BEFORE THE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

Application No 304 of 2019

IN THE MATTER OF

M Haridasan **...Applicant**

Vs

State of Kerala & others. **...Respondents**

3rd INTERIM STATUS REPORT OF THE JOINT COMMITTEE CONSTITUTED BY HON'BLE NATIONAL GREEN TRIBUNAL

INDEX

(Nazimuddin)
Scientist-F
Central Pollution Control Board
Parivesh Bhawan, East Arju Nagar
Delhi-110032

Date: 13.01.2023
Place: Delhi

THIRD INTERIM STATUS REPORT OF THE JOINT COMMITTEE CONSTITUTED BY HON'BLE NATIONAL GREEN TRIBUNAL PRINCIPAL BENCH IN THE MATTER OF OA NO. 304/2019

1.0 Background

Hon'ble National Green Tribunal (NGT) in the matter of OA No. 304/ 2019, directed to maintain longer distances for siting stone quarries as per the order dated 21st July, 2020; relying on the 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. As per the order, 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 Kerala filed appeals (MA Nos. 80, 83, 85, 88 to 95 of 2021) in the OA No. 304/2019 seeking impleadment with specific prayer of 'not to interfere' with the distance criteria already laid down by the mining department and Kerala State Pollution Control Board (KSPCB). After examining the project proponents' contentions in details, Honourable NGT directed for an expert study by a joint committee comprising representatives from IIT (ISM), Dhanbad, CSIR-CIMFR, Dhanbad, CSIR-CBRI, Roorkee, IIT, Roorkee, Wadia Institute of Himalayan Geology, Dehradun, Directorate General of Mine Safety (DGMS) and CPCB on the subject of safe distance for stone quarry mining from habitations vide order dated 09 th December, 2021 and relevant portion of the directions are reproduced herewith:

"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-site noise and air levels, on building and human and wildlife. The study may be completed within three months and report will be 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".

A copy of the Hon'ble NGT order dated 09th December, 2021 is annexed as **Annexure I**.

2.0 Joint Committee Initiatives

In pursuance to the Hon'ble NGT directions, a Joint Committee was constituted vide CPCB office memorandum dated 18th January, 2022 (**Annexure II**) with members/ representatives as per nominations received from respective institutes/ organizations. A representative of the Kerala State Pollution Control Board (KSPCB) was included in the joint committee as special invitee to attend all committee meetings as coordinator/ nodal officer for facilitating the expert study in Kerala. After the constitution of the joint committee, KSPCB coordinator was requested to pool/ compile relevant first order data/ information for the joint committee meetings/ deliberations. KSPCB was also instructed to constitute a State level facilitation committee for facilitating field studies in Kerala and to take stock of the monitoring infrastructure/ facilities available for the expert study. A detailed letter was forwarded to the Chairman, KSPCB in this regard on 8th March, 2022 (**Annexure III**).

Subsequently, several virtual joint committee meetings were carried out with KSPCB Coordinator as special invitee to the committee and with the members of the state level

facilitation committee. Two Interim Status reports were also filed before Hon'ble NGT apprising the initiatives taken by the Joint Committee in compliance to Hon'ble NGT directions in the matter.

Though it took considerable time to get important first order information, data sets on granite stone quarries and other relevant details necessary for mapping all quarries on the geological map of Kerala, the committee could map all working granite quarries with valid mining permits selecting locations for expert study. Since Kerala has myriad geological/ lithological/ tectonic profiles, it is important to select sites representing different geological profiles for assessing vibration under varying geological profiles. Accordingly, based on the selection rationale evolved by the committee, 21 quarry sites from various districts in Kerala were shortlisted for conducting expert study and final 9 quarries were selected based on extensive site visits to the shortlisted locations along with experts from Rock Excavation Engineering Division, CSIR-CIMFR.

3.0 Status of Expert Study in selected Stone Quarries in Kerala State

In compliance with the Hon'ble Tribunal order dated 09-12-2021, expert study encompassing assessments of blast induced vibration, air over pressure, fly rocks, dust emission and noise pollution at the distances of 50 m, 75 m, 100 m, 125 m, 150 m, 200 m, 250 m & 500 m from the blasting sites, is being carried out in the selected 9 stone quarries in Kerala. Blasting trials, vibration assessments and other allied parameters are being supervised/ conducted by an expert team from CSIR Central Institute of Mining & Fuel Research (CSIR-CIMFR) as per the joint committee recommendations. The work order and scope of work issued in this regard to CSIR-CIMFR through Kerala SPCB is annexed as **Annexure IV.** Assessment of dust emissions, noise monitoring and waste water samples are being carried out by the team constituted by the nodal officer of Kerala State Pollution Control Board (KSPCB) at the time of ongoing blasting trials, vibration assessment at the selected 9 stone quarry sites. For dust and noise monitoring the sampling distances of 50 m, 100 m, 200 m, & 500 m wherever feasible were adopted due to field restrictions and difficulties in safely deploying monitoring instruments with steady power supply.

It is submitted that, executing expert study took time due to various practical difficulties and the monitoring team is still encountering various site specific issues in executing the study as per the scheduled monitoring. Due to site specific features of the terrain and topography, assessment/ monitoring layout/ perimeters had to be modified to suit the study locations in many instances. Arranging steady power to run the monitoring instruments/ equipment was no less than a challenge in many locations.

Expert studies in the selected 9 stone quarries are progressing as per the schedule given below and as on 08.01.2023, monitoring completed in 6 selected stone quarries in Kerala as per the schedule. One of the previously selected stone quarry viz., M/s. K.K.J. Group International India Pvt. Limited located at Puvakkulam, Kottayam District which was not operational at present due to expiry of mining lease, M/s. Cochin Blue Metals located at Kottayam District has been selected for completing the study. Details of 9 stone quarries selected for studies and the present status of completion of the studies through CIMFR is given in the table below: -

STATUS OF EXPERT STUDIES IN SELECTED STONE QUARRIES IN KERALA (AS ON 0601.2023)

S. No.	*District*	*Name and address of quarry*	*Extent (Ha)*	*Lithology/ Geology*	*Study status*
1	Pathanamthitta	Adukadu Granites, Payyanamon P.O, Konni, Kerala – 689692.	4.3804	Charnockite	**COMPLETED** 12-16th Dec, 2022.
2	Kollam	Quarry Owned by Muhammad Roshen, Kottukkal Village, Kottarakkara.	1.21426	Charnockite	**COMPLETED** 17-20th Dec, 2022.
3	Trivandrum	POABS GRANITES, Kuthirakkalam PO. Vellanadu, Kerala – 695543	5.9747	Garnet- Biotite Gneiss with Migmatite	**COMPLETED** 21-24th Dec, 2022.
4	Ernakulam	Parackel Granites, Varapetty, Anjalpetty, Ernakulam, Kerala-686671	7.6606	Hornblende Gneiss	**COMPLETED** 26-29th Dec, 2022.
5	Idukki	United Granites and Metals (Kochuparambil), Vazhithala, Idukki, Kerala-685583	12.2987	Hornblende Gneiss	**COMPLETED** 01-04th January, 2023.
6	Kottayam	Cochin Blue Metal Industries Private Limited, Methiri P O, Ramapuram, Kottayam- 685583	4.891	Charnockite	**COMPLETED** 05-08th January, 2023.
7	Palakkad	Penta Granites, Neethipuram, Elavampadam P O, Palakkad	4.1371	Charnockite	Study scheduled during 09-12th January, 2023.
8	Wayanad	Profile Sand 1 (Quarry owned by Sudheesh A T), Vengappally, Waynad	2.1131	Hornblende Gneiss	Study scheduled during 13-16th January, 2023.
9	Kasaragod	National Granites (Quarry owned by P M Abdul Rahman), Koliyar Attenganam P O, Thayyannur, Kasragod, Kerala - 671532	3.242	Garnet- Sillimanite Kyanite Gneiss	Study scheduled during 17-20th January, 2023.

Planning of the experimental blasts have been carried out by the CSIR-CIMFR team 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. For the assessment of ground vibration, 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. CIMFR team informed that based on the collected data/ information, peak particle velocity (PPV) predictor equation shall be derived for all locations and generalized predictor equation also shall be derived based on the geology and for the whole State of Kerala. The above methodology, field activities and expected outcomes are presented in detail by Dr. Vivek Kumar Himanshu, CIMFR before the joint committee members in a VC meeting held on 09-01-2023. CSIR-CIMFR also submitted a brief status of the ongoing blasting trials, vibration

assessments and the interim report prepared and submitted by the CIMFR team is annexed as **Annexure V**.

For dust monitoring, respirable dust samplers/ particulate matter (PM) samplers were deployed to assess PM 10 and PM 2.5 fractions in the ambient air. Digital sound level (Type 1) meters were also used to assess the various descriptors of noise emanating from, during the blasting and regular activities of the stone quarries. The instruments were deployed based on the predominated wind directions at the site and the wind patterns are assessed by portable weather tracker instrument and by weather tracking app. The instruments are placed at 50, 100, 200 and 500 m perimeters with one in the upwind direction and two in the downwind direction and all the instruments are deployed at 120 degree angle from each other in a specific perimeter. Sound level meters are deployed regardless of the wind directions away from ambient air sampling equipment.

4.0 Request for time extension up to 31.03.2023 for completion and for submission of findings of the ongoing studies

The joint committee already completed assessment / monitoring at 6 selected stone quarries; studies at three more quarries are scheduled and shall be completed by 19-01-2023. Joint committee is currently at the penultimate stages of the assignment entrusted by the Honourable NGT and requires further time for analysing the study outcome and to prepare the final report.

Expert team from CSIR-CIMFR also requires at least one month's time from the date of completion of the studies for analysing the data and to sum up their findings in report form.

Further, site specific assessment reports are being prepared by the monitoring team with respect to water pollution, dust and noise assessment by Kerala SPCB in consultation with RD, CPCB, Bengaluru.

At this juncture, the joint committee needs further time to compile, collate and analyse all the relevant data/ information from the expert study and to put forth the findings in the form of a detailed final report along with the site-specific recommendations.

In view of the above, the joint committee request extension of time up to 31st March 2023 to complete the expert study and to submit the final report in compliance to the directions of the Hon'ble Tribunal.

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ANNEXURE - I

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-II

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. Smith
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. Smith
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

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.

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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.

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

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.

Interim Report On

SCIENTIFIC STUDY FOR THE ASSESSMENT OF INFLUENCE ZONES DUE TO BLASTING AT GRANITE QUARRIES IN THE STATE OF KERELA AS PER THE ORDER OF HON'BLE NATIONAL GREEN TRIBUNAL (NGT) OA 304/2019

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

JANUARY, 2023

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 granite 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 (air blast) to the surrounding dwellings 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**.

Table 1. List of the selected quarries for the experimental sites

S.No	District	Details of quarry	Extent of Quarry (Ha)	Lithology
1	Pathanamthitta	Adukadu Granites Private Limited, Payyanamon P.O, Konni, Pathanamthitta Dist., Kerala - 689692	4.3804	Charnockite
2	Kollam	Quarry Owned by Muhammad Roshen, Kottukkal Village, Kottarakkara Taluk, Kollam District,	1.21426	Charnockite
3	Trivandrum	POABS GRANITES PVT. LTD., Kuthirakkalam PO. Vellanadu, Trivandrum, Kerala – 695 543	5.9747	Garnet- Biotite Gneiss with Migmatite
4	Ernakulam	Quarry owned by P.K. Prasad & Varapetty	7.6606	Hornblende Gneiss
5	Idukki	Quarry owned by George Kochuparambil & Vazhithala	12.2987	Hornblende Gneiss
6	Kottayam	KKJ Group International India Pvt ltd & Puvakkulam	2.0766	Charnockite
7	Palakkad	Penta Granites & kizhakkenchery grama panchayath	4.1371	Charnockite
8	Wayanad	Quarry owned by Sudheesh A T & Vengappally grama panchayath	2.1131	Hornblende Gneiss
9	Kasargod	Quarry owned by P M Abdul Rahman & Kodombellor panchayath	3.242	Garnet- Sillimanite Kyanite Gneiss

The field investigations for the assessment of blasting influence zones due to blasting have being carried out by the Rock Excavation Engineering Research Group of CSIR-CIMFR, Dhanbad. The investigations commenced from 12th December 2022 and till date i.e. 14th

January, 2023 five quarries are already completed. This interim report contains the methodology followed in the field investigation work, brief information of works carried out at the different quarries.

2.0 SCOPE OF WORK

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

- Reconnaissance survey to map all structures and sensitive areas up to 500 m 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 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 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.

3.0 METHODOLOGY FOLLOWED IN THE INVESTIGATION

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 2** as bellow:

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

Table 2. 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 are 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 Vibrations 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 may 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 as well.

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, MiniMate seismographs of M/s Instantel Inc., Canada. All the seismographs are of four channels and provided with one tri-axial transducer for monitoring of 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

Till date, the field investigations at five quarries were already completed. The names of the quarry and the investigation periods are mentioned in **Table 3**.

Table 3. Names and period where field investigations were already completed

S.No	District	Name of the Quarry	Preriod
1	Pathanamthitta	Adukadu Granites Private Limited, Payyanamon P.O, Konni, Pathanamthitta Dist., Kerala - 689692	12th - 16th December, 2022
2	Kollam	Quarry Owned by Muhammad Roshen, Kottukkal Village, Kottarakkara Taluk, Kollam District,	17th - 19th December, 2022
3	Trivandrum	POABS GRANITES PVT. LTD., Kuthirakkalam PO. Vellanadu, Trivandrum, Kerala – 695 543	20th - 22th December, 2022
4	Ernakulam	Quarry owned by P.K. Prasad & Varapetty	26th - 29th December, 2022
5	Idukki	Quarry owned by George Kochuparambil & Vazhithala	1st - 4th January 2023

5.1 ADUKADU GRANITES PRIVATE LIMITED, PATHANAMTHITTA DISTRICT

The field investigation at Adukadu Granites Private Limited, Pathanamthitta was carried out during the period of 12th to 15th December, 2022. View of Adukadu Granites Private Limited is given in **Plate 1**. The investigational work conducted at Adukadu Granites Private Limited is briefly discussed in the following sections.

Plate 1. View of Adukadu Granites Private Limited

5.1.1 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 brief observations 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 is 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

5.1.2 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.

Plate 2. View of nature of rock deposit in Adukadu Granites Private Limited

Plate 3. View of rebound hardness testing on rock surface at Adukadu Granites Private Limited

5.1.3 Experimental Blasts

At Adukadu Granites Private Limited, ten rounds of experimental blasts were conducted at the top, middle and bottom benches of the quarry. Out of the ten experimental blasts, five blasts were conducted with the existing blast design pattern and the remaining five blasts were conducted with modified blast design pattern. All the blasts were conducted with 32 mm blast hole diameter, drilled with Jack Hammer drilling machines. Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge and Nonel (shock tube) initiation system of 250 ms DTH and 25 ms of TLD were used for all the holes. Summary of the blasts are given in **Table 4**.

In the existing pattern, hole depths of 1.8 m with burden varying from 1.0 to 1.2 m and spacing varying from 1.2 to 1.5 m were used. The explosive charge per hole varied from 0.66 to 0.75 kg. The number of holes varied from 5 to 10 and the total explosive charge

varied from 1.70 to 3.35 kg. In the modified pattern, burden varied from 0.8 to 1.0 and spacing varied from 0.8 to 1.0 m. All the holes were 1.8 m depth and the total number of holes varied from 7 to 15. The explosive charge per hole used was 0.75 kg and the total charge in a blasting round varied from 2.62 to 5.62 kg.

Table 4. Summary of experimental blasts at Adukadu Granites Private Limited

Blast No.	Hole Depth (m)	No. of holes	Burden (m) × Spacing (m)	Charge /hole (kg)	Total charge (kg)	Remarks
1.	1.8	10	1.0 × 1.5	0.66	3.35	Existing pattern
2.	1.8	05	1.0 × 1.5	0.66	1.70	Existing pattern
3.	1.8	07	1.0 × (1.0 – 1.2)	0.75	2.62	Existing pattern
4.	1.8	06	1.1 × (1.1 – 1.5)	0.75	2.25	Existing pattern
5.	1.8	09	0.8 × (0.8 – 1.5)	0.75	3.37	Existing pattern
6.	1.8	07	0.8 × 0.8	0.75	2.62	Modified pattern
7.	1.8	12	0.9 × 1.0	0.75	4.50	Modified pattern
8.	1.8	10	1.0 × 1.0	0.75	3.75	Modified pattern
9.	1.8	15	0.8 × (0.9 – 1.0)	0.75	5.62	Modified pattern
10.	1.8	10	0.8 × 0.9	0.75	3.75	Modified pattern

Plate 4. drilling of holes at Adukadu Granites Private Limited

Plate 5. Charging of holes at Adukadu Granites Private Limited

5.1.4 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air over pressures were monitored using eight number of seismographs. View of a few vibration monitoring points are given in Plates 6 to 10.

Plate 6. View of vibration monitoring at 4th Bench N-E Direction at 50 m from the blasts

Plate 7. View of vibration monitoring near Play school in Konnithazam village (200 m from the blasts)

Plate 8. View of vibration monitoring near Mr. T Vargeese house in Konnithazam village (320 m from the blasts)

Plate 9. View of vibration monitoring near the house of Mr. Daniel on Konnapara road in East Direction (575 m from the blasts)

Plate 10. View of vibration monitoring near Near abandoned house towards Konnithazam village in N-E Direction (200 m from the blasts)

5.2 QUARRY UNIT OF MUHAMMAD ROSHEN, KOLLAM DISTRICT

The field investigation at Quarry Unit of Muhammad Roshen was carried out during the period of 17th to 19th December, 2022. View of Adukadu Granites Private Limited is given in **Plate 11**. The investigational work conducted at the Quarry Unit of Muhammad Roshen is briefly discussed in the following sections.

5.2.1 Reconnaissance Survey

The reconnaissance survey was conducted on 17th and 18th December, 2022. The residential houses and important structures present within the zone of 500 m were inspected. Study on human response was also conducted before and after the experimental blasts. 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 were made of concrete with single storey. Few are also double storey buildings.

5.2.2 Study of land profile, nature of rock deposits and rebound hardness

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 12**.

Plate 11. View of Quarry Unit of Muhammad Roshen

Plate 12. View of closely spacing joints dipping towards East

5.2.3 Experimental Blasts

Ten experimental blasts were conducted at Muhammad Roshen Quarry. Out of the ten blasts, seven blasts were conducted with the existing pattern and the other three blasts were conducted using modified patterns. In the existing pattern, burden and spacing values were 1.0 - 1.3 m and 1.2 - 1.6 m respectively. Hole depth used was 1.5 m for all the holes and total number of holes varied from 5 to 20. In modified pattern, burden and spacing were reduced to 0.8 m and 0.9 m respectively. Total number of holes in the modified pattern varied from 5 to 11. Muffling was also done using conveyor belts and sandbags.

The explosive charge per hole in the existing pattern was 0.25 kg. In the modified pattern, the explosive charge per hole was reduced to 0.19 kg. Small diameter cartridge explosives of 25 mm diameter and 125 gm weight per cartridge were used in all the blasts. Nonel of 250 ms DTH and 25 ms TLD was used in al the blasts. The total explosive charge varied

from 1.25 to 5.00 kg. The summary of blasting patterns used in the experimental blasts is given in **Table 5**.

Table 5. Summary of experimental blasts at Muhammad Roshen Quarry, Kollam

Blast No.	Hole Depth (m)	No. of holes	Burden (m) × Spacing (m)	Charge /hole (kg)	Total charge (kg)	Remarks
1.	1.5	15	(1.3 – 1.4) × (1.1 – 1.3)	0.25	3.75	Existing pattern
2.	1.5	08	(1.0 – 1.6) × (1.1 – 1.4)	0.25	2.00	Existing pattern
3.	1.5	12	(1.0 – 1.1) × (1.1 – 1.6)	0.25	3.00	Existing pattern
4.	1.5	20	(1.0 – 1.1) × (1.1 – 1.6)	0.25	5.00	Existing pattern
5.	1.5	11	(1.0 – 1.2) × (1.0 – 1.2)	0.25	2.75	Existing pattern
6.	1.5	11	0.8 × 0.9	0.25	2.75	Modified pattern
7.	1.5	08	(1.0 – 1.2) × (1.0 - 1.2)	0.25	2.00	Existing pattern
8.	1.5	05	1.0 × (1.2 – 1.5)	0.25	1.25	Existing pattern
9.	1.5	11	0.8 × 0.9	0.19	2.12	Modified pattern
10.	1.5	05	0.8 × 0.8	0.25	1.25	Modified pattern

Plate 13. View of drilling at Muhammad Roshen Quarry

Plate 14. View of stemming material used at Muhammad Roshen Quarry

Plate 15. View of charging of holes at Muhammad Roshen Quarry

Plate 16. View of muffling arrangement made at Muhammad Roshen Quarry

5.1.4 Monitoring of Ground Vibration and Air Overpressure

Ground vibration monitoring points were selected based on the location of the residential houses while considering the different distances prescribed by the Joint Committee. The monitoring points covered the various distances starting from 50 m to 500 m. One vibration monitoring point was also selected on the roof of the building where vibration complaint was made by the house owner. View of some of the monitoring points are given in **Plates 17 to 23**.

Plate 17. View of vibration monitoring point on the haul road
(50 - 80 m from the blasts)

Plate 18. View of vibration monitoring point near the house of Naveesa Biwi,
N-E side of quarry (140 - 150 m from the blasts)

Plate 19. View of vibration monitoring point on the roof top (Terrace)
N-E side of quarry (175-185 m from the blasts)

Plate 20. View of vibration monitoring point near St. Thomas Church Eastern side of quarry (145-200 m from the blasts)

Plate 21. View of vibration monitoring point near the house of Regimon MT, Kattikul village, Eastern side of quarry (200-260 m from the blasts)

Plate 22. View of vibration monitoring point near the house of Leela Kuriyan, Southern side of quarry (265-300 m from the blasts)

Plate 23. View of vibration monitoring point behind the house of Mr. Saif, S-W side of the quarry (500 m from the blasts)

5.3 POABS GRANITES PVT. LTD., TRIVANDRUM

The field investigation at POABS Granite Pvt. Ltd. was carried out during the period of 21st to 23rd December, 2022. View of the quarry is given in **Plate 24**. The investigational works conducted at POABS Granite Pvt. Ltd. is briefly discussed in the following sections.

Plate 24. View of POABS Granite Pvt. Ltd quarry

5.3.1 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. The different structures identified within the zone of 500 m from the quarry are listed below:

- Within 300 m zone, no residential houses are located.
- 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.
- In the North, East and Southern directions, no residential houses are located within 500 m distance.
- Mild vibration and blast induced noise were felt at residential houses beyond 320 m from the quarry boundary.

5.3.2 Experimental Blasts

At POABS Granites Pvt. Ltd., eleven rounds of experimental blasts were conducted on the bottom bench of the quarry. Out of the eleven experimental blasts, ten blasts were conducted with the existing blast design pattern and one blast was conducted with modified pattern. 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 drill machine was 34 mm. Small diameter cartridge explosive of 25 mm diameter, 125 gm weight per cartridge and ANFO explosives were used in the experimental blasts. In dry hole, one cartridge was used for primer and ANFO explosive was used for the main charge. However, only cartridge explosives were used in case of watery holes. Nonel (shock tube) initiation system with 250 ms DTH and 25 ms TLD were used in all the blasts. For inter-row delay, 42 ms TLD was used. Summary of the experimental blasts is given in **Table 6**.

Table 6. Summary of experimental blasts at Muhammad Roshen Quarry, Kollam

Blast No.	Hole Depth (m)	No. of holes	Burden (m) × Spacing (m)	Charge /hole (kg)	Total charge (kg)	Remarks
1.	2.2 – 2.4	41	1.0 × 1.3	0.59	23.57	Existing pattern
2.	2.4	20	1.0 × 1.2	0.57	11.50	Existing pattern
3.	2.2	10	1.0 × 1.2	0.46	04.60	Existing pattern
4.	2.2	30	1.0 × 1.2	0.57	17.25	Existing pattern
5.	1.8	40	1.0 × 1.2	0.40	16.00	Existing pattern
6.	1.5	40	1.0 × 1.2	0.37	15.00	Existing pattern
7.	1.8	30	1.0 × 1.2	0.40	12.00	Existing pattern
8.	1.8	20	1.0 × 1.2	0.40	08.00	Existing pattern
9.	1.8	60	0.8 × 1.0	0.40	24.00	Modified pattern
10.	1.5	20	1.0 × 1.2	0.37	07.50	Existing pattern
11.	1.8	10	1.0 × 1.2	0.40	04.00	Existing pattern

In the existing pattern, hole depths of 1.5 m, 1.8 m, 2.2 m and 2.4 m. Burden and spacing were 1.0 m and 1.2-1.3 m respectively. The total number of holes varied from 10 to 41. Depending on the depth of holes, the explosive charge per hole varied from 0.37 to 0.59

kg. The total explosive charge in a blasting round varied from 4.00 – 23.57 kg. In the modified pattern, burden and spacing were reduced to 0.8 m and 1.0 m for 1.8 m hole depth. The total number of hole was 60 and the total explosive charge was 24.00 kg.

Plate 25. View of crawler mounted drill machine at POABS Quarry

Plate 26. View of drilling of holes with Jack Hammer at POABS Quarry

Plate 27. View of ANFO explosives used at POABS Quarry

Plate 28. View of charging of holes at POABS Quarry

Plate 29. View of recording of blasting event using High Speed Video Camera and digital video camera at POABS Quarry

5.3.3 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations were monitored using eight number of seismographs. The distance of vibration monitoring points varied from 50 to 500 m. Views of some of the vibration monitoring stations are given in **Plates 30 to 36**.

Plate 30. View of vibration monitoring at back side of the free face (50 - 75 m from the blasts)

Plate 31. View of vibration monitoring at back side of the free face (NE direction) (100 - 180 m from the blasts)

Plate 32. View of vibration monitoring at the Orphanage Home opposite to Ayiravalli – Tampura Temple in the S-W Direction (300 - 400 m from the blasts)

Plate 33. View of vibration monitoring near mine entry gate in N-W direction (320 - 410 m from the blasts)

Plate 34. View of vibration monitoring near the house of Mr. Suresh adjacent to Nettayam - Moonnammoodu Road in the S-W direction (475 - 540 m from the blasts)

Plate 35. View of vibration monitoring at backside of free face towards mine entry gate in the N-E direction (130-190 from the blasts)

5.4 ARACKAL STONE QUARRY, VARAPETTY OF M/S PRACKAL GRANITE KERALA (P) LTD. DIST.ERNAKULAM

The field investigation at Parackal stone quarry, Varapetty of M/s Prackal Granite Kerala (P) Ltd., Ernakulam was carried out during the period of 26th to 29th December, 2022. View of this quarry is given in **Plate 36**. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 36. View of Parackal stone quarry

5.4.1 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 house within the 500 m zone of the quarry is shown in **Plate 37**. 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 37. View of reconnaissance survey of the nearby structure by CIMFR and KSPCB team.

5.4.2 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 also conducted. It was observed that some of the residential houses were located at higher level than the quarry operations.

5.4.3 Experimental Blasts

At Parackal stone mine, ten rounds of experimental blasts were conducted with the varying blast design patterns. All the blasts were conducted with 32 mm blast hole diameter. Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge and ANFO cartriges were used for the charging of the blastholes. Twindet Nonel (shock tube) initiation system consisting of 250 ms DTH and 25 ms of TLD were used for the initiation of the charged blastholes. Additionally, TLDs of 42 ms were also used. Summary of the blasts are given in **Table 7**.

Table 7. Summary of experimental blasts conducted at Parackal stone quarry on 28.12.2022

S. No.	No. of holes	Hole dia. [mm]	Hole depth [feet]	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.	11	32	6	1.0	1.2	03	1.1	0.37	4.0	ANFO-21; Gel-11; Twindet-11; 42 ms-02
2.	23	32	6	1.0	1.0	03	1.1	0.33	7.625	ANFO-38; Gel-23; Twindet-23; 42 ms-02
3.	40	32	6	1.0	1.2	04	1.1	0.366	14.625	ANFO-77;Gel-05; Twindet-40; 42 ms-03
4.	22	32	6	0.9	0.9	02	1.3	0.295	6.50	ANFO-28;Gel-24; Twindet-22; 42 ms-01
5.	47	32	5	1.0	1.2	04	0.9	0.362	17.00	ANFO-89;Gel-47; Twindet-47; 42 ms-03
6.	19	32	6	1.0	1.0	03	1.2	0.304	5.775	ANFO-26;Gel-20; Twindet-19; 42 ms-02
7.	56	32	6	1.0-1.2	1.2-1.5	08	1.2	0.339	19.00	ANFO-91;Gel-61; Twindet-56; 42 ms-08
8.	20	32	5	1.0	1.2	02	0.9	0.368	7.375	ANFO-37;Gel-22; Twindet-20; 42 ms-01
9.	20	32	6	1.0	1.0	03	1.1	0.368	7.375	ANFO-39;Gel-20; Twindet-20; 42 ms-02
10.	11	32	6	1.1	1.2	02	1.1	0.363	4.00	ANFO-77;Gel-21; Twindet-11; 42 ms-01

Plate 38. Marking of drill holes at Parackal stone quarry

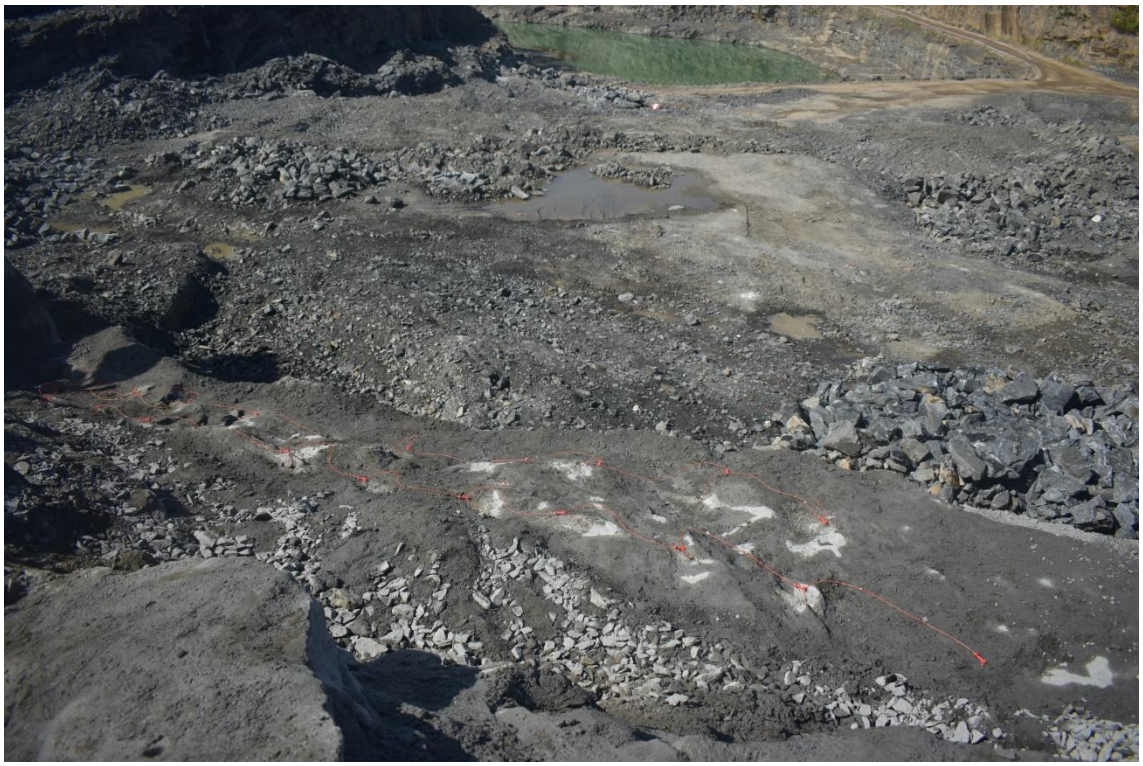

Plate 39. Connection of charged blast faces at Parackal stone quarry

5.4.4 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air over pressures were monitored using eight number of seismographs. View of a few vibration monitoring points are given in **Plates 40 to 47**.

Plate 40. Monitoring of ground vibration and air overpressure near blasting shelter in the quarry

Plate 41. Monitoring of ground vibration and air overpressure on the quarry roadway

Plate 42. Monitoring of ground vibration and air overpressure near AN mixing Centre

Plate 43. Monitoring of ground vibration and air overpressure behind AN store

Plate 44. Monitoring of ground vibration and air overpressure at Jeans' house

Plate 45. Monitoring of ground vibration and air overpressure at Anthru's house

Plate 46. Monitoring of ground vibration and air overpressure at Leela's house

Plate 47. Monitoring of ground vibration and air overpressure in the Latex garden of Leela's house

5.5 MANAKKAD STONE QUARRY, M/S UNITED GRANITES, THODUPUZHA, IDDUKI DISTRICT

The field investigation at Manakkad stone quarry of M/s United Granites, Thodupuzha, Idduki district was carried out during the period of 01st to 04th January, 2023. View of this quarry is given in **Plate 48**. The investigational work conducted at this quarry has been discussed in the following sections.

Plate 48. Overview of Manakkad stone quarry

5.5.1 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. View of reconnainace survey and assessment of human response of blasting at one of the house within the 500 m zone of the quarry is shown in **Plate 49**. 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 49. View of reconnaissance survey of the nearby structure of Manakkad stone quarry by CIMFR and KSPCB team.

5.5.2 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 rockmass was mostly massive with dominance of two sets of joints. Assessment of rebound hardness and joint mapping in this quarry is shown in **Plate 50 & 51**.

Plate 50. Assessment of rebound hardness at Manakkad stone quarry.

Plate 51. Assessment of joints at Manakkad stone quarry.

5.5.3 Experimental Blasts

At Manakkad stone quarry, ten rounds of experimental blasts were conducted with the varying blast design patterns. All the blasts were conducted with 32 mm blast hole diameter. Small diameter cartridge explosives of 25 mm diameter, 125 gm weight per cartridge were used as cap sensitive explosive. The rest of the explosive column was charged using ANFO. In case of watery holes, the holes were charged with catridge explosive only. Twindet Nonel (shock tube) initiation system consisting of 250 ms DTH and 25 ms of TLD were used for the initiation of the charged blastholes. Additionally, TLDs of 42 ms were also used. Summary of the blasts are given in **Table 8**.

Table 8. Summary of experimental blasts conducted at Manakkad stone quarry on 03.01.2023

S. No.	No. of holes	Hole dia. [mm]	Hole depth [feet]	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.	41	32	8	1.0	1.2	03	1.4	0.646	26.525	ANFO-14.4 kg; Gel-97; Twindet-41; 42 ms-02
2.	26	32	8	1.0	1.2	03	1.4	0.65	16.90	ANFO-10.40 kg; Gel-52; Twindet-26; Extra 25 ms-03;42 ms-03
3.	27	32	8	1.0	1.2	03	1.42	0.625	16.90	ANFO-8.9 kg;Gel-64; Twindet-27; 42 ms-02
4.	21	32	6	1.0	1.2	03	1.0	0.472	9.925	ANFO-6.3 kg;Gel-29; Twindet-21; 42 ms-02
5.	30	32	8	1.1	1.25	03	1.2	0.790	23.725	ANFO-12.1 kg;Gel-93; Twindet-30; 25 ms-10; 42 ms-16
6.	60	32	6	1.0	1.2	03	1.1	0.422	25.375	ANFO-16.50 kg;Gel-71; Twindet-60; 42 ms-02
7.	30	32	6	0.9	1.0	03	1.2	0.375	11.25	Gel-90; Twindet-30; 42 ms-02
8.	15	32	8	1.0	1.2	01	1.4	0.650	9.750	ANFO-6 kg;Gel-30; Twindet-15
9.	17	32	6	1.0	1.2	01	1.0	0.422	7.175	ANFO-4.8 kg;Gel-19; Twindet-17
10.	14	32	6	1.0	1.2	01	1.1	0.378	5.30	ANFO-3.3 kg;Gel-16; Twindet-14; 42 ms-13

Plate 52. Drilling of blastholes at Manakkad stone quarry

Plate 53. ANFO used for charging in blastholes at Manakkad stone quarry

5.5.4 Monitoring of Ground Vibration and Air Overpressure

Ground vibrations and air over pressures were monitored using eight numbers of seismographs. View of a few vibration monitoring points are given in **Plates 54 to 14.**

Plate 54. Monitoring of ground vibration and air overpressure near mine office

Plate 55. Monitoring of ground vibration and air overpressure near mine canteen

Plate 56. Monitoring of ground vibration and air overpressure near crusher plant

Plate 57. Monitoring of ground vibration and air overpressure in latex garden near MD's house

Plate 58. Monitoring of ground vibration and air overpressure at Jacob's house

Plate 59. Monitoring of ground vibration and air overpressure at Thomas' house

Plate 60. Monitoring of ground vibration and air overpressure at Mary's house

Plate 61. Monitoring of ground vibration and air overpressure near view point

6.0 CONCLUDING REMARKS

In the interim report, only the methodology followed for the investigations at the different quarries, brief information on the experimental blasts and vibration monitoring were presented. The ground vibration data recorded at different quarries, observations made and details analysis of ground vibration and air overpressure data will be reported when asked and required by the Joint Committee.

ANNEXURE-1

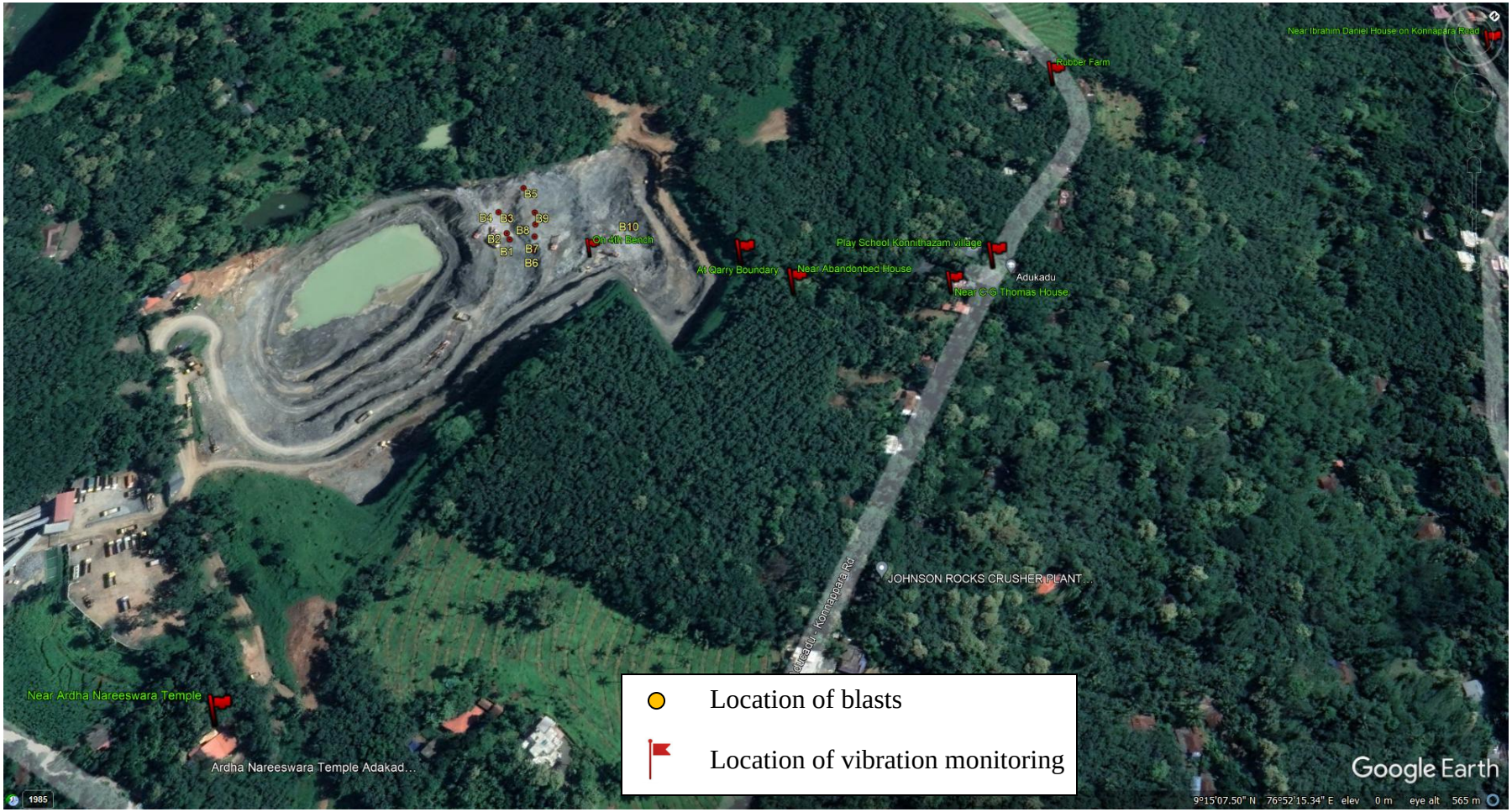

Fig. A1. Google map showing location of experimental blasts and vibration monitoring stations at Adukadu Granites Private Limited, Pathanamthitta District

ANNEXURE-2

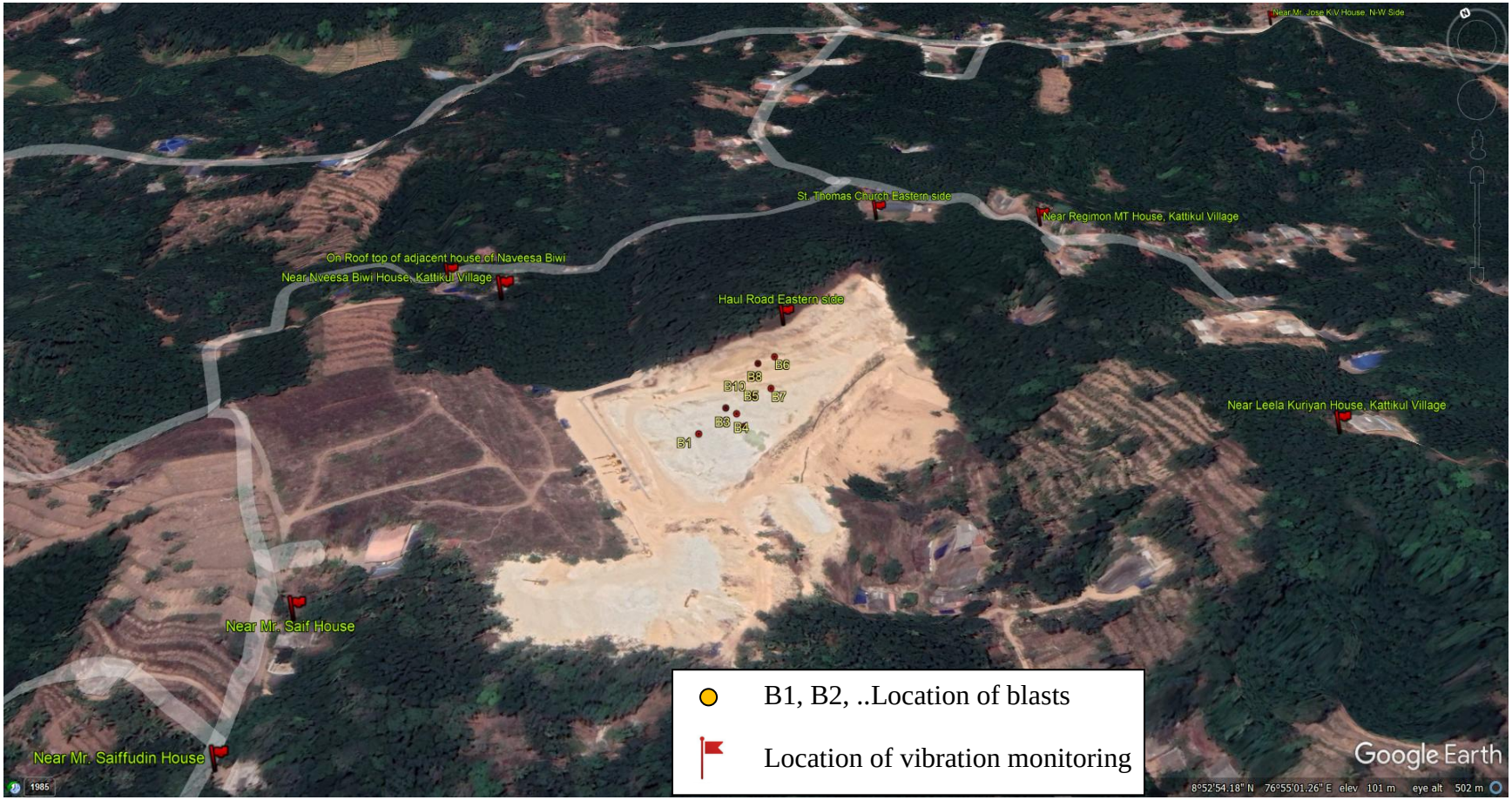

Fig. A2. Google map showing location of experimental blasts and vibration monitoring stations at Quarry Unit of Muhammad Roshen, Kollam District