

**BEFORE THE NATIONAL GREEN TRIBUNAL, PRINCIPAL
BENCH, NEW DELHI**

ORIGINAL APPLICATION NO. 304 OF 2019

IN THE MATTER OF:

M. Haridasan

...Applicant

VERSUS

State of Kerala & Ors.

... Respondent(s)

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PLACE: NEW DELHI
 DATED: 23.02.2024

**BEFORE THE NATIONAL GREEN TRIBUNAL, PRINCIPAL
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ORIGINAL APPLICATION NO. 304 OF 2019

IN THE MATTER OF:

M. Haridasan

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**ADDITIONAL REPLY ON BEHALF OF ADANI VIZHINJAM PORT
PRIVATE LIMITED TO THE ORIGINAL APPLICATION NO. 304
OF 2019**

MOST RESPECTFULLY SHOWETH:-

1. Adani Vizhinjam Port Private Limited ("AVPPL or Answering Respondent") who has been (impleaded as a Respondent by this Hon'ble Tribunal vide order dt. 05.10.2023) is filing the present reply to the main Original Application No. 304 of 2019.
2. The present reply is being filed pursuant to the order dt. 03.01.2024 passed by this Hon'ble Tribunal. The relevant extract of the said order reads as under:
 1. *In this original application registered in suo-moto exercise of power the issue of providing safeguards against operation of stone quarries close to the residences and public roads in State of Kerala is involved.*
 2. *The tribunal had earlier passed a detailed order in the matter which was subject matter of challenge by the aggrieved parties before the Hon'ble Supreme Court in Civil Appeal No. 6273/2021 and other Civil Appeals. The matter has been relegated by the Hon'ble Supreme Court permitting the parties to raise all permissible contentions before the tribunal.*
 3. *In the previous proceedings the application for impleadment made by the different parties were allowed and a liberty was*



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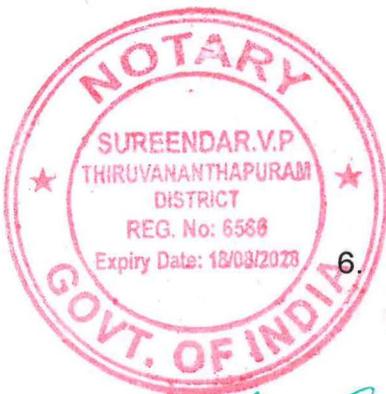
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granted to all the newly added parties to file objections and reply. Certain objections and replies have been filed but grievance of some of the parties is that they have not received copies thereof. Hence we permit the parties to exchange the pleadings within a period of three weeks. The concerned parties who are yet to file their replies/objections may file the same within this period.

A copy of the order dt. 03.01.2024 passed by this Hon'ble Tribunal in Original Application No. 304 of 2019 (Principal Bench) is annexed herewith and marked as **ANNEXURE R-1**.

3. That Kerala being having a unique geography since it is a long strip of land flanked by the Arabian Sea to the west and the Western ghats to the East, therefore, the strip of the land in the middle, which includes inhabited areas, is the only limited area available for economic activities, including quarrying.
4. Hence, the State of Kerala after detailed study and application of advanced mining methods of controlled blasting has prescribed distance criteria of 50 m for stone quarries by the mining/ quarry lessees (project proponents) in the State of Kerala.
5. That this Hon'ble Tribunal, vide order dt. 06.05.2019, on a written complaint filed by one resident being M. Haridasan residing in State of Kerala, *suo-moto* treated the above representation as an Original Application (OA No. 304/2019 - M. Haridasan & Ors. v. State of Kerala).

6. It is submitted that this Hon'ble Tribunal vide its order dated 09.10.2019 observed that State prescribed distance criteria of 50 m is highly inadequate and can have deleterious effects on noise pollution, air pollution, general environment and public



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health and consequently directed the KSPCB to revisit the existing criteria based on an appropriate study. Further, even the CPCB was asked to forward their views on the matter.

7. That the KSPCB submitted a Report reiterating the distance criterion of 50 meters and stating that the existing distance criterion can be maintained if quarry operators comply with the 14 conditions mentioned therein. It was also noted that the CPCB has not conducted any expert studies on the matter.
8. That this Hon'ble Tribunal vide its order dated 28.02.2020, observed that the distance of 50 mtrs for stone quarries, particularly where blasts are involved is highly inadequate and sought a report from the Central Pollution Control Board (CPCB) on the distance criteria for stone quarries and to prescribe more stringent conditions and appropriately longer distance. A copy of the Order dated 28.2.2020 passed by this Hon'ble Tribunal in OA No. 304/2019 is annexed herewith and marked as **ANNEXURE R-2.**
9. It is submitted that relying on the report dated 09.07.2020 submitted by CPCB, this Hon'ble Tribunal vide its order dated 21.07.2020 mandated to have 100m and 200m distance for stone quarry operations without and with blasting, respectively. A copy of the Order dated 21.7.2020 passed by this Hon'ble Tribunal in OA No. 304/2019 is annexed herewith and marked as **ANNEXURE R-3.**
10. That aggrieved by the order dated 21.07.2020 passed by this Hon'ble Tribunal, the mining/ quarry lessees (project proponents) in the State of Kerala filed appeals (MA Nos. 80, 83, 85, 88 to 95 of 2021) in the OA 304 of 2019 seeking impleadment with specific prayer '***not to interfere***' with the



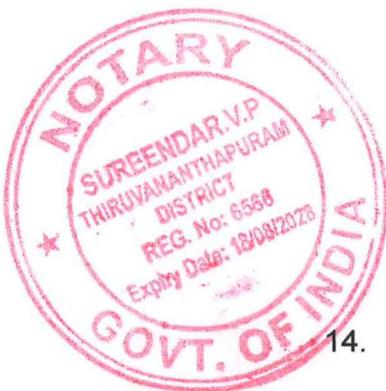
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distance criteria already laid down by the State Mining Department and KSPCB. The appeals filed by the project proponents also raised the question of whether NGT has jurisdiction to initiate '*Suo Motu*' action against violation of environmental norms.

11. Meanwhile, this new distance criterion came to be challenged by several parties before the Kerala High Court including the Petitioner vide Writ Petition being Writ Petition (C) No. 16455/2020 on 09.08.2020. Also, the State of Kerala filed W.P (C) No. 16367 of 2020 stating that if order dated 21.07.2020 is given effect to without considering the peculiar geographical nature of the State, all the stone quarries in the State have to be closed down and that the same would adversely affect the development activities taking place in the State.
12. That the Single Judge disposed of all Petitions by way of a Common Order dated 21.12.2020. wherein it was held that the Order of the NGT dt. 21.07.2020 be set-aside on the ground that the affected parties were not given an opportunity of hearing. Thus, the matter was remanded to this Hon'ble Tribunal for fresh consideration, after giving notice to the affected parties.
13. That the division bench of Kerala High Court vide its order dated 16.3.2021 upheld the Order dated 21.12.2020 passed by the Single Judge in in W.A. No. 294 of 2021 and connected matters. That AVPPL had challenged the said order before the Hon'ble Supreme Court by filing the Special Leave Petition (Civil) No.12699 OF 2021.
14. That the Hon'ble Supreme Court vide its order dated 07.10.2021 in Special Leave Petition (Civil) No.12699 OF



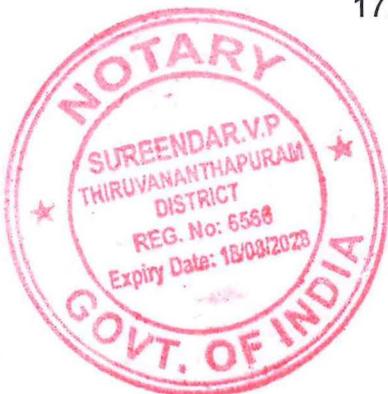

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2021 reported at **2021 SCC Online SC 897** upheld the Hon'ble High Court order and permitted the party likely to be affected in the *suo-moto* proceedings to be afforded due opportunity to present their side, before suffering any adverse orders.

15. In light of the directions and holding of the Hon'ble Supreme Court in the Judgment dated 07.10.2021 as well as the Order dated 25.10.2021, AVPPL had filed intervention in the present proceedings. That this Hon'ble Tribunal vide its Order dated 05.10.2023 while allowing AVPPL to implead in the present proceedings also gave liberty to AVPPL to file reply/objections to the report dated 28.02.2023 submitted by Joint Committee constituted by this Hon'ble Tribunal.
16. It is submitted that this Hon'ble Tribunal in view of the Hon'ble Supreme Court Order after considering the submissions made by project proponents passed an order dated 9.12.2021 out of abundant caution after examining the prayers in the original application and project proponent's contentions in detail, this Hon'ble Tribunal directed for an expert study about safe distance for stone quarry from habitations by a joint committee 7 members.
17. It is submitted that the recommendation of the Joint Committee to this Hon'ble Tribunal has irrationally and arbitrarily recommended a safety distance of 150m in building stone quarry operations. It is pertinent to mention here that no quarry site inspection was carried out by the Joint Committee qua the quarrying sites of AVPPL. The Report of the Joint Committee dated on 28.02.2023 submitted to Hon'ble Tribunal is fraught with factual mistakes and inconsistent results/findings, and based on complete misappreciation and



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misrepresentation of facts, the Committee has irrationally recommended a safety distance of 150m in building stone quarry operations.

18. The assessment study carried out by the Joint Committee constituted by this Hon'ble Tribunal was done only in nine quarries among total of approximately 650 quarries which are currently operating in the State of Kerala. Therefore, the Joint Committee Report represents a meagre amount of data set which does not represent accurate experimental data set for all the quarries and cannot be generalized for the whole State of Kerala. In fact, there has been no comprehensive study carried out by the Joint Committee and hence the Report ought to be rejected by this Hon'ble Tribunal.
19. The site study/inspection carried out by the Joint Committee is inadequate to arrive at any logical conclusion in respect of its recommendations.
20. That the extrapolation/ modelling predictions made using the 9 site specific data, may not result in an accurate prediction/ extrapolation. Even as per the minutes of the joint committee dt. 16.02.2023, Dr. D P Kanungo (member of the committee) commented that the vibration study was done only in 9 quarries among the several hundreds of quarries operating in Kerala, which is a small data set which may not be a representative experimental data set for all the quarries and cannot be generalised for the whole State of Kerala. He has further stated that the report of CIMFR is excellent but the committee should also see the operational level in which the recommendations are to be implemented.
21. Further, on the detailed objections to the Joint Committee Report, the Answering Respondent/AVPPL craves liberty to



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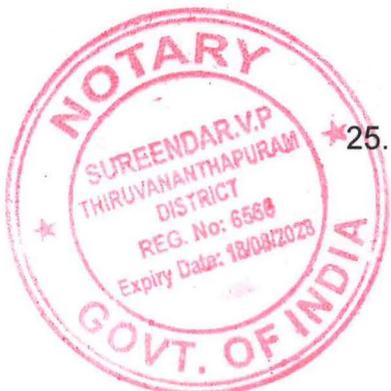


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rely on the detailed objections to the Joint Committee Report dt. 28.02.2023 filed before this Hon'ble Tribunal.

PRELIMINARY SUBMISSIONS:

22. It is submitted that Kerala being a densely populated state and a long agglomerate of small and medium towns, construction material (aggregate) needs of the State for its development projects can never be fulfilled with such unreasonable distance criteria of 150 meters.
23. Moreover, since the issue is being considered by this Hon'ble Tribunal's principal bench, a holistic view of the matter has to be taken by keeping in view other states and stakeholders which are involved outside the State of Kerala since it will have ramifications PAN India and the issue should not be dealt only restricted to the State of Kerala.
24. At the outset the answering respondent herein submits that it is always open towards providing safeguards against operation of stone quarries close to the residences and public roads in State of Kerala is involved. The same should be considered on case-to-case basis and on the basis of the compliances being carried out by the respective quarry mine operator like the answering Respondent herein.
- A. **The Minimum Distance Criteria must be at 50 meters and be subject to the compliance of the EC Conditions and not uniformly :**
25. That no uniform blanket distance should apply on the quarry mine given the population constrains and space for quarry mining in the entire State. In the present case, the mine of the AVVPL has not even been inspected by the Joint Committee appointed by this Hon'ble Tribunal.

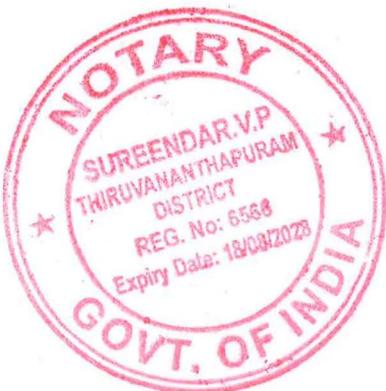


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26. AVPPL has all the requisite clearances/ NOCs/ authorizations for the construction of the Strategic Port as well as the for the carrying out of its captive quarry mining activities. A copy of the Chart demonstrating all statutory clearances is annexed herewith and marked as **ANNEXURE R-4.**
27. AVPPL has complied with all the EC conditions mentioned in Environment clearance Letter dated 01.03.2019. It is submitted that as per the "Sub Para (ii)" of "Para 10" of EIA Notification 2006, it is stated that "*It shall be mandatory for the project management to submit six monthly compliance reports in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year*" and as per compliance of condition mentioned in Environment Clearance Letter, Six monthly compliance reports should be submitted to the Regulatory Authority of Central and State Government. A copy of the Environment Clearance dated 01.03.2019 is annexed herewith and marked as **ANNEXURE R-5.**
28. The Environmental assessment is carried out to verify:
- 1) That the proposed project has not any adverse effect on the project site as well as its surrounding.
 - 2) That there is compliance with the conditions stipulated in the Environmental Clearance Letter of the Project.
 - 3) That the Project proponent is implementing the environmental safeguards and environmental pollution mitigative measures as suggested in approved Form-1 and Environmental Management Plan with true spirit.



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- 4) The non-conformity in the project with respect to the environmental implication of the project.
29. It is submitted that various scheduled site visits were conducted by a team of Experts to Monitor Pollution related parameters as defined by CPCB / KPCB at the quarry of AVPPL. It is submitted that based on the report submitted by AVPPL, State Environment Impact Assessment Authority Kerala (SEIAA) has submitted its recommendations, which were also complied by AVPPL.
30. The entire study carried out by the Joint Committee consists of 9 mining sites in which the site of AVPPL has not been included which uses State of Art NONEL Technology while carrying out the quarry mining operations. Therefore, a distinction needs to be made between those quarry sites which are using the State of Art Advance Technology and those sites which are carrying out generalised mining operations.
31. AVPPL uses State of Art NONEL Technology which produces minimal vibration, noise and nil flying rocks compared to conventional blasting methods technology. Hence, a distinction needs to be drawn between the quarry sites which are carrying out stone quarry mining activity and the impact of blasting with and without NONEL Technology while determining the distance of 150 meters.

Dust and air ambient quality measures adopted by AVPPL:

32. For dust control and air ambient quality, AVPPL conducted a study through NABL accredited laboratory/s M/s. Standards Environmental & Analytical Laboratories, at its quarry in the range of 50 m to 1000m from the project site, and found that



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in the AVPPL Quarry site the dust range is within permissible limits of NAAQM. Further, AVPPL, as part of its Environment Clearance condition no. 34, uses following measures for dust suppression at its quarrying site and for which half-yearly compliance report is sent regularly to the State Environment Impact Assessment Authority (“SEIAA”). The dust pollution control/ suppression measures already employed by AVPPL in its Quarry sites are as follows:

- A. AVPPL has developed a tar road of around 0.9 km from Kadavila junction to the quarry project site gate for movement of vehicles, thereby reducing the dust pollution.
- B. Regular water sprinkling through water tankers on haul road and other dust prone areas such as loading and unloading of minerals is being carried out.
- C. For Drilling in the Quarry, the wet drilling method is used to avoid dust emission.
- D. Environment Monitoring at the site has been carried out by NABL accredited laboratory/s M/s. Standards Environmental & Analytical Laboratories. The Certificate of Accreditation by NABL is annexed as **ANNEXURE R-6**. Summary of the Ambient Quality Monitoring (AAQM) during the compliance period has been within the limit. The same is elaborated in the half yearly compliance report of EC Conditions. The test results of PM 2.5 and PM 10 were found within limits in the range of 50 m to 1000m from the project site for the sample test carried out on 10.10.2023. Ambient Air Quality Monitoring Reports submitted by M/s. Standards Environmental & Analytical Laboratories forms part of



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the half - yearly Compliance Report. A copy of the Air Quality Monitoring Reports for a period between 03.10.2023-07.10.2023 at the Quarry Project Site is annexed herewith and marked as **ANNEXURE R-7**. A copy of the Air Quality Monitoring Reports for a period between 03.10.2023-07.10.2023 from distance of 1 Km from Quarry Site is annexed herewith and marked as **ANNEXURE R-8**. A copy of the Air Quality Monitoring Reports for a period between 03.10.2023-07.10.2023 from distance of 850 meters from Quarry Site is annexed herewith and marked as **ANNEXURE R-9**. A copy of the Air Quality Monitoring Reports for a period between 03.10.2023 - 07.10.2023 from distance of 650 meters from Quarry Site is annexed herewith and marked as **ANNEXURE R-10**. A copy of the Air Quality Monitoring Reports for a period between 03.10.2023-07.10.2023 from distance of 250 meters from Quarry Site is annexed herewith and marked as **ANNEXURE R-11**.

Noise Control measures adopted by AVPPL:

33. As per EC condition no. 36, AVPPL has to take measures for control of noise below 85 dBA in the quarry environment. It is submitted that following measures are taken for control of noise levels by AVPPL:

- a. **For drilling:** Good captive silencers are being used in drilling equipment.
- b. **For blasting:** AVPPL uses the NONEL method-bottom initiation with MS CONNECTORS to reduce the noise and Vibration while of blasting.



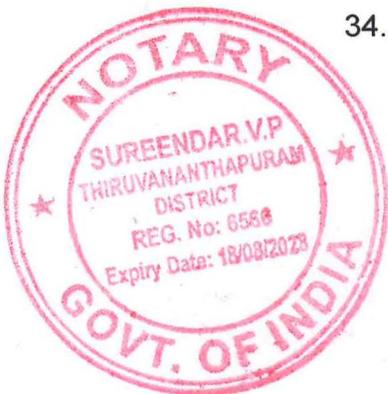
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- c. **Machinery and Tippers:** It is ensured that equipment is fitted with effective silencers, mufflers, acoustic linings, or shields, as necessary.
- d. **Vehicles:** Vehicles transporting the materials follow the speed limit to maintain the noise level.
- e. Vehicles are serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them.
- f. Further, Ambient Noise is being monitored by NABL accredited laboratory; Standards Environmental & Analytical Laboratories as per Noise Pollution (Regulation & Control) Rules, 2003 (Rule 3 (1) and 4 (1)) at 5 locations. The summary of the noise levels have also been annexed by AVPPL in its regular half yearly EC Conditions compliance report submitted to SEIAA. As per the noise control report dt. 20.11.2023 the noise emitted from the project have been found within the permissible limits at different time frames at AVPPL's site. A copy of the Noise Level Test Report dated 20.11.2023 of Standard Environmental and Analytical Laboratories is annexed herewith and marked as **ANNEXURE R-12 (Colly).**

34. That Rock blasting is even conducted at the closed distances of 20-50m in Metro Rail Projects by controlling all the above blast effects of Vibration, Air-overpressure and Fly rock. Similarly, it can be conducted at 50-100 m distances as per the Government of Kerala Rules by adopting controlled blasting measures suggested by scientific institutes. A copy of the Blasting induced noise and vibration study report of Anna,



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University for period 16.03.2021-17.03.2021 is annexed herewith and marked as ANNEXURE R-13.

35. Nowhere in world, the safe distance criteria is based on the 'Noise' as it is not a significant parameter which can cause structural damage. Moreover, the local public grievances are not related to 'Noise' levels.
36. It is submitted that merely because the Joint Committee has found PM 2.5 and PM 10 limit violations at 4 out of 9 quarries at 100 meters distance, does not mean that all other quarries operating in the State are at default. It is further submitted that every quarry has its own Environment Clearance and has to be comply with the mandated EC Conditions including the condition of maintain the dust pollution within the stipulated limits. If any quarry is found violative of the aforementioned EC. Condition then there will always be remedy in form of penalty and notices by the concerned State Pollution Control Board who act against such violators as per law. Hence, no straight jacket formula can be prescribed for maintaining the safe distance on account of dust pollution.
37. Moreover, the State has been following its own distance criteria of 50 meter after detailed study and application of advanced mining methods of controlled blasting. If such unreasonable distance criteria of 150 meters is imposed upon minor minerals such as mine quarries, then it will lead to a situation of holding of more land for quarrying and due to the requirement to keep longer buffer area, valuable minor minerals cannot be resourced optimally for the development projects of the State.



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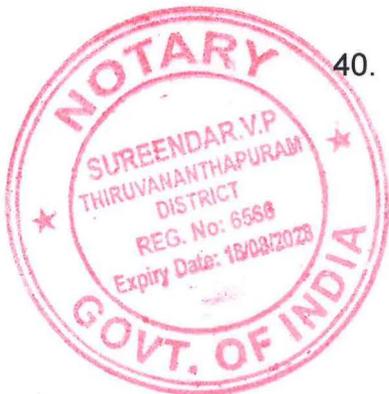
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B. The quarrying operation of AVPPL is captive and linked to the construction of Strategic Sea Port of the Country:

38. AVPPL is not doing the quarry mining for selling the stones/boulders in the open market and make any commercial gain at the cost of environment. AVPPL is carrying out the quarry mining operations due to captive linkage with the construction of strategic sea port which is of national importance. The quarry mining is necessary for meeting the construction requirement of rock boulders and stones. Once, the construction is complete the AVPPL will not be engaged with the requirement of stone quarrying as such. Therefore, a balance needs to be struck between the protection of environment and Sustainable Development. A distinction has to be drawn by those who are environmentally compliant by virtue of EC Conditions compliance and those who are the actual violators of the EC Conditions and use generalised way of quarry mining.

39. The AVPPL is currently constructing a port at Vizhinjam in Kerala and needs stones/boulders for construction of breakwater. That AVPPL requires 130 Lakh MT of rock boulders for construction of the breakwater at the Vizhinjam Port, of which another 55 Lakh MT is yet to be arranged/procured.

40. It is submitted that the Vizhinjam International Transshipment Port ("**Seaport Project**") is a major infrastructure project by the Government of Kerala which is developed in the Public Private Partnership model. That it is an ambitious step forward on the path to prosperity of our country and will be India's first Mega Transshipment Container Terminal in the Indian



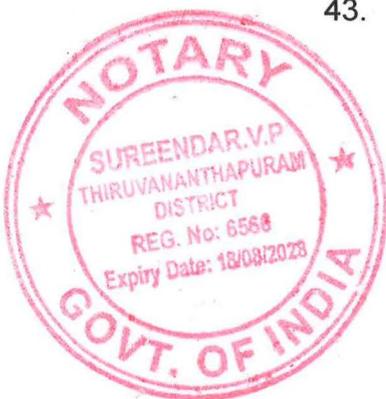
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subcontinent, closest to the international shipping routes, and is centrally located on the Indian coastline.

41. It is further submitted that this Sea Port Project has its own strategic importance, resulting from closeness to International Shipping Routes and geographical advantage, resulting from deep natural draught. That this Sea Port Project is one of the major infrastructure projects of the state and the country. Considering the importance of the project, Government of Kerala since 1995 had made multiple attempts to develop the port.
42. With the commissioning of Sea Port Project, the current transshipment of Indian cargo handled by Colombo, Salalah and Singapore will get shifted to Vizhinjam, owing to its closeness to International Shipping Route. This will result in large savings of Transshipment cost as well as foreign exchange. The savings will generate large consumer savings. There will also be considerable savings in transshipment time of goods, resulting in cost competitiveness. Resulting from the cost competitiveness induced by the port, the port will be ushering high industry growth in the country and the region. The port and resultant industry growth will be boosting employment generation in the country.
43. Considering the importance of this Sea Port Project, Vision document of Government of India "Maritime Amritkaal Vision 2047" published by Ministry of Ports, Shipping and Waterways, have already prioritized Development of Sea Port Project on immediate short-term basis. The Vision Document points out that about Indian Ports annually handle about 17.23 million TEUs, of which 4.30 million TEUs (25%) of the Indian origin and destined containers were transhipped. Out of 4.3



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million TEUs India's transshipped containers, 2.93 million TEUs (~ 68%) are handled outside India, at hubs such as Colombo, Singapore and Port Kelang. Indian Ports lose up to Rs. 1800 crore of potential revenue each year on transshipment of Indian origin and destined containers at foreign ports. There is also the lost opportunity in handling transshipment of non-India related cargo due to the absence of an Indian Hub. Considering the economic and national significance of the project and the priority accorded to it by Government of India and Government of Kerala, commissioning of the project in immediate short term is extremely crucial. Considering the requirement of increase capacity in immediate term, Government of Kerala vide GO (Ms) No. 2/2024/F&PD dated 15 February 2024 has already mandated AVPPL to develop phase 2, phase 3 and phase 4 of the Port Project before December 2028. The key engineering structure which forms part of the entire project is a 4080 meters long Boulders Mounted Breakwater providing tranquil berthing operations to large ships visiting the port. One of the key imperatives for completing the construction of the Breakwater is supply of boulders from Mines located in the project vicinity. The GO (Ms) No. 2/2024/F&PD dated 15 February 2024 is annexed herewith and marked as **ANNEXURE R-14**.

44. That in 2015, AVPPL was selected as the Concessionaire on the Design, Build, Finance, Operate and Transfer (DBOFT) basis of Seaport Project. That the work involves construction of breakwater and a fishing harbor, which requires quarried rock boulders.
45. AVPPL only after receiving the following requisite clearances/NOCs/authorization/permission for quarrying was



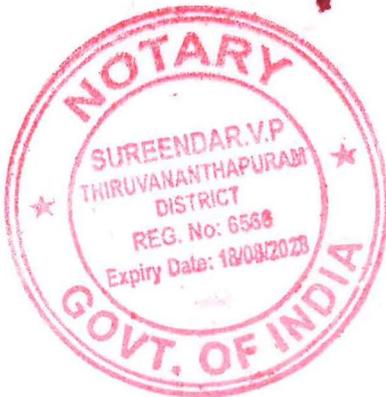
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 ADVOCATE & NOTARY



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issued by the Government of Kerala for the purpose of conducting quarrying in Government land for which the Government has absolute title and ownership has started the quarrying:

- i) That AVPPL got NOC from the District Collector, Thiruvananthapuram for conducting quarrying operations in the Government land of Puramboke land in Nagaroor Village, Chirayinkeezhu Taluk, which is having optimum rock deposit as per the EIA Report for the Vizhinjam Project.
- ii) AVPPL was also permitted to conduct quarrying on government lands available in Thiruvananthapuram, Kollam and Pathanamthitta districts.
- iii) Further, on 01.03.2019, AVVPL received an Environmental Clearance ("EC") from State Environment Impact Assessment Authority ("SEIAA") for the Nagaroor quarry Project in Thiruvananthapuram District.
- iv) Thereafter, on 05.03.2019, the Kerala State Pollution Control Board ("KSPCB") issued Consent to operate for the Nagaroor Quarry Project by way of Consent No. PCV/TVM-DO/ICO/QRY/103/2019.
- v) On 11.03.2019, the AVPPL obtained a D&O license from the Nagaroor Village Panchayat for the quarry Project.
- vi) On 20.05.2019, the Department of Mining and Geology accepted the AVPPL's Application for approval of



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 SURENDAR V.P. B.A., LL.B
 ADVOCATE & NOTARY
 Roll No. K/1114/1999
 VANCHIYOOR



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mining plan by way of letter bearing No. 1716/DOT/ML/18 for the Nagaroor Quarry Project.

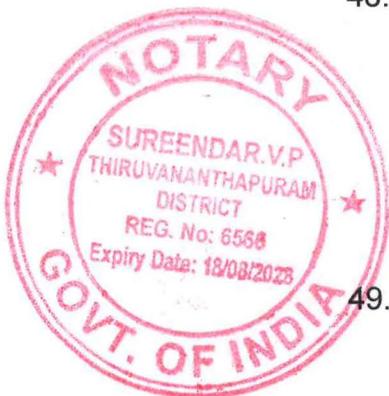
- vii) AVPPL was also granted the quarrying license over an area in Nagaroor Village, Chirayinkeezhu Taluk for a period of five years.
- viii) On 22.05.2019, AVPPL also entered into a lease agreement with the State Government as per Form-H, as per Rule 43 of the 2015 Rules for the Nagaroor Quarry Project.

46. It is submitted that in case this Hon'ble Tribunal decides to increase the distance for stone quarry operations, it will adversely impact AVPPL in constructing the national strategic port because no stones/boulders will be available for construction activities.

47. It is submitted that at the time when the AVVPL bid for the said Seaport Project, the prescribed distance criteria for stone quarries by the mining/ quarry lessees (project proponents) in the State of Kerala was 50 m. That change in the distance criteria will impact the costs, expenses, or expected income by AVPPL and other quarriers.

48. It is submitted that AVPPL is currently constructing a port at Vizhinjam in Kerala and needs stones/boulders for construction of breakwater. That AVPPL requires 130 Lakh MT of rock boulders for construction of the breakwater at the Vizhinjam Port.

49. The construction of the Seaport Project, Infrastructural Projects and NHAI Projects will be severely impacted if this



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ADVOCATE & NOTARY
Roll No. K/1114/1999
VANCHIYOOR
THIRUVANANTHAPURAM



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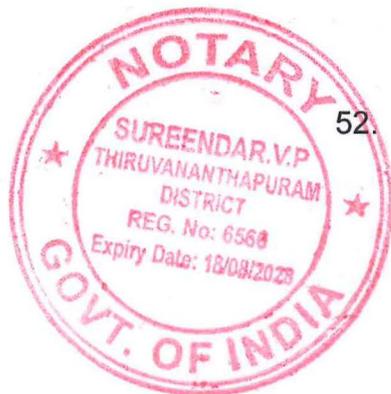
Hon'ble Tribunal decides to increase the distance for stone quarry operations.

C. THIS HON'BLE TRIBUNAL CANNOT INTERFERE WITH LEGISLATIVE MANDATE:

50. It is a settled legal proposition that the court and Tribunals can neither legislate nor issue a direction to the legislature to enact in a particular manner. It is most respectfully submitted that this Hon'ble Tribunal has no power even indirectly to require the executive to exercise its law-making power. That the Tribunals cannot usurp the functions assigned to the legislature under the Constitution and cannot even indirectly require the executive to exercise its law-making power in any manner. The courts/ Tribunals cannot assume to themselves a supervisory role over the rule-making power of the executive under Article 309 of the Constitution. That the Hon'ble Supreme Court in the matter of Narinder Chand Hem Raj v. UT, H.P. [(1971) 2 SCC 747, held that legislative power can be exercised only by the legislature or its delegate and none else.

51. It is submitted that the new distance criterion under consideration by this Tribunal would lead to amendment of the Kerala Minor Mineral Concession Rules, 2017 as laid down by the State of Kerela.

52. That Section 15 of the MMDR Act empowers the State Governments for making rules for regulating the grant of quarry leases, mining leases or other mineral concessions in respect of minor minerals and for purposes connected therewith.



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SUREENDAR V.P. B.A., LL.B
ADVOCATE & NOTARY
Roll No. K/1114/1999
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THIRUVANANTHAPURAM-35

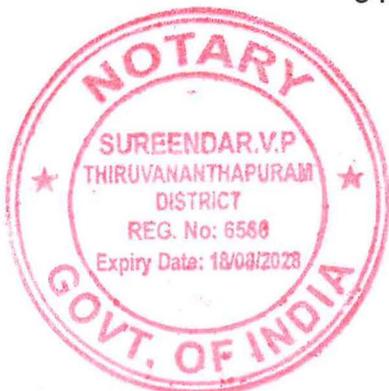


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53. In pursuance to Section-15 of the Mines and Minerals (Development Regulations) Act (“**MMDR Act**”) as enacted by the Parliament of India, the State of Kerala by way of delegated legislation has promulgated Kerala Minor Mineral Concession Rules, 2015 which was subsequently amended with Kerala Minor Mineral Concession (Amendment) Rules, 2017 (“**2017 Rules**”). The said 2017 amended rules already lay down a distance criterion in Rules 10(f) and 40(1)(i) which is reproduced herein below:

*“10.[...] (f) the permit holder shall not carry on or allow to be carried on any quarrying operations at or to any points within a distance of 100 meters from any railway line except with the previous written permission of the Railway Administration concerned and any bridge on National Highway or **50 meters from any reservoir, tanks, canals, rivers, bridges, other public works, residential buildings, the boundary walls of places of worship, burial grounds, burning ghats or village roads or one kilometer from the boundaries of National Park or Wildlife Sanctuaries except with the previous permission of the authorities concerned or the Government or the competent authority.**”*

54. That the aforementioned rules [10(f) and 40] were amended by the notification dated 22.6.2017 issued by KSPCB vide SRO No.346 of 2017, wherein the KSPCB revised the earlier circulars and laid down the minimum distance requirement for stone quarrying from residential buildings and human inhabited sites to 50 metres in tune with the requirement in Section 10(f) of the 2017 Rules. A copy of the amended



SUREENDAR V.P. B.A., LL.B
ADVOCATE & NOTARY
Roll No. K/1114/1999



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Kerala Minor Mineral Concession (Amendment) Rules, 2017 is annexed herewith and marked as **ANNEXURE R-15.**

A copy of EC Compliance Report for Oct-05-2022 to March-2023 is annexed herewith as marked as **ANNEXURE R-16.**

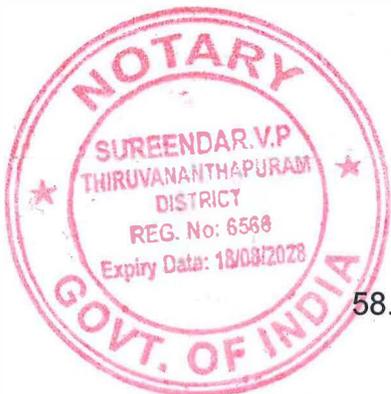
55. In the said notification, the rationale for adopting the distance criterion was given and is reproduced herein below: -

“In the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016 for major minerals, the distance criteria adopted for mining activities were retained as stipulated in the earlier Mineral Concession Rules. Hence a different criterion cannot be adopted in the case of minor minerals. In such circumstances, in order to make it in tune with the Minerals (Other than Atomic Hydro Carbons Energy Minerals) Concession Rules, 2016, it is decided to incorporate the same distance criterion in Rules 10 and 40 as well as Form H”

56. Therefore, the decision to specify the criteria of 50 meters in Rule 40 and 10(f) was based on sound reasoning of the legislature and can not be simply amended by this Tribunal.
57. That the Hon'ble Supreme Court in Union of India v. Deoki Nandan Aggarwal AIR 1992 SC 96 observed:

“14. ... It is not the duty of the court either to enlarge the scope of the legislation.... The court cannot rewrite, recast or reframe the legislation for the very good reason that it has no power to legislate. The power to legislate has not been conferred on the courts.”

58. In State of U.P. v. Jeet S. Bisht [(2007) 6 SCC 586], the Hon'ble Supreme Court held that issuing any such direction may amount to amendment of law which falls exclusively

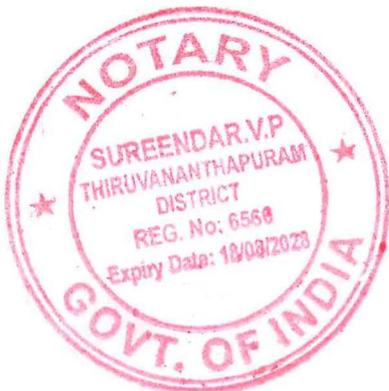


within the domain of the executive/legislature and the court cannot amend the law.

59. The Hon'ble Supreme Court in Civil Appeal Nos. 5348 of 2019 in the matter of "The State Of Himachal Pradesh And Others Versus Yogendera Mohan Sengupta and Anr." held as under:

"70. In that view of the matter, we find that the first order of NGT is liable to be set aside on the short ground that it has transgressed its limitations and attempted to encroach upon the field reserved for the delegatee to enact a piece of delegated legislation. We are of the considered view that when the TCP Act empowers the State Government and the Director to exercise the powers to enact a piece of delegated legislation, the NGT could not have imposed fetters on such powers and directed it to exercise its powers in a particular manner."

60. Thus, it is crystal clear that if the High Courts and the Supreme Court, in their extra-ordinary powers under Articles 226 and 32 of the Constitution cannot do so, then a Tribunal constituted under a statute, having a limited jurisdiction, cannot do so. That the Tribunal has a very limited role and in exercise of that, it is not open to have judicial legislation. Neither the Tribunal can legislate, nor has it any competence to issue directions to the legislature to amend the law in a particular manner. Therefore, it is most respectfully submitted that no interference should be carried out by this Hon'ble Tribunal in re-determining the distance of quarry mining in the State of Kerala as already prescribed in the State Rules framed under the MMDR, Act.



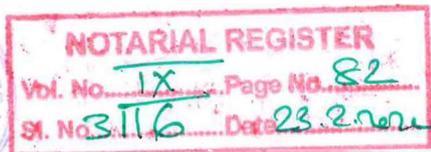
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ADVOCATE & NOTARY
Roll No. K/1114/1999
VANCHIYOOR



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61. It is submitted that at the time when the AVVPL bid for the said Seaport Project, the prescribed distance criteria for stone quarries by the mining/ quarry lessees (project proponents) in the State of Kerala was 50 m. That change in the distance criteria will impact the costs, expenses, or expected income by AVPPL and other quarriers.
62. It is submitted that in case this Hon'ble Tribunal decides to increase the distance for stone quarry operations, it will adversely impact AVPPL in constructing the national strategic port because no stones/boulders will be available for construction activities.
63. The construction of the Seaport Project, Infrastructural Projects and NHAJ Projects will be severely impacted if this Hon'ble Tribunal decides to increase the distance for stone quarry operations
64. Hence, it is clear that the State has laid down the distance criteria for quarrying only after considering the unique geographical location of the port and therefore, any change/amendment in the existing distance criteria will lead to interference in legislative law making power of the State.

For ADVANSHINJAM PORT PRIVATE LTD



Rajesh

Rajesh Kumar Jha
MD & CEO

BY *Mahesh Agarwal*

MAHESH AGARWAL
ADVOCATE FOR AVPPL
AGARWAL LAW ASSOCIATES
 19, BABAR ROAD, BENGALI MAKRET
 NEW DELHI - 110 001
 (M) 9910 48327
 EMAIL: mail@aglaw.in

PLACE: NEW DELHI
 DATED:

Attested
 23.2.2024
SUREENDAR V.P. B.A., LL.B
ADVOCATE & NOTARY
 Roll No. K/1114/1999
 VANCHIYOOR
 KOTTAYAM

ATTESTED



BEFORE THE NATIONAL GREEN TRIBUNAL, PRINCIPAL BENCH, NEW DELHI ORIGINAL APPLICATION NO. 304 OF 2019

IN THE MATTER OF:

M. Haridasan ...Applicant

VERSUS

State of Kerala & Ors. Respondent(s)

AFFIDAVIT

I, Mr. Rajesh Kumar Jha, S/o. Krishna Chandra Jha aged about 59 years, being the authorized signatory of the Respondent Company- Adani Vizhinjam Port Private Limited (AVPPL) in the abovementioned Original Application, having its office at No.1, Port Office Building, Mullur Road, Mullur, Thiruvananthapuram Dt, Kerala - 695521 , do hereby solemnly affirm and state as under:

- 1. That I am the authorized signatory of the Respondent Company in the aforesaid matter and I am well acquainted with all the facts and circumstances of the case and as such I am duly authorized to swear this affidavit.
2. I say that I have read and understood the facts and contents as stated in the reply to the Original Application and say that the facts stated therein are true and correct to my knowledge and belief and no part of it is false.
3. I state that the documents annexed to the reply are true copies of their respective originals.

For ADANI VIZHINJAM PORT PRIVATE LTD

Rajesh (handwritten signature)

Rajesh Kumar Jha MD & CEO

DEPONENT

VERIFICATION:

I, Rajesh Kumar Jha, the above named deponent do hereby verify that the averments of the facts stated herein above are true to my knowledge and belief and no part of it is false and no material fact has been concealed therefrom.

Verified on this 23rd day of February, 2024 at Thiruvananthapuram.

Solemnly affirmed and signed before me by the deponent, who is known to me on this the 23rd day of February 2024

at my office at Vanchiyoor, Tvpm-35 SURBENDAR V.P. B.A., LL.B ADVOCATE & NOTARY

For ADANI VIZHINJAM PORT PRIVATE LTD

Rajesh (handwritten signature)

DEPONENT

Rajesh Kumar Jha MD & CEO



3548 ANNEXURE-R-1

Item No.06

Court No. 1

BEFORE THE NATIONAL GREEN TRIBUNAL PRINCIPAL BENCH, NEW DELHI

Original Application No. 304/2019
(M.A. No. 81/2021, M.A. No. 83/2021, M.A. No. 96/2021,
I. A. No. 184/2022, I. A. No. 440/2023, I. A. No. 441/2023,
I. A. No. 443/2023 & I. A. No. 444/2023)

M. Haridasan Applicant

Versus

State of Kerala & Ors. Respondent(s)

Poabs Granites (Pvt.) Ltd. & Anr.	Applicant in MA 81/2021
And	
M/s. Panachayil Industries	Applicant in MA 83/2021
And	
Crystal Granites Ltd. & Anr.	Applicant in MA 96/2021

Date of hearing: 03.01.2024

**CORAM: HON'BLE MR. JUSTICE PRAKASH SHRIVASTAVA, CHAIRPERSON
HON'BLE MR. JUSTICE SUDHIR AGARWAL, JUDICIAL MEMBER
HON'BLE MR. ARUN KUMAR TYAGI, JUDICIAL MEMBER
HON'BLE DR. AFROZ AHMAD, EXPERT MEMBER**

Applicant: Ms. Nishtha Kumar, Adv. (Through VC)

Respondent: Mr. Pallav Sisodia, Senior Advocate with Mr. Nishe Rajen Shonker, Adv.
for the State of Kerala
Mr. Jogy Scaria & Ms. Beena Victor, Advs. for KSPCB
Mr. Atmaram N.S. Nadkarni, Senior Advocate with Mr. Mahesh Agarwal &
Mr. Arshit Anand, Advs. for Adani Vizhinjam Port Pvt. Ltd.
Mr. Alex M. Scaria & Mr. John Thomas Arakkal, Advs. in I.A 440-
441/2023
Mr. Anshuman Shrivastava, Mr. Abhijeet Shrivastava & Ms. Usha
Nandini Advs. in I.A 442-444/2023
Mr. Abhilash M.R & Mr. Sayooj Mohandas, Advs.in M.A 85 to 88/2021
Mr. E.M.S. Anam & Mr. Vishnu Shankar, Advs. in M.A 81 to 83/2022
Mr. Abu John Mathew, Adv. for Rockfield Estates Pvt. Ltd. (Through VC)

ORDER

1. In this original application registered in *suo-moto* exercise of power the issue of providing safeguards against operation of stone quarries close to the residences and public roads in State of Kerala is involved.

2. The tribunal had earlier passed a detailed order in the matter which was subject matter of challenge by the aggrieved parties before the Hon'ble Supreme Court in Civil Appeal No. 6273/2021 and other Civil Appeals. The matter has been relegated by the Hon'ble Supreme Court permitting the parties to raise all permissible contentions before the tribunal.

3. In the previous proceedings the application for impleadment made by the different parties were allowed and a liberty was granted to all the newly added parties to file objections and reply. Certain objections and replies have been filed but grievance of some of the parties is that they have not received copies thereof. Hence we permit the parties to exchange the pleadings within a period of three weeks. The concerned parties who are yet to file their replies/objections may file the same within this period.

4. Considering the nature of controversy involved in this matter we deem it proper to appoint Mr. Raj Panjwani, Senior Advocate as the amicus in the matter who will be paid remuneration amounting to Rs. 25,000/- per hearing from the ring fenced account by the state of Kerla.

5. Ms. Nishtha Kumar, Advocate who was appearing for the applicant in original application has submitted that she has no instruction in the matter and she wants to withdraw from this case. The prayer is allowed.

6. List on 29.02.2024.

Prakash Shrivastava, CP

Sudhir Agarwal, JM

Arun Kumar Tyagi, JM

Dr. Afroz Ahmad, EM

January 03, 2024

Original Application No. 304/2019

(M.A. No. 81/2021, M.A. No. 83/2021, M.A. No. 96/2021,
I. A. No. 184/2022, I. A. No. 440/2023, I. A. No. 441/2023,
I. A. No. 443/2023 & I. A. No. 444/2023)

AS.

Item No.04

Court No. 1

**BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI**

Original Application No. 304/2019

(With report dated 17.12.2019)

M. Haridasan&Ors.

Applicant(s)

Versus

State of Kerala

Respondent(s)

Date of hearing: 28.02.2020

**CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER
HON'BLE MR. SIDDHANTA DAS, EXPERT MEMBER**

For Respondent(s): Mr. Jogy Scaria, Advocate and Mr. Keerthipriyan, Advocate for Kerala SPCB
Mr. Nishe Rajen Shonker, Advocate for State of Kerala
Mr. Rajkumar, Advocate for CPCB

ORDER

1. Issue for consideration is the safeguards in operation of stone quarries close to residence and public roads. At present, the Kerala State PCB has permitted the stone quarry beyond 50 mtrs. from residence and public roads. This Tribunal vide order dated 09.10.2019 considered the matter and observed:

“3. We find that the environmental norms require assessment of impact of such activities and mere distance of 50 mtrs. By itself is not enough to dispense with such norms. In absence of any study, any stone quarry near the residence and public road is bound to cause air and noise pollution even beyond 50 mtrs. In this regard, reference may be made of observations in the judgments of the Hon'ble Supreme Court in *M.C. Mehta v. Union of India*, (1996) 8 SCC 496 and *Mohammed Haroon Ansari v. District Collector, Ranga Reddy District*, (2004) 1 SCC 491. In granting EC, this

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consideration has to be kept in mind in view of the fact that clean and safe environment is a part of right to life.

4. *Accordingly, we direct State PCB to revisit the existing criteria based on an appropriate study. CPCB may give its view in the matter to the State PCB within two weeks in light of available expert studies on the subject. The State PCB may furnish its action taken report in the matter by e-mail at judigical-ngt@gov.in before the next date."*

2. Accordingly, a report has been filed by the Kerala State PCB on 17.12.2019 retreating the distance criteria of 50 mtrs. and mentioning that no study is available with the CPCB.

3. We are of the view, as earlier observed that the distance of 50 mtrs. for stone quarry, particularly when blasts are involved, is highly inadequate and can have deleterious effect on noise and air pollution, environment and public health.

4. In view of above, we direct the CPCB to examine and lay down more stringent conditions and appropriately longer distance within one month and convey the same to the State Boards. The State Board may take further action accordingly. Compliance reports be filed before the next date by email at judicial-ngt@gov.in.

List again on 08.05. 2020.

Adarsh Kumar Goel, CP

Dr.Nagin Nanda, EM

Siddhanta Das, EM

February 28, 2020
Original Application No. 304/2019
AK

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ANNEXURE-R-3

Item No. 09

Court No. 1

**BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI**

(By Video Conferencing)

Original Application No. 304/2019

(With report dated 09.07.2020)

M. Haridasan & Ors.

Applicant(s)

Versus

State of Kerala

Respondent(s)

Date of hearing: 21.07.2020

**CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE S. P. WANGDI, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER**Respondent(s): Ms. Soni Singh, Advocate for CPCB
Mr. Jogy Scaria, Advocate for KSPCB**ORDER**

1. The Issue for consideration is the safeguards in operation of stone quarries close to residences and public roads. At present, the Kerala State PCB has permitted the stone quarry beyond 50 mtrs. from residences and public roads.

2. The Tribunal considered the matter on 28.02.2020. Finding the distance to be inadequate, CPCB was required to consider the matter and report. It was observed:

"2. Accordingly, a report has been filed by the Kerala State PCB on 17.12.2019 retreating the distance criteria of 50 mtrs. and mentioning that no study is available with the CPCB.

3. We are of the view, as earlier observed that the **distance of 50 mtrs. for stone quarry, particularly when blasts are involved, is highly inadequate and can have deleterious effect on noise and air pollution, environment and public health.**
4. In view of above, we direct the **CPCB to examine and lay down more stringent conditions and appropriately longer distance within one month and convey the same to the State Boards.** The State Board may take further action accordingly. Compliance reports be filed before the next date by email at judicial-ngt@gov.in.”

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	<i>Residential/Public buildings, Inhabited sites, locations to be considered by States.</i>
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.

A copy of this order be sent to the CPCB and all the State PCBs/PCCs by email for compliance.

The application is disposed of.

Adarsh Kumar Goel, CP

S. P. Wangdi, JM

Dr. Nagin Nanda, EM

July 21, 2020
Original Application No. 304/2019
AK

3556 ANNEXURE R-4

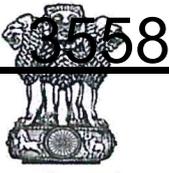
KADAVILA-1 STONE QUARRY		
NOC	B7-40269/2017	
LOI	9363/M3/2018	
Mine Plan Approval Letter	2436/DOT/ML/2020	
EC	02/2019	
CTO	PCB/TVM-DO/ICE/10171298/2019	
Panchayat License	1/2021-2022/A-2/150/21-22	
Explosives	E/SE/KL/22/331(E121778)	
Execution	10026/M3/2020	
Proceedings	490/2020-21/10026/M3/2020/DMG	
Notice of Opening Form D	Dated:	06.06.2019

KADAVILA-2&3 STONE QUARRY		
NOC	B7-17779/2018	
LOI	DMG/2879/2022-M3	
Mine Plan Approval Letter	2304/DOT/ML/18	
EC	92/Q/2022	
CTO	KSPCB/TV/ICO/10005087/2022	
Panchayat License	232/2022-2023/A-2/RPTL19/2139	
Explosives	E/SE/KL/22/331(E121778)	
Execution	DMG/2879/2022-M3	
Proceedings	30/2023-24/2879/M3/2022/DMG	
Notice of Opening Form D	Dated:	14.07.2023

MANICKAL STONE QUARRY		
NOC	B7-127329/2018	
LOI	5219/M3/2019	
Mine Plan Approval Letter	362/DOT/ML/18	
EC	29/2020	
CTO	PCB/TVM-DO/ICO/NDD-12806757/2020	
Panchayat License		
Explosives	E/SE/KL/22/331(E121778)	
Execution	7671/M3/2021	
Proceedings	428/2021-22/5219/M3/2019/DMG	
Notice of Opening Form D	Dated:	09.03.2022

KOODAL STONE QUARRY		
NOC	B7-186960/2018	
LOI	6676/M3/2019	
Mine Plan Approval Letter	1210/DOPTA/M/2019	
EC	88/Q/2022	
CTO	KSPCB/PT/ICO/10005066/2022	
Panchayat License	2359/22	
Explosives	E/SE/KL/22/331(E121778)	
Execution	DMG/3903/2022-M3	
Proceedings	125/2023-24/DMG/3903/2022-M3	
Notice of Opening Form D	Dated:	Not Yet Started

ARYANAD STONE QUARRY	
NOC	B7-14936/2018
LOI	5350/M3/2019
Mine Plan Approval Letter	360/DOT/ML/2019
EC	80/Q/2022
CTO	KSPCB/TV/ICO/10005098/2022
Panchayat License	JC-3/83/2023
Explosives	E/SE/KL/22/331(E121778)
Execution	DMG/301/2023-M1
Proceedings	85/2023-24/DMG/301/2023-M1
Notice of Opening Form D	Dated: Not Yet Started



सत्यमेव जयते

Validity expires on 28.02.2024

***Proceedings of the State Environment Impact Assessment
Authority Kerala***

*Present: Dr.H.Nagesh Prabhu, IFS (Rtd.), Chairman, Dr. K.Jayachandran, Member &
Dr.Usha Titus I.A.S Member Secretary.*

Sub: SEIAA- Environmental Clearance for the proposed building stone quarry project in Survey No. 555/2 at Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District, Kerala by Mr.Rajesh Jha, Chief Executive Officer, M/s Adani Vizhinjam Port Private Limited - Granted – Orders issued.

STATE ENVIRONMENT IMPACT ASSESSMENT AUTHORITY, KERALA

No. 1200/EC2/2018/SEIAA

Dated, Thiruvananthapuram 01.03.2019

- Ref: 1. Application received on 31.12.2018 from Mr.Rajesh Jha, Chief Executive Officer, M/s Adani Vizhinjam Port Private Limited, 2nd floor, Vipanchika Tower, Thycaud, Thiruvananthapuram – 695014
2. Minutes of the 90th meeting of SEAC held on 4th January, 2019
3. Minutes of the 92nd meeting of SEAC held on 22.01.2019
4. Minutes of the 89th meeting of SEIAA held on 27th February 2019.
5. Affidavit received on 28.02.2019 from Sri.Manoranjan Tripathy, Deputy General Manager- Projects, Adani Vizhinjam Port Pvt.Ltd.

ENVIRONMENTAL CLEARANCE NO.02/2019

Mr.Rajesh Jha, Chief Executive Officer, M/s Adani Vizhinjam Port Private Limited, 2nd floor, Vipanchika Tower, Thycaud, Thiruvananthapuram – 695014, vide the hardcopy of application received on 31.12.2018, has sought Environmental Clearance under EIA Notification, 2006 for the quarry project in Survey No. 555/2 at Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District, Kerala for an area of 3.6630 Ha. The project comes under Category B2, Activity 1(a), (i) as per the Schedule of EIA Notification 2006.

2. The proposed project site falls within Latitude 8^o43'42.88" N to 8^o33'51.74" N Longitude 76^o50'15.26" E to 76^o50'23.24" E . The lease area consists of 3.6630 hectares,

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which belongs to Government (Purambooke) land. The proposed project is for quarrying of 5,12,500 tonnes per annum. The daily water demand will be about 4 KLD, in which 2 KLD for domestic, 1KLD for plantation and 1KLD for dust suppression. The total project cost is 750 lakhs.

3. The proposal was placed in the 90th meeting of SEAC held on 4th January, 2019 and in the 92nd meeting of SEAC held on 22.01.2019. The Committee decided to recommend to issue EC subject to the following observations and conditions in addition to the general conditions.

1. *The NE and SW portion of the proposed quarry area is already mined to the localized baseline. Therefore, the area remaining to be mined out is the eastern portion of the proposed land.*
2. *On completion of the proposed mining activity, one quarter of the hillock under government land will vanish.*
3. *The geological reserve estimated is 51,96,250 tons out of which the mineable reserve is 17,78,750 tone (up to the bench level of 28m AMSL) and blocked reserve is 34,17,500 tons. The mineable reserve up to 40m AMSL is 15,07,500 tons. It means that if the total mineable quantity is allowed to be extracted, the mine will go below the present ground level of 40m AMSL by a depth of 12m creating a pit.*
4. *The reclamation and rehabilitation plan indicates that after the extraction over five years, there will a pit of 3 Ha out of which 0.95 Ha will be converted as a water pond and balance area of 2.05 Ha will be retained as pit.*
5. *The proposal for year-wise mining indicates that the extraction will be to the tune of 1,52,500 tons (1st year), 4,99,375 tons (2nd year), 5,12,500 tons (3rd year), 5,11,875 tons (4th year) and 1,02,500 tons (5th year). However, the proposal does not mention about the requirement for the next two years, during which it is understood that the breakwater construction will be over.*
6. *If we consider that the breakwater construction will be completed in two years and the quantity of stone projected for extraction in the first two years is the actual requirement for the proponent, then the quantity extracted will be 6,51,875 tons, i.e., 37% of the mineable reserve. If the mining is allowed upto the bench level of 70m as per the mine plan, the quantity extractable is 7,51,875 tons, i.e. 15% more than the requirement.*

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7. Kerala experiences intermittent micro earthquakes such as the ones in Nedumkandam in 1988 with 4.5 magnitude, Vadakkencherry in 1994 with 4.3 magnitude, Erattupetta in 2000 and 2001 with magnitudes 5 and 4.8 respectively, off the coast of Thiruvananthapuram in 2001 with magnitude 4.5 etc. Based on the studies on the causative factors of micro tremors in Kerala, it is understood that variation in hydraulic pressure in the near-surface joints and fractures, increased pore-pressure and its uncertain variations etc lead to disturbance in the subsurface rock formations. Studies also indicated that from among the micro-tremors recorded in the seismograph installed in Peechi between 2000 and 2008, 45% occurred between July and October and 29% between November and January when there is significant rainfall and groundwater recharge. It indicates that the landuse changes, hydraulic pressure build up, pore-pressure variations etc. could influence occurrence of micro-tremors. There have been micro-tremors centered around Vamanapuram in September 1988, Parippalli in December 1994, Kilimanur in August 2006 and Attingal in January 2008. It is suspected that the subsurface rock formations do not have adequate strength to absorb the high magnitude variations in the landuse pattern, landform changes, hydraulic pressure variations etc.. Therefore, there need to be utmost restraints in disturbing the natural landforms of the region.
8. The earlier quarrying of the hillock has left a vertical fall of 70m which is very dangerously poised. If mining is allowed as per mining rules, the vertical fall will become a bench cut which will improve the safety aspect of the frontal portion of the quarry.
9. Since the proposal is to extract stone from one portion of the hillock, there will not be complete removal of the hillock, thus overcoming the implications on micro-climate of the region.
10. There are other quarries in the vicinity of the proposed quarry, but not within 500m as per a document produced by the proponent. It may be verified whether the proponent has submitted the relevant documents along with the application for EC, so as to ensure that there are no quarries within the radius of 500m.
11. The mining is proposed with Non-electric detonator (NONEL) method thereby minimizing air blast, fly rock and ground vibration.
12. The proponent should be directed to constitute a Local Area Monitoring Committee, involving the Grama Panchayat.

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13. *No environmental management intervention could adequately mitigate the impacts caused due to the activities linked to quarrying/mining. However, the demand for building stones for essential developmental activities need to be met. Therefore, it is desirable to restrict mining to the minimum essential requirement so as to minimize the environmental impact as well as to protect the resource for future demand of development activities. Hence, mining should not be allowed for extracting the whole of mineable quantity but be permitted to meet the essential requirement. This approach will also minimize the change in landform.*
14. *The proponent may be permitted to extract a maximum of 7 lakh tons of building stone within a period of two years. Further permission for mining may be considered based on the requirement then and environmental assessment.*
15. *The proponent should be asked to comply with all mandatory environmental management conditions that are stipulated while giving EC for such mining projects.*
16. *The social and environmental needs of the locality should be assessed in consultation with the Local Governments based on which the Corporate Social & Environmental Responsibility should be exercised.*
4. The proposal was placed in the 89th meeting of SEIAA held on 27th February 2019. Authority decided to recommend for issuance of EC with general conditions in tune with KMMC Rules 2015 and its amendments and subject to the following specific conditions.
1. *The mining should be conducted with Non-electric detonator (NONEL) method thereby minimizing air blast, fly rock and ground vibration.*
 2. *Extract a maximum of 7 lakh tons of building stone within a period of two years. Further permission for mining may be considered based on the requirement then and environmental assessment.*
 3. *The proponent shall file an affidavit that he will expend Rs.15 lakhs as part of CER in consultation with Local Self Government.*
 4. *The proponent should follow the closure plans (progressive closure and final closure) as per KMMC Rules.*

The proponent has submitted notarised affidavit committing the CSR activities vide reference 5th cited.

5. Environmental Clearance as per the EIA Notification 2006 is hereby accorded for the quarry project of Mr.Rajesh Jha, Chief Executive Officer, M/s Adani Vizhinjam Port Private

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Limited, 2nd floor, Vipanchika Tower, Thycaud, Thiruvananthapuram – 695014 in Survey No. 555/2 at Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District, Kerala for an area of 3.6630 Ha, subject to the specific conditions as in para 4th above, all the environmental impact mitigation and management measures undertaken by the project proponent in the Form I, EMP, PFR and Mining plan submitted to SEIAA. The assurances and clarifications given by the proponent will be deemed to be a part of these proceedings as if incorporated herein. Also the general conditions for projects stipulated for mining (items 1 to 48), appended hereto will be applicable and have to be strictly adhered to.

6. The Clearance issued will also be subject to full and effective implementation of all the undertakings given in the application form, mitigation measures as assured in the Environment Management Plan and the mining features including progressive mine closure plan as submitted with the application and relied on for grant of this clearance. The above undertakings and the conditions and the undertakings in Chapter 2 (Mining) & (Blasting), Chapter 3 (Mines Drainage), Chapter 4 (Stacking of Mineral rejects and Disposal of waste) Chapter 8 (Progressive Mine Closure Plan) & EMP of the Mining Plan as submitted will be deemed to be part of this proceedings as conditions as undertaken by the proponent, as if incorporated herein.

7. Validity of the Environmental Clearance will be five years from the date of this clearance, subject to inspection by SEIAA on annual basis and compliance of the conditions, subject to earlier review of E.C in case of violation or non-compliance of conditions or genuine complaints from residents within the security area of the quarry.

8. Compliance of the conditions herein will be monitored by the State Environment Impact Assessment Authority or its authorised offices and also by the regional office of the Ministry of Environment & Forests, Govt. of India, Bangalore.

- i. Necessary assistance for entry and inspection should be provided by the project proponent and those who are engaged or entrusted by him to the staff for inspection or monitoring.
- ii. Instances of violation if any shall be reported to the District Collector, Thiruvananthapuram.

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- iii. The given address for correspondence with the authorised signatory of the project is Mr.Rajesh Jha, Chief Executive Officer, M/s Adani Vizhinjam Port Private Limited, 2nd floor, Vipanchika Tower, Thycaud, Thiruvananthapuram – 695014.

Sd/-

Dr.Usha Titus I.A.S
Member Secretary, SEIAA

To,

Mr.Rajesh Jha,
Chief Executive Officer,
M/s Adani Vizhinjam Port Private Limited,
2nd floor, Vipanchika Tower, Thycaud,
Thiruvananthapuram – 695014

Forwarded/By order



Administrator, SEIAA

Copy to,

1. MoEF Regional Office, Southern Zone, Kendriya Sadan, 4th Floor, E&F Wing, II Block, Koramangala, Bangalore-560034.
2. The Principal Secretary to Government, Environment Department, Government of Kerala.
3. District Collector, Thiruvananthapuram
4. Director, Mining & Geology, Thiruvananthapuram -4.
5. The Member Secretary, Kerala State Pollution Control Board
6. District Geologist, Thiruvananthapuram
7. Tahsildhar, Chirayinkeezhu Taluk, Thiruvananthapuram district
8. Village Officer, Nagaroor Village (Kadavila), Thiruvananthapuram
9. Chairman, SEIAA.
10. Website.
11. S/f
12. O/c



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STATE ENVIRONMENT IMPACT ASSESSMENT AUTHORITY KERALA
GENERAL CONDITIONS (for mining projects)

1. A separate environmental management and monitoring cell with qualified personnel should be set-up under the control of a Senior Executive, who will report directly to the Head of the Organization.
2. Suitable avenue trees should be planted along either side of the tarred road and open parking areas, if any, including of approach road and internal roads.
3. Sprinklers shall be installed and used in the project site to contain dust emissions.
4. Eco-restoration including the mine closure plan shall be done at the own cost of the project proponent.
5. In view of the deep pits left after the excavation, stacking at maximum top level should be carried out.
6. Corporate Environment Responsibility agreed upon by the proponent should be implemented.
7. The project proponent shall comply the conditions stipulated by the statutory authorities concerned.
8. Tarring /multiple options on the access roads shall be undertaken so as to reduce dust pollution during movement of vehicle.
9. Overburden materials should be managed within the site and used for reclamation of mine pit as per mine closure plan / specific conditions.
10. Height of benches should not exceed 5 m, and width should not be less than 5 m, if there is no mention in the mining plan/specific condition.
11. Ground level should be fixed in individual cases separately
12. No mining operations should be carried out at places having a slope greater than 45°.
13. Acoustic enclosures should have been provided to reduce sound amplifications in addition to the provisions of green belt and hollow brick envelop for crushers so that the noise level is kept within prescribed standards given by CPCB/KSPCB. This condition is applicable only in such cases if a crusher is adjacent to the quarry.
14. The workers on the site should be provided with the required protective equipment such as ear muffs, helmet, etc.
15. Garland drains with clarifiers to be provided in the lower slopes around the core area to channelize storm water.
16. The transportation of minerals should be done in covered trucks to contain dust emissions. The proponent should plant trees at least 5 times of the loss that has been occurred while clearing the land for the project. SEAC should assess the number of trees in each project site before the issuance of EC so as to ensure the promptness in planting.
17. Explosives should be stored in magazines in isolated place specified and approved by the Explosives Department.
18. A minimum buffer distance of 100m from the boundary of the quarry to the nearest dwelling unit or other structures, not being any facility for mining shall be provided.
19. 50 m buffer distance should be maintained from forest boundaries.
20. Consent from Kerala State Pollution Control Board under Water and Air Act(s) should be obtained before initiating mining activity.
21. All other statutory clearances should be obtained, as applicable, by project proponents from the respective competent authorities including that for blasting and storage of explosives.
22. In the case of any change(s) in the scope of the project, extent quantity, process of mining technology involved or in any way affecting the environmental parameters/impacts as assessed, based on which only the E.C is issued, the project would require a fresh appraisal by this Authority, for which the proponent shall apply and get the approval of this Authority.
23. The Authority reserves the right to add additional safeguard measures subsequently, if found necessary, and to take action including revoking of the environment clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.
24. The stipulations by Statutory Authorities under different Acts and Notifications should be complied with, including the p
1974, the Air (Prevention and c
1986, the Public Liability (Insura
tion and Control of Pollution) Act,
, the Environment (Protection) Act,
otification, 2006.

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25. The project proponent should advertise in at least two local newspapers widely circulated in the region, one of which (both the advertisement and the newspaper) shall be in the vernacular language informing that the project has been accorded Environmental Clearance and copies of clearance letters are available with the State Environment Impact Assessment Authority (SEIAA) office and may also be seen on the website of the Authority at www.seiaakerala.org. The advertisement should be made within 10 days from the date of receipt of the Clearance letter and a copy of the same signed in all pages should be forwarded to the office of this Authority as confirmation.
26. The Environmental Clearance shall be put on the website of the company by the proponent.
27. Proponent shall submit half yearly reports in soft copy and SEIAA will upload it on the website.
28. The details of Environmental Clearance should be prominently displayed in a metallic board of 3 ft x 3 ft with green background and yellow letters of Times New Roman font of size of not less than 40. Sign board with extent of lease area and boundaries shall be depicted at the entrance of the quarry, visible to the public
29. The proponent should provide notarized affidavit (indicating the number and date of Environmental Clearance proceedings) that all the conditions stipulated in the EC shall be scrupulously followed.
30. No change in mining technology and scope of working should be made without prior approval of the SEIAA, No further expansion or modifications in the mine shall be carried out without prior approval of the SEIAA, as applicable.
31. The Project proponent shall ensure that no natural water course and/or water resources shall be obstructed due to any mining operations. Necessary safeguard measures to protect the first order streams, if any, originating from the mine lease shall be taken.
32. The top soil, if any, shall temporarily be stored at earmarked site(s) only for the topsoil shall be used for land reclamation and plantation. The over burden (OB) generated during the mining operations shall be stacked at earmarked dump site(s) only. The maximum height of the dumps shall not exceed 8m and width 20m and overall slope of the dumps shall be maintained to 45°. The OB dumps should be scientifically vegetated with suitable native species to prevent erosion and surface run off. In critical areas, use of geo textiles shall be undertaken for stabilization of the dump. The entire excavated area shall be backfilled. Monitoring and management of rehabilitated areas should continue until the vegetation becomes self-sustaining.
33. Catch drains and siltation ponds of appropriate size shall be constructed around the mine working, mineral and OB dumps to prevent run off of water and flow of sediments directly into the river and other water bodies. The water so collected should be utilized for watering the mine area, roads, green belt development etc. The drains shall be regularly desilted particularly after monsoon and maintained properly.
34. Effective safeguard measures such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of PM₁₀ and PM_{2.5} such as haul Road, loading and unloading points and transfer points – it shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.
35. Fugitive dust emissions from all the sources should be controlled regularly. Water spraying arrangement on haul roads, loading and unloading and at transfer points should be provided and properly maintained.
36. Measures should be taken for control of noise levels below 85 dBA in the work environment.
37. The funds earmarked for environmental protection measures and CER activate should be kept in separate account and should not be diverted for other purpose. Year wise expenditure should be reported to the State Environment Impact Assessment Authority (SEIAA) office.
38. The Regional Office of MOEF & CC located at Bangalore shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (S) of the Regional Office by furnishing the requisite data/information/monitoring reports.
39. Any appeal against this Environmental Clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.
40. Concealing the factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environment (Protection) Act, 1986.
41. The SEIAA may revoke or suspend the order, for non implementation of any of the specific or this implementation of any of th
right to alter/modify the above environment protection. atisfactory. The SEIAA reserves the further condition in the interest of

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42. The above conditions shall prevail notwithstanding anything to the contrary, in consistent, or simplified, contained in any other permit, license on consent given by any other authority for the same project.
43. The Environmental Clearance will be subject to the final order of the courts in any pending litigation related to the land or project, in any court of law.
44. The mining operation shall be restricted to above ground water table and it should not intersect ground water table.
45. All vehicles used for transportation and within the mines shall have 'PUC' certificate from authorized pollution taking centre. Washing of all vehicles shall be inside the lease area'
46. Project proponent should obtain necessary prior permission of the competent authorities for drawal of requisite quantity of surface water and ground water for the project.
47. Regular monitoring of flow rates and water quality upstream and downstream of the springs and perennial nallahs flowing in and around the mine lease area shall be carried out and reported in the six monthly reports to SEIAA.
48. Occupational health surveillance program of the workers should be under taken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed.



For Member Secretary, SEIAA Kerala



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National Accreditation Board for
Testing and Calibration Laboratories
ANNEXURE-R6

CERTIFICATE OF ACCREDITATION

**STANDARDS ENVIRONMENTAL & ANALYTICAL
LABORATORIES**

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

**"General Requirements for the Competence of Testing &
Calibration Laboratories"**

for its facilities at

"STANDARDS", BUILDING NO. 338/A, B, C, D, E, EDAYAR, MUPPATHADAM P.O., KOCHI, ERNAKULAM,
KERALA, INDIA

in the field of

TESTING

Certificate Number: TC-12191

Issue Date: 05/09/2023

Valid Until:

20/11/2023

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: STANDARDS ENVIRONMENTAL & ANALYTICAL LABORATORIES

Signed for and on behalf of NABL



N. Venkateswaran
Chief Executive Officer

**TEST REPORT**

ULR No: TC1219123000002256F		
LRI No.: SEAAL23100422A	Date: 10-10-2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 28-09-2023

SAMPLE DETAILS			
Product Category	Atmospheric Pollution	Sample Code	EN23091096
Sample Name	Ambient Air	Sample Received on	29-09-2023
Sample Conditions at Receipt	Fit for Analysis	Test Commenced on	03-10-2023
Sampled by	Lab Authorized Sampler	Test Completed on	07-10-2023

DETAILS OF SAMPLING			
Sampling Location	Project Site	Date of Sampling	28-09-2023
Sampling Procedure	SEAAL/ENL/GEN/SOP/02	Humidity	65 %
Latitude	8° 43'48.11" N	Longitude	76° 50'23.12" E

INFORMATION PROVIDED BY CUSTOMER - SAMPLING SITE DETAILS			
Re - Survey No	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE					
SL NO	PARAMETERS	TEST METHOD	UNIT	RESULT	NAAQ STANDARD
1	Particulate matter, PM ₁₀	IS 5182 (Part 23): 2006	µg/m ³	69.4	100 (Max)
2	Particulate matter, PM _{2.5}	IS 5182 (Part 24): 2019	µg/m ³	37.8	60.0 (Max)
3	Sulphur dioxide as SO ₂	IS 5182 (Part 2): 2001	µg/m ³	BDL (LOD 4.00)	80.0 (Max)
4	Oxides of Nitrogen as NO ₂	IS 5182 (Part 6): 2006	µg/m ³	BDL (LOD 4.00)	80.0 (Max)

Note: BDL- Below Detection Limit

Remarks:

End of Report

Nesny A.K.
Chemist
Checked by



Laiju P.N.
Laboratory Head
Authorized Signatory

The results are related only to the samples submitted for analysis and this test report shall not be reproduced except in full, without the written approval of the laboratory.

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Accreditation & Approval: NABL accredited Testing Laboratory as per ISO/IEC 17025:2017

vide Certificate No. TC - 12191 & "A" Grade Laboratory approved by KSPCB.

'Standards' Bldg. No: 338/A,B,C,D,E (Behind BPCL Petrol Pump), Edayar, Muppathadam P.O., Ernakulam Dist. - 683110

Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

**TEST REPORT**

ULR No: TC1219123000002258F		
LRI No.: SEAAL23100424A	Date: 10-10-2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 28-09-2023

SAMPLE DETAILS			
Product Category	Atmospheric Pollution	Sample Code	EN23091098
Sample Name	Ambient Air	Sample Received on	29-09-2023
Sample Conditions at Receipt	Fit for Analysis	Test Commenced on	03-10-2023
Sampled by	Lab Authorized Sampler	Test Completed on	07-10-2023

DETAILS OF SAMPLING			
Sampling Location	Vanchiyoor UP School West Side (1 Km away from Project Site)	Date of Sampling	28-09-2023
Sampling Procedure	SEAAL/ENL/GEN/SOP/02	Humidity	65 %
Latitude	8° 43'42.7" N	Longitude	76° 50'16.1" E

INFORMATION PROVIDED BY CUSTOMER - SAMPLING SITE DETAILS			
Re - Survey No	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE					
SL NO	PARAMETERS	TEST METHOD	UNIT	RESULT	NAAQ STANDARD
1	Particulate matter, PM ₁₀	IS 5182 (Part 23): 2006	µg/m ³	60.7	100 (Max)
2	Particulate matter, PM _{2.5}	IS 5182 (Part 24): 2019	µg/m ³	26.9	60.0 (Max)
3	Sulphur dioxide as SO ₂	IS 5182 (Part 2): 2001	µg/m ³	BDL (LOD 4.00)	80.0 (Max)
4	Oxides of Nitrogen as NO ₂	IS 5182 (Part 6): 2006	µg/m ³	BDL (LOD 4.00)	80.0 (Max)

Note: BDL- Below Detection Limit
Remarks:

End of Report

Nesny A.K.

Nesny A.K.
Chemist
Checked by



Laiju P.N.

Laiju P.N.
Laboratory Head
Authorized Signatory

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Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

Standards

ANNEXURE R-9



TEST REPORT

ULR No: TC1219123000002259F		
LRI No.: SEAAL23100425A	Date: 10-10-2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 28-09-2023

SAMPLE DETAILS			
Product Category	Atmospheric Pollution	Sample Code	EN23091099
Sample Name	Ambient Air	Sample Received on	29-09-2023
Sample Conditions at Receipt	Fit for Analysis	Test Commenced on	03-10-2023
Sampled by	Lab Authorized Sampler	Test Completed on	07-10-2023

DETAILS OF SAMPLING			
Sampling Location	St. Joseph of Cluny Public School - South side (850 m away from Project Site)	Date of Sampling	28-09-2023
Sampling Procedure	SEAAL/ENL/GEN/SOP/02	Humidity	65 %
Latitude	8° 43'37.63" N	Longitude	76° 50'49.33" E

INFORMATION PROVIDED BY CUSTOMER - SAMPLING SITE DETAILS			
Re - Survey No	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE					
SL NO	PARAMETERS	TEST METHOD	UNIT	RESULT	NAAQ STANDARD
1	Particulate matter, PM ₁₀	IS 5182 (Part 23): 2006	µg/m ³	72.5	100 (Max)
2	Particulate matter, PM _{2.5}	IS 5182 (Part 24): 2019	µg/m ³	37.5	60.0 (Max)
3	Sulphur dioxide as SO ₂	IS 5182 (Part 2): 2001	µg/m ³	BDL (LOD 4.00)	80.0 (Max)
4	Oxides of Nitrogen as NO ₂	IS 5182 (Part 6): 2006	µg/m ³	BDL (LOD 4.00)	80.0 (Max)

Note: BDL- Below Detection Limit

Remarks:

End of Report

Nesny A.K.

Nesny A.K.
Chemist
Checked by



Laiju P.N.

Laiju P.N.
Laboratory Head
Authorized Signatory

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TEST REPORT

ULR No: TC1219123000002260F		
LRI No.: SEAAL23100426A	Date: 10-10-2023	Page 1 of 1

CUSTOMER DETAILS	
Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 28-09-2023

SAMPLE DETAILS			
Product Category	Atmospheric Pollution	Sample Code	EN23091100
Sample Name	Ambient Air	Sample Received on	29-09-2023
Sample Conditions at Receipt	Fit for Analysis	Test Commenced on	03-10-2023
Sampled by	Lab Authorized Sampler	Test Completed on	07-10-2023

DETAILS OF SAMPLING			
Sampling Location	Viswanadhapuram Shiva Temple East Side (650 m away from Project Site)	Date of Sampling	28-09-2023
Sampling Procedure	SEAAL/ENL/GEN/SOP/02	Humidity	65 %
Latitude	8° 44'9.02" N	Longitude	76° 50'18.82" E

INFORMATION PROVIDED BY CUSTOMER - SAMPLING SITE DETAILS			
Re - Survey No	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE					
SL NO	PARAMETERS	TEST METHOD	UNIT	RESULT	NAAQ STANDARD
1	Particulate matter, PM ₁₀	IS 5182 (Part 23): 2006	µg/m ³	58.4	100 (Max)
2	Particulate matter, PM _{2.5}	IS 5182 (Part 24): 2019	µg/m ³	27.3	60.0 (Max)
3	Sulphur dioxide as SO ₂	IS 5182 (Part 2): 2001	µg/m ³	BDL (LOD 4.00)	80.0 (Max)
4	Oxides of Nitrogen as NO ₂	IS 5182 (Part 6): 2006	µg/m ³	BDL (LOD 4.00)	80.0 (Max)

Note: BDL- Below Detection Limit
Remarks:

End of Report

Nesny

Nesny A.K.
Chemist
Checked by



Laiju

Laiju P.N.
Laboratory Head
Authorized Signatory

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Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

**TEST REPORT**

ULR No: TC121912300002257F		
LRI No.: SEAAL23100423A	Date: 10-10-2023	Page 1 of 2

CUSTOMER DETAILS	
Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 28-09-2023

SAMPLE DETAILS			
Product Category	Atmospheric Pollution	Sample Code	EN23091097
Sample Name	Ambient Air	Sample Received on	29-09-2023
Sample Conditions at Receipt	Fit for Analysis	Test Commenced on	03-10-2023
Sampled by	Lab Authorized Sampler	Test Completed on	07-10-2023

DETAILS OF SAMPLING			
Sampling Location	Near Operators Rest Room North Side (250 m away from Project Site)	Date of Sampling	28-09-2023
Sampling Procedure	SEAAL/ENL/GEN/SOP/02	Humidity	65 %
Latitude	8° 43'48.63" N	Longitude	76° 50'12.46" E

INFORMATION PROVIDED BY CUSTOMER - SAMPLING SITE DETAILS			
Re - Survey No	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE					
SL NO	PARAMETERS	TEST METHOD	UNIT	RESULT	NAAQ STANDARD
1	Particulate matter, PM ₁₀	IS 5182 (Part 23): 2006	µg/m ³	64.5	100 (Max)
2	Particulate matter, PM _{2.5}	IS 5182 (Part 24): 2019	µg/m ³	35.3	60.0 (Max)
3	Sulphur dioxide as SO ₂	IS 5182 (Part 2): 2001	µg/m ³	BDL (LOD 4.00)	80.0 (Max)
4	Oxides of Nitrogen as NO ₂	IS 5182 (Part 6): 2006	µg/m ³	BDL (LOD 4.00)	80.0 (Max)

Note: BDL- Below Detection Limit
Remarks:

End of Report

Nesny A.K.
Chemist
Checked by



Laiju P.N.
Laboratory Head
Authorized Signatory

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TEST REPORT

ULR No: TC121912300005063F

LRI No.: SEAAL23111526A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110781
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	10.45 am to 10.47 am
Latitude	8° 43'48.0" N	Longitude	76° 50'12.6" E
Monitoring Location	Kukku House (231 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	73.8

End of Report

Nesny A.K.
Chemist
Checked by



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Laboratory Head
Authorized Signatory

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TEST REPORT**ULR No: TC121912300005062F**

LRI No.: SEAAL23111525A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110780
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	10.45 am to 10.47 am
Latitude	8° 43'44.6" N	Longitude	76° 50'18.4" E
Monitoring Location	50 m Radius (50 m away from the Blasting Area)	Instrument Serial No	670501

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	76.3

End of Report



Nesny A.K.
Chemist
Checked by




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Laboratory Head
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TEST REPORT**ULR No: TC121912300005063F**

LRI No.: SEAAL23111526A

Date:

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110781
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	10.45 am to 10.47 am
Latitude	8° 43'48.0" N	Longitude	76° 50'12.6" E
Monitoring Location	Kukku House (231 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	73.8

End of Report



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TEST REPORT**ULR No: TC121912300005064F**

LRI No.: SEAAL23111527A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110782
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	10.45 am to 10.47 am
Latitude	8° 43'48.12" N	Longitude	76° 50'17.27" E
Monitoring Location	Boundary Pillar (B.P)-2 (111 m away from the Blasting Area)	Instrument Serial No	21389

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	66.5

End of Report



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TEST REPORT**ULR No: TC121912300005065F**

LRI No.: SEAAL23111528A

Date: 20-11-2023

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CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110783
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	11.01 am to 11.03 am
Latitude	8° 43'52.6" N	Longitude	76° 50'18.6" E
Monitoring Location	Ajay House (222 m away from the Blasting Area)	Instrument Serial No	21389

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	65.5

End of Report



Nesny A.K.
Chemist
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TEST REPORT**ULR No: TC121912300005066F**

LRI No.: SEAAL23111529A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110784
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	11.01 am to 11.03 am
Latitude	8° 43'51.74" N	Longitude	76° 50'17.27" E
Monitoring Location	Boundary Piller-3 (198 m away from the Blasting Area)	Instrument Serial No	670501

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	74.6

End of Report



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Chemist
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TEST REPORT

ULR No: TC121912300005067F

LRI No.: SEAAL23111530A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110785
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	11.01 am to 11.03 am
Latitude	8° 43'38.5" N	Longitude	76° 50'15.9" E
Monitoring Location	Babu House (245 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	70.8

End of Report



Nesny A.K.
Chemist
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TEST REPORT**ULR No: TC121912300005068F**

LRI No.: SEAAL23111531A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110786
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	1.57 pm to 1.59 pm
Latitude	8° 43'46.8" N	Longitude	76° 50'26.9" E
Monitoring Location	Trissulam Area (214 m away from the Blasting Area)	Instrument Serial No	670501

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	69.1

End of Report



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Chemist
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TEST REPORT**ULR No: TC121912300005069F**

LRI No.: SEAAL23111532A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110787
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	1.57 pm to 1.59 pm
Latitude	8° 43'45.2" N	Longitude	76° 50'31.2" E
Monitoring Location	Temple (343 m away from the Blasting Area)	Instrument Serial No	21389

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	71.2

End of Report



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TEST REPORT

ULR No: TC121912300005070F

LRI No.: SEAAL23111533A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110788
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	1.57 pm to 1.59 pm
Latitude	8° 43'44.0" N	Longitude	76° 50'29.7" E
Monitoring Location	Temple Shed (301 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	66.2

End of Report



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Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

TEST REPORT**ULR No: TC121912300005071F**

LRI No.: SEAAL23111534A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110789
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	2.11 pm to 2.12 pm
Latitude	8° 43'41.70" N	Longitude	76° 50'24.14" E
Monitoring Location	175 m Radius (175 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	71.9

End of Report



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Chemist
Checked by




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TEST REPORT**ULR No: TC1219123000005072F**

LRI No.: SEAAL23111535A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110790
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	2.11 pm to 2.12 pm
Latitude	8° 43'27.9" N	Longitude	76° 50'22.3" E
Monitoring Location	Kadavila Junction (553 m away from the Blasting Area)	Instrument Serial No	670501

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	72.9

End of Report



Nesny A.K.
Chemist
Checked by




Laiju P.N.
Laboratory Head
Authorized Signatory

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vide Certificate No. TC - 12191 & "A" Grade Laboratory approved by KSPCB.

'Standards' Bldg. No: 338/A,B,C,D,E (Behind BPCL Petrol Pump), Edayar, Muppathadam P.O., Ernakulam Dist. - 683 110
Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

TEST REPORT**ULR No: TC121912300005074F**

LRI No.: SEAAL23111537A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110792
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	2.25 pm to 2.26 pm
Latitude	8° 43'44.83" N	Longitude	76° 50'23.24" E
Monitoring Location	Boundary pillar (B.P)-4 (103 m away from the Blasting Area)	Instrument Serial No	685810

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	71.6

End of Report



Nesny A.K.
Chemist
Checked by




Laiju P.N.
Laboratory Head
Authorized Signatory

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TEST REPORT**ULR No: TC121912300005075F**

LRI No.: SEAAL23111538A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110793
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	2.25 pm to 2.26 pm
Latitude	8° 43'41.7" N	Longitude	76° 50'17.3" E
Monitoring Location	Rest Shelter (146 m away from the Blasting Area)	Instrument Serial No	670501

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	70.5

End of Report



Nesny A.K.
Chemist
Checked by




Laiju P.N.
Laboratory Head
Authorized Signatory

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Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

TEST REPORT**ULR No: TC1219123000005076F**

LRI No.: SEAAL23111539A

Date: 20-11-2023

Page 1 of 1

CUSTOMER DETAILS

Customer Name & Address	M/s Adani Vizhinjam Port Pvt Ltd Nagaroor, Chirayinkeezhu, Thiruvananthapuram District.
Customer Reference	Test Request date: 20-11-2023

SAMPLE DETAILS

Product Category	Atmospheric Pollution	Sample Code	EN23110794
Sample Name	Noise Level	Monitoring Commenced on	20-11-2023
Test Method	IS 9989:1981 RA:2008	Monitoring Completed on	20-11-2023
Sampled by	Lab Authorized Sampler	Blasting Time	2.25 pm to 2.26 pm
Latitude	8° 43'53.5" N	Longitude	76° 50'24.0" E
Monitoring Location	Muralidharan House (272 m away from the Blasting Area)	Instrument Serial No	21389

SAMPLING SITE DETAILS

Survey No.	555/2, Block No.37		
Village	Nagaroor	Taluk	Chirayinkeezhu
District	Thiruvananthapuram	State	Kerala

TEST RESULTS-CHEMICAL DISCIPLINE

SL NO	SOURCE	UNIT	RESULT
1	Ambient Sound Level (Leq)	dB (A)	69.0

End of Report



Nesny A.K.
Chemist
Checked by




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Laboratory Head
Authorized Signatory

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Tel. 0484-2546660, 93872 72402, 90743 41443, Web: www.sealabs.in, E-mail: seaalab@gmail.com

**Scientific Study on Blast Induced Ground Vibration for
Kadavila-1 Stone Quarry, Nagaroor Village, Chirayinkeezh
Taluk, Thiruvananthapuram District, Kerala of
M/s. Adani Vizhinjam Port Private Limited**

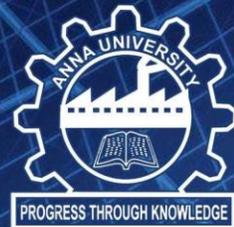


Submitted

adani

Adani Vizhinjam Port Private Limited
(AVPPL)

To
Adani Vizhinjam Port Pvt Ltd
2nd Floor, Vipanchika Tower, Thycaud
Thiruvananthapuram
Kerala - 695014



By
Dr. P. Balamadeswaran
Department of Mining Engg.
Anna University
Chennai 600 025

3589

Scientific Study on Blast Induced Ground Vibration
for Kadavila-1 Stone Quarry, Nagaroor Village,
Chirayinkeezh Taluk, Thiruvananthapuram District,
Kerala

adani

M/s. Adani Vizhinjam Port Private Limited

Submitted

by

Dr. P. Balamadeswaran

Department of Mining Engineering



College of Engineering Guindy
Anna University Chennai

Scientific Study on
Blast Induced Ground Vibration for Kadavila-1 Stone Quarry,
Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram, Kerala
of M/s. Adani Vizhinjam Port Private Limited

ACKNOWLEDGEMENTS

The author is greatly indebted to the management of M/S **M/s. Adani Vizhinjam Port Private Limited**, for awarding the Scientific Investigation to the Department of Mining Engineering, Anna University, Chennai.

We are very much thankful to Shri. **Rajesh Kumar Jha**, Chief Executive Officer & MD, Shri. **Vaddi Venkataramana**, Associate General Manager (Techno Commercial), Shri. **Biju Thomas Mathew**, Senior Officer (Techno Commercial) and Shri. **Palanivelu Kumar**, Mines Manager, Shri **N. Saravanan**, Asst Mine Manager, Shri. **G. Selvakumaresh**, Mine Foreman, Shri. **S. Madasamy**, Mining Mate of M/s. Adani Vizhinjam Port Pvt Ltd for their support during the blast vibration monitoring and for the help rendered in collecting the field data.

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Special thanks are due to Shri. S. Muthubharathi, Shri. S. Muthusankaranarayanan, Shri. E. Raghul, final year students of B.E. Mining Engineering, Anna University, Chennai for helping in carrying out the vibration monitoring in the field.

We express our sincere gratitude to Anna University and its officials for permitting us to take up the work.




28/06/2024

(Dr. P. BALAMA DESWARAN)
Assistant Professor

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Assistant Professor
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ANNA UNIVERSITY
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CERTIFICATION

Certified that this project report (No: AU/CEG/MN/1034/2020-2021) titled "Scientific Study on Blast Induced Ground Vibration for Kadavila-1 Stone Quarry, Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram, Kerala of M/s. Adani Vizhinjam Port Private Limited" is the bonafide work of Department of Mining Engineering, Anna University carried out under my supervision. I hereby affirm, to the best of knowledge and belief, based on the inspections, observations, field trials and upon the equations developed, that this Scientific Study on Blast Induced Ground Vibration for Kadavila-1 Stone Quarry, Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram, Kerala of M/s. Adani Vizhinjam Port Private Limited is completed and operable. The project was completed in accordance with the statutory requirements of act, regulations made thereunder and other provisions as recommended by the regulatory body (DGMS).


28/06/2021

(Dr. P. BALAMADESWARAN)
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Scientific Study on
Blast Induced Ground Vibration for Kadavila-1 Stone Quarry,
Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram, Kerala
of M/s. Adani Vizhinjam Port Private Limited

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Scientific Study on
Blast Induced Ground Vibration for Kadavila-1 Stone Quarry,
Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram
District, Kerala of M/s. Adani Vizhinjam Port Private Limited

EXECUTIVE SUMMARY

The scientific investigation is aimed at assessing the influence of blasting, principally the ground vibrations and noise levels in the Kadavila-1 Stone Quarry of M/s. Adani Vizhinjam Port Private Limited, Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram District, Kerala on the residential and other buildings of the neighbouring villages.

OBJECTIVES

- Study the existing blasting, its design and its influence on the surroundings in respect of blast induced ground vibrations.
- Design of trial blasts which will
 - restrict blast induced ground vibrations to levels that are tolerable on the residential and other civil structures not belonging to the quarry owner.
 - restrict generation of fly-rock and their throw to eliminate adverse effect on the residents and agricultural lands of the Nagaroor (Kadavila) village.
- Carry out at least 10 controlled trial blasts and monitor blast induced ground vibrations at least in 25 points and study the distance to which flying fragments are produced.
- Submit the report including suggesting suitable controlled blasting technique(s) including maximum explosive charge per delay in the Kadavila-1 Stone Quarry that will limit the blast induced ground vibrations to permissible levels and also suggesting suitable methodology for carrying out regular drilling, controlled blasting operations in the quarry and the appropriate safety measures to be taken to guard against blast induced vibrations and fly-rock.

FIELD INVESTIGATIONS

The Kadavila-1 Stone Quarry is drilling 33 mm diameter holes with Jack hammer drilling machines and blasting with the cap-sensitive Emulsion explosive cartridges of 25 mm diameter. The mine management is presently blasting three to five rows of holes with NONELs having in-hole delay of 250 ms & surface delays of 17/25 ms to mitigate adverse impacts such as air blast, fly rock and ground vibration. The instantaneous electrical detonators are being used for initiating the blasting circuit prepared with NONEL based detonators.

In order to carry out the controlled blasting operations in the Kadavila-1 Stone Quarry approaching towards surrounding villages, the quarry management intended to get the matter scientifically investigated for adopting properly designed controlled blasting techniques to restrict the blast induced ground vibrations to less than the permissible levels the structures in question can tolerate without damage.

The author of this report have carried out ground vibration monitoring of **10 Nos. of controlled trial blasts** with FIVE numbers of seismographs by locating them at different locations in the surface and sensitive buildings located nearer to the Kadavila-1 Stone Quarry at various distances (in the villages as well as inside the quarry) from the blasting site (a total recordings of **47** and the instruments triggered only at 36 stations). These trial blasts were carried out during the period from 16.03.2021 to 17.03.2021.

RESULTS AND DISCUSSIONS

Ten trial blasts were carried out 16.03.2021 to 17.03.2021 and blast vibrations were monitored using five seismographs located at various distances. The minimum and maximum charge per delay varied from 1.07 to 2.17 kg. A maximum of 80 holes were drilled with jack hammer drilling equipment with a maximum number of holes per delay of six. In all the 10 trial blasts, ground vibrations were monitored at 47 locations around the blasting sites and neighbouring village. Out of the total 47 measurements made, vibrations were recorded by the instruments only at 36 stations. The vibrations recorded behind the blast free face were of highest magnitude. The magnitude of vibration recorded in the flank of direction of initiation was lower than those on the opposite side of the flank of blast initiation.

All the 10 blasts were carried out using NONEL shock tube detonators with an in-hole delay of 250 ms and surface delay of 25 ms. Fast attenuation of vibration was recorded at shorter distances whereas at far-off distances the attenuation was slow and was influenced by low frequency blast wave characteristics.

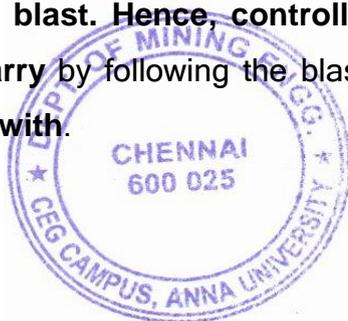


The recorded dominant frequencies of vibrations were in the range of 7.5 to 256 Hz. The Fast Fourier Transform (FFT) analyses of vibration data revealed that the concentration of vibration energy was in the range of 29.30 to 170.6 Hz. However, keeping in view the minimum frequency recorded during the trial blasts and the maximum peak particle velocity (PPV), structures of any type, can tolerate without damage or fall within the frequency range of 8 to 25 Hz. However, to avoid confusion for the people in the field, the maximum explosive charge per delay is calculated for this quarry to restrict the peak particle velocity to 5.0 mm/s only (irrespective of the type of structure), which is more conservative and safer as shown in the Table 2.1. Further it will secure the safety of Domestic houses & structures/Residential buildings located in the Nagaroor Village, Chirayinkeezhu Taluk, Thiruvananthapuram District, Kerala whose safety is also very important.

The analyses of vibration data recorded from detonation of blasts with higher amount of explosives generated higher level of vibrations at near-by-distances in comparison to the blasts which were detonated at the same bench face with lesser amount of explosives although the blast design and explosives parameters were kept identical. The explosives detonated in a delay in both the blasts were similar in weight.

The propagation equation for prediction of blast vibration have been established and are given as Equations 3. The permissible explosive weight per delay may be computed from the Equation to contain vibration within safe limits for distances of houses/structures concerned. For convenience, the permissible explosive weight per delay has been computed and is given in Table 3.22.

Based on the scientific study, it is concluded that **the blast induced ground vibrations and noise levels generated by the controlled blasting carried out in Kadavila-1 Stone Quarry was within permissible level and therefore is not affecting the residential buildings and other structures. Further, it has been observed that no flying fragments or projectiles travelled beyond 10 m from the site of blast. Hence, controlled blasting can be carried out at Kadavila-1 Stone Quarry by following the blasting parameters as recommended in the Table given herewith.**




28/06/2020

(Dr. P. BALAMADESWARAN)
Consultant



**SUMMARY OF SUGGESTED CONTROLLED BLAST DESIGN FOR
M/S. KADAVILA-1 STONE QUARRY**

Sl. No.	Parameter		Value
1.	Blast hole diameter		33 mm
2.	Burden		1.2 m
3.	Spacing		1.5 m
4.	Height of the bench		6.00 m
5.	Stemming length		Minimum 0.70 m
6.	Drilling patterns to be followed		Rectangular / Staggered
7.	Specific charge	For creating Initial (Box) Cut	0.16 to 0.17 kg/m ³
		For production blasting	0.15 to 0.16 kg/m ³
8.	Loading Density	Cap-sensitive Emulsion (or) Slurry Cartridges	0.26 kg/m
9.	Average explosive Quantity/hole	Cap-sensitive Emulsion (or) Slurry Cartridges	0.50 kg
10.	Maximum explosive charge per drillhole during production blasting	Cap-sensitive Emulsion (or) Slurry Cartridges	125 g
11.	Detonators recommended		NONEL based detonators of 17/25 ms surface delay with an in-hole delay of 250 ms
12.	Type of explosive recommended		Emulsion (or) slurry cartridge type (ø=25 mm)
13.	Initiation system recommended		Inverse initiation
14.	Method of connecting detonator		Series
15.	Maximum charge per delay		As stated in Table 3.22 based on the distance of the blasting site from the structure and the type of structure to be protected

Team Members involved in this study

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CHAPTER 1

INTRODUCTION

1.0 GENERAL

In modern mining era, the blasting technique is one of the most adopted techniques for rock breakage and fragmentation due to its economical and efficient aspects. However, the use of explosives for the blasting operation is limited by statutory regulations as it may have a severe impact on the surrounding environment such as vibration, noise and dust. Especially, a ground vibration induced by blasting has to be paid much attention in the mining operation as it may give an obvious impact on the surrounding facilities and buildings.

Many researches established safe level for blasting criteria, the ground vibration level is characterized by using three parameters; duration, amplitude (peak particle velocity: PPV) and frequency. Current studies on the blast-induced ground vibration is focused on two parameters amplitude (PPV) and frequency suggested by Directorate General of Mines Safety (DGMS) when the concerned subject is structure. Hence, the control of PPV and dominant frequency are very important in order to design an appropriate blasting standard and minimize its environmental impacts.

1.1 BLAST INDUCED GROUND VIBRATIONS - BACKGROUND

Globally, blasting is the principal method of rock breaking in mining and construction industry because of its distinct advantages like economy, efficiency, convenience, ability to achieve large production, high productivity and ability to break the hardest of the rocks.

When an explosive or a blasting agent is initiated, the chemical energy of it is converted into mechanical energy, which is used for breaking the rock. Even in a properly designed blast, only a portion of the total energy of the explosive is used for fragmenting and displacing the rock and the rest utilized in producing undesirable environmental effects like ground vibrations, fly rock, air overpressure (noise) and over-break making them an integral part of blasting. These undesirable effects cause damage to the civil, mining, defence structures and other properties in the vicinity.

With increasing mining and construction activities in areas close to human settlements, ground vibration has become a critical environmental issue as it can cause human annoyance and structural damage.

The adverse environmental effects produced by blasting cannot be totally eliminated, but effectively controlled by proper design of appropriate controlled blasting techniques. Further, optimum design of blast, based on scientific investigations relating to the explosives used, rock properties and other geological aspects, which are site specific, can also address the issues.

Some of the explosive energy (left over after rock breaking), of blasting, is transmitted to the surrounding rocks as elastic waves. As these waves travel, they displace particles in their path causing the particles to oscillate before returning to their original positions. These oscillations constitute ground vibrations. Special three dimensional seismographs are used to measure these vibrations in terms of displacement, velocity, acceleration and frequency.

The ground vibrations generated from the blast are compressive in nature and spread away from the blasting site in all directions like ripples spreading outwards when a stone is dropped in still water in a pond or tank. When these waves reach a free face, they get reflected back and get converted into tensile waves and cause breaking of rock (as rock is weak in tension). When no free face is available, they travel to a longer distance and finally get attenuated. These waves, which are not doing any useful work of breaking the rock, generate ground vibrations and cause damage to the surface structures like dams, places of worship, structures of archaeological importance, quarry slopes, residential buildings, etc. and also underground excavations. The ground vibrations have three mutually perpendicular components namely radial (**R**), transverse (**T**) and vertical (**V**).

1.2 Factors Influencing Blast Induced Ground Vibrations

From the literature, it can be seen that peak particle velocity (PPV) and the frequency of the vibrations are the most important parameters over which the stability of the structures depend. Peak particle velocity is defined as the *greatest velocity with which the ground vibrates during the vibration history and the same is*



measured in millimetres per second. Frequency is the number of cycles of the to- and- fro movement of ground particles per second. The units for measurement of frequency are Hz. The frequency of vibrations depends on the geology of the area, the rock type, etc.

When the frequency of the vibrations is equal to the natural frequency of the structures, maximum damage occurs to the structure. The range of natural frequency of surface civil structures is given in **Table 1.0**

Table 1.0 Natural frequency of surface civil structures (as per Central Mining and Fuel Research Institute (CMFRI), Council for Scientific and Industrial Research, Govt. of India Laboratory (Report 1991))

Type of Structure	Natural Frequency, Hz
Single storey brick structures	12-14
Double storey brick structures	8 - 10
Concrete Structures	9 - 16

In addition, blast induced ground vibrations are dependent on many more factors like type of rock and its properties, geological parameters, maximum charge per delay, strength of the explosive, distance of the structure from the blasting site, time delay between holes and rows, choking at the toe of the bench, priming sequence, sequence of blast hole detonation, spacing between holes and burden, angle of drill holes, stemming depth and type, charge length and diameter, confinement, blast geometry, total charge, etc. Amongst them, type of rock and its properties, the charge per delay and the distance of the blasting site from the structures are the most important ones. To keep the ground vibrations within desired levels, a clear understanding of the causes or factors, which influence generation, and propagation of ground vibration is essential.



1.3 Permissible Limits of Blast Induced Ground Vibrations –Peak Particle Velocity (PPV) for Surface Structures

The permissible levels of vibrations of various surface civil structures and other details specified by Directorate General of Mines Safety (DGMS), Dhanbad and others are given in **Tables 1.2 to 1.8**

Table 1.2 Directorate General of Mines Safety (DGMS) suggested peak particle velocities (PPV) various types of civil structures can tolerate without damage {DGMS (Tech) (S&T) Circular No.7 of 1997} (Ministry of Labour, Govt. of India)

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

Findings of some of the researchers in their investigations regarding the damages to residential structures due to blast induced ground vibrations are given in **Table 1.7**

Table 1.3 Safe Peak Particle Velocities (PPV) Surface Structures can withstand Without Damage as per Indian Standards (IS: 6922 – 1973)

Sl. No.	Type of strata	Maximum permissible PPV, mm/s	
		Where no monitoring is done	Where monitoring is done using suitable instruments
1.	Soils, weathered or soft rocks	50	70
2.	Hard rocks	70	100
Note: (1) <i>the values suggested above are lower than those which may be intolerable to human beings.</i>			
(2) <i>the suggested values are appropriate for masonry and will be conservative for concrete of M_{15} ($\sigma_c = 15$ MPa) quality</i>			



Table 1.4 USA standard (as per Siskind, et al, 1980)

Type of structure	Peak particle velocity, mm/s	
	Frequency (<40 Hz)	Frequency (>40 Hz)
Modern homes, dry wall interior	18.75	50
Older homes, plaster on wood lath construction	12.5	50

Table 1.5 Australian standard 2008 (AS 2187.2)

Type of structure	Maximum values
Historical building and monuments and building of special value	0.2 mm displacement for frequencies less than 15 Hz.
Houses and low rise residential buildings, commercial buildings not included below.	19 mm/s resultant ppv for frequency greater than 15 Hz
Commercial buildings and industrial buildings or structural of reinforced concrete or steel construction	0.2 mm maximum displacement corresponds to 12.5 mm/s ppv at 10 Hz and 6.25 mm/s at 5 Hz

Table 1.6 German standard (as per German DIN 4150, 1986)

Type of structure	Peak particle velocity at foundation, mm/s		
	<10 Hz	10-50 Hz	50-100 Hz
Offices and industrial premises	20	20-40	40-50
Domestic houses and similar constructions	5	5-15	15-20
Buildings that do not come under the above because of their sensitivity to vibrations	3	3-8	8-10

Table 1.7 Range of Common Residential Criteria and Effects suggested by other researchers

Type of structure and Damage	PPV mm/s	Reference
Plaster-on-lath construction near surface mines (long term, large scale, low frequencies vibrations)	12.7	Bureau of Mines (RI 5807)
Sheetrock constructed near surface mines	19.1	Bureau of Mines (RI 8507)
Residences near surface mines lying within a distance of 92 to 1,524 m	25.0	OSM regulatory limits
Widely accepted limit for residents near construction and quarry blasting	50.8	Bureau of Mines (RI 8507)
Minor damage to average house subjected to quarry blasting vibrations	137	Bureau of Mines (656)
About 90% probability of minor damage from construction or quarry blasting. Structural damage to some houses depending on vibration source and character of the vibration	229	---
For close-in construction blasting, minor damage to nearly all houses and structural damage to some at low frequencies, major damage to most houses	501	---



It was opined (based on results of field investigations) by National Institute of Rock Mechanics (NIRM), Kolar Gold Fields, Karnataka (Ministry of Science and Technology, Govt. of India) that the maximum tolerable Peak Particle Velocities (PPV) of various frequencies the buildings of different types can tolerate without damage suggested by Directorate General of Mines Safety are very conservative and requires upward revision and suggested higher values as given in **Table 1.8**.

Table 1.8 National Institute of Rock Mechanics (NIRM) (Ministry of Science and Technology, Govt. of India) Recommendations regarding the maximum Peak Particle Velocities (PPV) various civil structures can tolerate without damage (Anon, 2005)

Type of structure		Maximum permissible PPV, mm/s		
		Dominant frequency, Hz		
		<20	20-50	> 50
(A)	Buildings / structures not belonging to the owner			
(i)	Domestic houses/structures (kutchha brick & cement)	10	15	25
(ii)	Industrial buildings (RCC & framed structures)	20	25	35
(iii)	Objects of historical importance & sensitive structures	5	7	10
(B)	Buildings belonging to the owner with limited span of life			
(i)	Domestic houses/structures(kutchha brick & cement)	15	25	35
(ii)	Industrial buildings (RCC & framed structures)	55	35	50

Amongst the various norms (guidelines) discussed above, the DGMS norms are the most conservative and hence safest to protect different types of structures. Therefore, the same are adopted for the present study in deciding the maximum charge per delay for different distances of the structures from the blasting site in this report.

1.4 Ground Vibration Predictor Equations

For effective prediction and subsequent control of ground vibrations, rock constants which are site specific are determined for every site (by trial blasts) where blasting is to be carried out. These rock constants are used in the predictor equation (Equation 1) to calculate the maximum explosive charge per delay for a given



maximum PPV the structure in question can tolerate without damage and the distance between blasting site and the structure.

The tolerable PPV a structure can withstand (without damage) depends on the frequency of the vibrations, type of structure, material used for the construction of the structure and the type of rock (soft or hard) on which it is fixed.

For predicting ground vibrations, when both blasting and measurements are made on the surface, square root scaled distance formula (Equation 1) is used (as per the DGMS (Tech.) (S&T) circular No.7 of 1997) as it gives very reliable predictions of PPV to protect surface structures by limiting the vibrations to the tolerable levels when maximum charge per delay is restricted.

$$V = k(SD)^{-\beta} \dots\dots\dots (mm/s) \quad \dots \quad (1)$$

where,

- | | | |
|---------------|---|--|
| V | = | Peak particle velocity (PPV), mm/s |
| SD | = | Scaled distance, m/\sqrt{kg} |
| k and β | = | Rock constants, which are site specific. |

where, SD is calculated by equation (2)

$$SD = \frac{D}{\sqrt{W}} \quad (m/\sqrt{kg}) \quad \dots \quad (2)$$

where,

- | | | |
|---|---|--|
| D | = | Distance between the blasting site and the vibration monitoring station, m |
| W | = | Maximum explosive charge per delay, kg |

A linear regression analysis between PPV (on the y-axis) and scaled distance (on the x-axis) is to be carried out for the monitored data as per the DGMS guidelines; the best fit curve on log-log scale is to be drawn to determine the rock constants k and β for square root scaled distance formula. Linear regression analysis is a statistical tool to determine the line of best fit through a distribution of points in a graph.

1.5 Human Perception

Human beings are very sensitive and can detect even very low level of vibrations (as low as 0.5 mm/s) which cannot cause damage to the structures. Vibration levels

lesser than the ones that cause damage to the structures could cause rattling of doors or windows. Many a times, the slamming of a door or passing of a loaded lorry by the side of the house generates more vibration than a quarry blast. However, residents become alert and inquisitive by noise and rattling of objects in the immediate surroundings due to blasting in the neighbourhood and start looking for the damages to the structures like cracks in the walls in their residence. Finding a crack that existed even before blasting activity commenced in the neighbourhood, but not noticed, people start worrying and attributing the crack to blasting activity.

Dowding (1996) observed that the human sensitivity gets triggered by vibrations and air blasts and becomes inquisitive and suspicious about them from a blasting activity in the vicinity reaching the structure and resulting in some form of damage to it. The tolerance and reactions of humans to vibrations vary from person to person, the nature of the work he/she is doing, the environment in which they are present at the time of blast, etc. Blast induced ground vibrations may result in annoyance and interference with work proficiency.

1.6 SCOPE OF THE WORK

The management of Kadavila-1 Stone Quarry located at Nagaroor Village, Chirayinkeezh Taluk, Thiruvananthapuram District, Kerala of **M/s. Adani Vizhinjam Port Private Limited, Thiruvananthapuram** has requested the Department of Mining Engineering, Anna University, Chennai to carry out scientific investigation into the influence of ground vibrations due to blasting being carried out in the Kadavila-1 Stone Quarry, on the residential buildings and other civil structures of the nearest village, not belonging to the quarry owner.

Based on this, the field investigation has been carried out from 16.03.2021 to 17.03.2021. During the field investigation, ten number of trial blasts were carried out at various locations of the mine with varying designs and charging patterns. The blasts were monitored using five vibration monitoring seismographs which are capable of recording vibrations in all the three directions along with noise/air overpressure. Based on the analysis of the above trial blasts, the following report was prepared and submitted.



1.7 OBJECTIVES

The objectives of the study are as follows

- Site visit and collection of data.
- Study the existing blasting, its design and its influence on the surroundings in respect of blast induced ground vibrations
- Design of trial blasts which will
 - restrict blast induced ground vibrations to levels that are tolerable on the residential and other civil structures not belonging to the quarry owner.
 - restrict generation of fly-rock and their throw to eliminate adverse effect on the residents and agricultural lands of the Nagaroor (Kadavila) village.
- Carry out at least 10 controlled trial blasts and monitor blast induced ground vibrations at least in 25 points under the supervision of the author of this report and their team. Similarly, study the distance to which flying fragments are produced.
- Develop a scaled distance equation for the site and determine the site constants which are site specific.
- Fine tune the blast design, if required, which will restrict the blast induced ground vibrations to the levels tolerable to the said structures, and control the fly-rock to minimise their effect on the residents, and people working in the agricultural lands.
- Submit the report including suggesting suitable methodology for carrying out regular drilling, controlled blasting operations in the quarry and also appropriate safety measures to be taken to guard against blast induced vibrations and fly-rock.

1.8 BLAST VIBRATION MONITORING INSTRUMENTATION

Blast induced ground vibrations and air over pressure (noise) are monitored with three dimensional Seismographs. During the field investigations, the blast induced ground vibrations were monitored using two numbers of NOMIS and three numbers of INSTANTEL seismographs.



1.8.1 NOMIS Mini SuperGraph

NOMIS Mini SuperGraph instrument (shown in Figure 1.0) from NOMIS seismograph, Inc., Birmingham, Alabama, U.S.A. are used for monitoring ground vibrations and air overpressure. It is very light, portable and user-friendly instrument for ease of operation in the field. The instrument has tri-axial transducer to record the blast induced ground vibrations in all three directions viz. R, T, V and a microphone to measure and record the air over pressure levels. The instrument can be operated from mains and rechargeable battery.

The Vibration Monitoring System basically consists of

- Transducers for recording ground vibrations and a microphone for measuring air overpressure that convert physical motion or pressure to an electrical current, which is transmitted through a cable followed by an amplifying system. The vibration events are recorded on to the system.



Figure 1.0 NOMIS Seismograph

The software provided with the instrument works on windows operating system. The software provides for copying, viewing, analyzing and printing the data. The software is also capable of performing advanced analysis of waveforms, etc. for effective analysis of the ground vibrations. The instrument is to be properly fixed (Coupled) to the ground. Some of the salient features of NOMIS Seismograph are given in Table 1.9.

Table 1.9 Salient features of NOMIS Seismograph

S.No.	Parameter	Values
SEISMIC		
1.	Range	0-254 mm/s
2.	Accuracy	+/- 3%
3.	Frequency Response	2- 400 Hz (1 Hz optional)
SOUND		
1.	Range	92-148 dB
2.	Accuracy	+/- 0.1dBL at 30 Hz and 127 Hz
3.	Frequency Response	2- 400 Hz
WAVEFORM RECORDED DATA		
1.	Record Modes	Waveform and Manual
2.	Seismic trigger range	0.19- 254 mm/s, no trigger, manual Lower Levels Optional
3.	Sound trigger range	92- 148 dB, no trigger (other levels optional)
PHYSICAL SPECIFICATIONS		
1.	Weight	1.9 kg
2.	Battery	6 Volt, gel type rechargeable, 14 days duration
3.	Display-LCD	8 lines x 21 characters with backlight
4.	Pc Interface	RS-232 & additional 15 pin auxiliary connector

1.8.2 InstanTEL DS-077 Minimate & Blastmate

Instruments of InstanTEL, Canada (Figure 1.1) were also used for monitoring ground vibrations. The instrument can be operated with power from the rechargeable battery. It is very light, portable and user-friendly instrument for ease of operation in the field. The instrument has tri-axial transducer (seismograph) to record the blast induced ground vibration in all three directions viz. radial (R), transverse (T) & vertical (V) directions and a microphone to measure the air over pressure levels. Minimate is a PC compatible computer-based system with inbuilt memory. The seismograph can measure the PPV up to 127 mm/s, frequency in the range of 2 - 250 Hz and air over pressure in the range of 100 - 142 dB. For effective recording of the ground vibrations the instrument is properly coupled to the ground either by spiking or grouting or bolting.



1.8.3 Transducer Mounting

Monitoring of ground vibration is to be carried out after properly mounting (coupling) the transducer (Geophone) with the ground to receive and transmit the actual magnitude of the vibrations at that site. There are five methods of mounting the transducer on the ground as shown in Figure 1.2. In the first, the transducer is placed on a horizontal surface without any device to hold it (Figure 1.2 a).



(a) DS-077 Minimate

(b) Minimate Blaster

Figure 1.1 INSTANTEL Vibration Monitoring Instruments

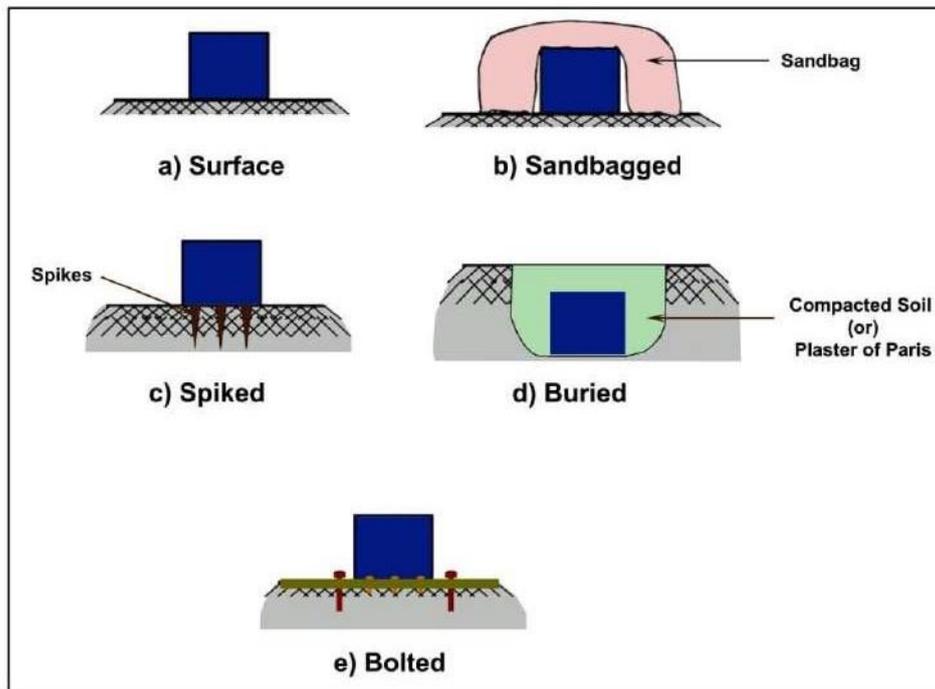


Figure 1.2. Five Common Methods of Transducer Mounting

The second one is also mounted in the same way but a loosely packed sandbag is placed over it so that all sides of the bag are directly in contact with ground (Figure 3b). In the third, the transducer is spiked into the ground (relatively loose) firmly, with the three spikes which are screwed to the transducer, by pressing into the ground

such that the base of the transducer is in direct contact with the ground (Figure 3c). In the fourth method, it is connected to the ground by completely burying it in soil or rock by making an excavation slightly bigger in size than that of the transducer and the soil compacted firmly around and over the transducer (Figure 3d). The same can be achieved by using „Plaster of paris” also. In the fifth method the transducer is bolted to the surface (floor or walls of a structure) to facilitate recording all the vibrations to which the surface is subjected to (Figure 3e).

1.9 CONTROLLED BLASTING

As stated earlier, when an explosive charge is blasted in a shot hole, in addition to doing the useful work of breaking rock and displacing it, it also produces adverse environmental effects like ground vibrations, over-break (back break), fly-rock, air-over pressure (noise) and air pollution with gases and dust. Some of these adverse effects cause damage to the structures in the vicinity and can cause injury to the people. Blasting by eliminating and / or controlling these adverse effects is termed as controlled blasting.

The blast induced ground vibrations get transmitted away from the blast in non-discriminating manner resulting in crushing and fracturing of the rock in the vicinity. This may pose a problem when blasting in the vicinity of the perimeter of a pit or a trench or civil, mining or defence structure. Hence, for the safety of the excavation and nearby structures, creation of new fractures and widening of the existing cracks due to the blasting are to be minimised, by generating less vibrations or preventing the vibrations from reaching the structure. The techniques to achieve this include

- Use of low strength explosives (explosives having less velocity of detonation).
- Reduced charge concentration by using less density explosives in small diameter drill holes.
- Reducing the quantity of explosive blasted at each moment of time by adopting delay blasting technique.
- Selecting optimum delay interval between two successive shots or groups of shots.
- Optimising the blast design parameters, viz. spacing, burden, length of the hole, charge factor, etc.



- Use of small diameter explosive charges (cartridges) in a large diameter holes (de-coupled charges).
- Use of air bags in the shot holes.
- Decking of explosives.
- Creating artificial cracks or discontinuity planes between the blasting site and the structures to be protected to limit the propagation of the radial cracks and transmission of shock waves.

1.9.1 Controlled Blasting Techniques

As on date, many blasting techniques are available to control the adverse effects of blasts. However, the selection of suitable technique primarily depends on the adverse parameter(s) of the blasting to be controlled. Some of the common techniques are (i) limiting the maximum charge per delay; (ii) line drilling; (iii) pre-splitting; (iv) cushion or smooth blasting; (v) air decking; (vi) muffling. Out of these, the first and sixth techniques, i.e. restricting the explosive quantity per delay and muffling with old tyres would be adopted for designing the controlled blasting technique in the Kadavila-1 Stone Quarry to protect the residential structures in the surrounding villages.

1.10 ADVERSE EFFECTS OF BLASTING

1.10.1 Abatement of Ground Vibrations by Controlled Blasting

The control measures for blast induced ground vibrations are:

- Design the blasts appropriate to the site and implement the designs scrupulously.
- Exercise good control over drill hole pattern by properly marking the shot holes on the floor of the bench prior to drilling, so that the designed spacing, burden and inclination are achieved.
- Provide maximum relief [by creating free face(s)] to ensure free movement of the rock with appropriate charge factor.
- If no additional free face is available, a properly designed initial cut pattern is to be implemented.
- Select and use appropriate explosives and accessories suitable for the ground conditions prevailing at the site.
- Select the appropriate charge factor (specific charge).



- Select the maximum charges per delay based on the distance of the structure to be protected from the blasting site.
- Select the appropriate delay interval between holes in the same row and rows of the holes.
- Deck the charges in a blast hole.

1.10.2 Fly Rock

When blasting is carried out, the rock gets fragmented and the fragmented material is moved away from the bench and gets piled up as fragmented mass to enable loading by an excavator. In addition to this desirable displacement of broken fragments, some stone pieces travel to certain distance away from the face resulting in scatter of the blasted muck pile and a few of them also project to a greater distance as shown in **Figure 1.3**. This undesirable projection of stones is termed as „fly rock’.

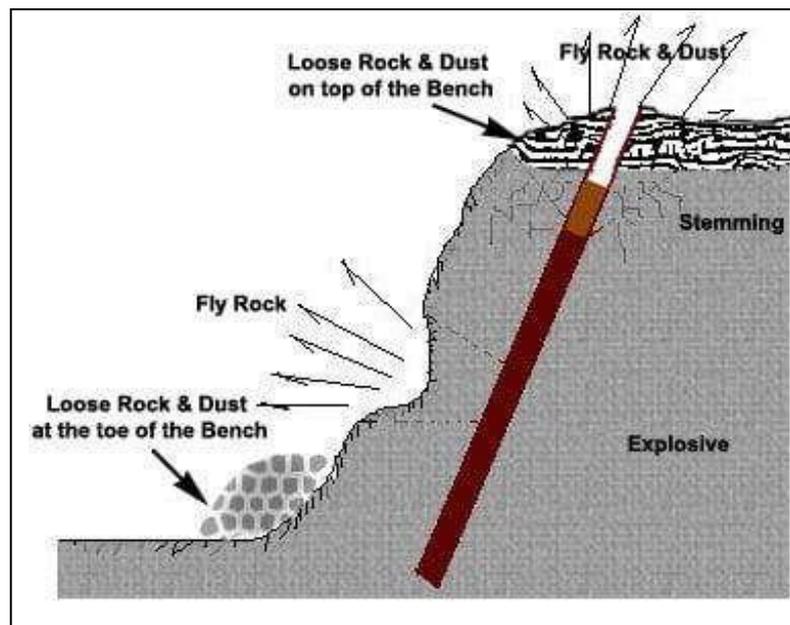


Figure 1.3 Fly-rock Generation

Fly rock is a serious environmental hazard and is often a cause of fatalities and /or serious injuries to the people, cattle, damage to the equipment, buildings and other property. Damage due to fly rock from blasting is one of the main causes of strained relations between the mine management and the people residing, working or passing by in the vicinity of blasting operations. This assumes prominence in mines having small leasehold area (when the danger zone falls beyond the leasehold area) and when the quarry is shallow with reference to the surroundings. These hazards



become serious as the blasting rounds become bigger with larger diameter boreholes, where fly rock of large sizes travel long distances. Fly rock is caused by improper blast design. The important parameters, which cause fly rock problem, are inadequate confinement of the explosive charge, high charge factor, decreased spacing and burden, overcharging, inaccurate drilling, inadequate stemming, faulty delay timing including not using delay detonators in multi-row blasting, improper initiation sequence, overlapping of delays, blast hole diameter, bench height, inclination of holes, charge distribution in holes, loose rock lumps lying on the top of bench or along slope, geological conditions like highly fractured and weathered rock and of course, human errors like - carelessness and improper supervision. In addition, secondary blasting is also a major source of fly rock and hence is to be avoided, wherever possible, or at least minimised by proper primary blast design (considering the above stated parameters) using delay detonators in conjunction with inverse initiation.

1.10.3 Control of fly-rock

Fly rock can be controlled by judicious selection of blast parameters mentioned above based on experience and calculations using certain empirical formulae developed from the site investigations. The fly rocks produced during the blasting can be controlled by adopting the following measures:

- Proper blast design and its implementation.
- Careful inspection of site before laying out blast holes and deciding the drilling pattern to be adopted based on the bench geometry.
- Drilling in accordance with the requisite blast design.
- Blast hole charging (using optimum charge factor).
- Maintaining the adequate stemming column.
- Use of proper stemming material (small pieces of stones with sharp edges are to be removed from the stemming material to eliminate the possibility of insulation of the detonator lead wires getting damaged or snapping of the lead wires and ultimately resulting in misfires).
- Imparting adequate training to the blasting crew.

In addition to the above, withdrawing all persons, cattle and traffic from the entire area falling **within a radius of 500 meters from the place of firing (hereinafter referred to as the danger zone)** as per **Reg. 188 (2)(b) of MMR 2019** and **DGMS Technical circular No. 2 of 2003**, and positioning of guards (sentries) at all probable entrances into the blasting zone is very essential to prevent inadvertent entry of persons, cattle and traffic.

1.10.4 Air Blast/Noise

When blasting is done, a loud noise is heard which is known as air blast. Air blast, however, is not simply the sound that is heard. Air blast is an increased pressure wave consisting of high frequency sound that is audible (from 20 Hz to 20 kHz) and low frequency sound or concussion (less than 20 Hz) that is sub-audible and cannot be heard. Although air blast seldom causes structural damage but sudden loud noise causes psychological fear in the nearby inhabitants and in some cases even breakage of window panes have been reported (Persson et al., 1994), if any building is present within a short distance from the blasting site. Air blast is influenced by type and amount of explosive, adequacy and type of material for stemming, direction of blast and meteorological conditions. The main cause of noise is the energy released in open air by the initiation system and inadequate stemming column, burden etc.

Air blasts are produced either by the direct action of the explosion products from the unconfined explosive (like, detonating cord) in air or by overcharging of explosive in a shot hole. The waves produced by the effect of blasting increases the air pressure from ambient pressure to peak and drops to negative (i.e., below ambient pressure) slowly. Its travel thereafter is governed by air temperature, wind direction & speed, and the presence of obstructions in the form of buildings, vegetation, and ground contour. Hence, blasting is to be avoided when the wind is blowing towards a critical area, which influences the air blast propagation. Similarly, blasting early in the morning and late in the evening is to be avoided, as there will be temperature inversions in the atmosphere during these periods of the day. Noise production is more with detonating cord and hence resorting to electric delay detonation reduces noise. However, United States Bureau of Mines (USBM) has correlated the damage due to air over-pressure. The recommended values are given below:



Table 1.10 United States Bureau of Mines (USBM) Values withstand Damage due to Air Over-pressure (Noise)

Over-pressure (dB)	Over-pressure (KPa)	Air Blast Effects
177	14	All windows break
170	6	Most windows break
150	0.63	Some windows break
140	0.20	Some large plate glass windows may break, desk and windows rattle
136	0.13	USBM interim limit for allowable air blast
126	0.05	Complaints likely

1.11 INITIATION SYSTEMS

There are a number of initiation techniques which can be used for supplying necessary energy to a column of explosive and thereby initiate the detonation process. The classification of initiation system is given in **Figure 1.4**

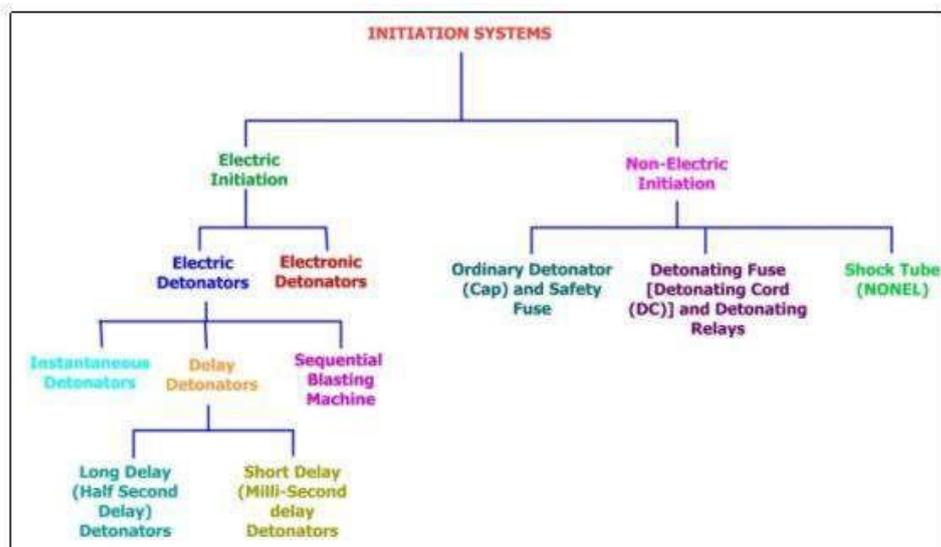


Figure 1.4 Blast initiation systems

Here, cap and safety fuse initiation is not recommended due to the difficulty in counting the number of shots during the firing of more number of holes in a single round creating unsafe situation.

Detonating fuse (DC) initiation system is also not recommended in this case because of its inability to provide inverse initiation (true bottom initiation). In addition, it produces more noise and increased possibility of misfires.

Shock tube initiation system can be used for better results and improved safety but it is more expensive.

Among the above, the **NONEL based initiation system** is having advantages of initiation systems like :

- As opposed to fuse initiation, the time of detonation is always under control.
- No damage is done to the stemming column.
- Delay blasting can be effectively carried out.
- True bottom initiation ensuring effective utilization of explosive energy thereby eliminating the stemming rejection and minimizing the flyrock travelling to large distances.
- No surface noises.
- Occurrence of misfires in the blasting can be minimised.
- Systems are cheaper and safe.

1.11.1 Shock Tube (NONEL)

The role of NONEL shock tube initiation system is the latest and advanced system in quarry blasting. The main component of a non-electric initiation system is shock tube that is a hollow plastic tube made with advanced materials designed to withstand field conditions. The inner walls of the tube are coated with high explosive of 14 to 20 mg/m length (**Figure 1.5**). With the help of non-electric millisecond delay detonators for down the hole initiation, two or three explosive decks in the same drill hole can be detonated by different delays. This reduces the maximum charge per delay thus controlling ground vibrations and can be very effectively used for carrying out controlled blasting operations. Use of NTD (Noiseless trunk line surface delay system) on the surface hook up, in place of detonating cord significantly reduces air blast/noise in view of the non-destructive nature of the tube. NTD or TLD (Trunk line delay) is a non-electric millisecond delay detonator for surface initiation of down line detonators. Combination of DTH and NTD give hole-by-hole initiation as well as sufficient 'burning front' thereby eliminating cut offs and misfires. Shock tube NONEL



system provides a high level of safety against initiation by static electricity, stray electrical currents and radio frequency transmissions.

1.11.2 Advantages of NONELs

- Noiseless, true bottom initiation, down-hole delays, simplified tie-in patterns, no limit on number of holes, reduction in air blasts/ground vibration, safe touse in extraneous electricity environments.

1.11.3 Disadvantages of NONELs

- Lack of firing circuit testing facility before firing (only visual examination is possible).
- Expensive compared to detonating cord and electric delay detonators.



Figure 1.5 Non- Electric Shock Tube Initiation Systems

CHAPTER 2.0 BLASTING PRACTICES IN THE QUARRY

2.0 DETAILS OF THE SITE

2.1 Company Profile

The Adani Group is one of India's leading business houses based at Ahmadabad – Gujarat, founded in 1988. Adani has grown to become a global integrated infrastructure player with businesses in key industry verticals – Resources, in coal mining and trading; Logistics, which is spread across ports, logistics, shipping and rail; Energy, with renewable, thermal, solar power generation and transmission businesses and Agro commodities and ancillary industries. The integrated model is well adapted to the infrastructure challenges of the emerging economies.

Adani Vizhinjam Port Private Limited (AVPPL) is a company belonging to Adani group, having their Registered office at Ahmedabad – Gujarat, and the local office at 2nd Floor, Vipanchika Tower, Thycaud, Thiruvananthapuram - 695014. The said company is in various infrastructural and construction activities, they have been awarded by the Government of Kerala for the development of Vizhijam port at Thiruvananthapuram, which is a National Developmental Project / Activity and is also a prestigious Sea Port for Kerala State. Hence, M/s. AVPPL is carrying out the stone quarrying operations in Sy. No. 555/2 of Nagaroor village (Kadavila), Chirayinkeezh Taluk, Thiruvananthapuram District over an area of 3.6630 Ha to facilitate the building stone material as the raw material for the development of the breakwater construction project.

2.2 Quarry Details

The present scientific study is in response to the request made by the management of M/s. Kadavila-1 Stone Quarry to investigate into the influence of blasting with emulsion explosives in their quarry relating to ground vibrations on the residential and other buildings of Kadavila village located around the quarry. The study is also aimed at investigating into the generation of the fly-rock, due to blasting and other mining activities of the quarry on the neighbourhood. Accordingly, the author of this report has carried out a preliminary survey followed by **10 number of controlled trial blasts** during **16.03.2021 to 17.03.2021** and prepared this report.

Figure 2.1 depict the Google map of the quarry area indicating the nearby surface structures and Figure 2.2 shows the surface plan of the leasehold area and locations of the nearest settlement and villages from the quarry lease area.

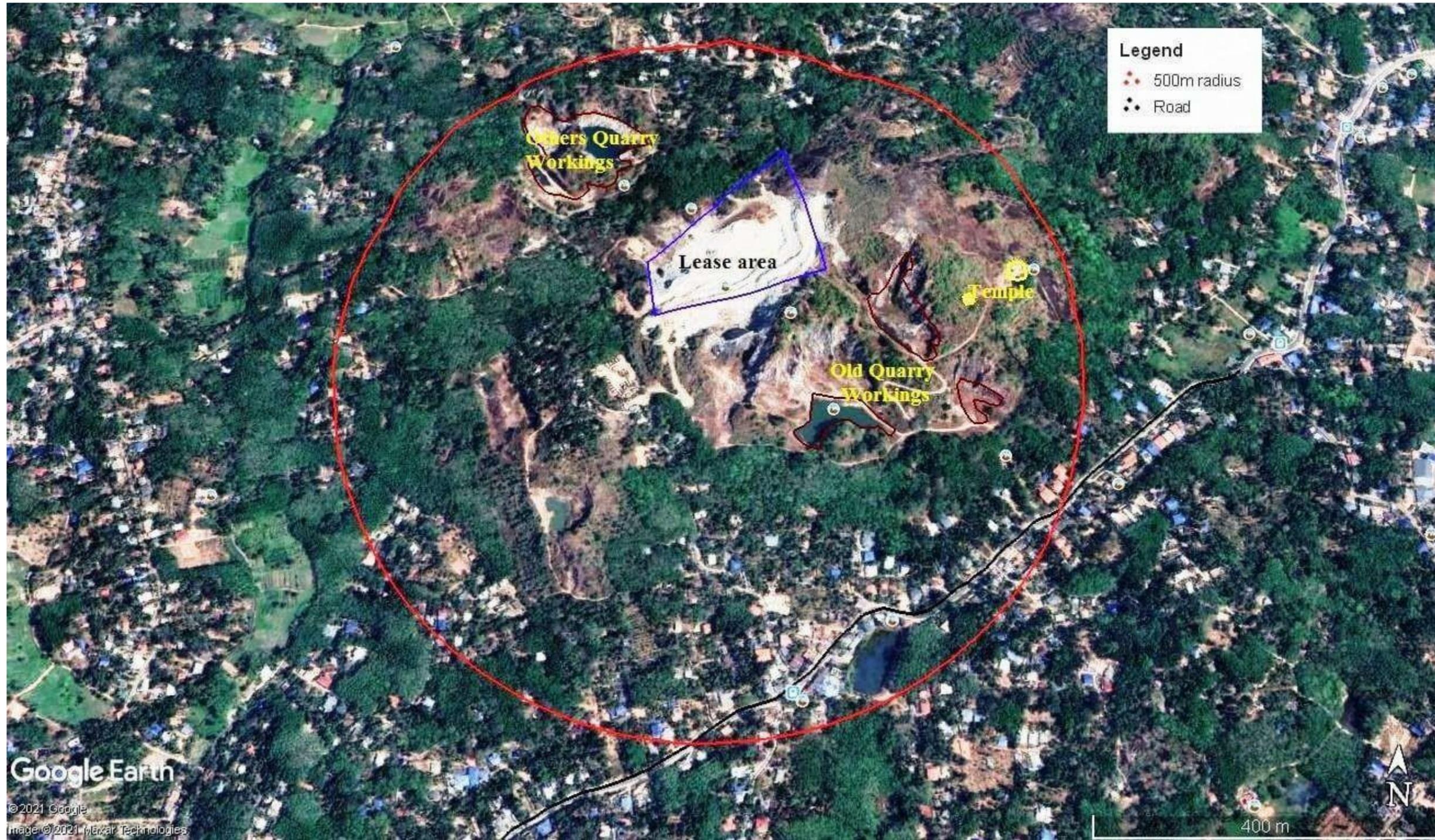


Figure 2.1 Shows the location of M/s. Kadavila-1 Stone Quarry in Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram District, Kerala and its surrounding settlement

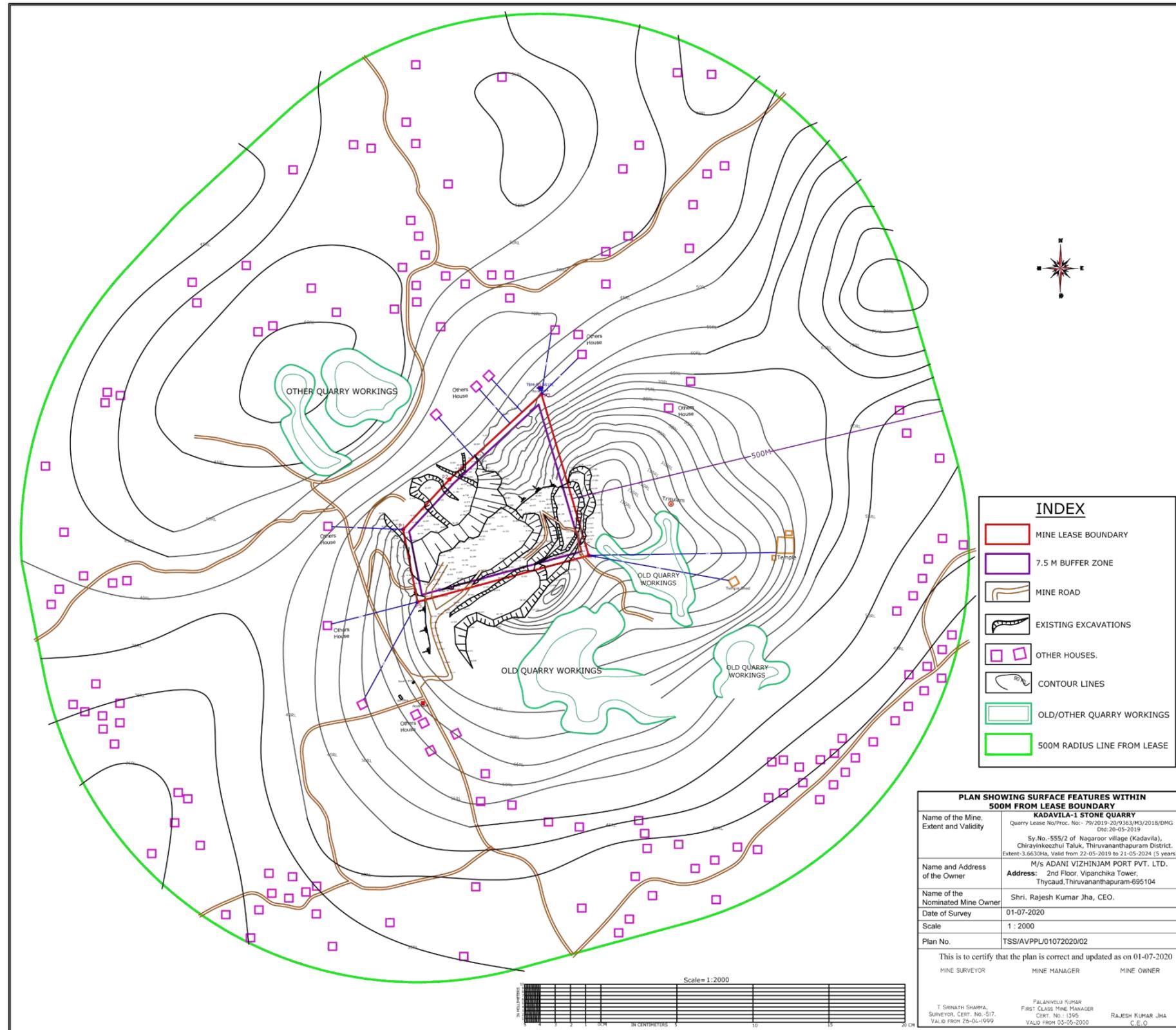


Figure 2.2 Shows the Surface Plan of M/s. Kadavila-1 Stone Quarry in Nagaroor village



The said quarry is located in Kadavila at a distance of 1.20 km towards southwest of Nagaroor village and lies towards north of Kadavila Bus stop at a distance of 0.50 km approximately. This lease area is approachable by all-weather road/s up to theup to Kadavila bus stop, thereafter a kutchra road towards north will leads to area.

The area is located between the geographical coordinates, **latitudes of 08°43' 42.88" N to 08°33' 51.74" N and longitudes of 76°50' 15.26" E to 76° 50' 23.24" E** and the total leasehold area of the mine is **3.6630 Ha (9.051 acres)** in Survey No. 555/2 (Government Land) of **Nagaroor village (Kadavila), Chirayinkeezh Taluk** of Thiruvananthapuram District, Kerala state. The Quarry is located at a distance of 35 km (by road) from Thiruvananthapuram which is the district head quarter and state's capital and at a distance of 13.0 km (by road) from Chirayinkeezh which is the Taluk head quarter, where all the infrastructural facilities are available. The nearest airport is at Thiruvananthapuram at a distance of 35.0 km and sea port at Kollam which is at a distance of 50.0 km. The nearest railhead on Broad gauge is Chirayinkeezh.

2.2.1 Geology of the area and properties of strata

Most of the quarry area is exposed by Charnockite (commercially known as Granite), only towards the north of the quarry area part is covered by topsoil with the thickness varying from 0.75 m to 1.00 m. The overburden is mainly topsoil, intercalated waste and mining rejects. Out of geological reserves of 5.196 million tonnes, only 1.778 million tonnes of reserves can be exploited / mineable, while the balance of 3.417 million tonnes of reserves is getting blocked which cannot be mined due to the boundary and practical constraints. The geological parameters of the ore body as follows:

Strike	: NW - SE with local variation of 15°- 20° on either side
Dip	: 70° - 80° dipping north
Strike length	: 250 m
Width of deposit	: 150-180m
Depth of deposit	: 50m



2.2.2 Method of Quarrying

Based on the mode and method so adopted and taking into the consideration of geological parameters, the quarry pit is designed such that the height of the bench is kept about 6.0 m maximum, and the width is also kept 6.0 m, maintaining 45° pit slope. The haul roads are properly laid and frequently wetted to suppress the dust being produced from the surface (Figure 2.3).



Figure 2.3 Benches and Haul road maintenance in the Quarry Face

Mining operation commenced from higher elevation to the lower elevation, benches developed and advanced in south and west direction laterally. Initially, the height of the highwall bench will be reduced, when it comes to the lower levels, benches will take the circular shapes and pit will be formed. The Mining operation is controlled and supervised by Statutory persons like Mine Manager, Assistant Mine Manager, Mine Foreman, Mining Mate Cum Blaster, who are certified by the Director General of Mines Safety, Dhanbad.

2.3 EXISTING BLASTING PRACTICES

The nature of the rock in the quarry has been found to be hard to medium hard in nature, possessing higher compressive strength and hence it requires drilling and

blasting operations to dislodge / loosen the material from the main rock mass to facilitate subsequent loading and transportation operations effectively.

The quarry is being worked systematically by constructing the benches with a maximum height of 6.0 m. Taking into consideration the parameters such as production requirement, required degree of fragmentation, type and capacity of excavator used, and environmental constraints, the **drill hole diameter of 33 mm** is being drilled using Jack hammer drilling machines. Based on the strength of the rock, the blasting pattern with a **burden** of 1.2 m and the **spacing** of 1.5 m are being maintained in the **row-by-row staggered patterns** (Fig. 2.4). The **hole depth** of 2.4 m for the above blastholes is maintained consistently for all the blasts. In the present case, vertical or inclined holes are used based on the bench conditions. If inclined hole drilling is adopted, the holes should be inclined at an angle of **15 to 20°** (more or less parallel to the inclined face of the bench) to the vertical and **inclined towards the free face** of the bench.

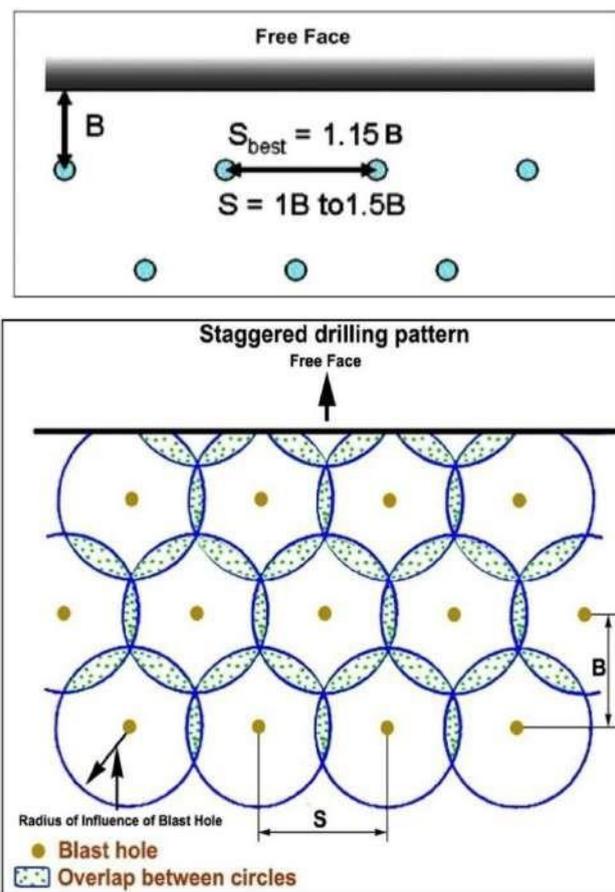


Figure 2.4 Staggered Pattern of Blast Holes

In the present site, a **minimum stemming length of 0.70 m** is used at the collar of the blast hole. The crushed angular rock of **2 to 4 mm (about 10% of blasthole diameter)** is used instead of fine drill cuttings to prevent premature venting of explosive gases. Keeping atleast two free faces during the current blasting practices in the Kadavila-1 stone quarry, a **charge factor of 0.15 to 0.16 kg/m³** is adopted for ensuring average charge quantity of 0.500 kg per hole. Accordingly, the cap-sensitive **Emulsion explosive** cartridges of **25 mm diameter** are used to charge the holes in **three to five** rows for ensuring effective fragmentation of rock and to minimise the fly-rock in the quarry. Maximum numbers of holes are being blasted at a time in a round are generally limited to 50 to 80 with Non-Electrical detonators (NONEL) with surface delay of 17/25 ms and an in-hole delay of 250 ms to mitigate adverse impacts such as air blast, fly rock and ground vibration. The instantaneous electrical detonators are being used for initiating the blasting circuit prepared with NONEL based detonators.

After completion of drilling, charging, stemming and hooking up by connecting the trunk-lines of NONEL shock tubes, the place would be ready for blasting (Figure 2.5 and 2.6). All blasting operations are carried out only during the day time (between sunrise and sunset) and under the personal supervision of the Assistant Mines Manager. However, it is ensured that cattle, stray dogs, human beings and traffic on the village road **within a distance of 500 m from the blasting site** (which is termed as blasting zone) are cleared away for the safety purposes. Similarly, the Mining Mate cum Blaster and his assistants are moved to a safe place and the **sentries with red flags and blowing whistles were kept in all the directions along the periphery of the blasting zone** on either side of the road within the blasting zone preventing any unauthorized entry of human beings or cattle or traffic into the blasting zone. After taking **the final clearance** from all sentries and the **final confirmation** from the Assistant Mines Manager, the exploder key is inserted into the exploder and the button is pressed for the firing.

After the completion of the blasting, the place is inspected for misfires, if any. **If no misfires are identified, all clear signal is given** and subsequently mucking (loading of the blasted rock) can be started.



Figure 2.5 Type of explosives used



Figure 2.6 Drilling and charging of blast holes



The summary of the blast design is given in **Table 2.1**

Table 2.1 Summary of the Blast Design being adopted in M/s. Kadavila-1 Stone Quarry

Sl. No.	Parameter		Value
1.	Blast hole diameter		33 mm
2.	Burden		1.2 m
3.	Spacing		1.5 m
4.	Height of the bench		6.00 m
5.	Stemming length		Minimum 0.70 m
6.	Drilling pattern being followed		Staggered
7.	Specific charge	For production blasting	0.15 to 0.16 kg/m ³
8.	Average explosive Quantity/hole	Emulsion cartridge	0.50 kg
9.	Maximum explosive charge per drillhole used during production blasting	Emulsion cartridge 125 g	0.625 to 0.688 kg
10.	Detonators used		NONEL based detonators of 17/25 ms surface delay with an in-hole delay of 250 ms
11.	Type of explosive used		Cap-sensitive type Emulsion cartridges (Ø=25 mm)
12.	Method of initiation system		IED/MSDD
13.	Method of connecting detonator		Series

Blasting shall be recognised as the most critical operation in mining and hence shall be carried out by maintaining highest standards of safety and reliability. Emphasis shall always be placed in creating a work-culture where it is to be emphasized that safety is the responsibility of all personnel working at the site. Hence, all these operations of drilling and blasting are being carried out under the direct supervision of qualified and experienced Assistant Mines Manager, Mining Mate cum Blaster in Kadavila-1 stone quarry.

CHAPTER 3.0

MONITORING AND ANALYSIS OF EXPERIMENTAL BLASTS

In response to the request made by the management of M/s. Kadavila-1 Stone Quarry to investigate into the influence of blasting with emulsion explosives in their quarry relating to ground vibrations on the residential and other buildings of Kadavila village located around the quarry, **10 number of controlled experimental blasts** were carried out during **16.03.2021 to 17.03.2021**. This scientific study is also aimed at investigating into the generation of the fly-rock and airblast (noise) due to blasting activities of the quarry on the neighbourhood.

Accordingly, five numbers of latest version of blast monitoring instruments (Two NOMIS and Three-Dimensional Seismographs of INSTANTEL make) have been used by the Anna University research team for monitoring blast induced ground vibrations in M/s. Kadavila-1 Stone Quarry.

After carrying out detailed site examination and discussion had with the management, **vibration levels** during the above **10 experimental blasts** were measured at the residential buildings, and other structures in the vicinity. The details of the blast parameters, peak particle velocities, their vectorial sum and the corresponding frequencies measured at the monitoring stations (**47 observations**) and other details of the blasts are given in **Table 3.1**. Regression curve has been drawn to develop the predictor equations for the site. From the predictor equation, site constants for M/s. Kadavila-1 Stone Quarry were determined. This enabled the blasting operations to be designed to maintain the permissible levels of peak particle velocity (blast induced ground vibrations) at any structure within the recommended level. The maximum explosive charge to be used per delay at each site to ensure no risk for the check dam, residential houses and other surrounding structures have been calculated using the **predictor equation with 95% confidence (Equation No. 3)** developed for various distance of the of structures from the blasting site.

Table 3.1 Details of the 10 Trial Blasts Carried out at Kadavila-1 Stone Quarry and the Blast Induced Ground Vibrations Recorded

Blast No.	Date	Location of Monitoring Site	Time	No of Holes	Average Depth of the holes	Average Burden & Spacing	Total charge./ Blast	Maximum Charge / delay	Volume of Rock Broken	Charge factor	Distance between the Blasting and the Monitoring Site	Vibration measurement recorded						Vectorial Sum	Air Overpressure
												Longitudinal		Transverse		Vertical			
												Peak Particle Velocity	Frequency	Peak Particle Velocity	Frequency	Peak Particle Velocity	Frequency		
No.	m	m	kg	kg	m ³	kg/m ³	m	mm/s	Hz	mm/s	Hz	mm/s	Hz	mm/s	dB(A)				
1	16.03.2021	S1 8°43'39.00" N 76°50'15.00"E	11.03 am	63	2.4	1.2,1.5	43.375	2.16875	265.356	0.1635	213	Not Triggered							
		S2 8°43'44.17"N 76°50'19.87"E	11.03 am	63	2.4	1.2,1.5	43.375	2.16875	265.356	0.1635	62	3.429	170.60	3.429	128.00	3.429	128.0	4.12	71.6
		S3 8°43'48.03"N 76°50'12.81"E	11.03 am	63	2.4	1.2,1.5	43.375	2.16875	265.356	0.1635	190	Not Triggered							
		S5 8°43'41.81"N 76°50'17.47"E	11.03 am	63	2.4	1.2,1.5	43.375	2.16875	265.356	0.1635	105	1.14	7.8	2.79	7.6	0.445	8.0	2.92	35.0
2	16.03.2021	S1 8°43'39.00" N 76°50'15.00"E	11.08 am	30	2.4	1.2,1.5	18.75	1.25	126.36	0.1483	297	Not Triggered							
		S2 8°43'44.17"N 76°50'19.87"E	11.08 am	30	2.4	1.2,1.5	18.75	1.25	126.36	0.1483	85	1.016	256.00	1.143	128.00	1.397	128.0	2.07	69.5
		S3 8°43'48.03"N 76°50'12.81"E	11.08 am	30	2.4	1.2,1.5	18.75	1.25	125.36	0.1483	253	Not Triggered							
		S5 8°43'41.81"N 76°50'17.47"E	11.08 am	30	2.4	1.2,1.5	18.75	1.25	126.36	0.1483	184	2.10	7.8	2.16	7.5	2.54	8.0	3.41	79.0

Scientific study on Blast Induced Ground Vibration for Kadavila-1 Stone Quarry, Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram District, Kerala of M/s. Adani Vizhinjam Port Private Limited



3	16.03.2021	S1 8°43'39.00" N 76°50'15.00"E	11.11 am	80	2.4	1.2,1.5	50	1.25	336.96	0.1483	267	Not Triggered							
		S2 8°43'44.17"N 76°50'19.87"E	11.11 am	80	2.4	1.2,1.5	50	1.25	336.96	0.1483	47	5.334	170.60	3.302	170.60	4.064	128.0	5.58	82.4
		S3 8°43'48.03"N 76°50'12.81"E	11.11 am	80	2.4	1.2,1.5	50	1.25	336.96	0.1483	264	Not Triggered							
		S5 8°43'41.81"N 76°50'17.47"E	11.11 am	80	2.4	1.2,1.5	50	1.25	336.96	0.1483	152	1.86	24	2.1	24	2.67	22	2.70	6.9
4	16.03.2021	S1 8°43'39.00" N 76°50'15.00"E	02.43 pm	30	2.4	1.2,1.5	18.75	1.33928	126.36	0.1484	136	0.381	0.0	0.245	0.0	0.254	0.0	0.832	4.5
		S2 8°43'44.17"N 76°50'19.87"E	02.43 pm	30	2.4	1.2,1.5	18.75	1.33928	126.36	0.1484	120	1.905	128.00	2.540	128.00	5.588	128.0	5.87	66.9
		S3 8°43'45.27"N 76°50'31.27"E	02.43 pm	30	2.4	1.2,1.5	18.75	1.33928	126.36	0.1484	465	0.572	8.1	0.889	7.8	0.508	8.0	0.968	6.9
		S4 8°43'41.81"N 76°50'17.47"E	02.43 pm	30	2.4	1.2,1.5	18.75	1.33928	126.36	0.1484	60	Not Triggered							
		S5 8°43'52.19"N 76°50'18.62"E	02.43 pm	30	2.4	1.2,1.5	18.75	1.33928	126.36	0.1484	282	1.52	7.7	2.48	7.5	0.953	8.0	2.81	57.3
5	16.03.2021	S1 8°43'39.00" N 76°50'15.00"E	02.45 pm	24	2.4	1.2,1.5	15	1.25	101.088	0.1484	296	0.889	204.80	0.254	68.30	1.143	29.30	1.47	18.9
		S2 8°43'44.17"N 76°50'19.87"E	02.45 pm	24	2.4	1.2,1.5	15	1.25	101.088	0.1484	102	4.064	73.10	4.572	128.00	7.366	102.4	7.52	63.1
		S3 8°43'45.27"N 76°50'31.27"E	02.45 pm	24	2.4	1.2,1.5	15	1.25	101.088	0.1484	359	0.254	8.0	0.381	7.8	0.191	8.0	0.397	12.9
		S4 8°43'41.81"N 76°50'17.47"E	02.45 pm	24	2.4	1.2,1.5	15	1.25	101.088	0.1484	185	Not Triggered							
		S5 8°43'52.19"N 76°50'18.62"E	02.45 pm	24	2.4	1.2,1.5	15	1.25	101.088	0.1484	151	0.191	7.7	0.381	7.5	0.191	7.8	0.429	36.1



6	17.03.2021	S1 8°43'41.81"N 76°50'17.47"E	10.55 am	60	2.4	1.2,1.5	37.5	1.875	252.72	0.1484	80	8.509	170.60	5.842	128.00	3.175	73.10	9.8	30.4	
		S2 8°43'44.17"N 76°50'19.87"E	10.55 am	60	2.4	1.2,1.5	37.5	1.875	257.72	0.1484	95	1.524	170.60	2.032	256.00	3.302	170.6	3.41	92.6	
		S3 8°43'38.74"N 76°50'16.72"E	10.55 am	60	2.4	1.2,1.5	37.5	1.875	257.72	0.1484	174	1.97	7.7	1.84	7.8	1.27	8.0	2.11	6.9	
		S4 8°43'48.03"N 76°50'12.81"E	10.55 am	60	2.4	1.2,1.5	37.5	1.875	252.72	0.1484	170	0.635	8.2	0.508	7.7	0.572	7.8	0.778	52.4	
		S5 8°43'47.04"N 76°50'12.20"E	10.55 am	60	2.4	1.2,1.5	37.5	1.875	252.72	0.1484	165	0.572	7.8	0.635	7.6	0.318	8.0	0.683	73.4	
7	17.03.2021	S1 8°43'41.81"N 76°50'17.47"E	10.56 am	50	2.4	1.2,1.5	31.25	1.736	210.60	0.1484	75	7.747	170.60	10.16	170.60	5.969	128.0	11.09	70.9	
		S2 8°43'44.17"N 76°50'19.87"E	10.56 am	50	2.4	1.2,1.5	31.25	1.736	210.60	0.1484	125	1.651	51.20	1.778	170.60	2.032	128.0	2.51	68.2	
		S3 8°43'38.74"N 76°50'16.72"E	10.56 am	50	2.4	1.2,1.5	31.25	1.736	210.60	0.1484	157	1.46	7.7	2.10	7.8	1.14	8.0	2.24	6.9	
		S4 8°43'48.03"N 76°50'12.81"E	10.56 am	50	2.4	1.2,1.5	31.25	1.736	210.60	0.1484	160	0.953	8.2	0.953	7.7	0.699	7.8	1.17	47.2	
		S5 8°43'47.04"N 76°50'12.20"E	10.56 am	50	2.4	1.2,1.5	31.25	1.736	210.60	0.1484	154	1.71	7.8	1.14	7.6	0.572	8.0	1.89	56.3	
8	17.03.2021	S1 8°43'41.81"N 76°50'17.47"E	2.37 pm	30	2.4	1.2,1.5	18.75	1.339	126.36	0.1484	105	5.207	170.60	4.826	102.40	2.667	128.0	6.12	64.4	
		S2 8°43'44.17"N 76°50'19.87"E	2.37 pm	30	2.4	1.2,1.5	18.75	1.339	126.36	0.1484	68	1.651	56.80	1.270	128.00	2.032	51.20	2.3	78.0	
		S3 8°43'38.33"N 76°50'16.63"E	2.37 pm	30	2.4	1.2,1.5	18.75	1.339	126.36	0.1484	218	Not Triggered								
		S4 8°43'48.03"N 76°50'12.81"E	2.37 pm	30	2.4	1.2,1.5	18.75	1.339	126.36	0.1484	182	1.08	8.2	0.826	7.7	0.889	7.8	1.40	62.4	

Scientific study on Blast Induced Ground Vibration for Kadavila-1 Stone Quarry, Nagaroor village, Chirayinkeezh Taluk, Thiruvananthapuram District, Kerala of M/s. Adani Vizhinjam Port Private Limited



		S5 8°43'53.22"N 76°50'22.62"E	2.37 pm	30	2.4	1.2,1.5	18.75	1.339	126.36	0.1484	282	1.27	7.7	0.635	7.6	1.59	7.8	1.68	6.9	
9	17.03.2021	S1 8°43'41.81"N 76°50'17.47"E	2.39 pm	24	2.4	1.2,1.5	15	1.071	101.088	0.1484	186	3.302	170.60	2.794	256.0	1.413	170.6	3.47	67.8	
		S2 8°43'44.17"N 76°50'19.87"E	2.39 pm	24	2.4	1.2,1.5	15	1.071	101.088	0.1484	91	0.762	36.50	1.016	256.00	1.270	42.60	1.75	69.2	
		S3 8°43'38.33"N 76°50'16.63"E	2.39 pm	24	2.4	1.2,1.5	15	1.071	101.088	0.1484	293	Not Triggered								
		S4 8°43'48.03"N 76°50'12.81"E	2.39 pm	24	2.4	1.2,1.5	15	1.071	101.088	0.1484	205	0.317	8.2	0.317	7.7	0.317	7.8	0.524	63.7	
		S5 8°43'53.22"N 76°50'22.62"E	2.39 pm	24	2.4	1.2,1.5	15	1.071	101.088	0.1484	209	0.889	7.7	0.826	7.6	0.572	7.8	1.00	56.3	
10	17.03.2021	S1 8°43'41.81"N 76°50'17.47"E	2.46 pm	25	2.4	1.2,1.5	15.625	1.116	105.3	0.1484	146	2.54	170.60	2.54	256.0	1.397	170.6	3.4	56.2	
		S2 8°43'44.17"N 76°50'19.87"E	2.46 pm	25	2.4	1.2,1.5	15.625	1.116	105.3	0.1484	46	1.270	22.20	1.651	256.00	1.778	170.6	2.29	72.1	
		S3 8°43'38.33"N 76°50'16.63"E	2.46 pm	25	2.4	1.2,1.5	15.625	1.116	105.3	0.1484	259	Not Triggered								
		S4 8°43'48.03"N 76°50'12.81"E	2.46 pm	25	2.4	1.2,1.5	15.625	1.116	105.3	0.1484	245	0.191	8.2	0.191	7.7	0.127	7.8	0.206	59.1	
		S5 8°43'53.22"N 76°50'22.62"E	2.46 pm	25	2.4	1.2,1.5	15.625	1.116	105.3	0.1484	243	0.254	7.7	0.191	7.6	0.254	7.8	0.318	56.3	



3.1 Trial Blast Details

The details of the trial blasts along with the measured blast induced ground vibrations and blasting pattern are reported in the following paragraphs. From the adopted blasting pattern and charging practices during the aforesaid experimental blasts, maximum charge per delay and predictor equation were determined for the present site.

Blast No: 1: The first trial blast was conducted on 16th March, 2021 and the adopted blasting pattern and details are given in the Table 3.2 and 3.3. The Figure 3.1 depicts the blasting pattern and location of blasting site and monitoring station is provided in the Figure 3.2

Table 3.2 Co-ordinates of Blast & Instrument Locations

Sl. No	Location	Serial of Instrument	Distance (m)	Latitude (N)	Longitude (E)	PPV (mm/s)	Noise dB(A)	Type of structure/ Permissible limit
1	Blast Location (B1)			8°43'45.19"	76°50'18.17"	---		
2	VMS_1 Location	11772	213	8°43'39.00"	76°50'15.00"	Not Triggered		Belonging to the owner
3	VMS_2 Location	20484	62	8°43'44.17"	76°50'19.88"	4.12 Within permissible limit	71.6	Belonging to the owner, maximum value is 15 mm/s
4	VMS_3 Location	5993	190	8°43'48.033"	76°50'12.81"	Not Triggered		Not belonging to the owner
6	VMS_5 Location	4687	105	8°43'41.81"	76°50'17.47"	2.92 Within permissible limit	35.0	Belonging to the owner, maximum value is 15 mm/s

Table 3.3 Details of Blast Parameters

Average Burden (m)	Average Spacing (m)	Average Hole Depth (m)	No. of holes (Nos.)	Maximum Charge per Hole (kg)	Maximum Charge per Delay (kg)	Total quantity of Explosives used (kg)
1.2	1.5	2.4	63	0.688	2.168	43.375

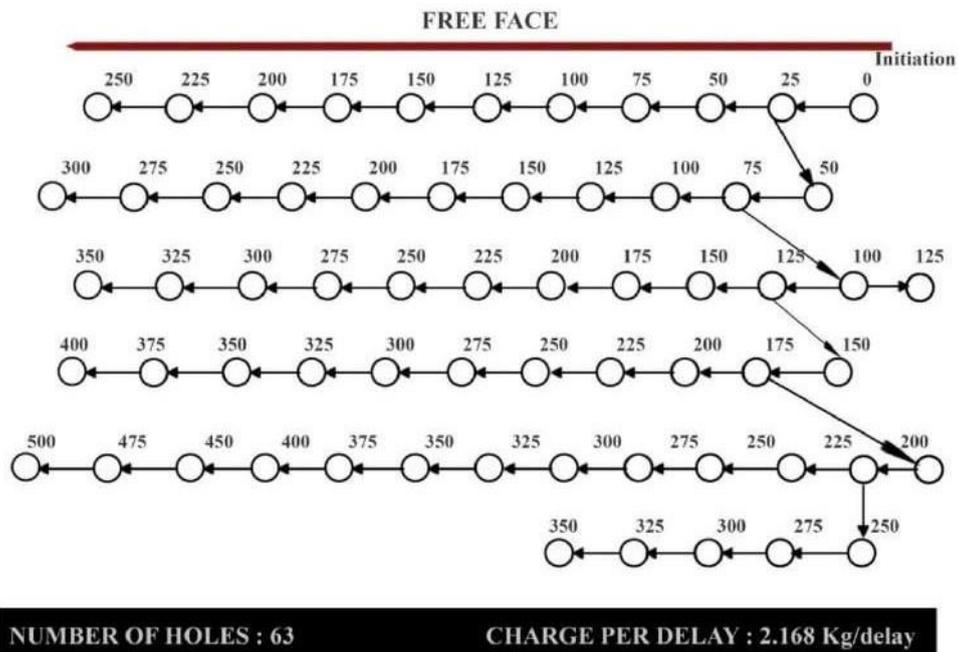


Figure 3.1 Schematic diagram of adopted blasting pattern for the blast 1

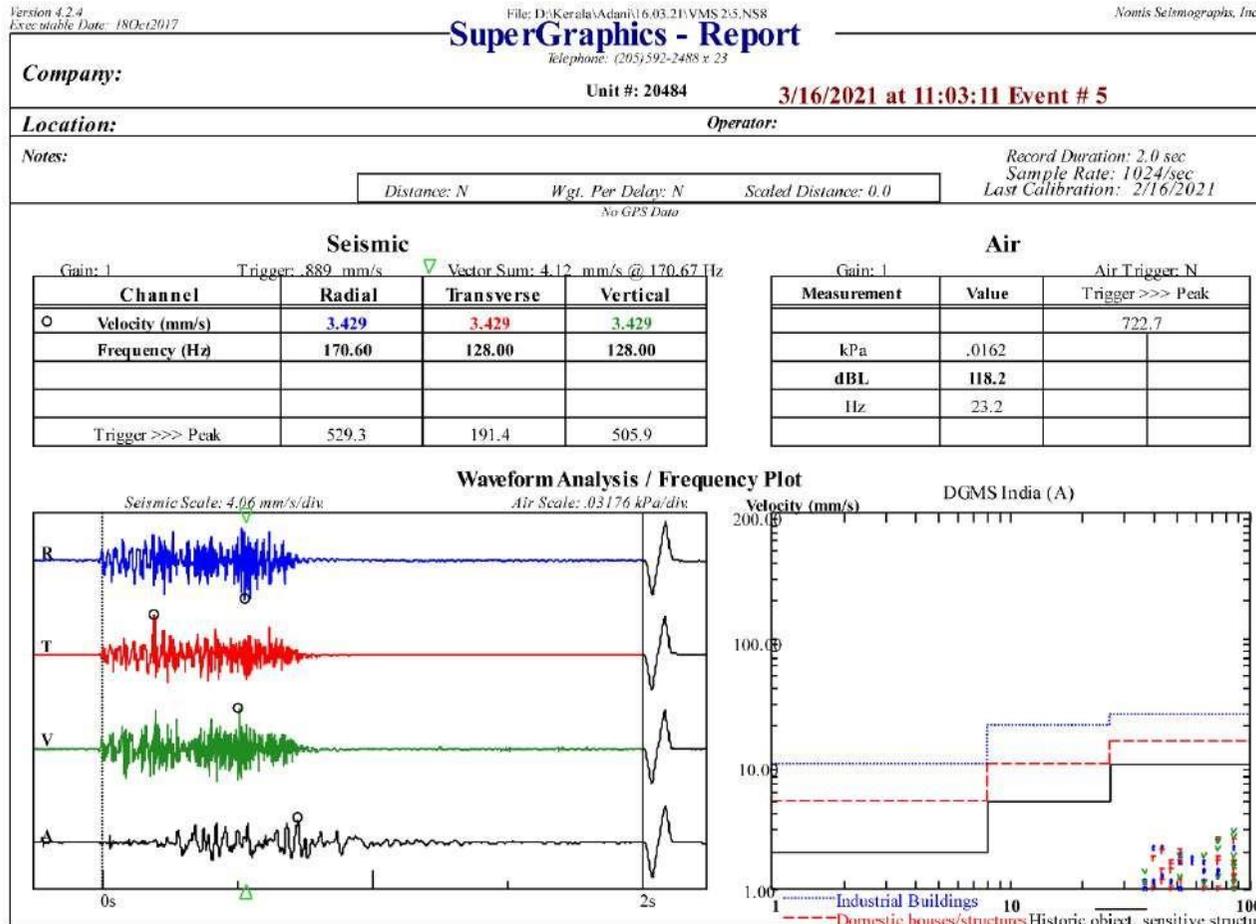
Post Blast Observations

During the post blast observations, the following conditions were identified:

- No backbreak was observed.
- Muckpile was loose.
- The throw of the blast has been around 10-15 m which is considered to be normal.
- A drop of about 0.5 m from the top surface of bench has been found at the rear side of the blasted muck pile.
- No fly rock has travelled beyond 10 m from the blast.
- No misfires have occurred.
- The ground vibrations level monitored by the mine management was well within permissible level.
- Few big sized boulders have been found on the blasted muck pile.
- Summary of the field data related to the above blast is given in **Table 3.2 & 3.3.**



VMS_2 Location : EVENT REPORT





VMS_5 Location : EVENT REPORT



Event Report

Date/Time MicL at 10:59:23 March 16, 2021
Trigger Source Geo: 0.492 mm/s
Range Geo: 127 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 4687 V 2.61 MiniMate
Battery Level 6.4 Volts
Calibration April 21, 2017 by UES, New Delhi
File Name F687IW9Q.IZO

Notes
 Location: KADAVILA STONE QUARRY
 Client: ADANI PORT PVT LTD
 User Name: ANNA UNIVERSITY
 Converted: February 26, 2011 04:50:28 (V8.12)

Extended Notes

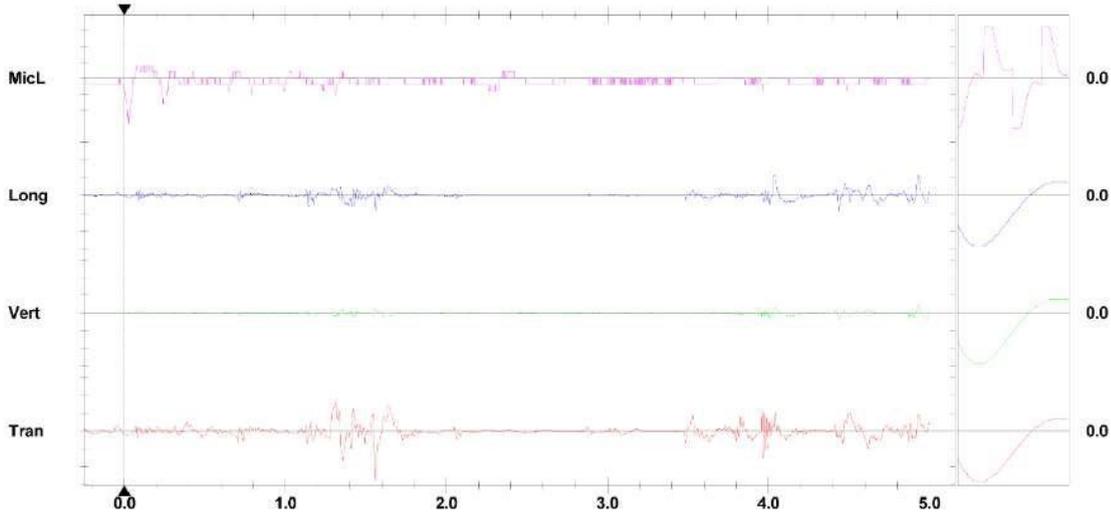
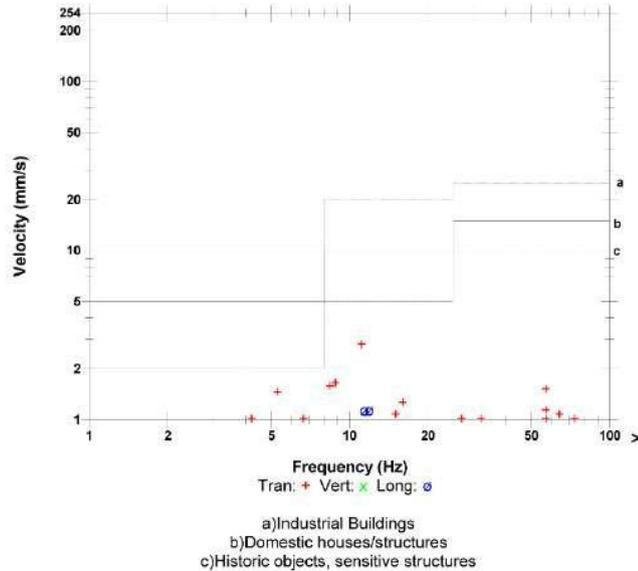
Post Event Notes

Microphone Linear Weighting
PSPL 116.9 dB(L) at 0.027 sec
ZC Freq 7.0 Hz
Channel Test Passed (Freq = 20.0 Hz Amp = 503 mv)

	Tran	Vert	Long	
PPV	2.79	0.445	1.14	mm/s
ZC Freq	11	20	11	Hz
Time (Rel. to Trig)	1.561	4.930	4.037	sec
Peak Acceleration	0.0530	0.0265	0.0199	g
Peak Displacement	0.0346	0.00307	0.0151	mm
Sensorcheck	Passed	Passed	Passed	
Frequency	7.6	8.0	7.8	Hz
Overswing Ratio	3.6	3.3	3.5	

Peak Vector Sum 2.92 mm/s at 1.562 sec

DGMS India (A)
Permissible Ground Vibration



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 1.000 mm/s/div Mic: 5.00 pa.(L)/div
 Trigger =

Sensorcheck

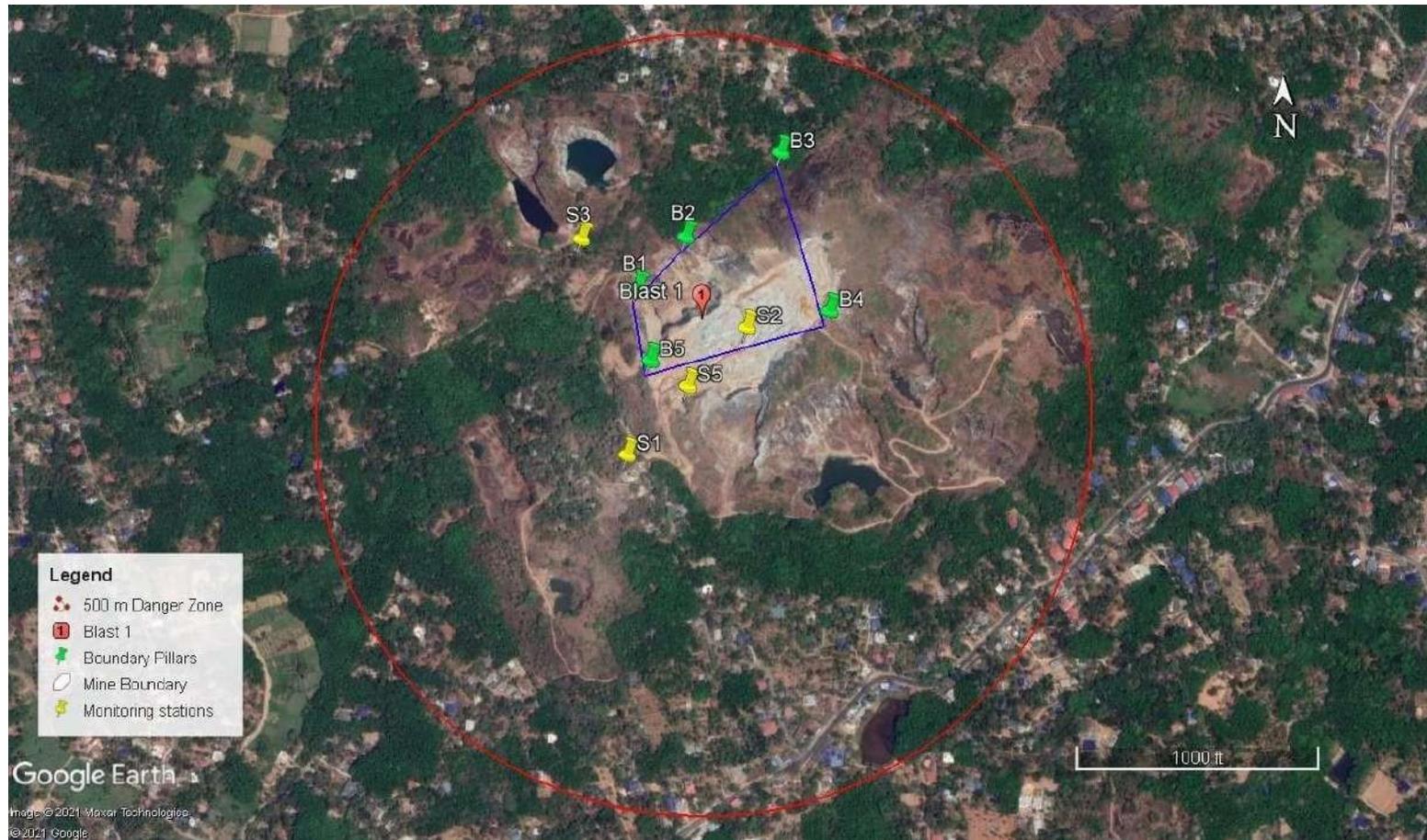


Figure 3.2 Imagery shows the location blast site 1 and its corresponding monitoring stations of M/s. Kadavila-1 Stone Quarry



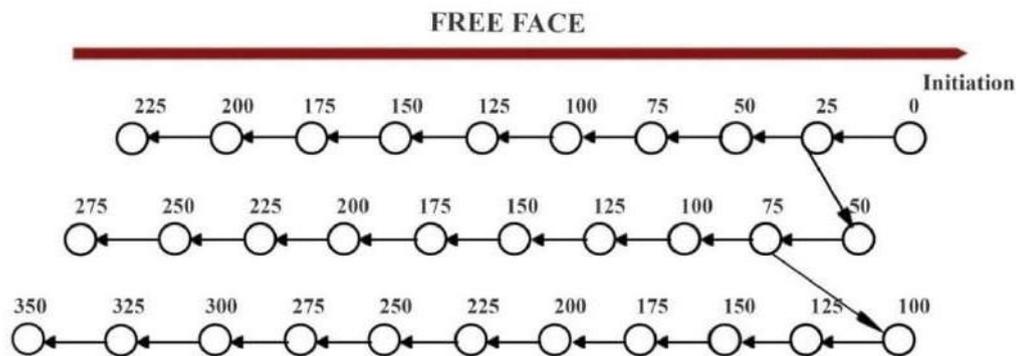
Blast No 2: The second blast was conducted on 16th March, 2021 and the adopted blasting pattern and details are given in the Table 3.4 and 3.5. The Figure 3.3 depicts the blasting pattern and location of blasting site and monitoring station is provided in the Figure 3.4

Table 3.4 Co-ordinates of Blast & Instrument Locations

Sl. No	Location	Serial of Instrument	Distance (m)	Latitude (N)	Longitude (E)	PPV (mm/s)	Noise dB(A)	Type of structure/ Permissible limit
1	Blast Location (B2)			8°43'46.73"	76°50'20.89"	---		
2	VMS_1 Location	11772	297	8°43'39.00"	76°50'15.00"	Not Triggered		Belonging to the
3	VMS_2 Location	20484	85	8°43'44.17"	76°50'19.88"	2.07 Within permissible limit	69.5	Belonging to the owner, maximum value is 15 mm/s
4	VMS_3 Location	5993	253	8°43'48.033"	76°50'12.81"	Not Triggered		Not belonging to the owner
5	VMS_5 Location	4687	184	8°43'41.81"	76°50'17.47"	3.41 Within permissible limit	79.0	Belonging to the owner, maximum value is 15 mm/s

Table 3.5 Co-ordinates of Details of Blast Parameters

Average Burden (m)	Average Spacing (m)	Average Hole Depth (m)	No. of holes (Nos.)	Maximum Charge per Hole (kg)	Maximum Charge per Delay (kg)	Total quantity of Explosives used (kg)
1.2	1.5	2.4	30	0.625	1.25	18.75



NUMBER OF HOLES : 30

CHARGE PER DELAY : 1.442 Kg/delay

Figure 3.3 Schematic diagram of adopted blasting pattern for the blast 2

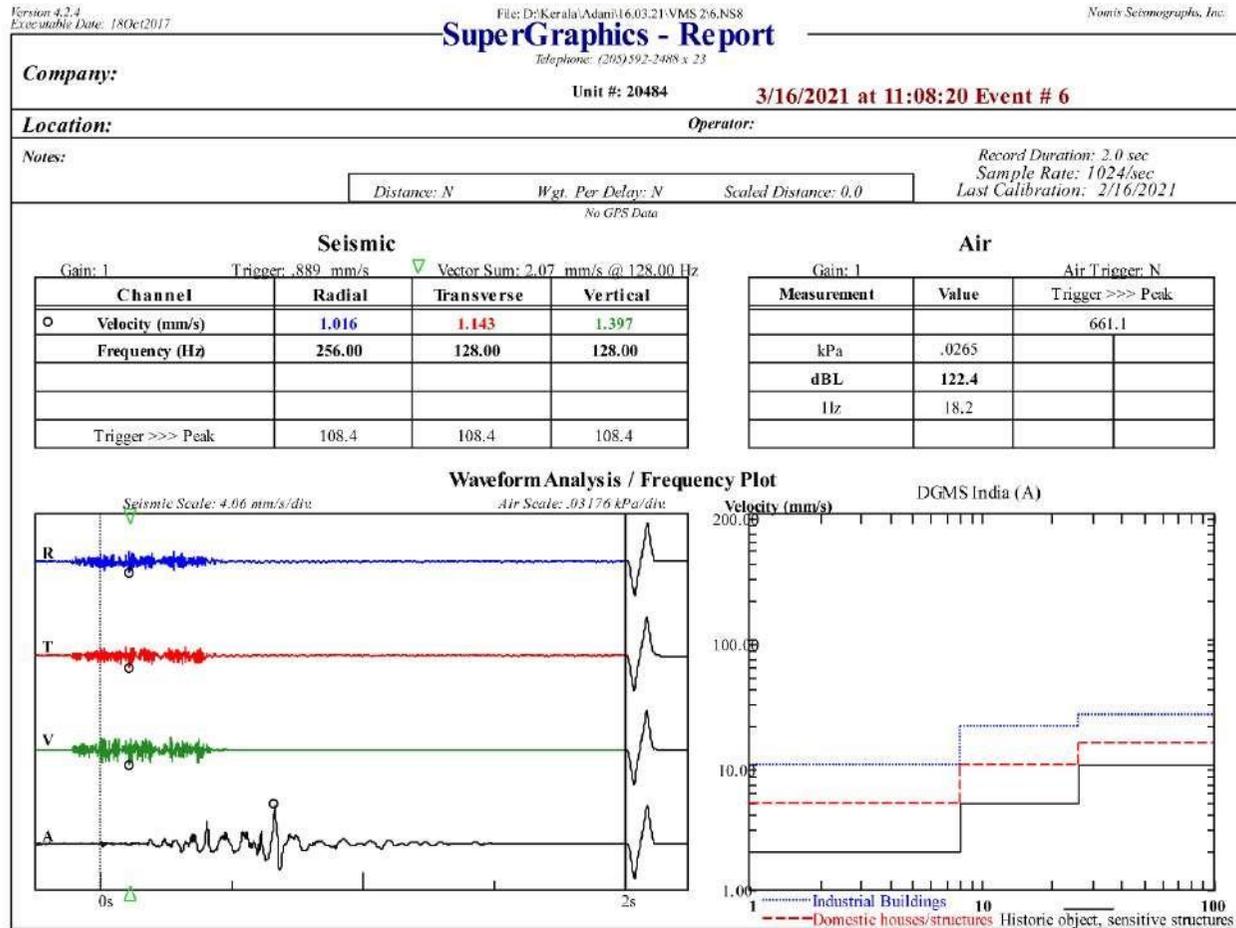
Post Blast Observations

During the post blast observations, the following conditions were identified:

- No backbreak was observed.
- Muckpile was found to be loosen.
- The throw of the blast has been around 10-12 m which is considered to be normal.
- A drop of about 1m from the top surface of bench has been found at the rear side of the blasted muck pile.
- No fly rock has travelled beyond 12 m from the blast.
- No misfires have occurred.
- The ground vibrations level monitored in the Neighbouring house was well within permissible level.
- Few big sized boulders have been found on the blasted muck pile.
- Summary of the field data related to the above blast is given in **Table 3.4 & 3.5.**



VMS_2 Location : EVENT REPORT





VMS_5 Location : EVENT REPORT



Event Report

Date/Time Vert at 11:03:08 March 16, 2021
Trigger Source Geo: 0.492 mm/s
 Mic: 106 dB(L)
Range Geo :127 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 4687 V 2.61 MiniMate
Battery Level 6.4 Volts
Calibration April 21, 2017 by UES, New Delhi
File Name F687IW9Q.P80

Notes
 Location: KADAVILA STONE QUARRY
 Client: ADANI PORT PVT LTD
 User Name: ANNA UNIVERSITY
 Converted: February 26, 2011 04:50:28 (V8.12)

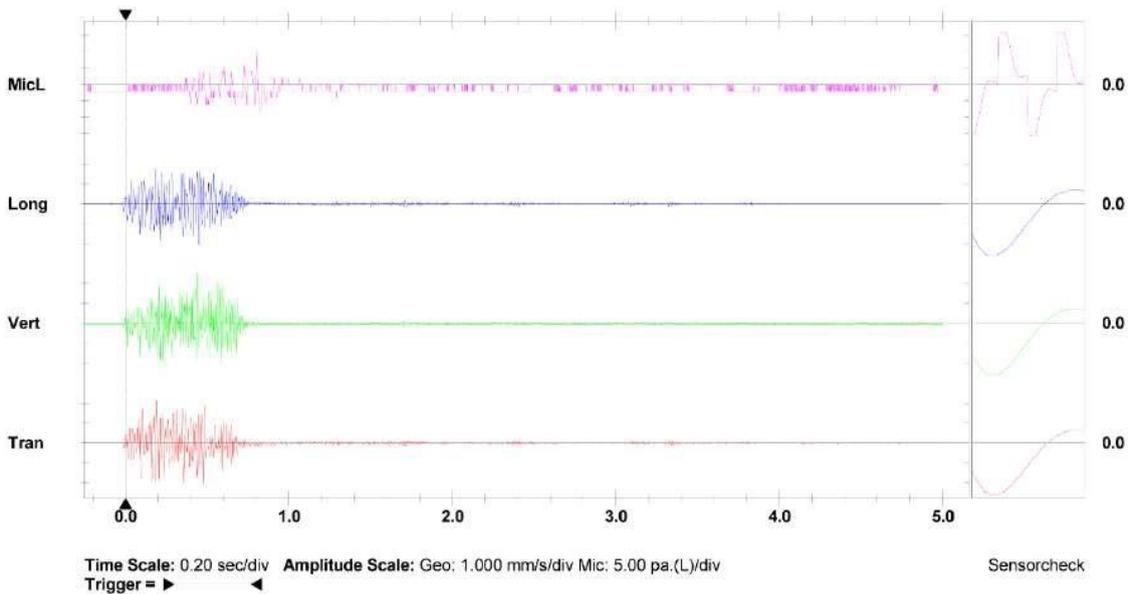
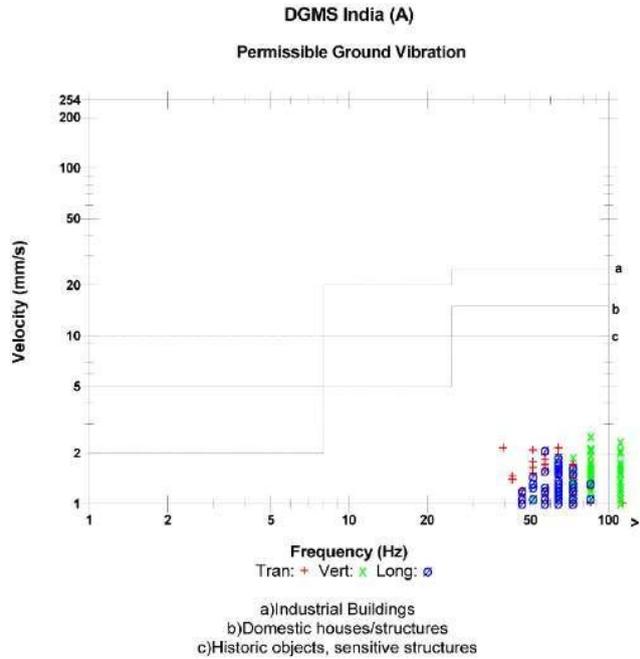
Extended Notes

Post Event Notes

Microphone Linear Weighting
PSPL 114.0 dB(L) at 0.800 sec
ZC Freq 39 Hz
Channel Test Passed (Freq = 20.0 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	2.16	2.54	2.10	mm/s
ZC Freq	37	85	57	Hz
Time (Rel. to Trig)	0.190	0.441	0.448	sec
Peak Acceleration	0.0928	0.232	0.0994	g
Peak Displacement	0.00595	0.00493	0.00493	mm
Sensorcheck	Passed	Passed	Passed	
Frequency	7.5	8.0	7.8	Hz
Overswing Ratio	3.6	3.3	3.5	

Peak Vector Sum 3.41 mm/s at 0.441 sec



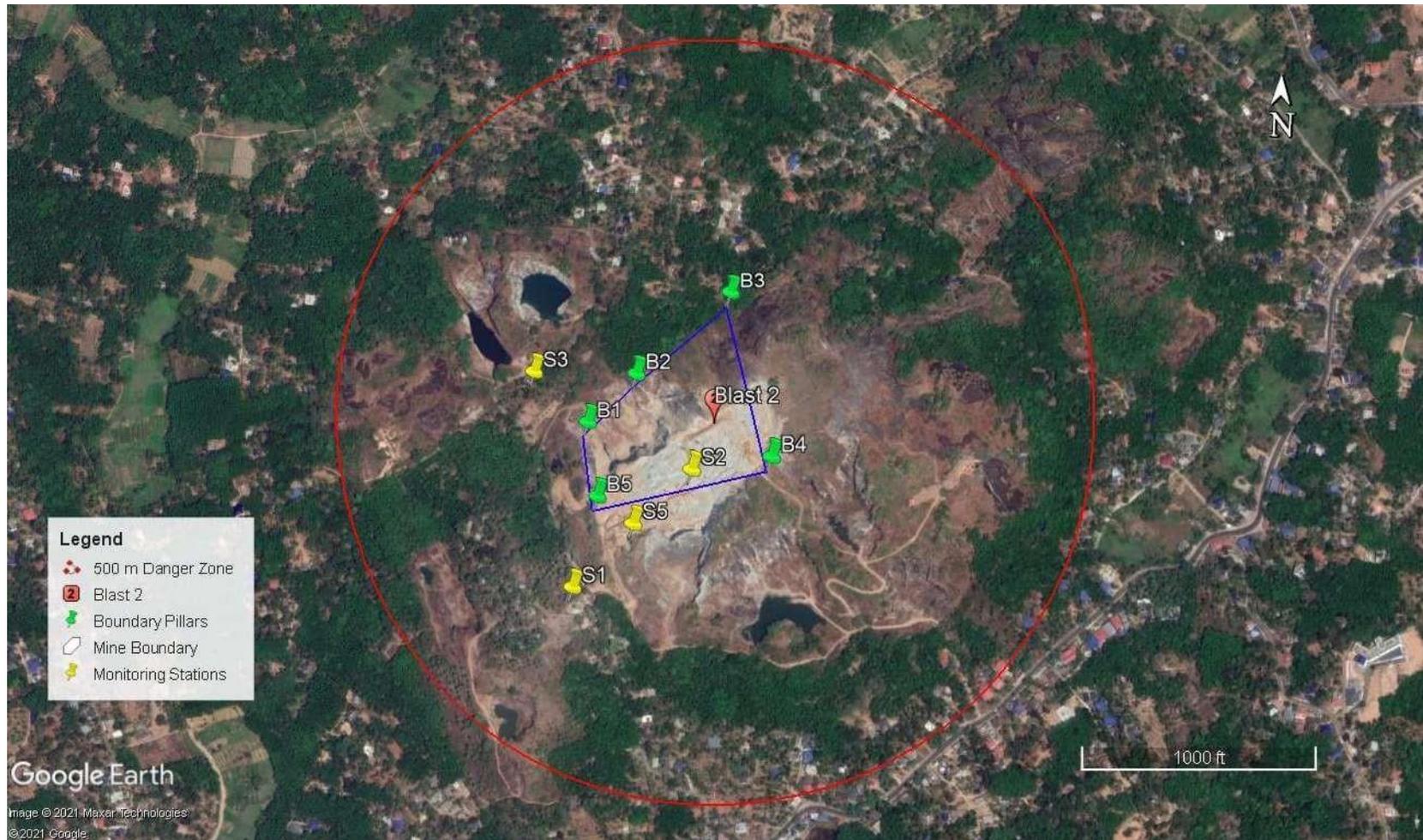


Figure 3.4 Imagery shows the location blast site 2 and its corresponding monitoring stations of M/s. Kadavila-1 Stone Quarry



Blast No 3: The third blast was conducted on 16th March, 2021 and the adopted blasting pattern and details are given in the Table 3.6 and 3.7. The Figure 3.5 depicts the blasting pattern and location of blasting site and monitoring station is provided in the Figure 3.6

Table 3.6 Co-ordinates of Blast & Instrument Locations

Sl. No	Location	Serial of Instrument	Distance (m)	Latitude (N)	Longitude (E)	PPV (mm/s)	Nois dB(A)	Type of structure/ Permissible limit
1	Blast Location (B3)			8°43'45.46"	76°50'20.86"	---		
2	VMS_1 Location	11772	267	8°43'39.00"	76°50'15.00"	Not Triggered		Belonging to the owner
3	VMS_2 Location	20484	47	8°43'44.17"	76°50'19.88"	5.58 Within permissible limit	82.4	Belonging to the owner, maximum value is 15 mm/s
4	VMS_3 Location	5993	264	8°43'48.033 "	76°50'12.81"	Not Triggered		Not belonging to the owner
5	VMS_5 Location	4687	152	8°43'41.81"	76°50'17.47"	2.7 Within permissible limit	6.9	Belonging to the owner, maximum value is 15 mm/s

Table 3.7 Details of Blast Parameters

Average Burden (m)	Average Spacing (m)	Average Hole Depth (m)	No. of holes (Nos.)	Maximum Charge per Hole (kg)	Maximum Charge per Delay (kg)	Total quantity of Explosives used (kg)
1.2	1.5	2.4	80	0.625	2.174	50

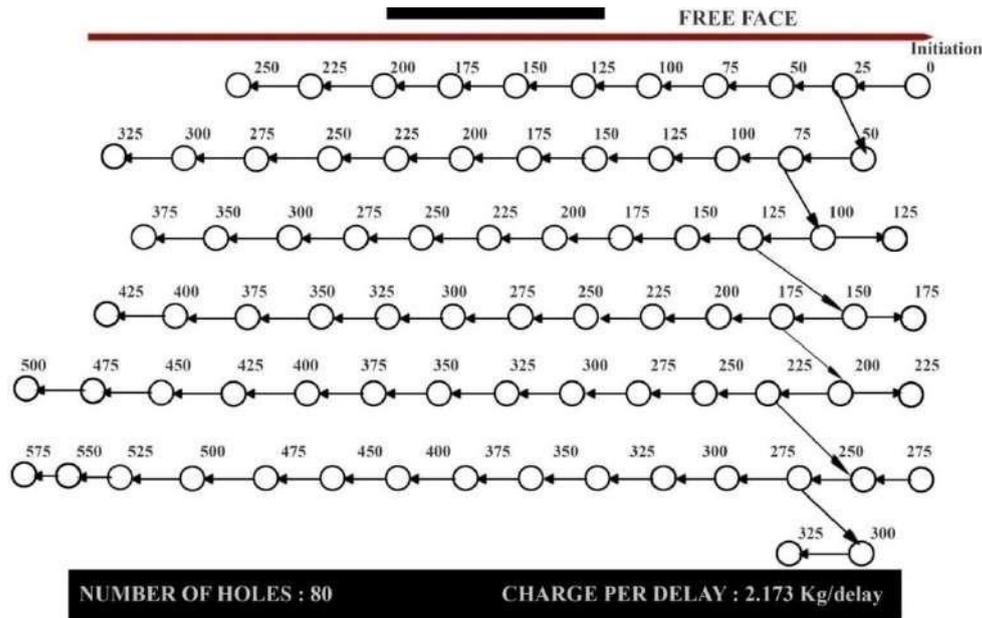


Figure 3.5 Schematic diagram of adopted blasting pattern for the blast 3

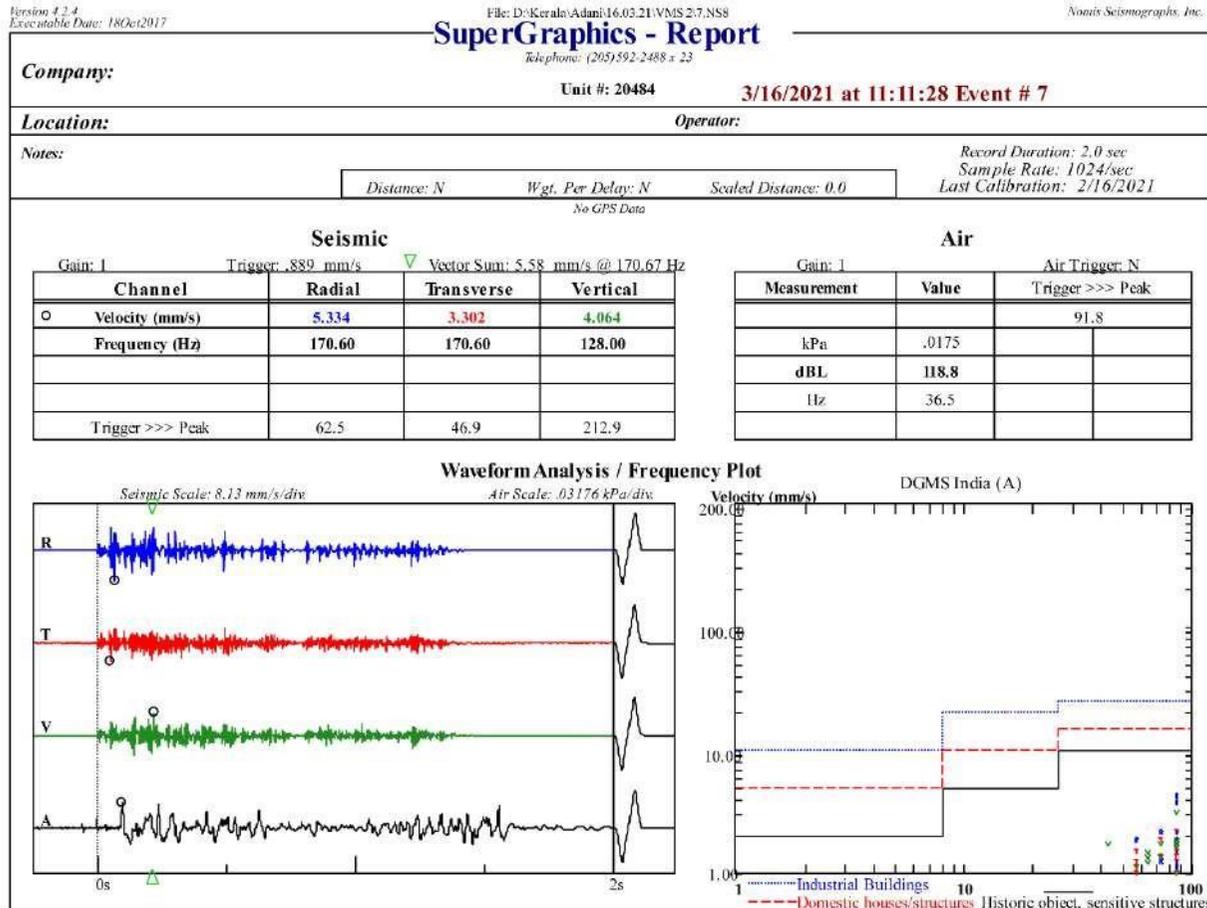
Post Blast Observations

During the post blast observations, the following conditions were identified:

- No backbreak was observed.
- Muckpile was found to be adequately loosen.
- The throw of the blast has been around 12-15 m which is considered to be normal.
- A drop of about 1m from the top surface of bench has been found at the rear side of the blasted muck pile.
- No fly rock has travelled beyond 10 m from the blast.
- No misfires have occurred.
- The ground vibrations level monitored in the Neighbouring house was well within permissible level.
- Few big sized boulders have been found on the blasted muck pile.
- Summary of the field data related to the above blast is given in **Table 3.6 & 3.7.**



VMS_2 Location : EVENT REPORT





VMS_5 Location : EVENT REPORT



Event Report

Date/Time Tran at 11:11:30 March 16, 2021
Trigger Source Geo: 0.492 mm/s
 Mic: 106 dB(L)
Range Geo :127 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 4687 V 2.61 MiniMate
Battery Level 6.4 Volts
Calibration April 21, 2017 by UES, New Delhi
File Name F687IW9R.360

Notes
Location: KADAVILA STONE QUARRY;
Client: ADANI PORT PVT LTD
User Name: ANNA UNIVERSITY
Converted: February 26, 2011 04:50:28 (V8.12)

Extended Notes

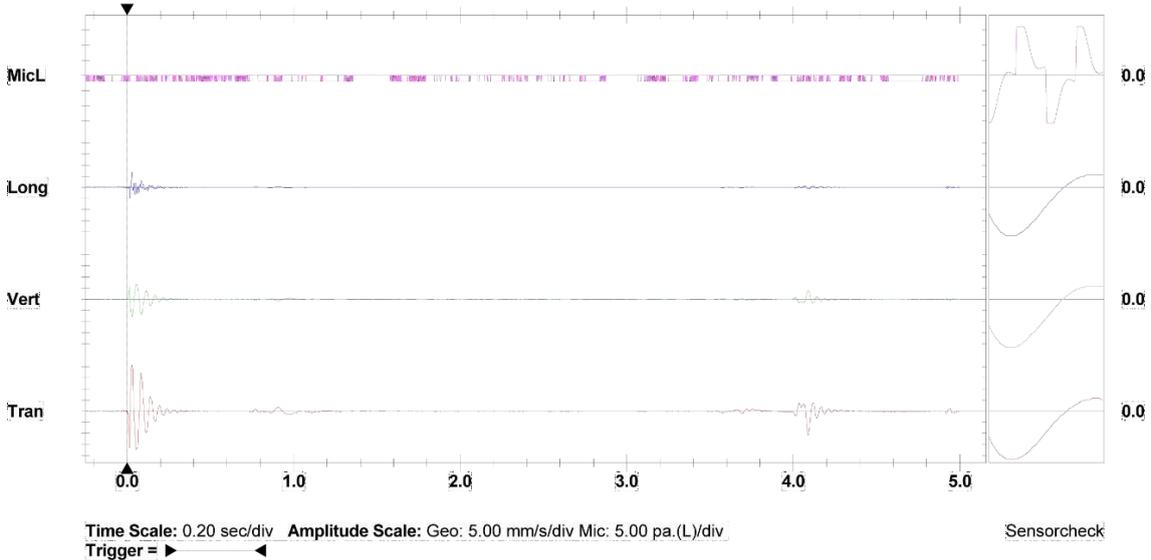
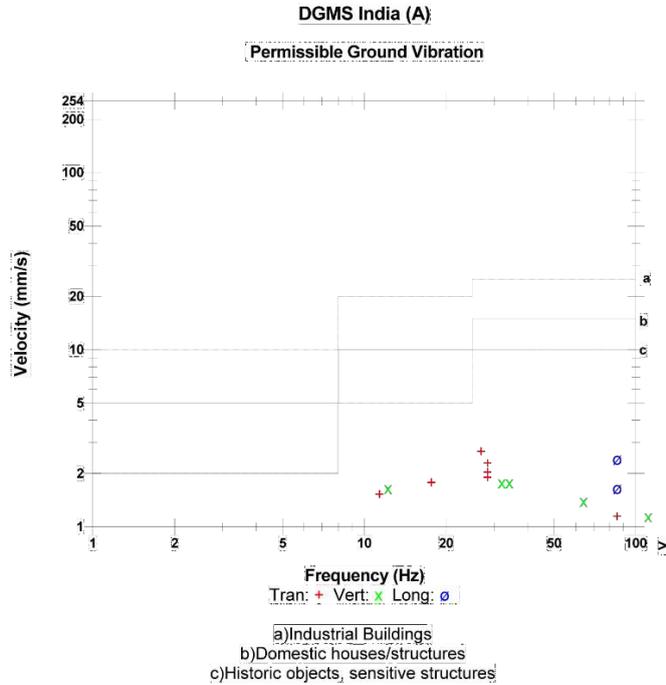
Post Event Notes

Microphone Linear Weighting
PSPL 100.0 dB(L) at 0.001 sec
ZC Freq N/A
Channel Test Passed (Freq = 20.0 Hz Amp = 506 mv)

	Tran	Vert	Long	
PPV	2.10	2.67	1.86	mm/s
ZC Freq	24	22	24	Hz
Time (Rel. to Trig)	0.032	0.030	0.029	sec
Peak Acceleration	0.464	0.305	0.212	g
Peak Displacement	0.184	0.0705	0.0206	mm
Sensorcheck	Passed	Passed	Passed	
Frequency	7.5	7.8	7.7	Hz
Overswing Ratio	3.5	3.3	3.3	

Peak Vector Sum 2.7 mm/s at 0.032 sec

N/A: Not Applicable



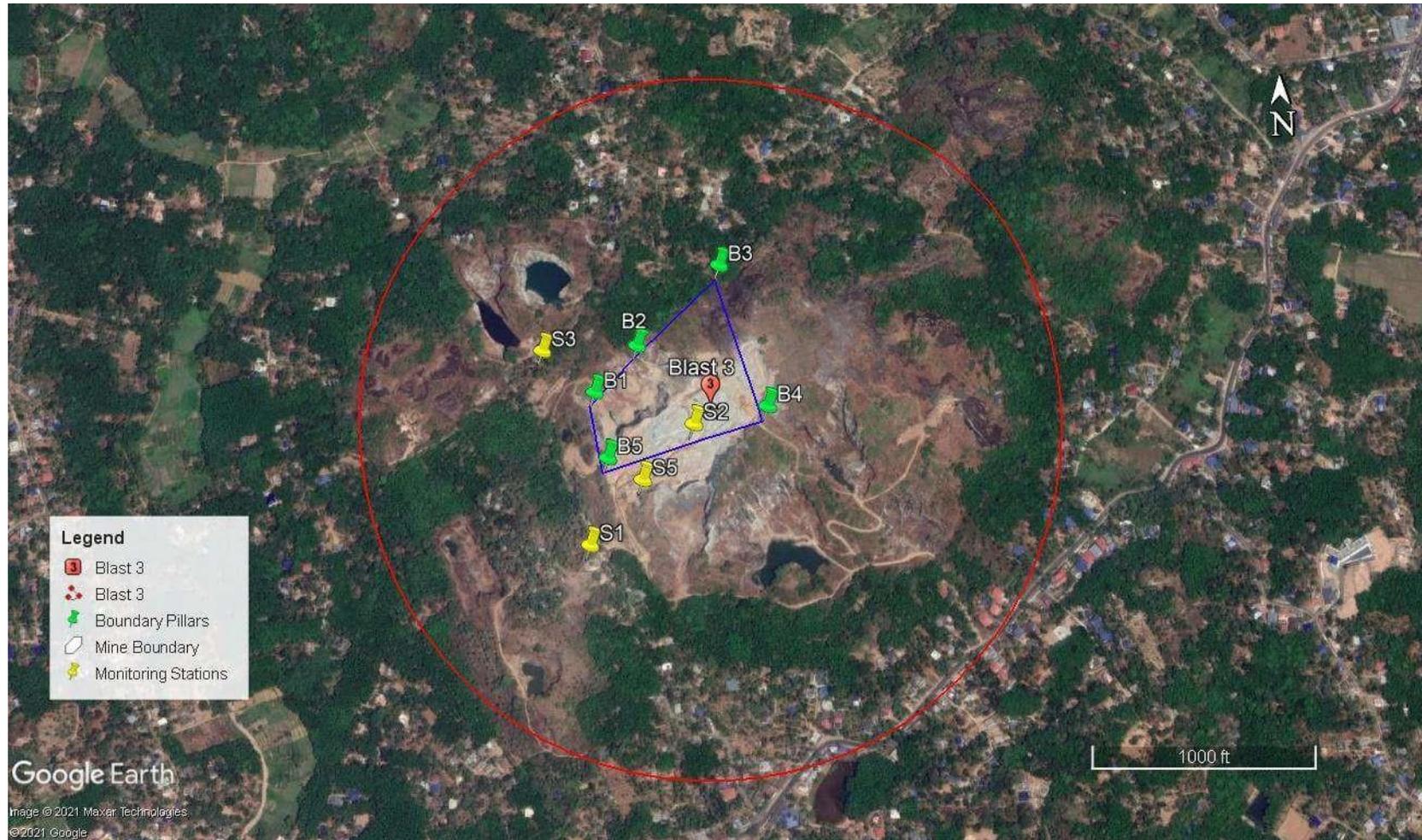


Figure 3.6 Imagery shows the location blast site 3 and its corresponding monitoring stations of M/s. Kadavila-1 Stone Quarry



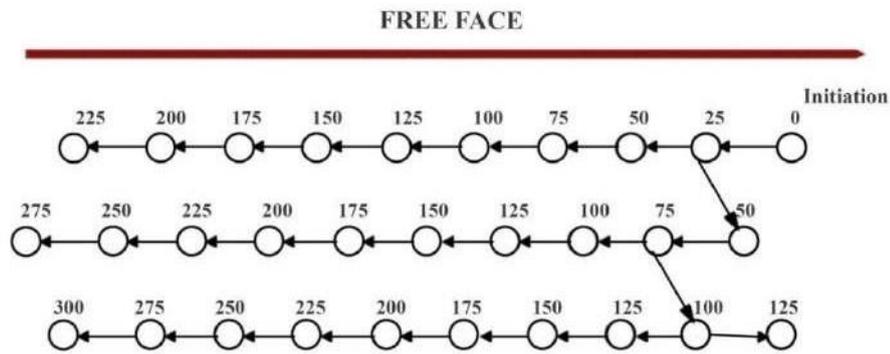
Blast No 4: The fourth blast was conducted on 16th March, 2021 and the adopted blasting pattern and details are given in the Table 3.8 and 3.9. The Figure 3.7 depicts the blasting pattern and location of blasting site and monitoring station is provided in the Figure 3.8

Table 3.8 Co-ordinates of Blast & Instrument Locations

Sl. No.	Location	Serial of Instrument	Distance (m)	Latitude (N)	Longitude (E)	PPV (mm/s)	Noise dB(A)	Type of structure/ Permissible limit
1	Blast Location (B4)			8°43'43.29"	76°50'16.16"	---		
2	VMS_1 Location	11772	136	8°43'39.00"	76°50'15.00"	0.832 Within permissible limit	4.5	Not belonging to the owner, maximum value is 5 mm/s
3	VMS_2 Location	20484	120	8°43'44.17"	76°50'19.88"	5.87 Within permissible limit	66.9	Belonging to the owner, maximum value is 15 mm/s
4	VMS_3 Location	5993	465	8°43'45.28"	76°50'31.27"	0.968 Within permissible limit	6.9	Not belonging to the owner, maximum value is 5 mm/s
5	VMS_4 Location	4688	60	8°43'41.81"	76°50'17.47"	Not Triggered		Belonging to the owner
6	VMS_5 Location	4687	282	8°43'52.19"	76°50'18.62"	2.81 Within permissible limit	57.3	Not belonging to the owner, maximum value is 5 mm/s

Table 3.9 Details of Blast Parameters

Average Burden (m)	Average Spacing (m)	Average Hole Depth (m)	No. of holes (Nos.)	Maximum Charge per Hole (kg)	Maximum Charge per Delay (kg)	Total quantity of Explosives used (kg)
1.2	1.5	2.4	30	0.625	1.339	18.75



NUMBER OF HOLES : 30

CHARGE PER DELAY : 1.562 Kg/delay

Figure 3.7 Schematic diagram of adopted blasting pattern for the blast 4

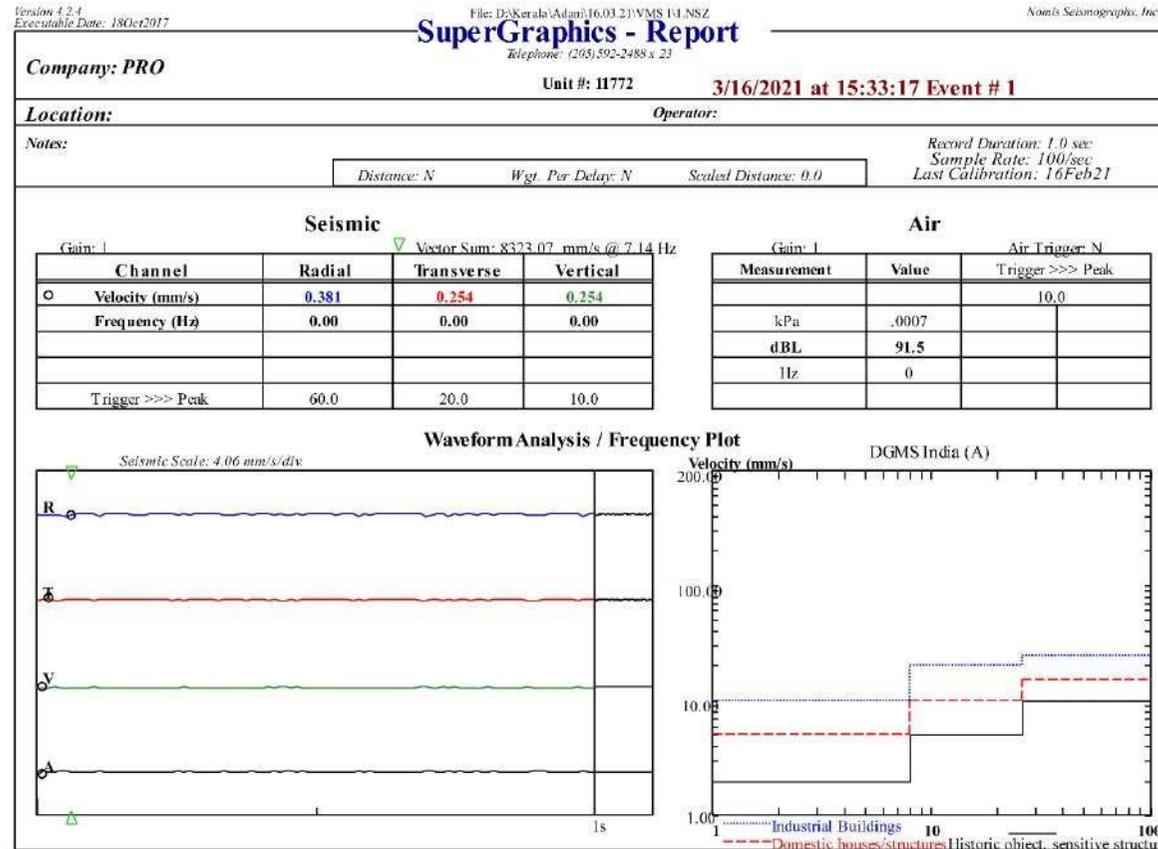
Post Blast Observations

During the post blast observations, the following conditions were identified:

- Backbreak was observed of about 0.5 - 1.0 m.
- Muckpile was found to be adequately fragmented.
- The throw of the blast has been around 15 m which is considered to be normal.
- A drop of about 0.5 to 0.75 m from the top surface of bench has been found at the rear side of the blasted muck pile.
- No fly rock has travelled beyond 15 m from the blast.
- No misfires have occurred.
- The ground vibrations level monitored in the Neighbouring village was well within permissible level.
- Few big sized boulders have been found on the blasted muck pile.
- Summary of the field data related to the above blast is given in **Table 3.8 & 3.9.**

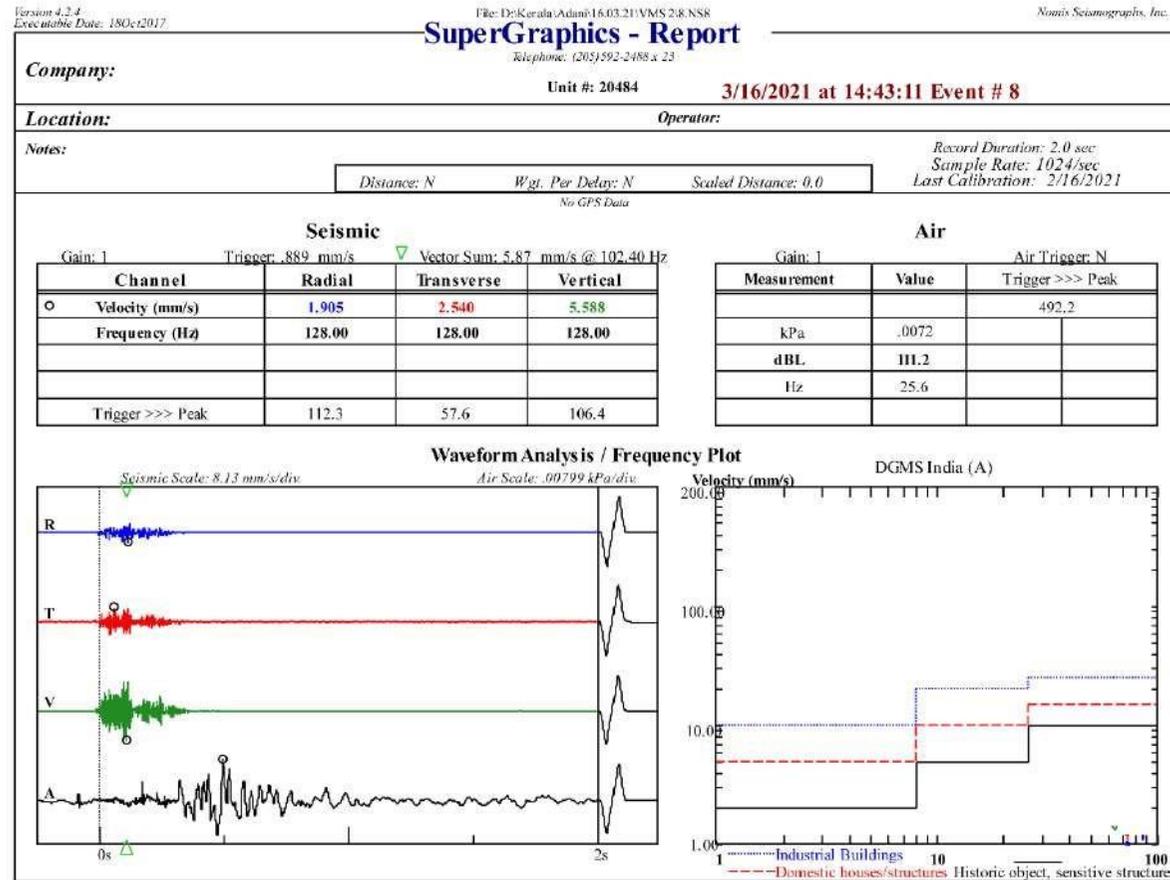


VMS_52 Location : EVENT





VMS_53 Location : EVENT





VMS_3 Location : EVENT REPORT



Event Report

Date/Time Tran at 14:41:51 March 16, 2021
Trigger Source Geo: 0.492 mm/s, Mic: 106.0 dB(L)
Range Geo: 127.0 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 5993 V 2.61 MiniMate
Battery Level 6.6 Volts
Unit Calibration March 1, 2021 by UES New Delhi
File Name G993IWA0.TR0

Notes

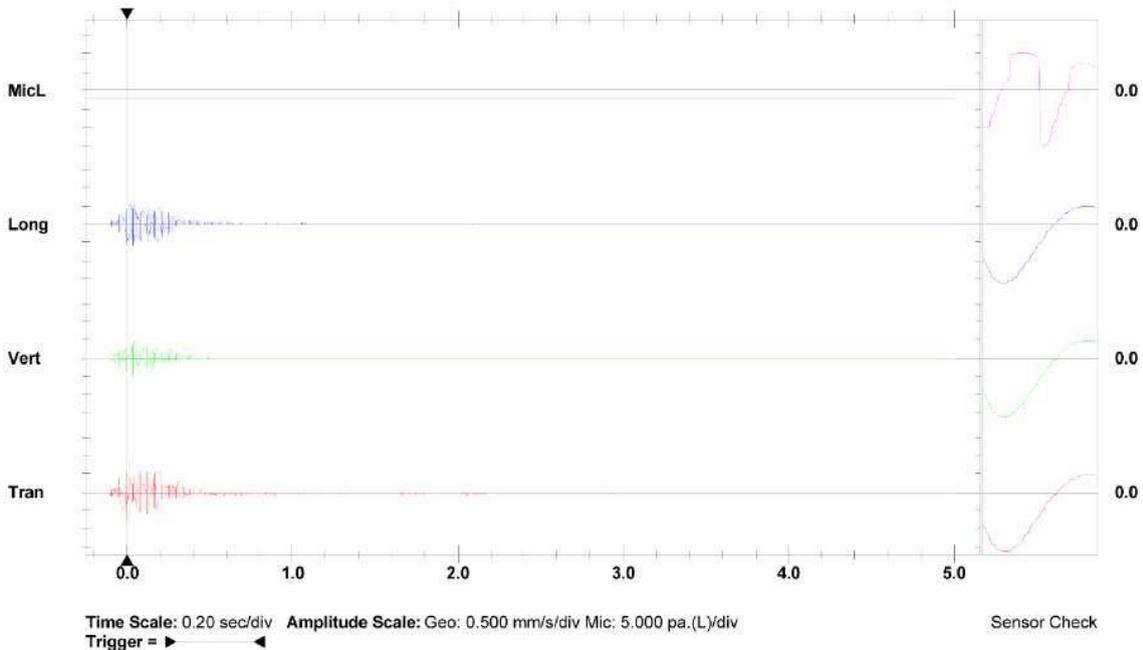
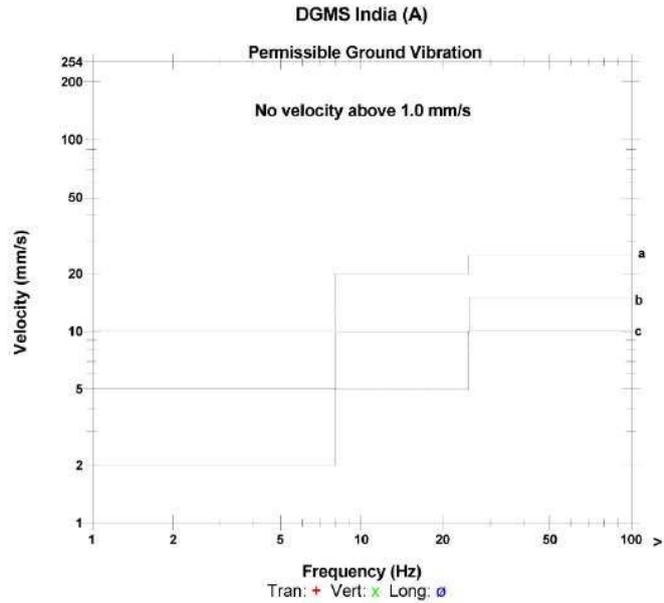
Location: KADAVILA STONE QUARRY
 Client: ADANI PORT PVT LTD
 User Name: ANNA UNIVERSITY
 Converted: February 26, 2011 07:25:35 (V8.12)

Extended Notes

Microphone Linear Weighting
PSPL 100.00 dB(L) at 0.293 sec
ZC Freq N/A
Channel Test Check (Freq = 0.0 Hz Amp = 30 mv)

	Tran	Vert	Long	
PPV	0.889	0.508	0.572	mm/s
ZC Freq	>100	N/A	N/A	Hz
Time (Rel. to Trig)	0.009	0.038	0.005	sec
Peak Acceleration	0.060	0.053	0.046	g
Peak Displacement	0.001	0.001	0.001	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.8	8.0	8.1	Hz
Overswing Ratio	3.6	3.5	3.5	

Peak Vector Sum 0.968 mm/s at 0.009 sec
 N/A: Not Applicable





VMS_5 Location : EVENT REPORT



Event Report

Date/Time Tran at 14:43:02 March 16, 2021
Trigger Source Geo: 0.492 mm/s
 Mic: 106 dB(L)
Range Geo :127 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 4687 V 2.61 MiniMate
Battery Level 6.4 Volts
Calibration April 21, 2017 by UES, New Delhi
File Name F687IWA0.VQ0

Notes
 Location: KADAVILA STONE QUARRY
 Client: ADANI PORT PVT LTD
 User Name: ANNA UNIVERSITY
 Converted: February 26, 2011 07:20:35 (V8.12)

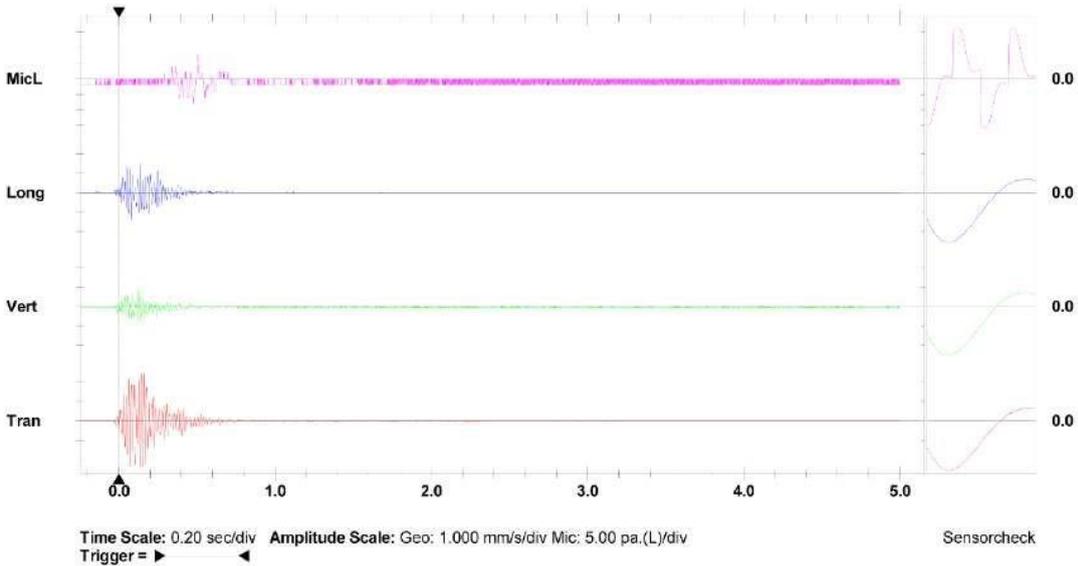
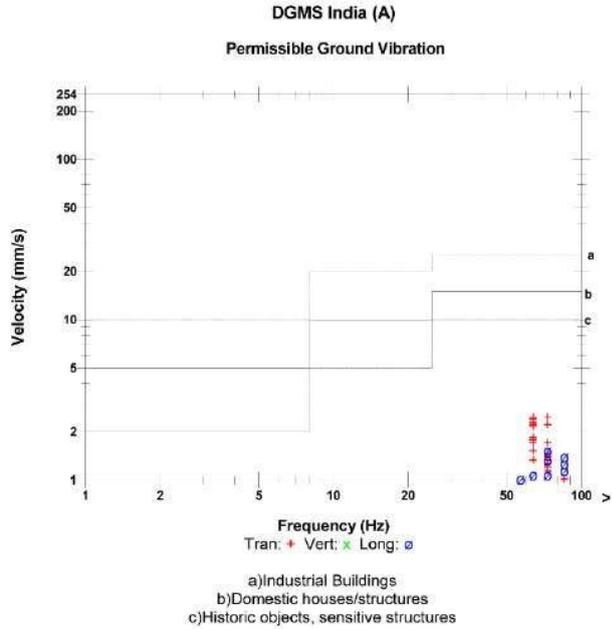
Extended Notes

Post Event Notes

Microphone Linear Weighting
PSPL 112.0 dB(L) at 0.479 sec
ZC Freq 17 Hz
Channel Test Passed (Freq = 20.0 Hz Amp = 505 mv)

	Tran	Vert	Long	
PPV	2.48	0.953	1.52	mm/s
ZC Freq	73	64	73	Hz
Time (Rel. to Trig)	0.147	0.126	0.139	sec
Peak Acceleration	0.113	0.0530	0.0729	g
Peak Displacement	0.00629	0.00229	0.00316	mm
Sensorcheck	Passed	Passed	Passed	
Frequency	7.5	8.0	7.7	Hz
Overswing Ratio	3.5	3.2	3.2	

Peak Vector Sum 2.81 mm/s at 0.140 sec



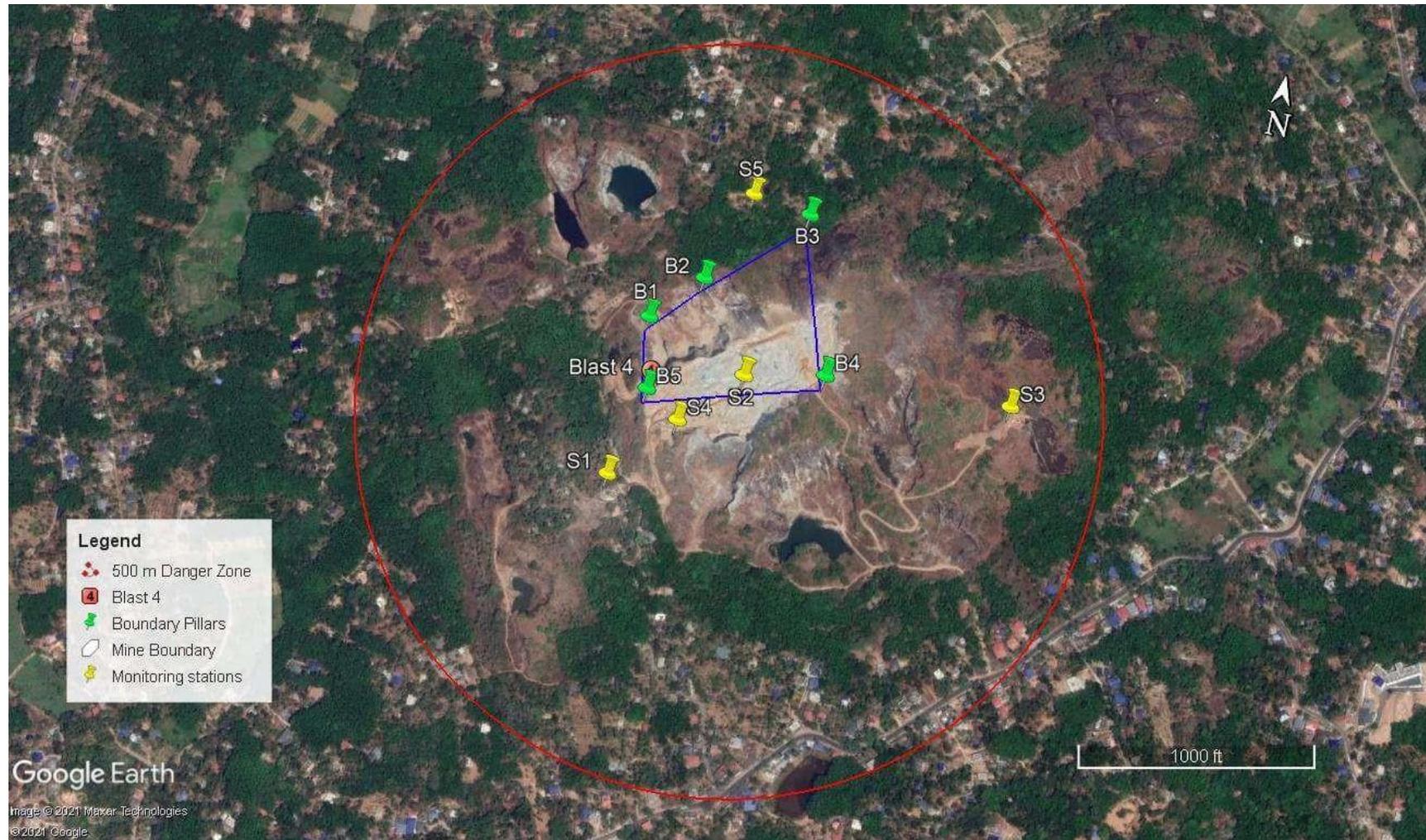


Figure 3.8 Imagery shows the location blast site 4 and its corresponding monitoring stations of M/s. Kadavila-1 Stone Quarry



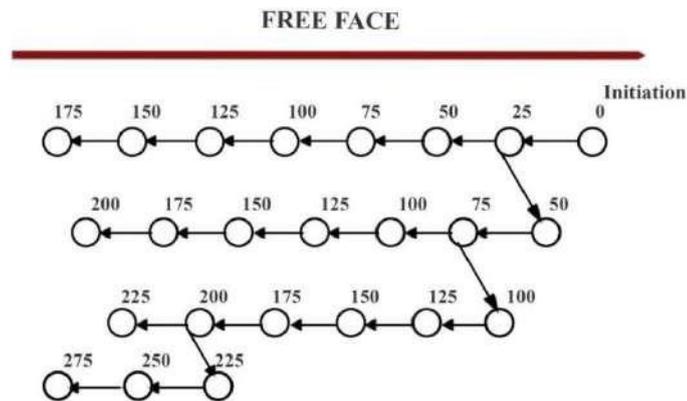
Blast No 5: The fifth blast was conducted on 16th March, 2021 and the adopted blasting pattern and details are given in the Table 3.10 and 3.11. The Figure 3.9 depicts the blasting pattern and location of blasting site and monitoring station is provided in the Figure 3.10

Table 3.10 Co-ordinates of Blast & Instrument Locations

Sl. No.	Location	Serial of Instrument	Distance (m)	Latitude (N)	Longitude (E)	PPV (mm/s)	Noise dB(A)	Type of structure/ Permissible limit
1	Blast Location (B5)			8°43'47.55"	76°50'19.50"	---		
2	VMS_1 Location	11772	296	8°43'39.00"	76°50'15.00"	1.47 Within permissible limit	18.9	Belonging to the owner, maximum value is 15 mm/s
3	VMS_2 Location	20484	102	8°43'44.17"	76°50'19.88"	7.52 Within permissible limit	63.1	Belonging to the owner, maximum value is 15 mm/s
4	VMS_3 Location	5993	359	8°43'45.28"	76°50'31.27"	0.397 Within permissible limit	12.9	Not belonging to the owner, maximum value is 5 mm/s
5	VMS_4 Location	4688	185	8°43'41.81"	76°50'17.47"	Not Triggered		Belonging to the owner
6	VMS_5 Location	4687	151	8°43'52.19"	76°50'18.62"	0.429 Within permissible limit	36.1	Not belonging to the owner, maximum value is 5 mm/s

Table 3.11 Details of Blast Parameters

Average Burden (m)	Average Spacing (m)	Average Hole Depth (m)	No. of holes (Nos.)	Maximum Charge per Hole (kg)	Maximum Charge per Delay (kg)	Total quantity of Explosives used (kg)
1.2	1.5	2.4	24	0.625	1.25	15



NUMBER OF HOLES : 24

CHARGE PER DELAY : 1.363 Kg/delay

Figure 3.9 Schematic diagram of adopted blasting pattern for the blast 5

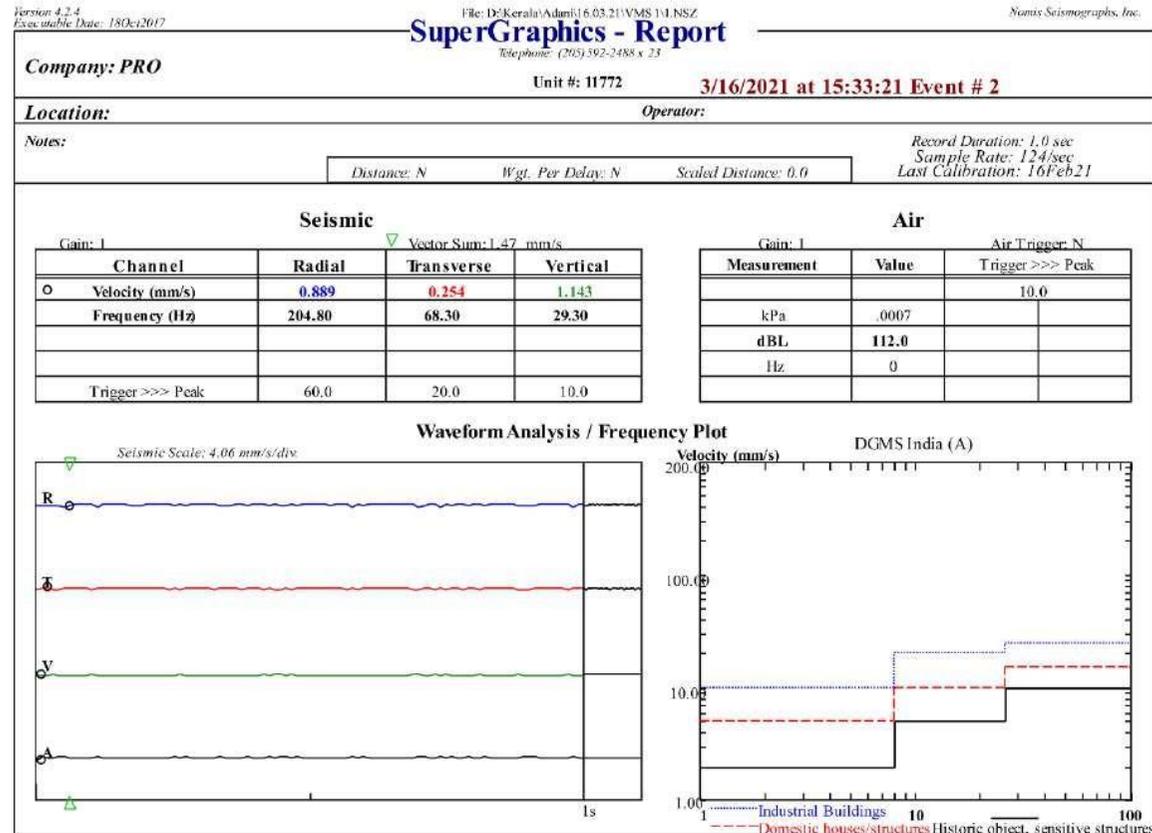
Post Blast Observations

During the post blast observations, the following conditions were identified:

- No Backbreak was observed.
- Muckpile was found to be adequately fragmented.
- The throw of the blast has been around 10 m which is considered to be normal.
- A drop of about 0.75 to 1 m from the top surface of bench has been found at the rear side of the blasted muck pile.
- No fly rock has travelled beyond 12 to 15 m from the blast.
- No misfires have occurred.
- The ground vibrations level monitored in the Neighbouring village was well within permissible level.
- Few big sized boulders have been found on the blasted muck pile.
- Summary of the field data related to the above blast is given in **Table 3.10 & 3.11.**

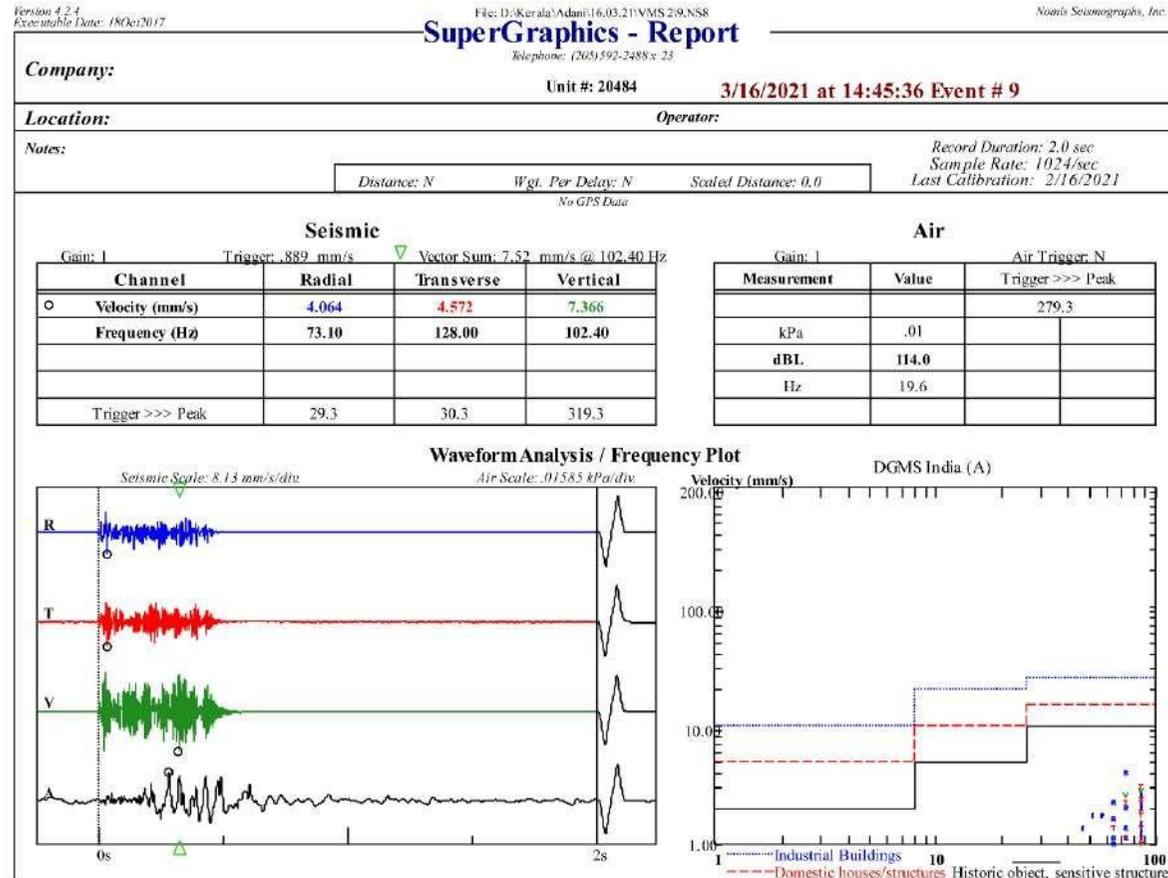


VMS_59 Location : EVENT





VMS_60 Location : EVENT





VMS_3 Location : EVENT REPORT



Event Report

Date/Time MicL at 14:44:10 March 16, 2021
Trigger Source Geo: 0.492 mm/s, Mic: 106.0 dB(L)
Range Geo: 127.0 mm/s
Record Time 5.0 sec at 1024 sps

Serial Number 5993 V 2.61 MiniMate
Battery Level 6.6 Volts
Unit Calibration March 1, 2021 by UES New Delhi
File Name G993IWA0.XM0

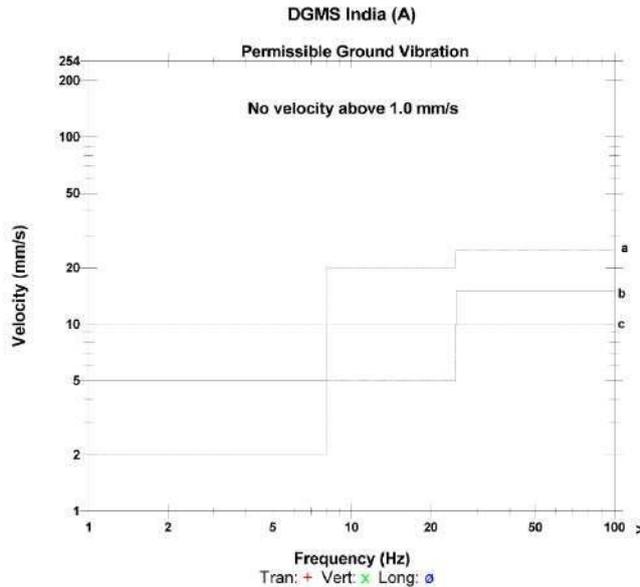
Notes
 Location: KADAVILA STONE QUARRY
 Client: ADANI PORT PVT LTD
 User Name: ANNA UNIVERSITY
 Converted: February 26, 2011 07:25:35 (V8.12)

Extended Notes

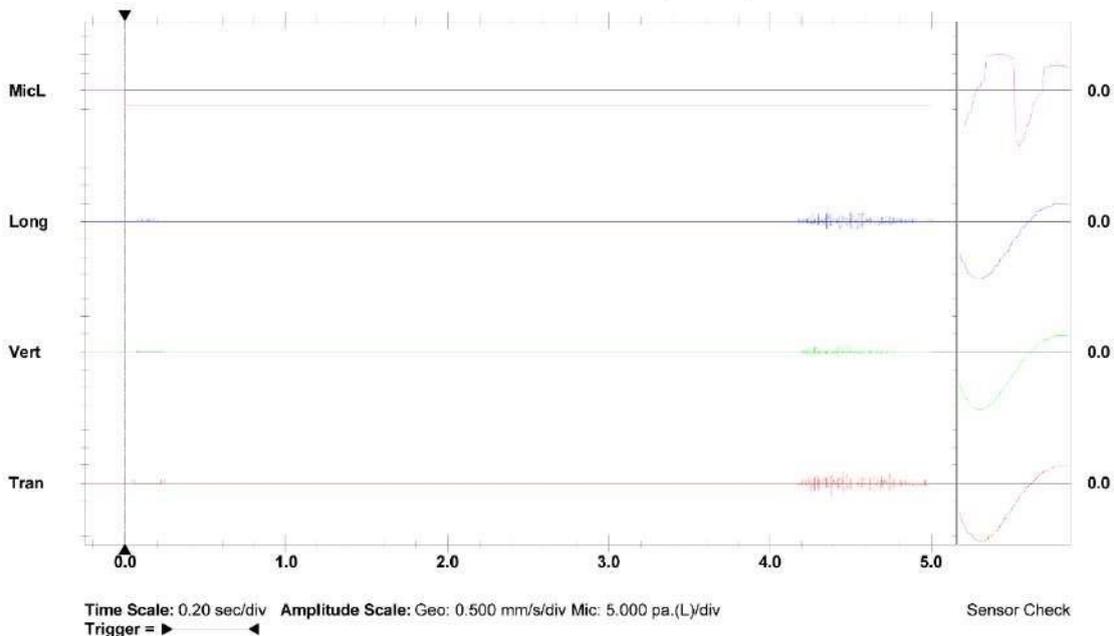
Microphone Linear Weighting
PSPL 106.0 dB(L) at 0.293 sec
ZC Freq N/A
Channel Test Check (Freq = 0.0 Hz Amp = 27 mv)

	Tran	Vert	Long	
PPV	0.381	0.191	0.254	mm/s
ZC Freq	N/A	N/A	N/A	Hz
Time (Rel. to Trig)	4.392	4.386	4.362	sec
Peak Acceleration	0.027	0.020	0.020	g
Peak Displacement	0.000	0.000	0.000	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.8	8.0	8.0	Hz
Overswing Ratio	3.6	3.5	3.5	

Peak Vector Sum 0.397 mm/s at 4.392 sec
 N/A: Not Applicable



- a) Industrial Buildings
- b) Domestic houses/structures
- c) Historic objects, sensitive structures



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