is used as column charge. e. NONEL based Shocktube detonators are used for initiation. blasting operations are carried out as per the recommendations of CIMFR, Nagpur report (Project No: SSP/N/567/2021-22 dated 09.06.2021).

In total 47 blasts were conducted during one week duration starting from 02nd Dec- 2024 to 07th Dec- 2024. Ground vibrations & noise levels were monitored for all the blasts using 2 instruments covering 94 locations. Charge per hole varied from 0.325 to 0.500kg, maximum charge per delay is same as charge per hole as each hole is provided with individual delay. Total charge per blast varied from 8.8 to 32.5kg. Ground vibration monitoring distance varied from 40 to 480m.

The highest Peak Particle Velocity (PPV) recorded was 3.44 mm/s at a distance of 60m in Blast No. 35, where as the permissible level is 5mm/s for different structures as per DGMS guidelines irrespective of frequency (frequency of less than 8Hz). Beyond 160m distance from blast location, instrument has not triggered indicating that the PPV was less than 0.51 mm/s.

The highest noise level recorded is 128.9 dB at a distance of 60m in Blast No. 35 and second highest is 125 dB at distance of 80m in Blast No. 27, at some locations the noise levels are less than 100dB.

So, it can be stated that the intensity of ground vibrations generated from quarry blasting are within the permissible levels.

INTRODUCTION

M/s Poabs Granites Pvt. Ltd. is operating Peroorkada stone quarry over an area of 5.9747 Ha in Re-Sy Block No: 23, Re-Sy Nos. 460/2-1pt, 460/2-2, 460/10, 448/2, 461/1, 446/4pt, 461/2, 461/3, 461/4, 462/1, 462/2, 462/3, 462/5 & 446/8pt in Peroorkada Village, Thiruvananthapuram Taluk, & District of Kerala. The quarry management requested the Principal Investigator from National Institute of Technology Karnataka (NITK – Govt. of India) – Surathkal to monitor the ground vibrations generated due to blasting operations for one week duration.

Field monitoring was carried from 02nd December - 07th December- 2024. A broad view of the quarry is shown in Fig. 1 and a close view is shown in Fig. 2.

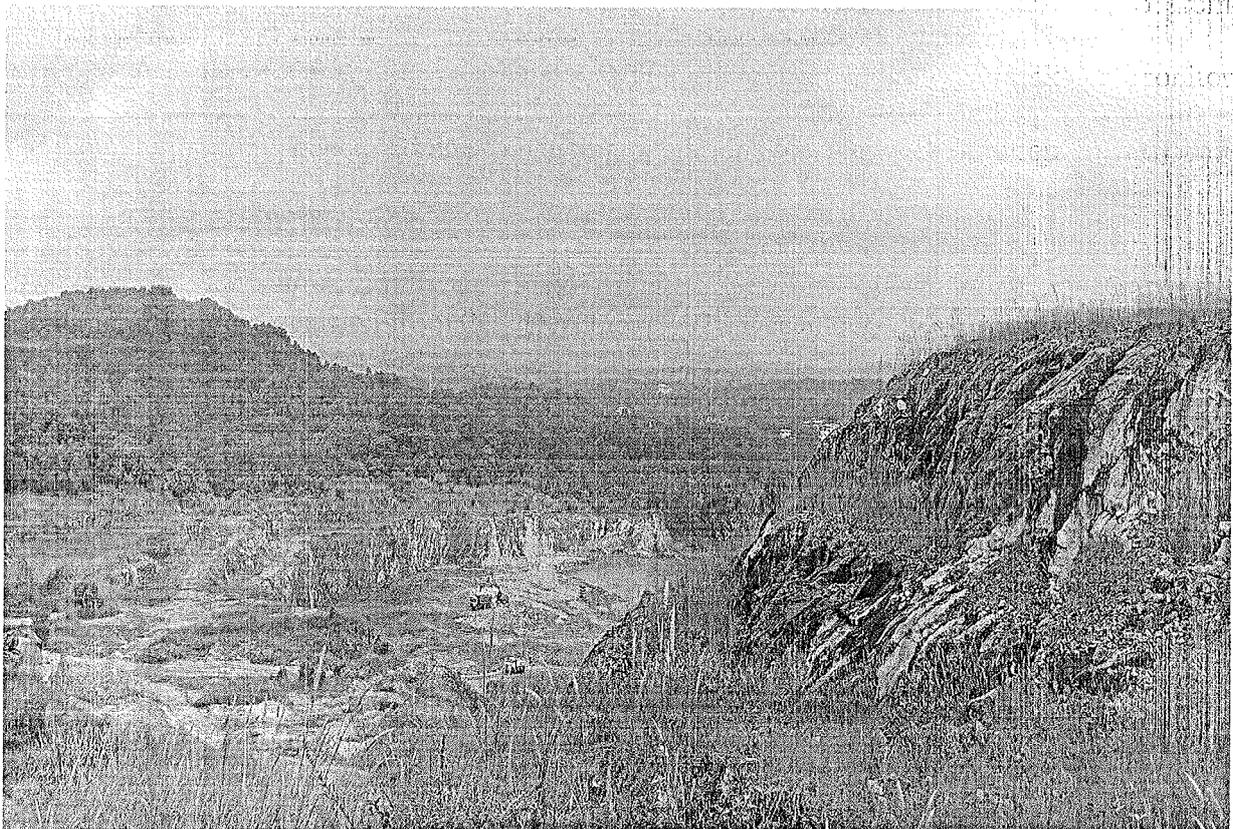


FIG. 1 A BROAD VIEW OF THE QUARRY

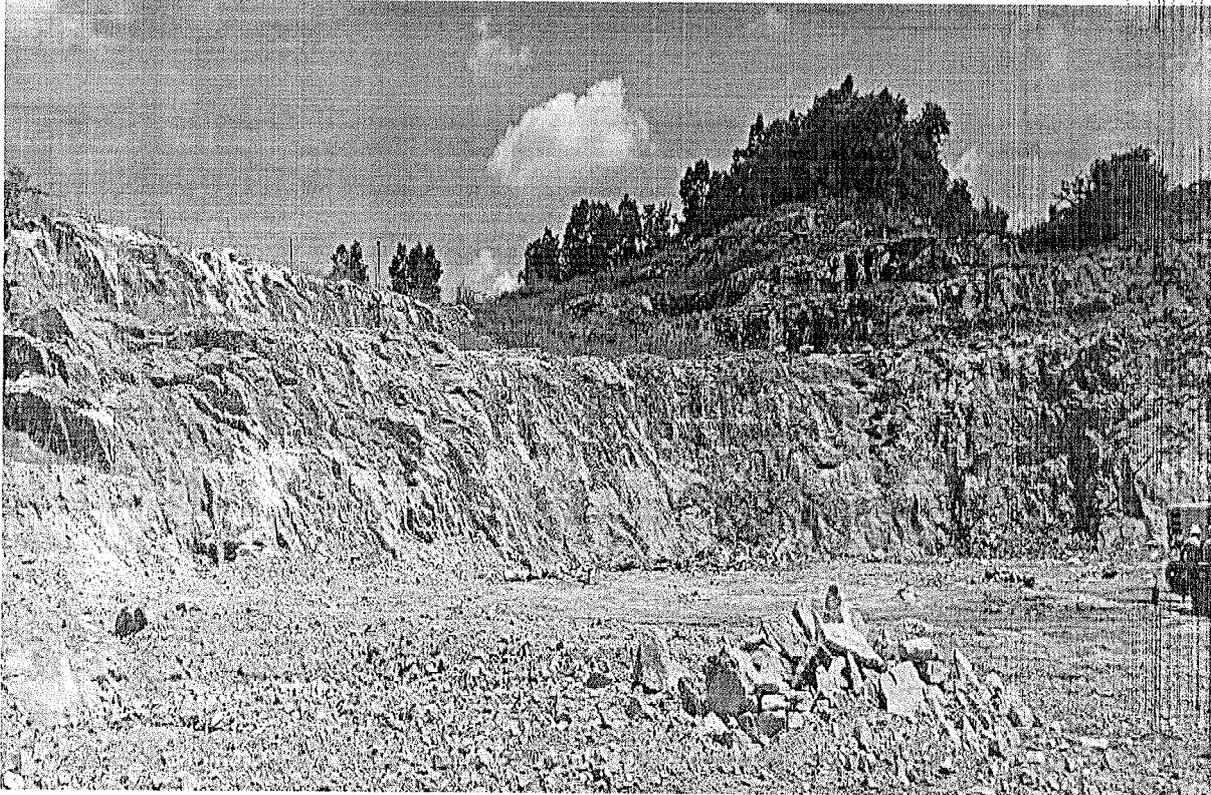


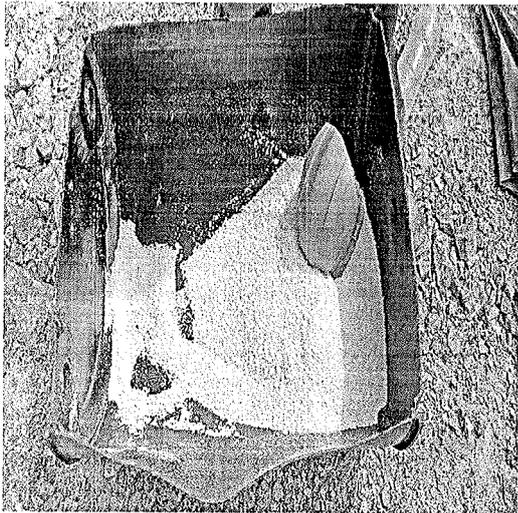
FIG. 2 A CLOSE VIEW OF THE BENCHES IN THE QUARRY

Blasting Operations

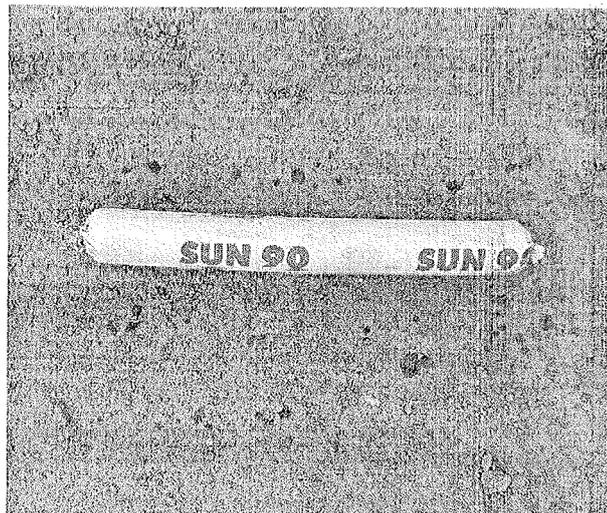
Blasts are conducted in different locations of the quarry. 32mm diameter holes are drilled with Jack Hammer drill for a depth of 1.82 to 1.98m (Fig. 3). Burden x spacing are 0.91x1.21m. Each blasthole is measured accurately before charging. 125gm cartridged explosives are used as base charge along with initiation system and Ammonium Nitrate & Fuel Oil (ANFO) is used as column charge (Fig. 4). NONEL based Shocktube detonators are used for initiation (Fig. 5). Required quantity of explosive is used based on the depth of each blasthole (Fig. 6) and the remaining depth is filled with inert material and effective stemming is done (Fig. 7). The blasting operations are carried out as per the recommendations of CIMFR, Nagpur report (Project No: SSP/N/567/2021-22 dated 09.06.2021).



FIG. 3 A VIEW OF DRILLING OPERATION IN THE QUARRY



(a). ANFO



(b). Cartridged Explosive

FIG. 4 A VIEW OF EXPLOSIVES USED IN THE QUARRY

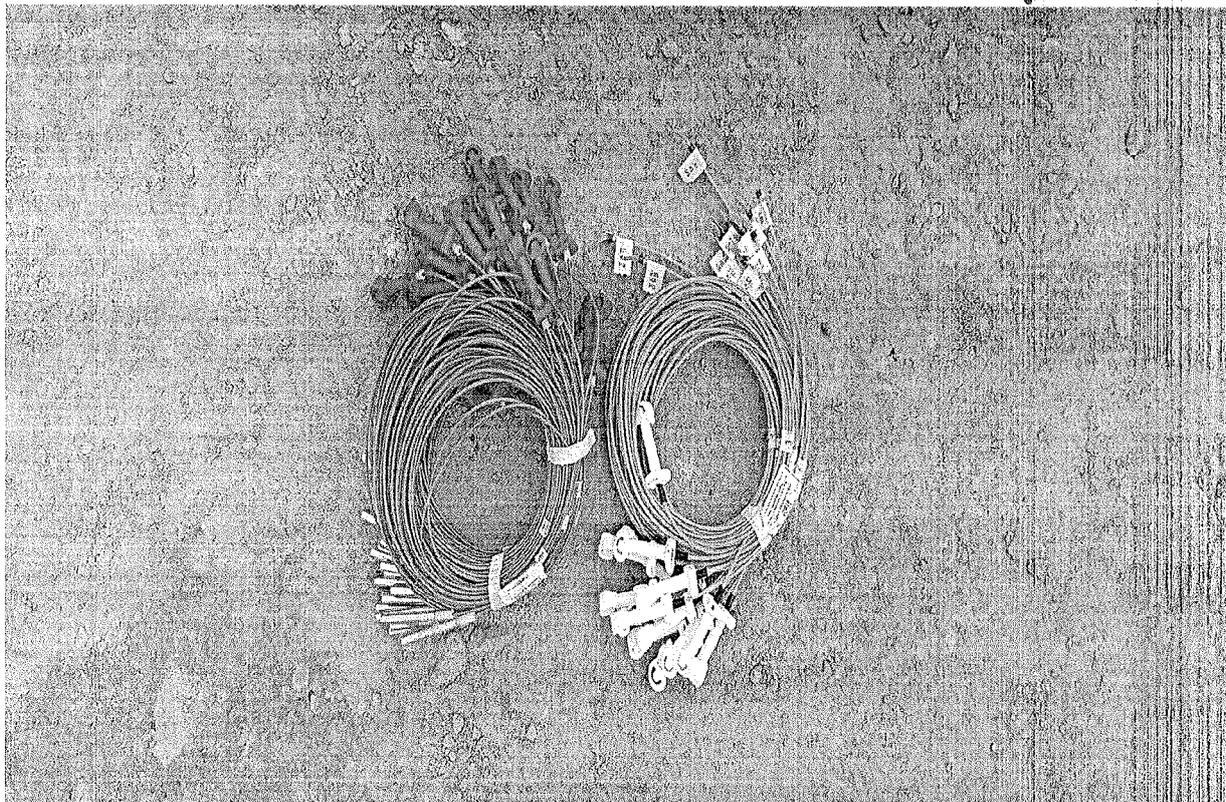


FIG. 5 A VIEW OF NONEL BASED SHOCKTUBE DETONATORS



FIG. 6 A VIEW OF CHARGING OF THE HOLE

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FIG. 7 A VIEW OF STEMMING OF THE HOLE

Ground Vibration & Noise Monitoring

Ground vibrations & Noise generated from different blasts were monitored using one unit Micromate of Instantel, Canada and one unit of Real Wave Analyser of Svib Software Technology Pvt Ltd Bengaluru. Geophone of these blast vibration monitors records the ground vibrations in three mutually orthogonal directions - Longitudinal, Transverse and Vertical. Geophones of these instruments were set to their minimum trigger level (0.51mm/s). This indicates that the instrument will start monitoring ground vibrations if the intensity is more than the trigger level. Geophone of the instrument was glued to the ground effectively using Plaster of Paris (PoP) powder or digging a notch of 6-8" in the ground and burying the geophone. Microphone attached to the same unit will measure the noise levels. Ground vibrations monitoring around the blast locations is shown in Fig. 8. Details of all the blasts are

given in Appendix-I and Layouts of some of the blasts are given in Appendix-II. Summary of the blasts monitored are given in Table-1. Blast event sheets are given in Appendix- III.



FIG. 8 (A)



FIG. 8 (B)

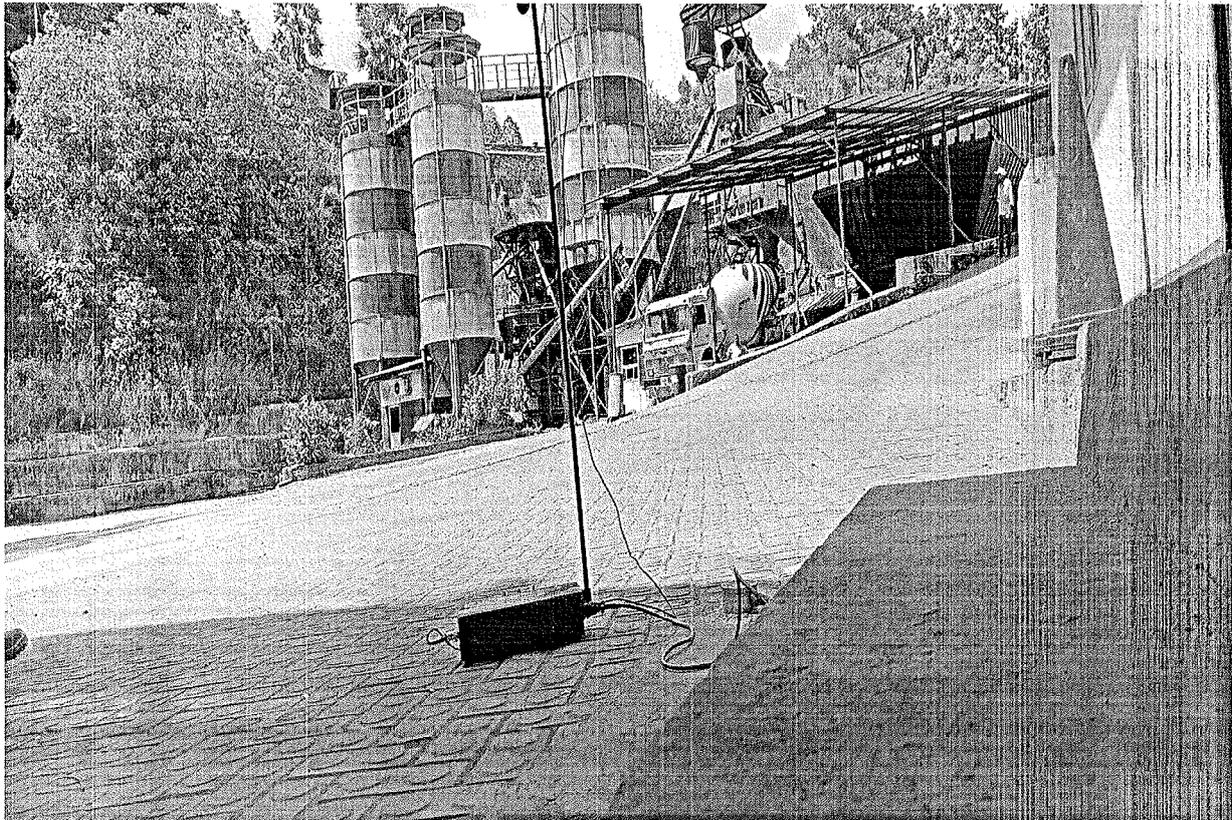


FIG. 8 (C)

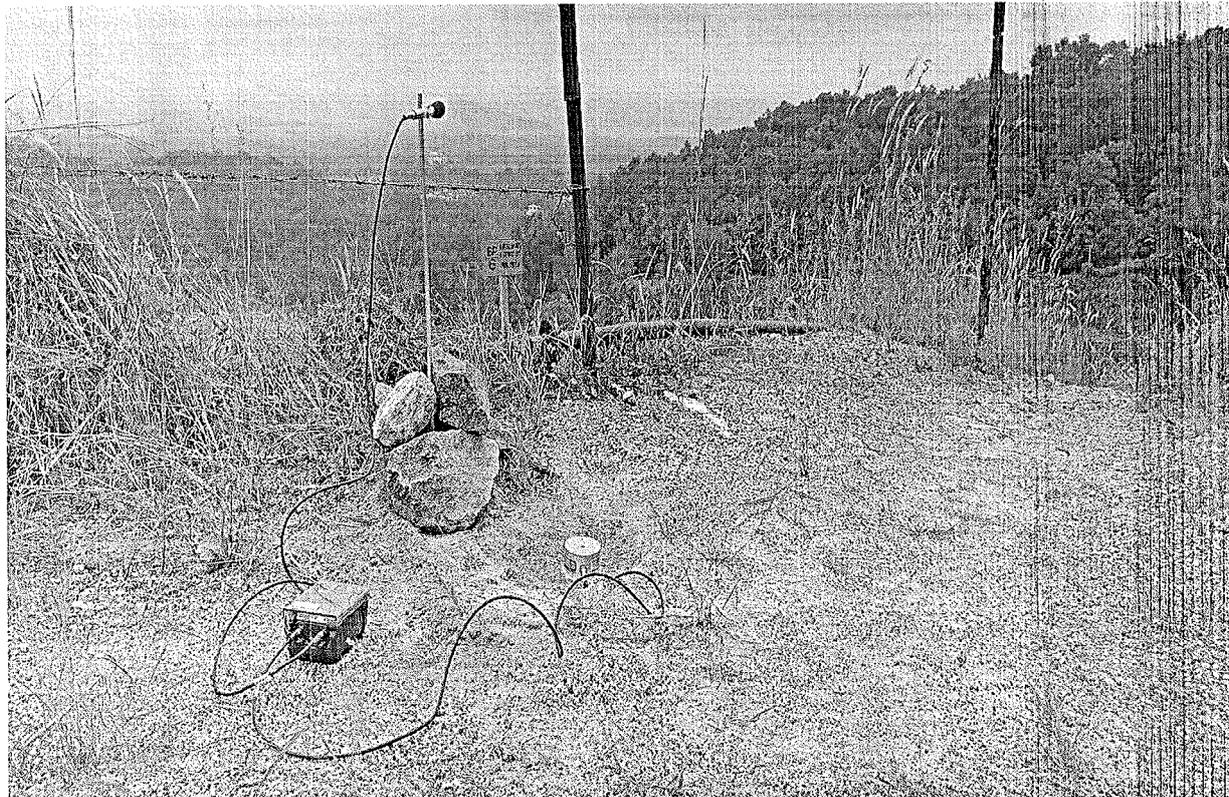


FIG. 8 (D)

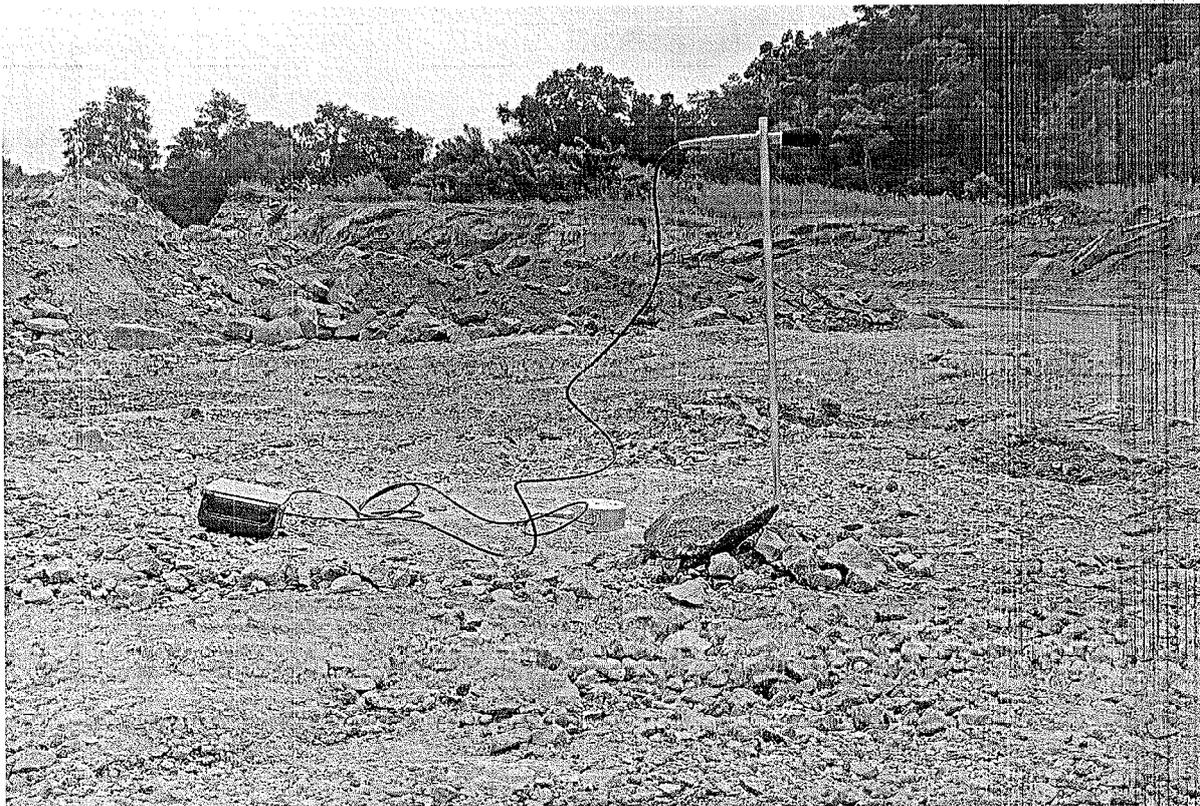


FIG. 8 (E)

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FIG. 8 (F)

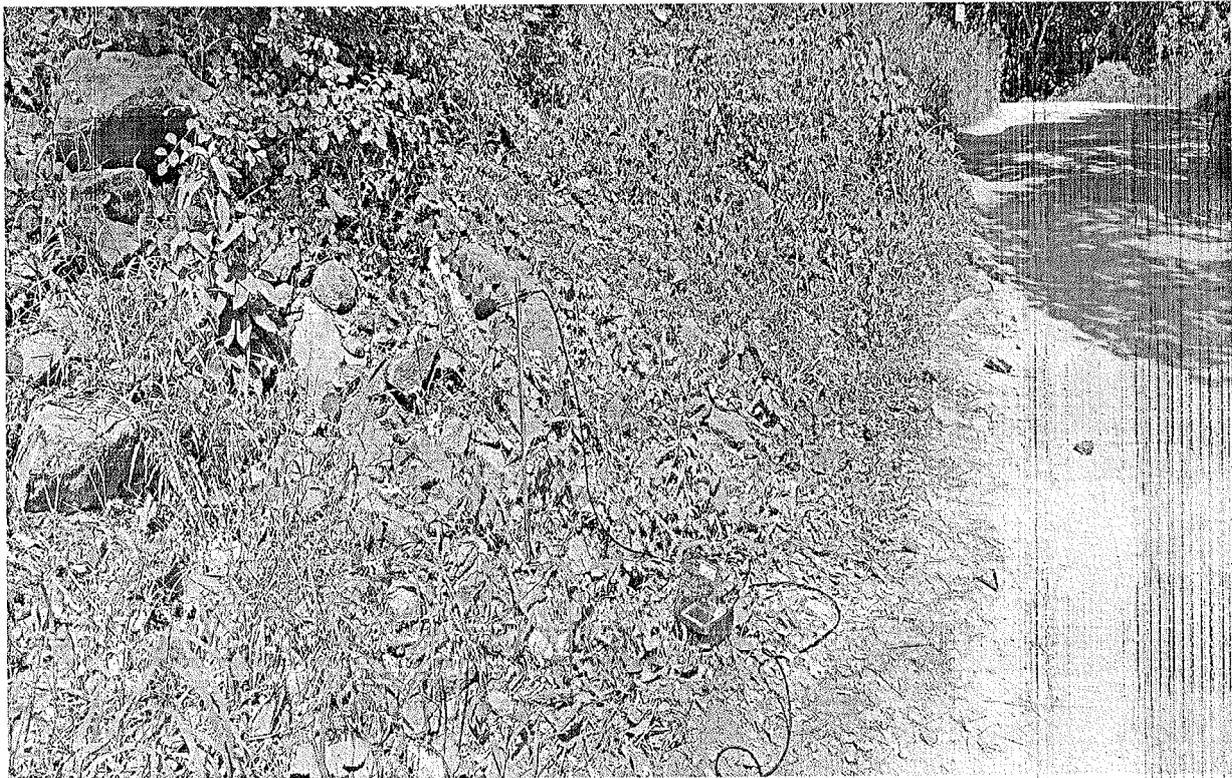


FIG. 8 (G)

TABLE-1 SUMMARY OF THE BLASTS MONITORED

Blast No.	Maximum Charge per Delay (Kg)	Distance (m)	Peak Particle Velocity (mm/s)	Noise (dB)
1	0.400	200	<0.51	-
		300	<0.51	-
2	0.450	220	<0.51	-
		320	<0.51	-
3	0.400	100	<0.51	-
		200	<0.51	-
4	0.400	90	0.56	104.5
		180	<0.51	-
5	0.400	95	<0.51	-
		190	<0.51	-
6	0.400	205	<0.51	-
		305	<0.51	-
7	0.450	225	<0.51	-
		320	<0.51	-
8	0.325	100	0.969	107.5
		195	<0.51	-
9	0.325	95	0.528	104.6
		195	<0.51	-
10	0.325	90	0.631	107.9
		190	<0.51	-
11	0.400	90	0.946	118.7
		180	0.58	94.50
12	0.400	85	1.088	123.7
		185	<0.51	-
13	0.375	210	<0.51	-
		350	<0.51	-

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Blast No.	Maximum Charge per Delay (Kg)	Distance (m)	Peak Particle Velocity (mm/s)	Noise (dB)
14	0.425	220	<0.51	-
		360	<0.51	-
15	0.375	150	<0.51	-
		160	<0.51	-
16	0.375	130	<0.51	-
		180	<0.51	-
17	0.375	110	<0.51	-
		210	<0.51	-
18	0.375	100	<0.51	-
		220	<0.51	-
19	0.425	205	<0.51	-
		340	<0.51	-
20	0.375	215	<0.51	-
		350	<0.51	-
21	0.375	105	0.536	112.2
		135	<0.51	-
22	0.375	100	1.36	93.94
		140	<0.51	-
23	0.375	70	1.71	120.2
		410	<0.51	-
24	0.500	60	2.19	115.4
		420	<0.51	-
25	0.375	85	0.70	114.6
		380	<0.51	-
26	0.375	75	1.37	120.2
		390	<0.51	-
27	0.375	80	0.71	125.0
		400	<0.51	-

Blast No.	Maximum Charge per Delay (Kg)	Distance (m)	Peak Particle Velocity (mm/s)	Noise (dB)
28	0.400	170	<0.51	-
		280	<0.51	-
29	0.450	150	<0.51	-
		300	<0.51	-
30	0.400	140	1.09	92.45
		210	<0.51	-
31	0.400	150	<0.51	-
		220	<0.51	-
32	0.400	160	<0.51	-
		230	<0.51	-
33	0.400	120	<0.51	-
		235	<0.51	-
34	0.400	130	<0.51	-
		240	<0.51	-
35	0.400	60	3.44	128.9
		480	<0.51	-
36	0.450	150	<0.51	-
		470	<0.51	-
37	0.400	180	<0.51	-
		320	<0.51	-
38	0.400	190	<0.51	-
		330	<0.51	-
39	0.400	200	<0.51	-
		340	<0.51	-
40	0.400	220	<0.51	-
		360	<0.51	-
41	0.400	80	1.36	109.5
		280	<0.51	-

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Blast No.	Maximum Charge per Delay (Kg)	Distance (m)	Peak Particle Velocity (mm/s)	Noise (dB)
42	0.425	70	2.79	112.4
		270	<0.51	-
43	0.400	260	<0.51	-
		300	<0.51	-
44	0.400	250	<0.51	-
		290	<0.51	-
45	0.400	265	<0.51	-
		280	<0.51	-
46	0.400	270	<0.51	-
		320	<0.51	-
47	0.400	280	<0.51	-
		310	<0.51	-

Conclusions

- In total 47 blasts were conducted during one week duration starting from 02nd Dec- 2024 to 07th Dec- 2024.
- Ground vibrations & noise levels were monitored for all the blasts using 2 instruments covering 94 locations.
- The depth of the holes varied from 1.82 to 1.98m. burden and spacing is 0.91m x 1.21m. Charge per hole varied from 0.325 to 0.500kg, maximum charge per delay is same as charge per hole as each hole is provided with individual delay. Total charge per blast varied from 8.8 to 32.5kg. Ground vibration monitoring distance varied from 40 to 480m.

- The highest Peak Particle Velocity (PPV) recorded was 3.44 mm/s at a distance of 60m in Blast No. 35, where as the permissible level is 5mm/s for different structures as per DGMS guidelines irrespective of frequency (frequency of less than 8Hz). Beyond 160m distance from blast location, instrument has not triggered indicating that the PPV was less than 0.51 mm/s.
- The highest noise level recorded is 128.9 dB at a distance of 60m in Blast No. 35 and second highest is 125 dB at distance of 80m in Blast No. 27, at some locations the noise levels are less than 100dB.

Prof. K. Ram Chandar
Principal Investigator

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APPENDIX-I

Details of Blasts Monitored

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 1	Blast No. 2	Blast No. 3
1	Date of Blast	02-12-2024	02-12-2024	02-12-2024
2	Time of Blast (Hours)	12.58	12.58	12.58
3	Location of Blast	South side of the quarry	South side of the quarry	North side of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.98	1.82
8	No. of Blastholes	32	25	30
9	Explosive Charge / Hole (kg)	0.400	0.450	0.400
10	Maximum Charge / Delay (kg)	0.400	0.450	0.400
11	Total Charge / Blast (kg)	12.8	11.25	12
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	200	220	100
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Behind the blast at top of the hill	Behind the blast at top of the hill	Behind the blast at top of the hill
19	Distance 2 (m)	300	320	200
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 4	Blast No. 5	Blast No. 6
1	Date of Blast	02-12-2024	02-12-2024	02-12-2024
2	Time of Blast (Hours)	12.58	12.59	13.02
3	Location of Blast	North part of the quarry	North part of the quarry	South part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.98	1.82
8	No. of Blastholes	30	31	33
9	Explosive Charge / Hole (kg)	0.400	0.400	0.400
10	Maximum Charge / Delay (kg)	0.400	0.400	0.400
11	Total Charge / Blast (kg)	12.0	12.4	13.2
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	90	95	205
16	PPV 1 (mm / s)	0.56	<0.51	<0.51
17	Noise 1 (dB)	104.5	-	-
18	Location of Instrument 2	Behind the blast at top of the hill	Behind the blast at top of the hill	Behind the blast at top of the hill
19	Distance 2 (m)	180	190	305
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 7	Blast No. 8	Blast No. 9
1	Date of Blast	02-12-2024	02-12-2024	02-12-2024
2	Time of Blast (Hours)	13.03	13.03	13.04
3	Location of Blast	South part of the quarry	North part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.98	1.82	1.82
8	No. of Blastholes	25	35	35
9	Explosive Charge / Hole (kg)	0.450	0.325	0.325
10	Maximum Charge / Delay (kg)	0.450	0.325	0.325
11	Total Charge / Blast (kg)	11.25	11.37	11.37
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	225	100	95
16	PPV 1 (mm / s)	<0.51	0.96	0.528
17	Noise 1 (dB)	-	107.5	104.6
18	Location of Instrument 2	Behind the blast at top of the hill	Behind the blast at top of the hill	Behind the blast at top of the hill
19	Distance 2 (m)	320	195	195
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 10	Blast No. 11	Blast No. 12
1	Date of Blast	02-12-2024	02-12-2024	02-12-2024
2	Time of Blast (Hours)	13.05	13.05	13.07
3	Location of Blast	North part of the quarry	North part of the quarry top bench	North part of the quarry top bench
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	34	28	22
9	Explosive Charge / Hole (kg)	0.325	0.400	0.400
10	Maximum Charge / Delay (kg)	0.325	0.400	0.400
11	Total Charge / Blast (kg)	11.05	11.2	8.8
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	90	90	85
16	PPV 1 (mm / s)	0.63	0.94	1.08
17	Noise 1 (dB)	107.9	118.7	123.7
18	Location of Instrument 2	Behind the blast at top of the hill	Behind the blast at top of the hill	Behind the blast at top of the hill
19	Distance 2 (m)	190	180	185
20	PPV 2 (mm / s)	<0.51	0.58	<0.51
21	Noise 2 (dB)	-	94.50	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 13	Blast No. 14	Blast No. 15
1	Date of Blast	03-12-2024	03-12-2024	03-12-2024
2	Time of Blast (Hours)	13.02	13.03	13.04
3	Location of Blast	South part of the quarry	South part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.98	1.82
8	No. of Blastholes	33	27	29
9	Explosive Charge / Hole (kg)	0.375	0.425	0.375
10	Maximum Charge / Delay (kg)	0.375	0.425	0.375
11	Total Charge / Blast (kg)	12.375	11.425	10.875
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	210	220	150
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Towards water tank	Towards water tank	Towards water tank
19	Distance 2 (m)	350	360	160
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 16	Blast No. 17	Blast No. 18
1	Date of Blast	03-12-2024	03-12-2024	03-12-2024
2	Time of Blast (Hours)	13.05	13.06	13.12
3	Location of Blast	North part of the quarry	North part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	37	36	32
9	Explosive Charge / Hole (kg)	0.375	0.375	0.375
10	Maximum Charge / Delay (kg)	0.375	0.375	0.375
11	Total Charge / Blast (kg)	13.875	13.5	12
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	130	110	100
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Towards water tank	Towards water tank	Towards water tank
19	Distance 2 (m)	180	210	220
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 19	Blast No. 20	Blast No. 21
1	Date of Blast	03-12-2024	03-12-2024	03-12-2024
2	Time of Blast (Hours)	13.13	13.14	13.16
3	Location of Blast	South part of the quarry	South part of the quarry	North part of the quarry top bench
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.98	1.82	1.82
8	No. of Blastholes	39	27	30
9	Explosive Charge / Hole (kg)	0.425	0.375	0.375
10	Maximum Charge / Delay (kg)	0.425	0.375	0.375
11	Total Charge / Blast (kg)	16.575	10.125	11.25
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	205	215	105
16	PPV 1 (mm / s)	<0.51	<0.51	0.536
17	Noise 1 (dB)	-	-	112.2
18	Location of Instrument 2	Towards water tank	Towards water tank	Towards water tank
19	Distance 2 (m)	340	350	135
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 22	Blast No. 23	Blast No. 24
1	Date of Blast	03-12-2024	04-12-2024	04-12-2024
2	Time of Blast (Hours)	13.17	13.18	13.19
3	Location of Blast	North part of the quarry top bench	South part of the quarry	South part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.98
8	No. of Blastholes	20	65	65
9	Explosive Charge / Hole (kg)	0.375	0.375	0.500
10	Maximum Charge / Delay (kg)	0.375	0.375	0.500
11	Total Charge / Blast (kg)	7.5	24.375	32.5
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	100	70	60
16	PPV 1 (mm / s)	1.36	1.71	2.19
17	Noise 1 (dB)	93.94	120.2	115.4
18	Location of Instrument 2	Towards water tank	Near the EC boundary line	Near the EC boundary line
19	Distance 2 (m)	140	410	420
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 25	Blast No. 26	Blast No. 27
1	Date of Blast	4-12-2024	04-12-2024	04-12-2024
2	Time of Blast (Hours)	13.20	13.22	13.24
3	Location of Blast	North part of the quarry	North part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	65	65	65
9	Explosive Charge / Hole (kg)	0.375	0.375	0.375
10	Maximum Charge / Delay (kg)	0.375	0.375	0.375
11	Total Charge / Blast (kg)	24.375	24.375	24.375
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	85	75	80
16	PPV 1 (mm / s)	0.70	1.37	0.71
17	Noise 1 (dB)	114.6	120.2	125
18	Location of Instrument 2	Near the EC boundary line	Near the EC boundary line	Near the EC boundary line
19	Distance 2 (m)	380	390	400
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 28	Blast No. 29	Blast No. 30
1	Date of Blast	05-12-2024	05-12-2024	05-12-2024
2	Time of Blast (Hours)	13.02	13.03	13.04
3	Location of Blast	South part of the quarry	South part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.98	1.82
8	No. of Blastholes	65	65	65
9	Explosive Charge / Hole (kg)	0.400	0.450	0.400
10	Maximum Charge / Delay (kg)	0.400	0.450	0.400
11	Total Charge / Blast (kg)	26	29.25	26
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast at quarry access road	Behind the blast at quarry access road	Behind the blast at quarry access road
15	Distance 1 (m)	170	150	140
16	PPV 1 (mm / s)	<0.51	<0.51	1.09
17	Noise 1 (dB)	-	-	92.45
18	Location of Instrument 2	Towards North gate of the quarry	Towards North gate of the quarry	Towards North gate of the quarry
19	Distance 2 (m)	280	300	210
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 31	Blast No. 32	Blast No. 33
1	Date of Blast	05-12-2024	05-12-2024	05-12-2024
2	Time of Blast (Hours)	13.04	13.05	13.06
3	Location of Blast	North part of the quarry	North part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	65	64	25
9	Explosive Charge / Hole (kg)	0.400	0.400	0.400
10	Maximum Charge / Delay (kg)	0.400	0.400	0.400
11	Total Charge / Blast (kg)	26	25.6	10
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast at quarry access road	Behind the blast at quarry access road	Behind the blast at quarry access road
15	Distance 1 (m)	150	160	120
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Towards North gate of the quarry	Towards North gate of the quarry	Towards North gate of the quarry
19	Distance 2 (m)	220	230	235
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 34	Blast No. 35	Blast No. 36
1	Date of Blast	05-12-2024	06-12-2024	06-12-2024
2	Time of Blast (Hours)	13.07	13.09	13.10
3	Location of Blast	North part of the quarry	South part of the quarry	South part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.98
8	No. of Blastholes	25	65	60
9	Explosive Charge / Hole (kg)	0.400	0.400	0.450
10	Maximum Charge / Delay (kg)	0.400	0.400	0.450
11	Total Charge / Blast (kg)	10	26	27
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast at quarry access road	Behind the blast	Behind the blast
15	Distance 1 (m)	130	60	150
16	PPV 1 (mm / s)	<0.51	3.44	<0.51
17	Noise 1 (dB)	-	128.9	-
18	Location of Instrument 2	Towards North gate of the quarry	Near old structure of the quarry towards settling tank	Near old structure of the quarry towards settling tank
19	Distance 2 (m)	240	480	470
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 37	Blast No. 38	Blast No. 39
1	Date of Blast	06-12-2024	06-12-2024	06-12-2024
2	Time of Blast (Hours)	13.11	13.12	13.13
3	Location of Blast	North part of the quarry	North part of the quarry	North part of the quarry top bench
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	65	65	20
9	Explosive Charge / Hole (kg)	0.400	0.400	0.400
10	Maximum Charge / Delay (kg)	0.400	0.400	0.400
11	Total Charge / Blast (kg)	26	26	8
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Behind the blast	Behind the blast
15	Distance 1 (m)	180	190	200
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Near old structure of the quarry towards settling tank	Near old structure of the quarry towards settling tank	Near old structure of the quarry towards settling tank
19	Distance 2 (m)	320	330	340
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

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DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 40	Blast No. 41	Blast No. 42
1	Date of Blast	06-12-2024	07-12-2024	07-12-2024
2	Time of Blast (Hours)	13.15	13.10	13.11
3	Location of Blast	North part of the quarry top bench	South part of the quarry	South part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.98
8	No. of Blastholes	30	65	60
9	Explosive Charge / Hole (kg)	0.400	0.400	0.425
10	Maximum Charge / Delay (kg)	0.400	0.400	0.425
11	Total Charge / Blast (kg)	12	26	25.5
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Behind the blast	Towards Haul Road	Towards Haul Road
15	Distance 1 (m)	220	80	70
16	PPV 1 (mm / s)	<0.51	1.36	2.79
17	Noise 1 (dB)	-	109.5	112.4
18	Location of Instrument 2	Near old structure of the quarry towards settling tank	Infront of the office	Infront of the office
19	Distance 2 (m)	360	280	270
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 43	Blast No. 44	Blast No. 45
1	Date of Blast	07-12-2024	07-12-2024	07-12-2024
2	Time of Blast (Hours)	13.12	13.13	13.14
3	Location of Blast	North part of the quarry	North part of the quarry	North part of the quarry
4	Diameter of Blasthole (mm)	32	32	32
5	Burden (m)	0.91	0.91	0.91
6	Spacing (m)	1.21	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82	1.82
8	No. of Blastholes	65	65	65
9	Explosive Charge / Hole (kg)	0.400	0.400	0.400
10	Maximum Charge / Delay (kg)	0.400	0.400	0.400
11	Total Charge / Blast (kg)	26	26	26
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row	Row by Row
14	Location of Instrument 1	Towards Haul Road	Towards Haul Road	Towards Haul Road
15	Distance 1 (m)	260	250	265
16	PPV 1 (mm / s)	<0.51	<0.51	<0.51
17	Noise 1 (dB)	-	-	-
18	Location of Instrument 2	Infront of the office	Infront of the office	Infront of the office
19	Distance 2 (m)	300	290	280
20	PPV 2 (mm / s)	<0.51	<0.51	<0.51
21	Noise 2 (dB)	-	-	-

44

DETAILS OF THE BLASTS MONITORED

Sl. No.	Parameters	Blast No. 46	Blast No. 47
1	Date of Blast	07-12-2024	07-12-2024
2	Time of Blast (Hours)	13.15	13.16
3	Location of Blast	North part of the quarry top bench	North part of the quarry top bench
4	Diameter of Blasthole (mm)	32	32
5	Burden (m)	0.91	0.91
6	Spacing (m)	1.21	1.21
7	Depth of Blasthole (m)	1.82	1.82
8	No. of Blastholes	29	21
9	Explosive Charge / Hole (kg)	0.400	0.400
10	Maximum Charge / Delay (kg)	0.400	0.400
11	Total Charge / Blast (kg)	11.6	8.4
12	Initiation System	Nonel-based shocktube	Nonel-based shocktube
13	Initiation Pattern	Row by Row	Row by Row
14	Location of Instrument 1	Towards Haul Road	Towards Haul Road
15	Distance 1 (m)	270	280
16	PPV 1 (mm / s)	<0.51	<0.51
17	Noise 1 (dB)	-	-
18	Location of Instrument 2	Infront of the office	Infront of the office
19	Distance 2 (m)	320	310
20	PPV 2 (mm / s)	<0.51	<0.51
21	Noise 2 (dB)	-	-

45

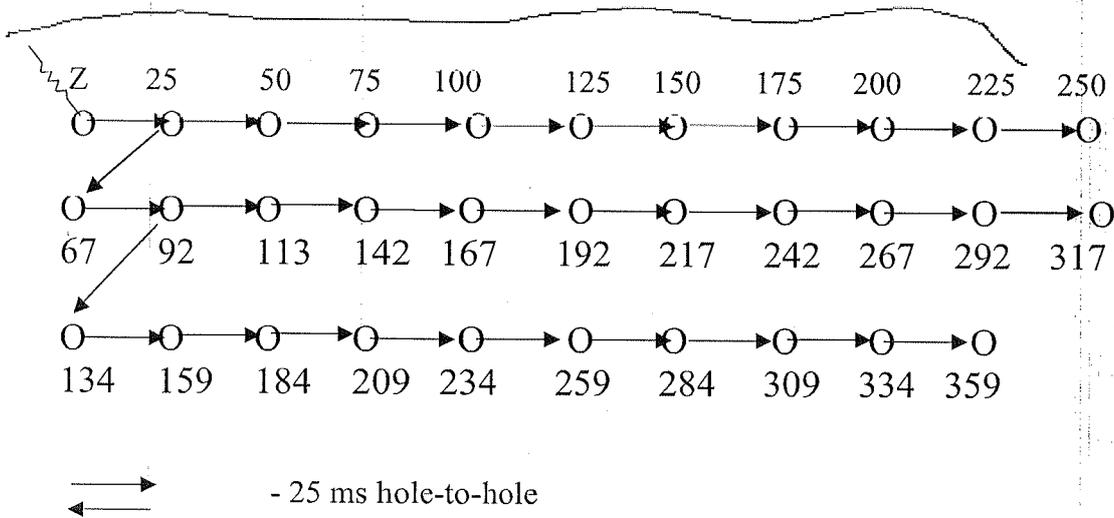
APPENDIX- II

LAYOUTS OF SOME OF THE

BLASTS MONITORED

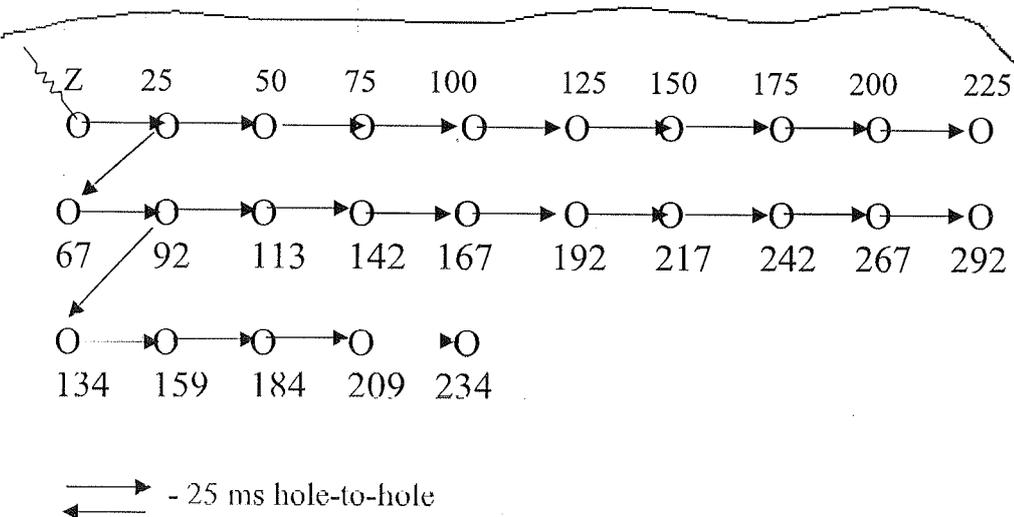
46

FREE FACE



Layout of Blast No. 1

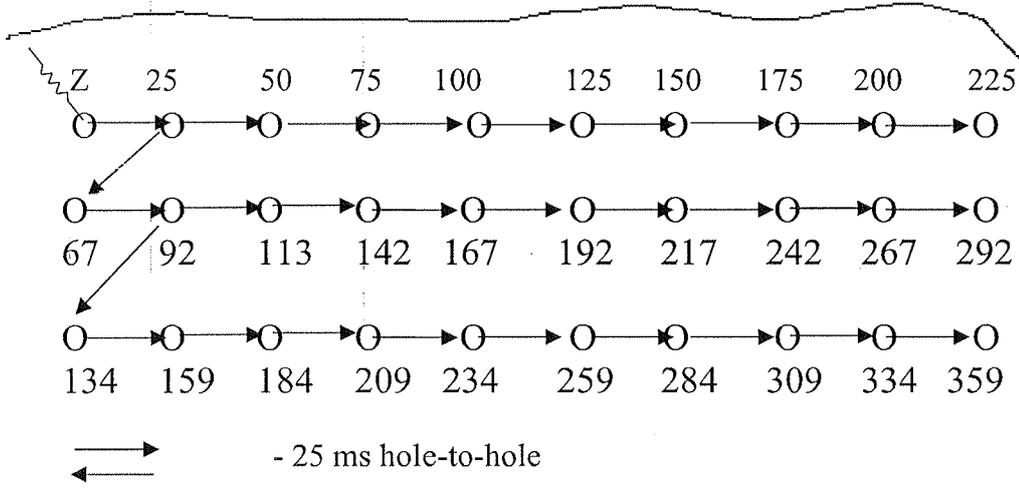
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Layout of Blast No. 2

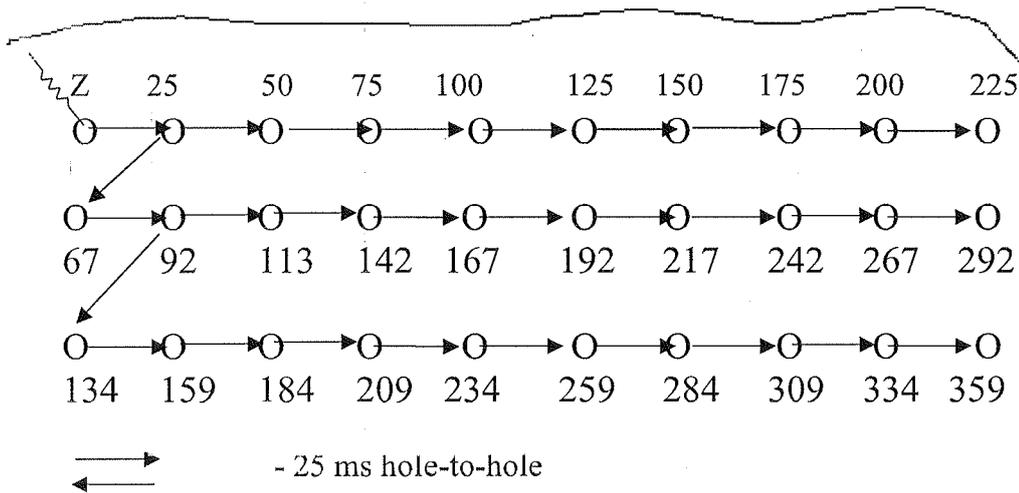
47

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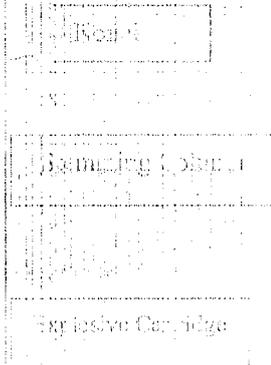
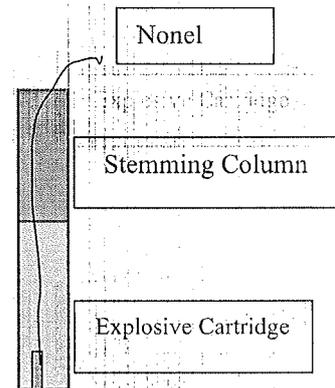
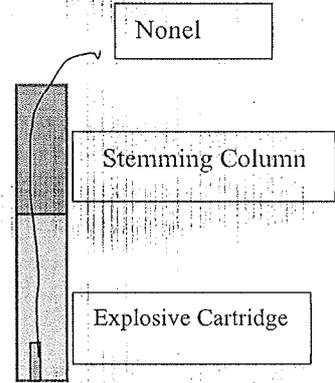


Layout of Blast No. 3

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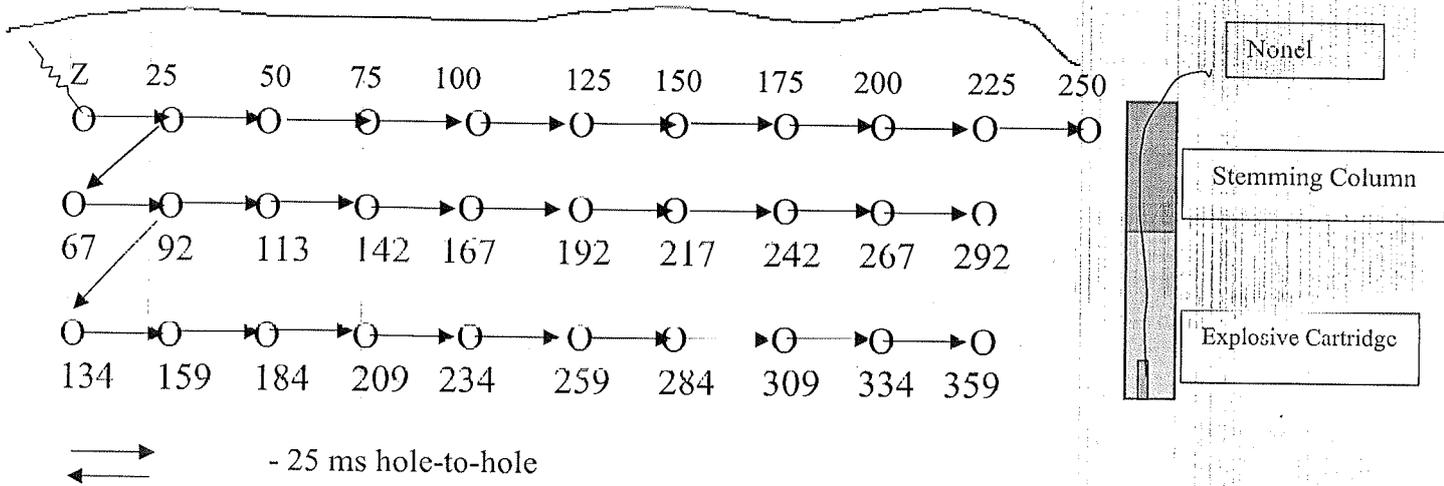


Layout of Blast No. 4



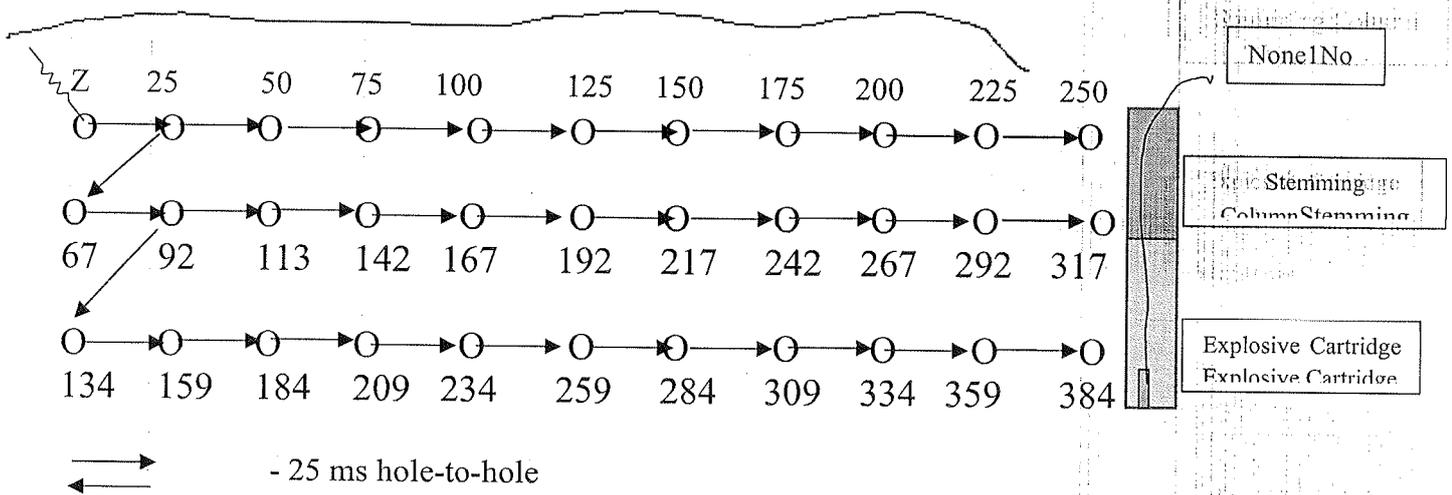
48

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Layout of Blast No. 5

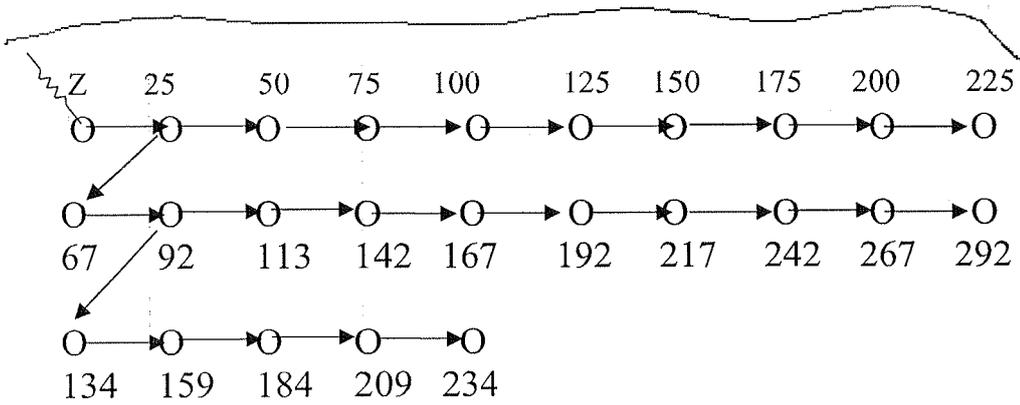
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Layout of Blast No. 6

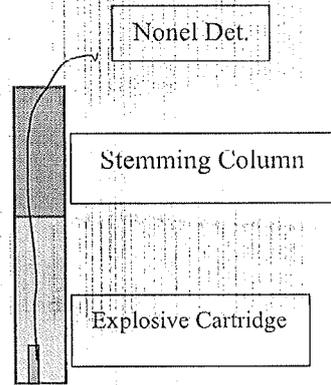
49

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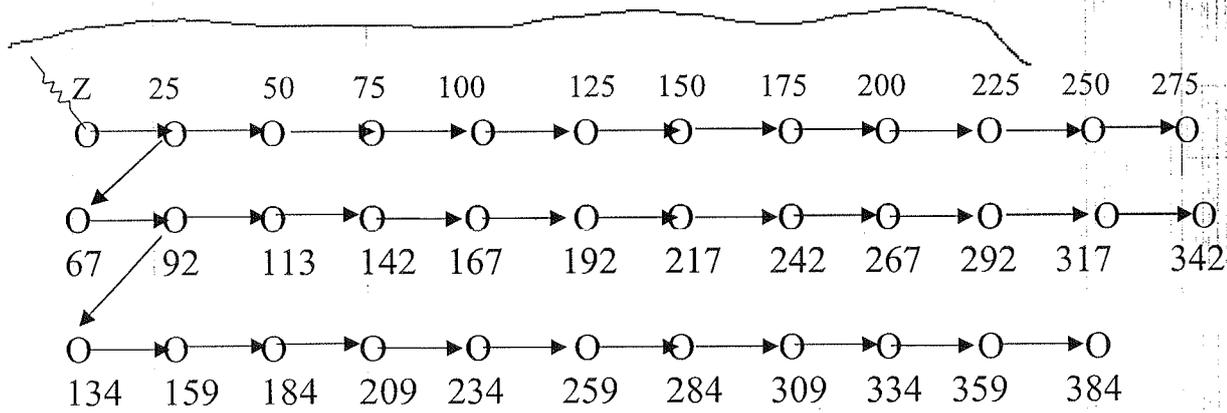


→ - 25 ms hole-to-hole
←

Layout of Blast No. 7

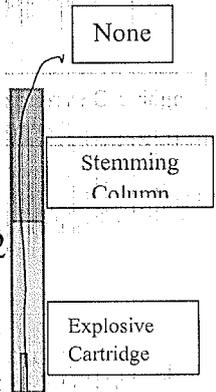


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→ - 25 ms hole-to-hole
←

Layout of Blast No. 8



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APPENDIX- III

BLAST EVENTS

Our main consultancy services are offered in the areas of
“Rock Blasting” and “Slope / Dump Stability”
 SOME OF OUR RECENT CLIENTS ARE:

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Govt./Public Sector Companies

- The Singareni Collieries Company Limited-Kothagudem. Govt. of Telangana (Mines in Telangana & Odisha)
- IREL (India) Limited – Govt. of India (Mines in Tamil Nadu)
- Dept. of Mines & Geology- Govt. of Karnataka.
- Southern Railways, Mangalore
- Hindustan Petroleum Corporation Limited, Mangalore

Iron Ore Companies

- MSPL Limited, Hospet, Karnataka
- Vedanta Limited, Karnataka
- VESCO Limited, Sandur, Karnataka.
- PBS & Sons Limited, Hospet, Karnataka
- M/s. BKG Mining Private Limited, Sandur, Karnataka
- M/s. Zeenath Transport Company, Sandur, Karnataka
- SMIORE Limited- Sandur
- JSW Limited - Ballari

Cement Industry/ Limestone Sector

- Ultratech Cements Private Limited, Andhra Pradesh, Gujarat
- Bharathi Cements Limited, Andhra Pradesh
- Chettinad Cements Limited, Karnataka
- Lafarge Umiam Mining Private Limited, Meghalaya
- Orient Cements Limited- Karnataka
- Shree Cements Limited- Karnataka
- Dalmia Cements- Karnataka

Others

- TJN Construction Pvt Ltd- Bangalore
- Aastraa Resources- Goa
- M/s. Utkal Coal Mining India Private Limited- Odisha
- BGR Mining & Infra Pvt Ltd- Jharkhand
- Various granite quarries in the state of Karnataka, Kerala, Andhra Pradesh, Tamil Nadu

Expertise in Blasting:

- Controlled blasting to protect important structures near mines/quarries and other Civil/infra projects
- Ground vibration and noise monitoring
- Blast optimization
- Fragmentation analysis
- Blast performance analysis with High-speed camera

Expertise in Slope Stability:

- Design of Slopes and Dumps
- Slope stability analysis
- Dump stability analysis

Total No. of Project carried out: 230

Principal Investigator

Dr. Ram Chandar Karra

Professor & Former Head of the Department

Dept. of Mining Engineering

NITK, Surathkal (Govt. of India), Mangalore-575025

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