BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

ORIGINAL APPLICATION NO.732 OF 2022

IN THE MATTER OF:

Janak Palta McGiligan & Ors **……. Applicant**

-Versus-

State of Madhya Pradesh **…… Respondent**

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Joint Committee Report

In the Matter of

Original Application No.732/2022

Janak Palta McGilligan & Ors.

V/s

State of Madhya Pradesh

w.r.t.

Hon`ble National Green Tribunal [Principal Bench]
New Delhi Order dated 02.01.2023

Date of Visit: 25 January 2023

Location: Mandhata Island, Omkareshwar
District-Khandwa (MP)

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Joint Committee Report

Joint Committee Report in the matter of Hon'ble NGT OA No. 732/2022 (Janak Palta McGilligan & Ors. V/s State of Madhya Pradesh) in compliance of the Hon'ble NGT directions dated 02/01/2023

Hon'ble NGT Principal Bench, New Delhi vide its Order dated 02/01/2023 in O.A. No. 732/2022 (Janak Palta McGilligan & Ors. V/s State of Madhya Pradesh) directed in para No. 1 & 2 as under.

1. *This original application has been registered under Section 14& 15 of the National Green Tribunal Act, 2010 (hereinafter referred to as 'NGT Act, 2010') on a letter petition received from Dr. Smt. Janak Palta McGilligan complaining about pollution of air and water near Omkareshwar in Madhya Pradesh due to construction of 'Statue of Oneness'. The said construction is going on near Omkareshwar Jyotirling Tirth, Madhya Pradesh. It is alleged that for purpose of construction of said statue, more than 1000 trees have been cut. The land upto 30-40 feet has been dug by using heavy machines without following scientific methods causing huge damage to the top soil and debris of the construction is being dumped in River Narmada causing damage to aquatic life. It is also alleged that sewage is directly being discharge in River Narmada causing health hazard to local residents and ecological disturbance is also being caused due to damage caused to the hilly track for the construction. In support of complaint, photographs have been appended with letter petition. Perusal whereof shows that debris of construction material have been dumped in river path and logs of trees also shows cutting of huge number of trees.*

2. *In our view, before taking any further action in the matter, it would be appropriate to obtain a factual report for which purpose, we constitute a joint committee comprising State PCB, CPCB, Divisional Forest Officer, Khandwa and District Magistrate, Khandwa who shall visit the site, collect relevant information and submit factual report within two weeks by email at judicial-ngt@gov.in preferably in the form of searchable PDF/OCR Support PDF and not in the form of Image PDF. Nodal agency will be the State PCB for coordination and compliance.*

In Compliance of above directions passed by Hon'ble NGT, Madhya Pradesh Pollution Control Board has nominated Regional Officer Indore and Central Pollution Control Board Bhopal has nominated Shri Milind Nimje, Scientist-C as member of joint inspection committee.

Joint Committee comprised of following Officers have visited the construction site of "Statue of Oneness" at Mandhata Island near Omkareshwar, District-Khandwa on dated 25/01/2023 :-

1. **Shri Anup Kumar Singh, IAS, Collector Khandwa.**
2. **Shri Devanshu Shekhar, District Forest Officer, Khandwa**
3. **Shri Shriniwas Dwivedi, Regional Officer, MPPCB, Indore**
4. **Shri Milind Nimje, Scientist-C, CPCB, Regional Directorate Bhopal.**

Following Officers of the different concerned Departments were also present during the visit:-

1. Shri C.S. Solanki, SDM Punasa, District-Khandwa
2. Shri Uday Mandloi, Tehsildar Punasa, District-Khandwa
3. Shri Mahesh Chandra Verma, SDO, Forest, District-Khandwa
4. Shri Atul Kotiya, Scientist, Regional Lab, MPPCB, Indore
5. Shri Prateek Mandloi, Sub Engineer, PWD Bridge Division, District-Khandwa
6. Ms. Monika Pardhi, Chief Municipal Officer (CMO), Omkareshwar, District-Khandwa
7. Dr. Shailendra Mishra, Assistant Director, Department of Sanskrati & Incharge Officer Aacharya Shankar Ekta Nyas
8. Dr. Krupal Verma, Assistant Director Horticulture Department
9. Shri Sachin Verma, Assistant Mining Officer, District-Khandwa
10. Shri P.K. Chaturvedi, Additional Director, M.P. Tourism, District-Khandwa
11. Shri D.S. Parihar, Executive Engineer (EE), M.P. Tourism, District-Khandwa

Petitioner Mrs. Janak Palta McGilligan was also present during the inspection.

Issues raised by the Petitioner in the Application (OA 732/2022):

1. Pollution of Air and Water near Omkareshwar due to construction of "Statue of Oneness".
2. Cutting of more than 1000 trees for the purpose of construction of the Statue.
3. Digging of land upto 30-40 feet by using heavy machines without following scientific methods causing huge damage to top soil.
4. Dumping of debris of the construction in River Narmada causing damage to aquatic life.

5. Direct discharge of sewage in River Narmada causing health hazard to local residence.
6. Ecological disturbance due to damage caused to the hilly track for construction.

Earlier Petition before Hon'ble NGT (CZ) on similar issue :

A petition was filed by OA Number 31/2022 (CZ) (Shiva Mission Trust Vs State of Madhya Pradesh & Org. before the Hon'ble NGT Central Zonal Bench Bhopal in year 2022. The main issued raised by the applicant were :-

1. Cutting of trees on Mandhata Island and the approach area without permission.
2. Hill cutting, excavation and terraforming for purpose of road construction on Mandhata Island.
3. Loss of ecology which may poses risk to the river bed siltation, pollution and flooding due to tree cutting and terraforming / hill cutting.
4. Use of buldzers and heavy machineries in construction may disturb local wild life.

Hon'ble NGT (CZ) had constituted a Joint Inspection Committee comprising of the District Forest Officer, Khandwa and the Regional Officer, M.P. Pollution Control Board Indore and directed to visit the site and submit factual report vide its order dated 02/05/2022. In compliance of Hon'ble NGT order dated 02/05/2022, the joint committee had visited the site on 29/06/2022 and submitted its report. **Hon'ble NGT (CZ) had disposed the application vide their order dated 27/07/2022 with directions that project must follow the conditions specified in the environmental clearance**. Copy of the order dated 27-07-2022 is enclosed as **Annexure-1.**

Factual Report in Compliance of Hon'ble NGT (Principal Bench) Order dated 02/01/2023 :

The Joint Committee has visited on dated 25/01/2023, the Mandhata Island including road & museum construction sites on the Island, plantation area, tree cutting areas and details are as follows:

1. Mandhata Parvat is located as Island in between two stream of the River Narmada. On the Island there are natural trees, bushes, plantations, temples and some previous constructions were also seen. Google map of the Island and the river Narmada is enclosed as **Annexure-2.** In the Google map two streams of Narmada & Omkar Parvat of Mandhata Island may be perused.
2. Layout plan of the area showing location of the River, Bridge, Approach Road, the Museum, the Statue, debris/excavated material stacking area and the proposed plantation with number of plants and area is enclosed as **Annexure-3**.

3. Govt of MP has allotted 11.56 ha. Land for construction of the Statue of Guru Aadi Shankarachrya and the Shankar Museum on the Mandhata Island. Acharya Shankar Sanskritik Ekta Nyas, Govt. of MP. Sanskriti Department is occupier or owner of the land allotted. The project construction agency is M.P. State Tourism Development Corporation Limited (MPSTDCL) which is also a corporation under Govt. of MP.

4. Execution of the project for construction of the Statue of Guru Shree Aadi Shankaracharya and the Shankar Museum is being done by the **Acharya Shankar Sanskritik Ekta Nyas Govt. of MP, Sanskriti Department and M.P. Tourism Development Corporation Limited (MPTDCL).** The approach road is being constructed by Public Works Department (PWD) of the MP State.

5. **Observations :**

Brief of observations during visit are as follows:

(A) **Current status of project constructions :**

1. A bridge across the river Narmada is under construction to reach to the Island. The Bridge is being constructed by the PWD of the State Govt. Approx 40-50% work have been completed.

2. A temporary Rapta Bridge across the River by pipe culverts has been constructed to reach to the Island.

3. Approach road of 14m width and 1.270 KM length from the River to the Museum site has been constructed by the PWD of the State Govt.

4. For construction of the Shankar Museum, excavation work for foundation was observed.

5. For Construction of the Statue of Shree Guru Aadi Shankaracharya, excavation work for foundation has been completed and concrete work for foundation is under progress.

6. Excavated material has been stacked in the project area at 400-500 meter away from North stream of the River bank. The stacked material will be reused for backfilling work around the Museum by the Nyas. Dumping of debris in the River was not observed.

(B) **Overview regarding Excavation, Plant Cuttings and Proposed Plantation for the Project :**

An overview of the Museum (including Statue) site including excavation and plantation details has been submitted by Madhya Pradesh State Tourism Development Corporation which is enclosed as **Annexure-4**. Details are summarized as follows:

1. **Excavation & Stacking (Museum Site) :**

a.	The total surface area of excavation	21350 Sqm.
b.	Total Excavated Soil	1,05,335 Cum.
c.	Average Height of Excavation	4.90 m.
d.	Maximum Height at any point	8.35 m.
e.	Total Surface area used for stacking the excavated soil	16400 sqm.
f.	The Use of Stacked excavated soil	Proposed to be reused for backfilling at Museum site.

2. **Excavation & Stacking (Approach Road):**

a.	The total Length of the Approach Road	1270 M.
b.	Total Excavated Soil	61,542 Cum.
c.	Average Height of Excavation	3.40 m.
d.	Maximum Height at any point	8.50m.
e.	Excavated soil reused in Approach Road	46130 Sqm.
f.	Excavated soil issued to contractor for reuse in backfilling	15412 Sqm.

3. **Trees Cutting & Plantation (Approach Road) :**

a.	Tree cutting permission (Granted by SDM, Punasa)	1051 trees	
b.	Trees have been cut by PWD	1051 trees	
c.	Proposed plantation along the sides of Approach Road (By PWD)	1200	Total 2202 Plants
d.	Proposed plantation in other areas on the Island by PWD	1002	

4. **Trees Cutting & Plantation (Museum Site) :**

a.	Tree cutting permission in 11.56 ha. land of Museum site (As per EC)	418 Trees	
b.	Trees have been cut (till date)	260 Trees	
c.	Trees yet to be cut	158 Trees	
d.	Proposed plantation at 11.56 ha. land of Museum site (By MPTDCL)	6025	Total 36025 plants
e.	Proposed plantation at Mandhata Island other than Museum Site (By MPTDCL)	30000	
f.	Proposed Plantation at Mandhata Island (By MPTDCL)	2410 plants	

(C) **Status of trees cuttings, permissions obtained and proposed plantation:**

1. Trees on the land of Approach Road were counted by the Revenue Department and total 1051 trees were on the way of approach road accordingly permissions to cut the trees were obtained by PWD from Sub Divisional officer Punasa District-Khandwa vide their letter dated 10/11/2021 and 10/12/2021. Copies of the permission letters are enclosed as **Annexure-5 & 6**.

2. The PWD has cut total 1051 numbers of trees and deposited the wood received after cutting of the trees to Forest depot Sanawad District Khandwa.

3. Counting of trees on the land of 11.56 ha. allotted for construction of the Statue and Museum has been conducted by the Revenue Department and the Forest department during March-April 2022. On the above land area 1181 trees and 4316 bans/bamboo were found. Report & Panchnama in this regard is enclosed as **Annexure-7**.

4. Assistant Director, Department of Sanskrit Cum Officer Incharge Acharya Shankar Sanskriti Ekata Nyas, Govt of MP has obtained permission for cutting of trees of land area 11.56 ha. (Museum Site) The Sub Divisional officer Punasa District Kandwa has granted permission for cutting of trees vide order no 346 dated 24/03/2022. Copy of the order is enclosed as **Annexure-8**.

5. Environmental Clearance has been granted by MP State Environment Impact Assessment Authority (MPSEIAA) to the project. Copy of the Environment Clearance is enclosed as **Annexure-9**. **As per EC granted, 418 trees have been permitted to be cut** at the Statue and Museum site of the project.

6. As mentioned above **total trees proposed to be cut** as follows :

a.	At museum site (11.56 ha.)	418
b.	For construction of approach road	1051
	Total trees proposed to cut for complete project	**1469**

7. As per current status, **trees already cut or uprooted till dated** as follows :

a.	At museum site (11.56 ha.)	260
b.	For construction of approach road	1051
	Total trees already cut till date	**1311**

In addition to above 1525 bans/bamboo have also been removed from the Project site.

8. **Proposed plantation** :

a.	Proposed plantation at 11.56 ha. (Museum Site)	6025
b.	Proposed plantation at Mandhata Island	30000
c.	Proposed plantation along Approach Road sides	1200
d.	Proposed plantation at other areas by PWD	1002
	Total proposed plantation	**38227 plants**

9. The Project has already **done plantation till date** as follows :

a.	Plantation at 11.56 ha. (Museum Site)	1200
b.	Plantation at other places on Mandhata Island	1210
	Total Plantation done	**2410 plants**

Location sites of plantation done on the Island may be perused in Annexure-2.

The Project Proponent has **planted 2410 trees on total 2.26 ha. area till date**. Plant **species** are Neem (1425), Karanj (670), Pipal (125), Bargad (80), Putranjivak (20), Belpatra (50), Madhukamini (20) and Kadamb (20). Plantation have been observed during the visit.

A **schedule of future plantation** has also been submitted which is enclosed as **Annexure- 10**. Details are as follows :

S.No.	Duration of Plantation	Number of Plants to be planted	Plant Species
1	June-2023	5000	Karanj, Neem, Pipal, Bargad, Bellpatra, Dhavad, Anjan, Amaltas, Palash & other forest plant species
2	July-2023	5000	
3	May-2024	10000	
4	June-2024	5000	
5	July-2024	5000	

As mentioned above, project has proposed to plant 38227 trees on Mandhata Island which is more than 10 times of the total trees (1469 trees) to be cut for the project construction.

(D) Reply on the issues raised by the Petitioner in the Application (OA 732/2022):

1. Pollution of Air and Water near Omkareshwar due to construction of "Statue of Oneness" : -

The Project has provided following measures for control of air and water pollution :

- The Project Proponent has **obtained Environmental Clearance** from MP State Environment Impact Assessment Authority (MPSEIAA) vide letter issued dated 15-04-2022. The copy of the EC may be perused as **Annexure-9**.
- The Project has **obtained Consent to Established** from Madhya Pradesh Pollution Control Board U/s 25 of the Water (Prevention and Control of Pollution) Act 1974 and U/s 21 of the Air (Prevention and Control of Pollution) Act 1981. The copy of consent letter is enclosed as **Annexure-11.**
- The project proponent has proposed to install sewage treatment plant for treatment of any waste water to be generated from the premises and will be reused in plantation and greenbelt development on the Island only.
- The Project has provided water sprinkling arrangements at construction site to control fugitive emission during construction activities. Ambient air quality monitoring has been carried out by MPPCB at 02 locations at the construction site on the inspection day. Copy of analysis report is enclosed as **Annexure-12.** As per analysis report, PM-10 was found 58.1 & 65.4 Microgram/cum which is within prescribed limit as per National Ambient Air Quality Standards of 100 microgram/cum.
- Project Proponent has **proposed to install 02 STP** (Sewage Treatment Plant) of total capacity 800 KLD (600 KLD + 200 KLD) at the site of Museum.
- At present there is no generation of sewage due to construction of the Statue and the Museum.
- Nagar Parishad, Omkareshwar has already installed 04 STPs at 04 different locations to take care the sewage generating within Nagar Parishad area.
- Water sample of River Narmada at up-stream and down-stream of the project site were collected by MPPCB and analysis report is enclosed as **Annexure-13 & 14**. Quality of the River water conforms the Category-A of Surface Water Quality Standards IS:2296.

- As mentioned here in above, the project proponent has proposed to install adequate facilities for treatment and disposal of wastewater to be generated due to activities at the Museum site and to prevent any discharge into the River.

2. **Cutting of more than 1000 trees for the purpose of construction of the Statue :**

   - As mentioned here in above Parra C, the Project has proposed to do plantation on the Mandhata Island to maintained good Environmental conditions. The project has proposed to plant 38227 trees instead of 1469 trees which to be cut for the project. **Plantation has been proposed on the 4.00 hect. land near Museum and 36 hect. additional land allotted** for plantation on the Island.
   - As mentioned here in above, plantation is going on and till date 2410 trees have been planted and remaining shall be planted by July-2024 as per the scheduled submitted by Project.
   - The project has proposed to plant more than 10 times trees as compared to number of trees to be cut for the complete project to improve environmental conditions of the area.

3. **Digging of land upto 30-40 feet by using heavy machines without following scientific methods causing huge damage to top soil :**

   - The project is under construction and excavation for foundation has been done. Digging of land upto 30-40 feet has not been done as submitted by the applicant. For construction of Statue, excavation upto 15-16 feet and for Museum, excavation from zero to approx 27 feet has been carried out.
   - A Bridge across the River Narmada is also under construction to reach Mandhata Island, where the Statue and the Museum is under construction. At present there is a temporary rapta bridge by laying 68 row 1200 mm pipe culverts has been constructed with a valley bridge of 25 m x 2.5 m to allow regular flow of water in the river at downstream. Obstruction of water flow in the River was not observed during visit.
   - Information submitted by Public Works Department, Bridge Khandwa is enclosed here with for reference as **Annexure-15**.
   - Machineries being used for excavation : Hydraulic Excavator with Breaker – 210 Hyundai and Hitachi (No Blasting is used). The excavation was done base on the Geo-technical study for the site. Geo-technical study report is annexed as **Annexure-16**.

4. **Dumping of debris of the construction in River Narmada causing damage to aquatic life :-**

- Top soil & excavation material has been kept stacked in project site in safe manner. Distance between stacked material and River stream is approx 400-500 meter. Disposal of debris or excavated material was not observed in the river stream.
- As submitted by the Project, 2100 Cum murrum, 31920 Cum. ordinary rock & 27521.92 Cum hard rock was received due to excavation and cutting for road construction work. Total 46130.14 Cum rock and murrum has been re-used for the road construction work and remaining 15411.78 Cum serviceable hard rock has been issued to contract agency for reuse like construction of toe walls etc.
- As submitted by the Project, 105335 Cum soil has been received due to excavation of foundation for Statue and Museum, which has been kept stacked on 1.64 ha. area in project site. Stack material is proposed to be reused for backfilling at Museum site during construction.
- There is no dumping of debris of the construction in River Narmada was observed.

5. **Direct discharge of sewage in River Narmada causing health hazard to local residence :-**

- At present, the Project is under construction stage and there is no generation of sewage, hence no discharge of sewage in the River. River water quality has been tested and found under Category-A of the surface water quality standards IS:2296.
- The Project has proposed to install STPs for treatment of any sewage which will be generating after completion of the project and treated wastewater shall be reused for plantation and green belt development on the Island.

6. **Ecological disturbance due to damage caused to the hilly track for construction :-**

- The applicant has raised issues of ecological disturbance the river and pollution etc. due to construction of Approach Road, the Statue and the Museum on the Island and trees cutting. In this regard, it is pertinent to state that the project proponent has proposed to plant 38227 new trees in place of 1469 trees to be cut which is more than 10 times in number as compared to number of trees to be cut. Therefore, adverse impact on the environmental conditions will not arise. Due to dense plantation on both sides of the approach road and on other remaining area of the Island, number of plants will be more than that at present, which will prevent soil erosion on the Island and improve the environmental conditions.

- The applicant has raised the issue regarding effect of use of bulldozers and heavy machineries on local wild life. In this regard, it is stated that water sprinkling is applied to suppress dust at construction site to control fugitive air pollution and adverse effect on local wild lives will not arise.

- The Museum site is located at approx. 400-500 m from North bank of the river and above 90m from the river. Plantation on Island has been proposed and boundary wall around Museum is also proposed to be constructed; hence, there will be no possibility of dust particles to be reached in the river.

- The Project is under construction by taking care of environment, hence ecological disturbance to the hilly track for construction will not arise.

6. The Petitioner has submitted in their petition some of the monuments are protected by Madhya Pradesh Ancient Monument and Archeological Sites and Remains Act 1974 and instead of that construction work is under progress without taking care of the monuments. It is pertinent to submit here that **Aacharya Shankar Sanskritik Ekta Nyas Bhopal has obtained permission from the Directorate of Archeological Department Bhopal.** Copy of the permission letter is enclosed as **Annexure-17**. According to permission of Archeological Department, construction is taking place.

7. Petitioner Mrs. Janak Palta McGilligan was also present during the inspection & submitted **a memorandum to the Joint Committee** which is attached as **Annexure-18**. Issued raised in the memorandum are as same as described above in this report and related to cutting of trees, excavation for road and Statue and Museum construction and dumping of debris into the River.

8. Conclusions:

1. **Counting of trees have been done prior to cut trees by the concerned department. 1051 trees were counted on the land of approach road and 1181 trees were counted on the Museum site of 11.56 ha. The project proponent has obtained permission from the Sub Divisional Officer Punansa District Khandwa for cutting of trees for construction of the approach road and the Statue & Museum.**

2. **As mentioned above in the report, total 1469 trees (1051 for approach road and 418 for Museum site) are required to be cut. Out of 1469 trees, total 1311 trees have been cut till date and remaining trees (maximum upto 158 trees) at Museum site will also be cut.**

3. Plantation is under progress and till date 2410 plants have been planted on the Island.

4. The project proponent have started plantation and approx. 38227 trees are proposed to be planted on Mandhata Island for improvement of environment and to protect any soil erosion or silting etc. Plantation proposed is more than 10 times of the number of trees to be cut (1469 trees) for the project. As result of the proposed plantation, densification of trees on the Island will take place and will improve the environmental conditions of the area as well.

5. Environmental Clearance (EC) from MPSEIAA as per requirement of EIA Notification 2006 and consent under the Water/Air Acts have been obtained from MPPCB.

6. Aacharya Shankar Sanskritik Ekta Nyas Bhopal has also obtained permission from the Directorate of Archeological Department Bhopal for construction of Statue and the Museum.

7. Project Proponent has proposed to install 02 STP (Sewage Treatment Plant) of total capacity 800 KLD (600 KLD + 200 KLD) at the site of Museum for treatment of sewage to be generated during operation of the project and treated effluent will be reused for plantation and green belt development. Project proponent shall not be allowed to discharge any wastewater into the river in any circumstances as per EC and Consent.

8. The Project proponent has provided water sprinkling arrangement for control of fugitive emission due to construction of the project.

9. Ambient Air quality monitoring has been carried out and air quality was found within prescribed limit. Similarly the Narmada River water quality was also conforms to the category-A of surface water quality standards IS:2296.

10. Excavated material/soil/murrum/rock etc. have been kept stacked within premises in safe manner and it will be reused for backfilling at Museum site. Debris material was not found dumped into the River.

11. Excavation has been done by traditional machines like hydraulic excavator with breaker without blasting.

12. A Bridge across the River Narmada is also under construction to reach Mandhata Island where the Statue and the Museum is under construction. At present, there is a temporary rapta bridge has been constructed by laying pipe culverts and constructing a valley bridge to allow regular flow of water in the River.

13. **The Project proponent has assured for compliance of conditions of EC & Consent, so that Environmental Conditions of the area, the River water quality and aquatic lives will not get affected due to operation of the project.**

Photographs taken during visit may be perused.

Enclosures: As above

(Milind Nimje)
Scientist-C, Regional Directorate,
Central Pollution Control Board,
Bhopal

(Devanshu Shekhar)
District Forest Officer,
Khandwa

(S N Dwivedi)
Regional Officer
MP Pollution Control Board,
Indore

(Anup Kumar Singh, IAS)
Collector-Khandwa

Photographs

Approach Road

Excavation for Museum Foundation

Verification of Excavation depth

Inspection at Museum Site

The Statue foundation under construction

Stacking of debris material

View on back side of Museum site showing no dumping of debris towards the River

Plantations

Photograph with Petitioner

Bridge (under construction) & Rapta across the River Narmada

ANNEXURE-1

Annexure – 1

Item No. 4

BEFORE THE NATIONAL GREEN TRIBUNAL
CENTRAL ZONE BENCH, BHOPAL
(Through Video Conferencing)

Original Application No.31/2022(CZ)

Shiva Mission Trust — Applicant(s)

Versus

State of Madhya Pradesh & Ors. — Respondent(s)

Date of hearing: **27.07.2022**

CORAM: HON'BLE MR. JUSTICE SHEO KUMAR SINGH, JUDICIAL MEMBER
HON'BLE DR. ARUN KUMAR VERMA, EXPERT MEMBER

For Applicant(s): None

For Respondent(s): Mr. Sachin Mehta, Adv
Ms. Parul Bhadoria, Adv.

ORDER

1. The background given by the applicant is that a land admeasuring 1.00 hectare in Khasra No. 7/1 was allotted to the applicant for afforestation and development of garden and the Trust planted large number of trees in the area. Currently there is temporary shelter established therein for the guard/watchman and further a small piece of land is also occupied by one ascetic namely Sant Shree Shreekalasi Baba since 2008 whose residence has been refurbished by the trust. The Trust has also appointed a *Pujari* namely Shri Gajendra Das who also resides and maintains a cowshed on said land.

2. It has come to the notice of the Trust vide order no. 286/2022 of the Nagar Parishad, Omkareshwar that a trust namely Achaarya Shankar Sanskriti Ekta Trust in consonance with the Cultural Department of the State Government has planned to construct a 108 ft. statue of the Achaarya and a museum. The grievance is in furtherance of the same

the respondent trust and the government have begun haphazard felling of trees on the hillock and the approach area. That the same is being done without and prior permits from the Tree Officer as envisioned under Section 6 of the M.P. Vrikshon Ka Parirakshan (Nagariya Kshetra) Adhiniyam 2001.

3. That, for the purpose of road construction the State is also indiscriminately terraforming the surrounding area which form part of the Omkareshwar hill. That, presently enough hill-cutting, excavation and terraforming has been already done that vehicles are able to approach the summit which is greatly disturbing the soft ecology of the area.

4. Trees are being felled haphazardly without any permits from the Municipal Tree Officer, leading to deforestation and loss of ecology in absolute contravention of the M.P. Vrikshon Ka Parirakshan (Nagariya Kshetra) Adhiniyam, 2001.

5. That construction of unnecessary road is causing noise and air pollution and disturbing the local ecology and wildlife which will further disturb the sensitive balance in which this river is land thrives.

6. That, there is threat to the river changing its course and eventual flooding because of the siltation that will be caused during rains. That, the unbridled excavation being carried out right now will permanently damage the ecology and terrain of the area.

7. This application has been filed with the relief to stop felling of trees and cutting of trees and with a prayer with direction to made plantation 10 times of the number of trees destroyed. The matter was taken up by this Tribunal on 02.05.2022 and committee consisting the Dy. Forest Officer, Khandwa and representative of the State Pollution Control

Board was constituted with a direction to submit a factual and action taken report. The committee visited the site and submitted the report, which is as follows :

"The Joint Committee visited the Mandhata Island including road & museum construction sites on the Island, plantation area, tree cutting areas and observations are as follows:

1. Mandhata Parvat is located as Island in between two stream of the River Narmada. On the Island there are natural trees, bushes, plantations, temples and some previous constructions were also seen. Google map of the Island and the river Narmada is enclosed as Annexure-I. In the Google map two streams of Narmada & Omkar Parvat of Mandhata Island may be perused.

2. Najari Naksha of the project area is enclosed as Annexure-2 which shows right stream of the river (Named Kaveri River), location of bridge under construction across River Narmada, approach road, land allotted to Acharya Shankar Sanskritik Ekta Nyas Govt. of M.P. Sanskriti Department.

3. Govt of MP has allotted 11.56 ha. land for construction of the Statue of Guru Aadi Shankarachrya and the Shankar Museum on the Mandhata Island. Acharya Shankar Sanskritik Ekta Nyas, Govt. of M.P. Sanskriti Department is occupier or owner of the land allotted. The project construction agency is M.P. State Tourism Corporation Limited which is also a corporation under Govt. of M.P. The land area of I1.56 ha. is inclusive of the area of 1.00 ha. which was previously given to Shiva Mission Trust for plantation only. Permission granted to the Shiva Mission Trust has been cancelled by Collector Khandwa vide its order dated 02.03.2022 and the land is given to the Sankriti Department for construction of Statue and the Museum. Copy of the order is enclosed as Annexure -3.

4. M/s Shiva Mission Trust (the applicant in OA) was given permission for plantation and horticulture development on land area of 1.00 ha on the Island at Survey No. 7/1 by Sub Divisional Officer, Khandwa District Khandwa vide order

no. I I 16/Re-2/08 Khandwa dated 12.05.2008 with conditions that any other activity or construction work shall be prohibited and ownership of the land shall be vested with the Government of Madhya Pradesh. Copy of the permission letter is enclosed as Annexure -4.

5. M/s Shiva Mission Trust has done plantation on land and also constructed water tanks, swimming pool, residential house, toilets and some other pakka construction on the land which may be perused in the Google map of earlier date enclosed as Annexure-5. M/s Shiva Mission Trust has violated the conditions of permission and accordingly a fine of Rs. 20000/- was imposed to them by Naib Tehsildar, Tappa, Mandhata, district Khandwa vide their order dated 22.03.2014. Copy of the order is enclosed as Annexure -6 for perusal.

6. Execution of the project for construction of the Statue of Guru Shree Aadi Shankaracharya and the Shankar Museum being done by the Acharya Shankar Sanskritik Ekta Nyas Govt. of MP, Sanskriti Department and M.P. Tourism Development Corporation Limited. The approach road is being constructed by Public Works Department (PWD) of the State.

Observations :

Brief of observations during visit are as follows:

(A) Current status of project constructions :

1. A bridge across the river Narmada is under construction to reach to the Island. The Bridge is being constructed by the PWD of the State Govt.

2. A road of 14m width and 1.2 KM length is under construction from bridge to the Museum site. The road is also being constructed by the PWD of the State Govt. Out of 1.2 KM road length, 700 m length has been made by hill cutting and terraforming and remaining by filling.

3. For construction of the Shankar Museum, excavation work for foundation was observed. Excavated material has

been stocked on the nearby land and it is proposed to be reused for filling work around the Museum by the Nyas.

4. For Construction of the Statue of Shree Guru Aadi Shankaracharya, excavation work for foundation was observed

(B)Status of trees cuttings and permissions obtained :

1. Trees on the land of Approach Road were counted by the Revenue Department and accordingly permissions to cut the trees coming on the way of approach road were obtained by PWD. Sub Divisional officer Punasa district kandwa vide letter dated 10.11.2021 and 10.12.2021 has allowed to cut a total of 1051 trees. Copies of the permission letters are enclosed as Annexure 7 & 8.

2. The PWD has cut total 1051 trees and deposited the wood received after cutting of the trees to forest depot Sanawad District Kandwa.

3. Counting of trees on the land of 11.56 ha. Allotted for the Statue and Museum (which includes land area of 1.00 ha. of Shiva Mission trust) has been conducted by the Revenue Department and the Forest department prior to removal of encroachment during March-April 2022 and 1181 trees and 4316 bans were found on the land area Report & Panchnama in this regard is enclosed as Annexure 9 for reference.

4. Shri Shailendra Mishra Assistant Director, Department of Sanskrit Cum Officer Incharge Acharya Shankar Sanskriti Ekata Nyas, Govt of MP has obtained permission for cutting of trees of land area 11..56 ha. The Sub Divisional officer Punasa District Kandrva has granted permission for cutting of trees vide order no 346 dated 24.03.2022. Copy of the order is enclosed as Annexure 10. As per the order, 207 trees of teak tree and 974 trees of *neem, jamun, sitafal* etc. (total-1081 trees) and 4316 bans have been granted.

5. During Visit of the committee, it has been observed that for construction of the road 1051 trees have been cut and only 200 trees from Museum site have been cut. As per

information given during visit 218 more trees will be required to be cut from the Museum site. 1525 nos. of bans have also been cut for museum site. As mentioned above in this Parra 1469 trees and 1525 bans (Total 2994) are required to be cut for construction of the project including approach road.

(C) Status of proposed Plantation :

1. The Department / Nyas has proposed to plant new trees to compensate ecological imbalance of the Island. Details of trees to be cut for completion of the Project and proposed plantation to be done is enclosed as Annexure- 1L. Details are summarized as follows:

1. Along both sides of the approach road (1.2 KM road length) 1200 trees are proposed to be planted. The Sub Divisional Officer Punasa District Khandwa has issued letter to the Shree Aacharya Shankar Sanskritik Ekata Nyas for plantation along both sides of approach road vide their letter no 532 dated 29.06.2022.Copy of the letter is enclosed as 12 Annexure-12.

2. At Museum Site of 11.56 ha. land area. built up area will be approx. 4 ha. On remaining area densification of trees has been proposed to be done by planting 6025 trees in the area.

3. Additional land of 36 ha. is also allotted to Shree Aacharya Shankar Sanskritik Ekata Nyas for plantation on the Island on back side of the Museum site away from parikrama marg. Approx 30000 tree plantation has been proposed by the Nyas under densification of trees.

4. The Forest Range Officer Punasa District Khandwa has been informed by MP state Tourism Development Corporation Ltd. vide letter no. 117 dated 25.06.2022 that 36 ha. land has been reserved to plant approx 30000 plants and in accordance to this 800 pits have been prepared for plantation. Copy of the letter is enclosed as Annexure 13.

5. As mentioned above in sub-paras no 1 to 3, total 37225 trees have been proposed to be planted on the Mandhata Island to compensate any adverse effect in the environmental conditions.

2. During visit. it has been observed that plantation in the slope area of the Island towards left stream of the river has been started and approx. 470 pits have been found prepared for plantation. Plantation is proposed to be started from 28th July, 2022 (Hariyali Amavasya) on 36 ha. land also.

(D) Other Issues raised by the Applicant in the OA :

1. The applicant has raised issues of ecological disturbance and silting problem in the river, flooding and pollution etc. due to construction of Approach Road, the Statue and the Museum on the Island and trees cutting. In this regard, it is pertinent to state that the project authorities have assured and proposed to plant 37225 new trees in place of 2994 trees to be cut which is more than 10 times in number as compared to number of trees to be cut. Therefore, adverse impact on the environmental conditions seems not to arise. Due to dense plantation on both sides of the approach road and on other remaining area of the Island including valley and hill, number of plants will be more than at present and there seems no soil erosion or silting problem in the river.

2. The applicant has raised the issue regarding effect of use of bulldozers and heavy machineries on local wild life. In this regard, it is stated that water sprinkling by movable tankers is applied to suppress dust at construction site to control fugitive air pollution and seems no significant adverse effect on local wild lives.

3. The Museum site is located at approx. 300 rn from north bank of the river and above 90m from the river. Plantation on Island has been proposed and boundary wall around Museum is also proposed to be constructed; hence there rvill be least possibility of dust or soil particles to be reached in the river.

(E) Status of Environment Clearance and proposal for Air Water pollution Control:

1. The Project has obtained Environmental Clearance from MP State Environment Impact Assessment Authority (MPSEIAA)

vide letter issued dated 15.04.2022. The copy of the sameis enclosed as Annexure 14.

2. The project authorities has proposed to install sewage treatment plant for treatment of any waste water to be generated from the premises and will be reused in plantation and greenbelt development on the Island only) As per information during visit, it has been told that there will not be any discharge of treated or untreated wastewater into the river.

(F) Information summary provided by the Aacharya Shankar Sanskritik Ekta Nyas Bhopal vide letter no. 1607 dated 02.07.2022 is enclosed as Annexure 15 for reference.

Conclusions:

1. The project authorities have obtained permission from the Sub Divisional Officer Punansa District Khandwa for cutting of trees for construction of the approach road and the Statue & Museum.

2. Counting of trees have been done prior to cut trees by the concerned department. l05l trees were counted on the land of approach road. 1181 trees and 4316 bans were counted on the Museum site of 11.56 ha.

3. 1.051 trees have already been cut for construction of the approach road.200 trees & 1525 bans have been cut for construction of the Statue & Museum. From the Museum site 218 more trees are yet to be cut.

4. For approach road total l05l trees and for Museum total 418 trees and 1525 bans are required to be cut. As mentioned above total number of trees and bans to be cut are 2994 for execution of the complete project.

5. The project authorities have started plantation and approx, 37225 trees are proposed to be planted on Mandhata Island for compensation of any adverse impact on environmental and to protect any soil erosion or silting etc. while total trees to be cut are 2994. Plantation proposed is more than l0 times of the plants to be cut for the project. Result of the

proposed plantation, densification of trees on the Island will take place and will improve the environmental conditions of the area as well.

6. The applicant was permitted to do plantation only on 1.00 ha Government land but the applicant had violated the conditions of permission by construction of residential house. toilets. swimming pools etc. and fine of Rs. 20,000 was also imposed on the applicant trust by Naib Tehsildar Tappa Mandhata, District Khandwa. Now permission has been cancelled by the Collector Khandwa and encroachments and some of the constructions have been removed.

7. Environmental Clearance (EC) from MPSEIAA as per requirement of EIA Notification 2006 for building projects has been obtained and the project is under construction as per EC.

8. The Project Authorities has proposed to install Sewage Treatment Plant as per EC condition and to reuse treated effluent for plantation and assured not to discharged any waste water jn the river.

9. The Project Authorities has proposed to take care any water and air pollution during construction phase also."

8. A perusal of the record reveals that the Collector vide order dated 02.03.2021 modified the order dated 23.02.2021 whereby and where under the right of plantation given to the applicant was modified and withdrawn. It is further reported that a Writ Petition No. 957 of 2014 was filed before the Hon'ble High Court of Madhya Pradesh at Jabalpur and vide order dated 27.01.2014 it was directed to remove the encroachments the matter was enquired by the Tehsildar Mandhata and it was found that the applicant has encroached the land and make certain directions for which the applicant was directed to deposit an amount Rs. 20,000/-as penalty and was further directed to remove the encroachment within a time limit.

9. The matter of further planning against which the present petition have been filed was duly considered by the concerned court and vide order dated 10.11.2021 an order has been passed. The Forest Department / Revenue Department has properly monitored and counted the number of trees and there are certain directions for plantation of trees. The project finds approval of Ministry of Environment, Forest & Climate Change vide order dated 15.04.2022 with certain conditions.

10. The Cultural Department of the State of Madhya Pradesh vide order dated 02.07.2022 has initiated the development of the site, taking proper protection of trees and re-plantation.

11. In view of the above discussion, we are of the view that proper precautions have been taken by the State Government and the Forest Department / Revenue Department and protection of the plantations and re-afforestation have been taken into account, the Sahayak Sanchalak Sanskriti has further directed for plantation of more than 30,000 of trees.

12. Accordingly, there is no violation of environmental law and rules and we do not intend to interfere with order impugned. The policy matters are within the domain of the State Government. The project finds approval of Ministry of Environment Forest & Climate Change and Environmental Clearance from the department concerned. Project must follow the conditions specified in the Environmental Clearance. No further action is required, thus Original Application No. 31 of 2022 (CZ) stands **disposed of**.

Sheo Kumar Singh, JM

Dr. Arun Kumar Verma, EM

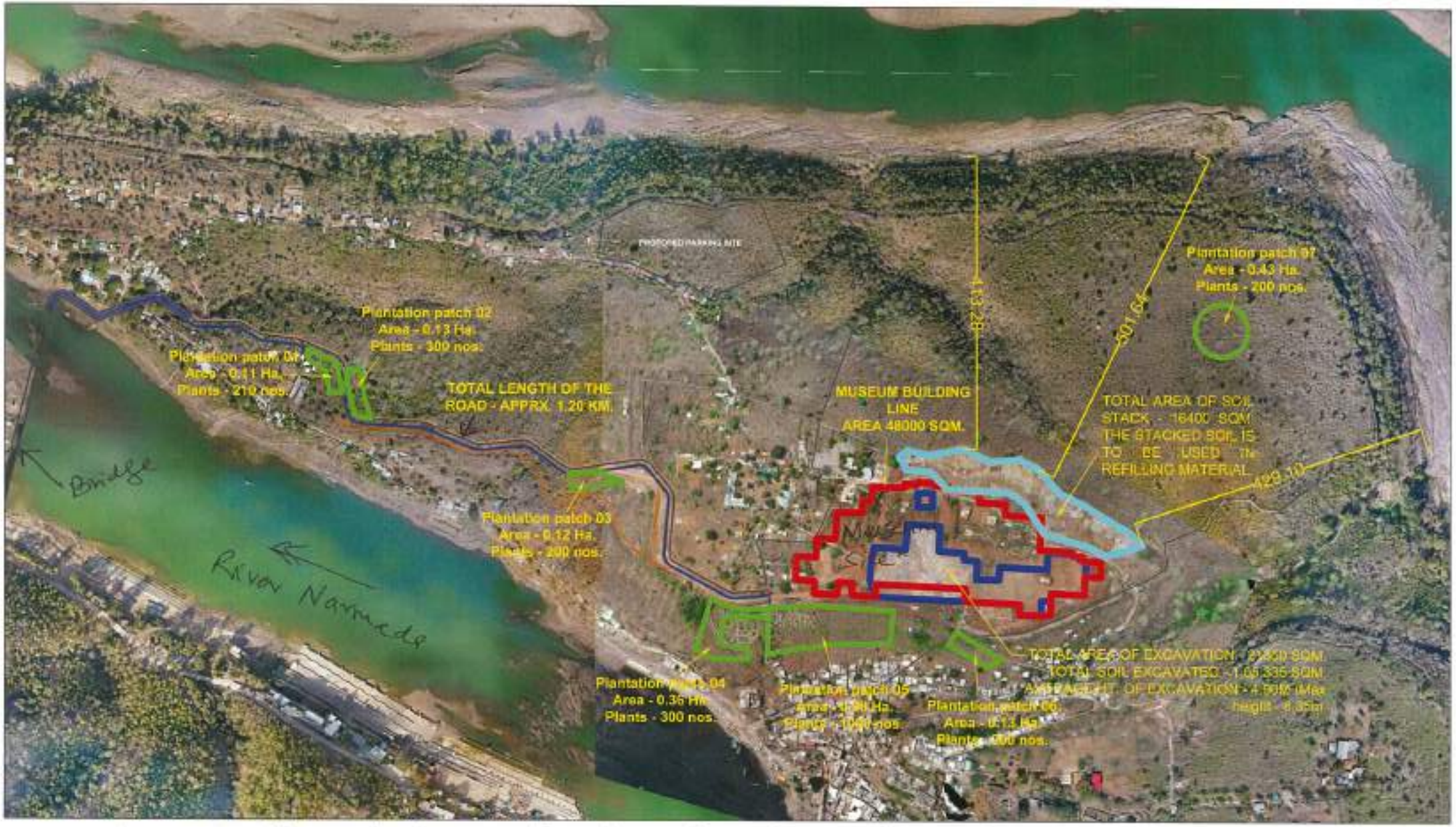
27th July, 2022
O.A. No. 31/2022 (CZ)
K

ANNEXURE-2

Google View of Mandhata Island, Omkareshwar, District-Khandwa

Annexure - 2

ANNEXURE-3



Lay out Plan showing Location of the River Bridge, Approach Road, Museum, Statue, Stacking Area, Proposed Plantation

Annexure - 3

ANNEXURE-4

Annexure - 4

मध्यप्रदेश राज्य पर्यटन विकास निगम मर्यादित
Madhya Pradesh State Tourism Development Corporation Ltd.

a host in the heart of India
www.mpstdc.com

No- 498 /EPC1/SOO/ENG/MPSTDC/22/Bhopal Dated 27/01/2023

STATUS OVERVIEW OF THE STATUE & MUSEUM SITE (MANDHATA ISLAND) IN STATUE OF ONENESS PROJECT AT OMKARESHWAR, M.P.

The following update shall be noted till date in the Statue of Oneness Project at Mandhata Island, Omkareshwar.

1) Excavation & Stacking (Museum Site): (Annexure:01.02)

a. The total surface area of excavation	-	21350 sqm.
b. Total Excavated Soil	-	1,05,335 cum.
c. Average Height of Excavation	-	4.90m.
d. Maximum Height at any point	-	8.35m.
e. Total surface area used for stacking the excavated soil	-	16400 sqm.
f. The Used of Stacked excavated soil	-	For refilling.

2) Excavation & Stacking (PWD Road): As per information received from PWD department. (annexure:03)

a. The total Length of the Road	-	1270 m.
b. Total Excavated Soil	-	61,542 cum.
c. Average Height of Excavation	-	3.40m.
d. Maximum Height at any point	-	8.50m.
e. Excavated soil reused in road	-	46130 sqm.
f. Excavated soil issued to serviceable Hard rock	-	15412 sqm.

3) Tree Cutting & Plantation (PWD Road): As per information received from PWD department. (annexure:04)

a. Tree cutting permission	-	1051 trees.
b. Total trees cut by PWD dept.	-	1051 trees.
c. Trees to be planted alongside the road	-	1200 trees.
d. Trees to be planted in other areas	-	1002 trees.

4) Tree cutting & Plantation (Statue of Oneness Project, Mandhata Island):

a. Tree cutting permission in 11.56Ha	-	418 trees. (Annexure:05)
b. Total trees cut (till date)	-	260 trees.
c. Trees yet to be cut	-	158 trees.
d. TotalTrees to be planted in 11.56 Ha	-	6025 trees. (Annexure:05)
e. Total trees Planted in 11.56 Ha till date	-	1200 trees. (Annexure:02)
f. Total trees planted in Mandhata Island	-	2410 trees. (Annexure:06)
e. Trees schedules to be planted in Mandhata	-	30000 trees. (Annexure:06)

f. Planned green cover drawing attached : (Annexure:07)

5) Geo-Technical data (Statue of Oneness Project, Mandhata Island): (Annexure:08)

6) The machinery being used for excavation: Hydraulic excavator with breaker 210 Hyundai & Hitachi **(No Blasting is used).** The excavation was done base on the Geo-technical study for the site.

7) The stacked excavated soil is approx. 400-500 away from riverbank. Thus, there is no question of any slurry being discharged in the river Narmada.

8) No Treated or Untreated water is or sewage is being discharged in River. The zero discharged policy is being followed.

9) Sewage Treatment Plant will be installed & operational before completion of the project & CTO will be obtained relatively.

27/4/2023

Project Director
MPSTDC Bhopal

ANNEXURE-5

कार्यालय अनुविभागीय अधिकारी एवं दण्डाधिकारी, अनुभाग–पुनासा जिला खंडवा

प्रकं./ 08/अ–62/2021–22

ग्राम मांधाता तह. पुनासा

1– कार्यपालन यंत्री, लोक निर्माण विभाग सेतु निगम, खंडवा छोटे – आवेदक

–विरूद्ध–

म.प्र. शासन

– आदेश –

आवेदक कार्यपालन यंत्री लोक निर्माण विभाग म.प्र. सेतु निगम खंडवा द्वारा आदि गुरू शंकराचार्य की प्रमि स्थापना स्थल तक पहुच मार्ग बनाये जाने वाले मार्ग में आने वाले वृक्षों कुल उन्नयन कार्य हेतु ग्राम गोदडपुरा रा.नि. मंडल मांधाता की आकार पर्वत शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल 10.00 मीटर चौडा मार्ग बनाया जाना है, 10.00 मीटर चौडाई मार्ग के दोनो ओर 2–2 मीटर अतिरिक्त भूमि इस प्रकार चौडाई मार्ग में दोनो ओर 2–2 मीटर अतिरिकत भूमि इस प्रकार प्रस्तावित मार्ग 14.00मीटर उप वनमंडलाधिकारी पुनासा सा. का पत्र कमांक मा. चि/221/1838 पुनासा दिनांक 11.08.2021 के उक्त प्रस्तावित मार्ग में लगभग 950 मीटर लम्बाई एवं 14 मीटर चौडाई में आने वोलें वृक्षों का दिनांक 14.09.2021 को संयुक्त निरीक्षण किया गया। उक्त भूमि ग्राम मांधाता ओंकार पर्वत की भूमि ख.न 7/1 रकबा 19.990है. मद नजूल भूमि है। संयुक्त दल द्वारा उक्त प्रस्तावित मार्ग में 311 वृक्षों को सूचितबद्ध किया गया है,सूची पर संयुक्त दल द्वारा हस्ताक्षर किये हैं, जिसमें 159 वक्ष तथा अरकाट 152 वृक्ष बताये हे। उक्त वृक्षों को सामान्य वन मंडल अधिकारी द्वारा क्षेत्रसत्यापण किया गया है। संलग्न सूची अनुसार कुल 311 जिसमें 159 वृक्ष सागौन एवं फलदाल तथा 152 वृक्ष आरकाट बाधित वृक्षों फलदार/अफलदार को काटने की अनुमति प्रदान की जाये।

कलेक्टर महोदय खंडवा द्वारा प्रकरण कमांक 8/अ–62/2021–22 आदेशिका दिनांक 08.11.2021 के माध्यम से ओंकार शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल तक पहुच मार्ग निर्माण कार्य हेतु आने वालें ग्राम गोदडपुरा में प्रस्तावित भूमि पर संलग्न सूची अनुसार बाधित कुल 311 वृक्षों को काटने की अनुमति अनुविभागीय अधिकारी लोक निर्माण विभाग सेतु निर्माण उपसंभाग खंडवा को म.प्र. भू–राजस्व सहिता 1959 की धारा 240 एवं 241 तथा इसके अंतर्गत बने नियमों के अनुसार इस शर्त पर प्रदान की जाती हे कि वृक्षों की समस्त लकडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद में जमा कराई जायेगी। इन वृखों की कटाई का काटाई से लेकर परिवाहन तक का पर्यवेक्षण अनुविभागीय अधिकारी रा. स्वयं करेंगे जिससे की राजस्व की हानि न हो साथ ही इस आशय की ' अंडरटेकिंग' प्राप्त कर प्रकरण मे संलग्न करें कि वे मार्ग का निर्माण कार्य रोड के दोनो तरफ दो गुना वृक्ष/पौधे लगाने का एवं उनके रखरखाव का कार्य विभाग के माध्यम से किया जावेगा। तदुपरांत कटाई/छटाईकी विधिवत अनुमति जारी करें।

कलेक्टर महोदय खंडवा द्वारा कमांक 8/अ–62/2021–22 आदेशिका दिनांक 08.11.2021के माध्यम से ओंकार शिखर पर आदि गुरू शकराचार्य की प्रतिमा स्थापना स्थल तक पहुच मार्ग निर्माण कार्य हेतु आने वाले ग्राम गोदडपुरा में प्रस्तावित भूमि पर संलग्न सूची अनुसार बाधित कुल 311 वृक्षों को काटने की अनुमति अनुविभागीय अधिकारी लोक निर्माण विभाग सेतु निर्माण उपसंभाग खंडवा को म.प्र. भू.रा.सं. की धारा 240 एवं 241 के प्रावधानों के तहत प्रदान निम्न शर्तो के अधीन अनुमति प्रदान की गई है। प्रकरण में आवेदक विभाग द्वारा चाही गई अंडरटेकिंग एवं वन विभाग द्वारा मांग की गई राशी जमा कर रसीद प्रस्तुत की है।

1– वृक्षों की समस्त लकडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद मे जमा कराई जावेगी।

2– इन वृक्षों की कटाई का कटाई से लेकर परिवहन तक का पर्यवेक्षण नायब तहसीलदार मांधाता के द्वारा किया जायेगा। जिससे राजस्व हानी न हो।

अनुविभागीय अधिकारी

3- प्रकरण में लोक निर्माण विभाग सेतु निर्माण संभाग से इस आशय की आण्डर टेकिंग प्रस्तुत करें की परियोजना कार्य पूर्ण होने से पूर्व दो गुना वृक्ष/पौधे लगाने एवं उनके रखरखाव का कार्य लोक निर्माण विभाग सेतु निर्माण संभाग द्वारा कन्सेशनायर के माध्यम से किया जावेगा तदुपरांत वृक्षों के कटाई/छटाई की जायेगी।

4- काटे जाने वालें वृक्षों की कटाई तथा निलामी नायब तहसीलदार के पर्यवेक्षण एवं निर्देशन में संबंधित परियजना के अधिकारी द्वारा विहित प्रकिया का पालन करते हुये की जायेगी नीलामी हेत वन विभाग द्वारा किये गये मुल्यांकन के समतुल्य आधार मूल्य रखा जाएगा ओर नीलामी में प्राप्त राशि शासकीय खजाने में जमा की जायेगी।

5- संबंधित इस बात का ध्यान रखेगे की जिन वृक्षों को काटे जाने की अनुमति प्रदान की जा रही है केवल उन्हें वृक्षों को काटा जाए कोई अन्य वृक्ष नहीं काटा जाये।

6- शर्तो का उल्लंघन होने पर अनुमति स्वतः निरस्त मानी जायेगी ।

10/11/21

अनुविभागीय अधिकारी (रा.से.)
अनुभाग-पुनासा
अनुभाग-पुनासा

पृ.कं./प्रवा/2021/2345
पुनासा,दिनांक- 10.11.2021

प्रतिलिपि:-

1- कलेक्टर महोदय, वाचक शाखा खंडवा की ओर सूचनार्थ।
2- वन मंडलाधिकारी, वन विभाग खंडवा
3- कार्यपालन यंत्री लोक निर्माण विभाग सेतु निर्माण संभाग खंडवा की ओर पालनार्थ।
4- उप वन मंडलाधिकारी, वन विभाग पुनासा
5- तहसीलदार/नायब तहसीलदार मांधाता
6- राजस्व निरीक्षक मांधाता
7- हल्का पटवारी मांधाता

10/11/21

अनुविभागीय अधिकारी (रा.से.)
अनुभाग-पुनासा

ANNEXURE-6

कार्यालय अनुविभागीय अधिकारी एवं दण्डाधिकारी, अनुभाग–पुनासा जिला खंडवा

प्रकं / 07 / अ–62 / 2021–22

ग्राम मांधाता तह. पुनासा

1– अनुविभागीय अधिकारी, लोक निर्माण विभाग सेतु निगम, खंडवा – आवेदक

–विरूद्ध–

म.प्र. शासन

– आदेश –

आवेदक अनुविभागीय अधिकारी लोक निर्माण विभाग म.प्र. सेतु निगम खंडवा द्वारा आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल तक पहुच मार्ग बनाये जाने वाले मार्ग में आने वाले वृक्षों कुल उन्नयन कार्य हेतु ग्राम गोदडपुरा स.नि. मंडल मांधाता की ओंकार पर्वत शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल 400 मीटर लम्बाई एवं 10 मीटर चौडाई का मार्ग बनाया जाना है, 10.00मीटर चौडाई मार्ग के दोनो ओर 2–2 मीटर अतिरिक्त भूमि इस प्रकार चौडाई मार्ग मे दोनो ओर 2–2 मीटर अतिरिक्त भूमि इस प्रकार प्रस्तावित मार्ग 14.00मीटर उप वनमंडलाधिकारी पुनासा सा. का पत्र कमांक मा.वि / 221 / 1838 पुनासा दिनांक 11.08.2021 के उक्त प्रस्तावित मार्ग में लगभग 950 मीटर लम्बाई एवं 14 मीटर चौडाई में आने वाले वृक्षों का दिनांक 14.09.2021 को संयुक्त निरीक्षण किया गया। उक्त भूमि ग्राम मांधाता ओंकार पर्वत की भूमि स.न. 7 / 1 रकबा 19.990है. मद नजूल भूमि है। संयुक्त दल द्वारा उक्त प्रस्तावित मार्ग में 740 वृक्षों को सूचिताबद्ध किया गया है,सूची पर संयुक्त दल द्वारा हस्ताक्षर किये है, जिसमे 712पौधे चोपित एवं 28 पौधे प्राकृतिक रूप से पाये गये। कुल 740 वृक्ष प्रस्तावित मार्ग में है। संभागीय प्रबंधक खंडवा परियोजना मंडल खंडवा द्वारा उनके पत्र कमांक पविवि / मावि / 3729 दिनांक 15.10.2021 के द्वारा उक्त 740 चोपित वृक्षों को उक्त प्रयोजन काटे जाने की अनुमति दी जा सकती है। सूची अनुसार प्रकरण मे नियमानुसार वृक्षों की कटाई / छटाई किये जाने की अनुमति प्रदान करने की अनुशंसा की है।

कलेक्टर महोदय खंडवा द्वारा प्रकरण कमांक 7 / अ–62 / 2021–22 आदेशिका दिनांक 06.12.2021 के माध्यम से ओंकार शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल तक पहुच मार्ग निर्माण कार्य हेतु आने वाले ग्राम गोदडपुरा में प्रस्तावित भूमि पर संलग्न सूची अनुसार बाधित कुल 740 वृक्षों को काटने की अनुमति अनुविभागीय अधिकारी लोक निर्माण विभाग सेतु निर्माण उपसंभाग खंडवा को म.प्र. भू–राजस्व संहिता 1959 की धारा 240 एवं 241 तथा इसके अंतर्गत बने नियमो के अनुसार इस शर्त पर प्रदान की जाती है कि वृक्षों की समस्त लकडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद में जमा कराई जायेगी। इन वृक्षों की कटाई का काटाई से लेकर परिवाहन तक का पर्यवेक्षण अनुविभागीय अधिकारी स्व. स्वयं करेंगे जिससे की राजस्व की हानि न हो साथ ही इस आशय की ' अंडरटेकिंग' प्राप्त कर प्रकरण मे संलग्न करें कि वे मार्ग का निर्माण कार्य रोड के दोनो तरफ दो गुना वृक्ष / पौधे लगाने का एवं उनके रखरखाव का कार्य विभाग के माध्यम से किया जावेगा। तदुपरांत कटाई / छटाईकी विधिवत अनुमति जारी करें।

कलेक्टर महोदय खंडवा द्वारा कमांक 7 / अ–62 / 2021–22 आदेशिका दिनांक 06.12.2021 के माध्यम से ओंकार शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना स्थल तक पहुच मार्ग निर्माण कार्य हेतु आने वाले ग्राम गोदडपुरा मे प्रस्तावित भूमि पर संलग्न सूची अनुसार बाधित कुल 740 वृक्षों को काटने की अनुमति अनुविभागीय अधिकारी लोक निर्माण विभाग सेतु निर्माण उपसंभाग खंडवा को म.प्र. भू.रा.स. की धारा 240 एवं 241 के प्रावधानों के तहत प्रदान निम्न शर्तो के अधीन अनुमति प्रदान की गई है। प्रकरण में आवेदक विभाग द्वारा भरी गई अंडरटेकिंग एवं वन विभाग द्वारा मांग की गई राशी जमा कर रसीद प्रस्तुत की है।

1- वृक्षों की समस्त लंडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद में जमा कराई जावेगी।

2- इन वृक्षों की कटाई का कटाई से लेकर परिवहन तक का पर्यवेक्षण नायब तहसीलदार मांधाता के द्वारा किया जायेगा। जिससे राजस्व हानी न हो।

3- प्रकरण में लोक निर्माण विभाग सेतु निर्माण संभाग से इस आशय की आण्डर टेकिंग प्रस्तुत करे की परियोजना कार्य पूर्ण होने से पूर्व दो गुना वृक्ष/पौधे लगाने एवं उनके रखरखाव का कार्य लोक निर्माण विभाग सेतु निर्माण संभाग द्वारा कन्सेशनावर के माध्यम से किया जावेगा तदुपरांत वृक्षों के कटाई/छटाई की जायेगी।

4- काटे जाने वाले वृक्षों की कटाई तथा निलामी नायब तहसीलदार के पर्यवेक्षण एवं निर्देशन में संबंधित परियोजना के अधिकारी द्वारा विहित प्रक्रिया का पालन करते हुये की जायेगी नीलामी हेतु वन विभाग द्वारा किये गये मुल्यांकन के समतुल्य आधार मूल्य रखा जाएगा और नीलामी में प्राप्त राशि शासकीय खजाने में जमा की जायेगी।

5- संबंधित इस बात का ध्यान रखेंगे की जिन वृक्षों को काटे जाने की अनुमति प्रदान की जा रही है केवल उन्हें वृक्षों को काटा जाए कोई अन्य वृक्ष नहीं काटा जाये।

6- शर्तों का उल्लंघन होने पर अनुमति स्वतः निरस्त मानी जायेगी।

अनुविभागीय अधिकारी (रा)
अनुभाग-पुनासा

पुनासा,दिनांक- 10.12.2021

पृ.क्र./प्रवा/2021/2456

प्रतिलिपि-

1- कलेक्टर महोदय, वाचक शाखा खंडवा की ओर सूचनार्थ।
2- वन मंडलाधिकारी, वन विभाग खंडवा
3- कार्यपालन यंत्री लोक निर्माण विभाग सेतु निर्माण संभाग खंडवा की ओर पालनार्थ।
4- उप वन मंडलाधिकारी, वन विभाग पुनासा
5- संभागीय प्रबंधक म.प्र. राज्य वन विकास निगम लि. की ओर सूचनार्थ।
6- तहसीलदार/नायब तहसीलदार मांधाता
7- राजस्व निरीक्षक मांधाता
8- हल्का पटवारी मांधाता

अनुविभागीय अधिकारी (रा)
अनुभाग-पुनासा

ANNEXURE-7

Annexure - 9

प्रति,

माननीय नायब तहसीलदार महोदय,

तथा - मोथरा,

तहसील - सुजानपुर,

विषय :- आवासीय बालिका उच्च विद्यालय की स्थापना एवं चारदीवारी हेतु आवंटित भूमि में खड़े कि कराई हेतु कि अग्रिम धनराशि)

महोदय जी,

उपरोक्त विषयांतर्गत निवेदन है कि ग्राम मोथरा, प.ह.न 05, थाना कि.न. मोथरा, तहसील सुजानपुर में, मोथरा पर्वत पर आवास बोर्ड कि 108 कीट अट्ठानवे प्रतिशत तथा बोर्ड बालिका उच्च विद्यालय कि स्थापना हेतु आवंटित भूमि खसरा नं 2/1 एवं 7/1 में उपरोक्त भूमि पर पूर्व कार्य किए जाने कि अनुमति के आदेश पर माननीय अतिरिक्त मजिस्ट्रेट महोदय सुजानपुर के मार्गदर्शन अनुसार विद्यालय के अंतिम हल मोथरा पटवारी एवं पत्र क्रमांक के अनुरूप विभाग के मध्य हुए समझौते एवं शीर्ष अनुसार कि उपाधिकारी के कार्यालय कलेक्टर जिला अम्बेडकर के पत्र क्रमांक 1/1032/वाद/2021 दिनांक 27/12/21 में संदर्भित भूमि जिसमें चारदीवारी हेतु आवंटित 7.10 है. एवं बालिका विद्यालय की स्थापना हेतु आवंटित 11.51 है. भूमि का मौके पर निर्धारण किया जाना। मौके पर चारदीवारी हेतु आवंटित 7.10 है. भूमि पर पत्र मजरा किया गया परीक्षण किया गया है जिसमें निर्धारित प्रजाति के कलहार व इमली कलम के पेड़ खड़े हैं। किसी लगाए गए हैं। तथा बालिका उच्च विद्यालय कि स्थापना हेतु आवंटित 11.51 है. भूमि पर विभिन्न प्रजाति के कलहार, नागौन व अन्य इमली लकड़ी के पेड़ हैं, जिनकी मौके पर गणना कि गई एवं चिन्हित किए गए, जिसमें नागौन के कुल 207 वृक्ष हैं, एवं नीम, नागफन, सीताफल व अन्य कलहार के निर्धारित प्रजाति के कुल 074 पेड़ हैं इस प्रकार कुल वृक्ष 1181 चिन्हित किए गए, एवं कोम किई के कुल 431 कोम चिन्हित किए गए।

अतएव, श्रीमान उचित कार्यवाही हेतु अग्रसर करावें

संलग्न

1) निर्धारण पंचनामा

2) प्रजाति अनुसार सूची

धन्यवाद

केवल पेंडनामा

हम पेंडनामा ग्राम भोंधाता के होकर यह पेंडनामा लिखवा देते हैं कि आज दिनांक 29/12/2021 को ग्राम भोंधाता, प.ह.नं. 05, रा.नि.म. भोंधाता, तहसील पूनासा में भोंधाता पर्वत पर आदर्श शेकर की 108 फीट बहुधातु प्रतिमा तथा शेकर संग्रहालय की स्थापना हेतु आवंटित भूमि ख.नं. 2/1 एवं 7/1 के उपनित भूमि पर वृक्ष कटाई किए जाने कि अनुमति के आवेदन पर श्रीमान अनुविभागीय अधिकारी महोदय पूनासा के आदेशानुसार राजस्व विभाग के गठित दल एवं वन विभाग के वनपाल विमल अखनार एवं कीर्ति खरवार की उपस्थिती में कार्यालय कलेक्टर जिला खण्डवा के पत्र क्रमांक /19192/ वनक कले/2021 दिनांक 22/12/2021 में संदर्भित भूमि जिसमें पार्किंग हेतु आवंटित 7.10 हे. एवं शेकर संग्रहालय की स्थापना हेतु आवंटित 11.56 हे. भूमि का मौके पर निरीक्षण किया गया, मौके पर पार्किंग हेतु आवंटित भूमि 7.10 हे. पर वन मण्डल निगम द्वारा वृक्षारोपण किया गया है एवं वृक्ष कि गणना जारी है। तथा शेकर संग्रहालय कि स्थापना हेतु आवंटित 11.56 हे. भूमि में फलदार एवं इमारती व सागौन तथा मिश्रित प्रजाति के विभिन्न वृक्ष है, जिनका मौके पर निरीक्षण किया गया, इस प्रकार कुल 1181 वृक्षों को निरीक्षण किया गया, तथा बाँस के कुल 4316 बाँस को निरीक्षण किया गया।

पेंडनामा लिखा पढ़ा सुना बाद हस्ताक्षर किए जो सही।

कान - मोथाता, प.ह.न.-05, न.नि.म. - मोथाता, तहसील [illegible], [illegible]

आचार्य शंकर कि मूर्ति स्थापना एवं शंकर योगालय कि स्थापना हेतु आवेदित भूमि मन या 9.7 मे से आवेदित 11.56 हे भूमि पर पहले कि गणना सूची

पहले कि प्रजाति	पहले कि गोलाई (सेंमी में)								
	21-30	31-45	46-60	61-75	76-90	91-120	121-150	151 के उपर	कुल योग
व्यागीत	57	49	37	22	15	24	02	01	207
विभिन्न कलहर व मन्य मिश्रित प्रजाति	248	215	160	87	82	79	28	75	974
कुल योग	305	264	197	109	97	103	30	76	1181

ग्राम - मोधाता, प. ह. नं. 05, ग्रा० नि० म० - मोधाता, तहसील - कासा, जिला - सबवा

आवार्य बोलर कि पूर्वि स्थापना एवं बोलर सेवाधन्य कि स्थापना हेतु आवेदित भूमि खाता 2/1 व 7/1 मे आवेदित 11.51 है. भूमि पर बोम फिरे कि जनन सूची

छल बोम फिरे संख्या	बोम कि प्रजातिवार संख्या				
	करला	महिला	पकिया	सूखा	छल योग
116 फिरे	2817	434	454	611	4316
छल योग	2817	434	454	611	4316

ग्राम - मोथाना, प.ह.न. 05, रा.नि.म. मोथाना, तहसील - पुनाना, जि. खण्डवा

आचार्य श्रीमान कि प्रतिनिधि एवं संग्रहालय स्थापना हेतु
आवंटित 11.56 हे भूमि में वृक्षों कि गणना सूची

क्रमांक	पेड़ कि प्रजाति	पेड़ कि गोलाई (सेमी)
1	अशोक	77
2	—॥—	33
3	—॥—	62
4	कनेर	48
5	अशोक	64
6	—॥—	85
7	नीम	78
8	जामुन	46
9	जामफल	47
10	—॥—	21
11	—॥—	30
12	निलगिरी	57
13	—॥—	57
14	—॥—	29
15	जामफल	26
16	निलगिरी	32
17	—॥—	30
18	—॥—	38
19	सरकारी इमली	36
20	जामुन	23
21	जाम	24
22	चितापत	22
23	बो वाला पेड़	145
24	निम्ब	25
25	—॥—	25
26	नारियल	140
27	—॥—	69
28	—॥—	80
29	जामुन	40

पंचनामा

हम पंचगण ग्राम मांधाता तहसील पुनासा में ओमकारेश्वर मांधाता पर्वत पर आचार्य शंकराचार्य की 108 फीट बहुधातु प्रतिमा तथा संग्रहालय कि स्थापना हेतु आवंटित भूमि ख.न. 2/1 एवं 7/1 में चयनित भूमि 7/1 पर जिसका रकबा/क्षेत्रफल 11.56 हे० है उक्त भूमि पर लगे बांस के पेड़ों की कटाई हेतु पंचनामा तस्तीक करते है कि आचार्य शंकराचार्य (ओमकारेश्वर प्रकल्प) में चिन्हित भूमि 11.56 हे० पर कुल 1525 बांस काटने हेतु मार्किंग किये गये है। उक्त भूमि पर शेष 2791 बांस के पेड़ वर्तमान में काटने हेतु मार्किंग एरिये से बाहर है।

अतः चयनित भूमि पर काटे जाने वाले बांस की संख्या 1525 है उक्त संबंध में हम पंचगण के समक्ष पेड़ों की गिनती की गई, पंचनामा बनाया गया एवं पढ़ा कर सुनाने जाने के पश्चात हस्ताक्षर किये गये है।

सिता राम

Jetendra

JETENDRA KUMAR
SKM RAMDIN

Amit Chauchan
SKM Ramdin.

MPT Subedar 07/03/2022

Sagar
MPT contractor.

ANNEXURE-8

Annexure – 10

कार्यालय अनुविभागीय अधिकारी एवं दण्डाधिकारी, अनुभाग–पुनासा जिला खंडवा

प्रकं./09/अ–62/2021–22

ग्राम मांधाता तह. पुनासा

1– डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग – आवेदक

–विरूद्ध–

म.प्र. शासन

– आदेश –

आवेदक डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग द्वारा ग्राम गोदडपुरा रा.नि. मंडल मांधाता की आकार पर्वत शिखर पर आदि गुरू शंकराचार्य की प्रतिमा स्थापना एवं संग्रहालय स्थापना हेतु आवंटित भूमि जिसमें पार्किंग हतु 7.10है. एवं शंकर संग्रहालय की स्थापना हेतु 11.56है. भूमि आवंटित है। मौके पर निरीक्षण किया गया। भूमि पर वन मंडलाधिकारी द्वारा वृक्षारोपण किया गया है। जिसमें विभिन्न प्रजाति के फल्दार व इमारती लकडी के वृक्ष है। जिसकी गणना की गई है। शंकर संग्राहलय की सीपना हेतु आवंटित 11.56है. भूमि पर विभिन्न प्रजापति के फलदार, सागौन व अन्य इमारती लकडी के वृक्ष है निकी मौके पर गणना की गई एव चिन्हांकित किया गया है, जिसमें सागौन के कुल 207 वृक्ष है एवं नीम, जामुन, सीताफल के फलदार विभिन्न प्रजाति के कुल 974 वृक्ष है। इस प्रकार कुल वृक्ष बांस 1181 है चिन्हांकित किया गया है। साथ ही बांस के कुल 4316 बास चिन्हांकित किये गये है। आने बोले वृक्षों का दिनांक 24.12.2021 को संयुक्त निरीक्षण किया गया। संयुक्त दल द्वारा उक्त प्रस्तवित स्थल में शंकर संग्राहलय की सीपना हेतु आवंटित 11.56है. भूमि पर विभिन्न प्रजापति के फलदार, सागौन व अन्य इमारती लकडी के वृक्ष है निकी मौके पर गणना की गई एवं चिन्हांकित किया गया है, जिसमें सागौन के कुल 207 वृक्ष है एवं नीम, जामुन, सीताफल के फलदार विभिन्न प्रजाति के कुल 974 वृक्ष है। इस प्रकार कुल वृक्ष बांस 1181 है चिन्हांकित किया गया है। साथ ही बांस के कुल 4316 बास चिन्हांकित किये गये है। जिन्हें उक्त प्रयोजन हेतु काटने/छाटने की अनुमति दी जा सकती है। संभागीय प्रबंधक खंडवा परियोजना मंडल खंडवा द्वारा उनके पत्र कमांक विवि/माचि/2021/10390, दिनांक 17.12.2021 के द्वारा उक्त 1181 विभिन्न प्रजातियों के वृक्षों के साथ 4316 बास को उक्त प्रयोजन काटे जाने की अनुमति दी जा सकती है। सूची अनुसार प्रकरण में नियमानुसार वृक्षों की कटाई/छटाई किये जाने की अनुमति प्रदान करने की अनुशंसा की है।

कलेक्टर महोदय खंडवा द्वारा प्रकरण कमांक 9/अ–62/2021–22 आदेशिका दिनांक 02.03.2022 के माध्यम से ऑकार शिखर पर आदि गुरू शकराचार्य की प्रतिमा स्थापना ग्राम गोदडपुरा रा.नि. मडल मांधाता की आकार पर्वत शिखर पर आदि गुरू शकराचार्य की प्रतिमा स्थापना एवं संग्रहालय स्थापना हेतु आवंटित भूमि जिसमें पार्किंग हतु 7.10है. एवं शंकर संग्रहालय की स्थापना हेतु 11.56है. भूमि आवंटित है। मौके पर निरीक्षण किया गया। भूमि पर वन मडलाधिकारी द्वारा वृक्षारोपण किया गया है। जिसमें विभिन्न प्रजाति के फल्दार व इमारती लकडी के वृक्ष है। जिसकी गणना की गई है। शंकर संग्राहलय की स्थापना हेतु आवंटित 11.56है. भूमि पर विभिन्न प्रजापति के फलदार, सागौन व अन्य इमारती लकडी के वृक्ष है निकी मौके पर गणना की गई एव चिन्हांकित किया गया है, जिसमें सागौन के कुल 207 वृक्ष है एवं नीम, जामुन, सीताफल के फलदार विभिन्न प्रजाति के कुल 974 वृक्ष है। इस प्रकार कुल वृक्ष बांस 1181 है चिन्हांकित किया गया है। साथ ही बांस के कुल 4316 बास चिन्हांकित किये गये है। उक्त वृक्षों को काटने की अनुमति डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग को म.प्र. भू–राजस्व संहिता 1959 की धारा 240 एव 241 तथा इसके अंतर्गत बने नियमों के अनुसार इस शर्त पर प्रदान की जाती है कि वृक्षों की समस्त लकडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद में जमा कराई जायेगी।

SUB DIVISIONAL MAGISTRATE

Scanned with CamScanner

इन वृक्षों की कटाई का काटाई से लेकर परिवाहन तक का पर्यवेक्षण अनुविभागीय अधिकारी रा. स्वयं करेंगे जिससे की राजस्व की हानि न हो साथ ही इस आशय की "अंडरटेकिंग" प्राप्त कर प्रकरण मे संलग्न करें कि वे मार्ग का निर्माण कार्य रोड के दोनो तरफ दो गुना वृक्ष/पौधे लगाने का एवं उनके रखरखाव का कार्य विभाग के माध्यम से किया जावेगा। तदुपरांत कटाई/छटाईकी विधिवत अनुमति जारी करें।

कलेक्टर महोदय खंडवा द्वार क्रमांक 9/अ-62/2021-22 आदेशिका दिनांक 02.03.2022 के माध्यम से ओंकार शिखर पर शंकर संग्राहलय की स्थापना हेतु आवंटित 11.56है. भूमि पर विभिन्न प्रजापति के फलदार, सागौन व अन्य इमारती लकडी के वृक्ष है निकी मौके पर गणना की गई एवं चिन्हांकित किया गया है, जिसमें सागौन के कुल 207 वृक्ष है एवं नीम, जामुन, सीताफल के फलदार विभिन्न प्रजाति के कुल 974 वृक्ष है। इस प्रकार कुल वृक्ष वांस 1181 है चिन्हांकित किया गया है। साथ ही बांस के कुल 4316 बास के वृक्षों को काटने की अनुमति डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग को म.प्र. भू.रा. स. की धारा 240 एवं 241 के प्रावधानों के तहत प्रदान निम्न शर्तो के अधीन अनुमति प्रदान की गई है। प्रकरण में आवेदक विभाग द्वारा चाही गई अंडरटेकिंग प्रस्तुत करें।

1- वृक्षों की समस्त लकडी वन विभाग को हस्तांतरित कर प्राप्त राशि राजस्व के मद में जमा कराई जावेगी।

2- इन वृक्षों की कटाई से लेकर परिवहन तक का पर्यवेक्षण नायब तहसीलदार मांधाता के द्वारा किया जायेगा। जिससे राजस्व हानी न हो।

3- प्रकरण में डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग से इस आशय की आण्डर टेंकिंग प्रस्तुत करें की परियोजना कार्य पूर्ण होने से पूर्व दो गुना वृक्ष/पौधे लगाने एवं उनके रख रखाव का डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग द्वारा कन्सेशनायर के माध्यम से किया जावेगा तदुपरांत वृक्षों के कटाई/छटाई की जायेगी।

4- काटे जाने वालें वृक्षों की कटाई तथा निलामी नायब तहसीलदार के पर्यवेक्षण एव निर्देशन में संबंधित परियजना के अधिकारी द्वारा विहित प्रकिया का पालन करते हुये की जायेगी नीलामी हेत वन विभाग द्वारा किये गये मुल्यांकन के समतुल्य आधार मूल्य रखा जाएगा ओर नीलामी में प्राप्त राशि शासकीय खजाने में जमा की जायेगी।

5- संबंधित इस बात का ध्यान रखेगे की जिन वृक्षों को काटे जाने की अनुमति प्रदान की जा रही है केवल उन्हें वृक्षों को काटा जाए कोई अन्य वृक्ष नहीं काटा जाये।

6- शर्तो का उल्लंघन होने पर अनुमति स्वतः निरस्त मानी जायेगी ।

अनुविभागीय अधिकारी (रा)
अनुभाग-पुनासा

पृ.क./प्रवा/2022/ 347 पुनासा,दिनांक– 24.03.2022

प्रतिलिपि:–

1– कलेक्टर महोदय, वाचक शाखा खंडवा की ओर सूचनार्थ।
2– वन मंडलाधिकारी, वन विभाग खंडवा
3– डॉ. शैलेन्द्र मिश्रा सहायक संचालक संस्कृति सह प्रभारी अधिकारी, अचार्य शंकर सांस्कृति एकता न्यास म.प्र. शासन संस्कृति विभाग की ओर पालनार्थ।
4– उप वन मंडलाधिकारी, वन विभाग पुनासा
5– संभागीय प्रबंधक म.प्र. राज्य वन विकास निगम लि. की ओर सूचनार्थ।
6– तहसीलदार/नायब तहसीलदार मांधाता
7– राजस्व निरीक्षक मांधाता
8– हल्का पटवारी मांधाता

अनुविभागीय अधिकारी (रा)
s:अनुभाग:पुनासा
DIVISION PUNASA

ANNEXURE-9

ENVIRONMENTAL CLEARANCE

PARIVESH

(Pro-Active and Responsive Facilitation by Interactive, and Virtuous Environmental Single-Window Hub)

Government of India
Ministry of Environment, Forest and Climate Change
(Issued by the State Environment Impact Assessment Authority(SEIAA), Madhya Pradesh)

To,

The Director (Technical)
M P STATE TOURISM DEVELOPMENT CORPORATION LIMITED
Madhya Pradesh State Tourism Development Corporation Limited.
Bhadbhada Road, Bhopal (M.P.) - 462003 -462003

Subject: Grant of Environmental Clearance (EC) to the proposed Project Activity under the provision of EIA Notification 2006-regarding

Sir/Madam,

This is in reference to your application for Environmental Clearance (EC) in respect of project submitted to the SEIAA vide proposal number SIA/MP/MIS/261610/2022 dated 17 Mar 2022. The particulars of the environmental clearance granted to the project are as below.

1.	**EC Identification No.**	**EC22B038MP123334**
2.	**File No.**	9084/2022
3.	**Project Type**	New
4.	**Category**	B2
5.	**Project/Activity including Schedule No.**	8(a) Building and Construction projects
6.	**Name of Project**	"Statue of Oneness" Proposed Development for Site A-1 Statue & Museum and Site A-2 Parking"
7.	**Name of Company/Organization**	M P STATE TOURISM DEVELOPMENT CORPORATION LIMITED
8.	**Location of Project**	Madhya Pradesh
9.	**TOR Date**	N/A

The project details along with terms and conditions are appended herewith from page no 2 onwards.

Date: 15/04/2022

(e-signed)
Shriman Shukla
Member Secretary
SEIAA - (Madhya Pradesh)

Note: A valid environmental clearance shall be one that has EC identification number & E-Sign generated from PARIVESH.Please quote identification number in all future correspondence.

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Ref: Proposal No. SIA/MP/MIS/261610/2022, Case No 9084/2022: Prior Environment Clearance for Proposed Development for Site A-1 Statue & Museum and Site A-2 Parking "Statue of Oneness" at Village - Mandhata, Tehsil - Punasa, Dist. Khandwa, MP Total Plot Area-1,86,600.00 sq.m. (18.66 ha) 55100.62 sq.m (A1 - 52346.5 sq. m + A2 = 2754.12 sq.m.) by Madhya Pradesh State Tourism Development Corporation Limited, Dist. Bhopal, MP – 462003 Email: sooproject2022@gmail.com Envt. Consultant: In situ enviro care, Bhopal (MP)

With reference to above the proposal has been appraised as per prescribed procedure & provisions under the EIA notification issued by the Ministry of Environment & Forests vide S.O. 1533 (E), dated 14th September 2006 and its amendment, on the basis of the mandatory documents enclosed with the application viz., Form -2, Form IA, Conceptual Plan, drawings and subsequently submission of EMP report, PPT& the additional clarifications furnished in response to the observations of the State Expert Appraisal Committee (SEAC) and State Environment Impact Assessment Authority (SEIAA) constituted by the competent Authority.

i. This is a case of Prior Environment Clearance for Proposed Developemnt of Site for A-1 (Statue & Museum and Site A-2 Parking) "Statue of Oneness" at Village - Mandhata, Tehsil - Punasa, Dist. Khandwa, MP.
ii. The project involves the construction/development of Statue of Oneness, Museum and Parking Facility. The maximum heights for the statue will be 60 M and for Building 12 M. The Total Land Area– 1,86,600.00 sq. m [18.66 ha (11.55 ha. For Site A1 + 7.1 ha. For Site A2)] Net Planning Area – 1,15,600.00 sq.m. Total Proposed Built up area - 55100.62 (A1 = 52346.5 sq. m + A2 = 2754.12 Sq.mt.)
iii. As per the T & CP Khandwa & Burhanpur (163/JAN-434/NAGRANI/2022 Khandwa dated 13/02/2022) the total Area is – 150.140 ha.Out of the total 150.140ha area 18.660 ha land is allocatd for the eshtablishment of "statue of Oneness". The total built up area proposed by PP is 55100.62 sq.m. The project comes under 8 (a) category (B) of schedule of EIA Notification, 2006 because total construction is between 20,000 sq.mt. & 1, 50,000 sq mt. and plot area is less than 50 ha.
iv. The case was discussed in SEAC meeting 562nd dtd.29.03.22 and is recommended for grant of prior EC subject to specific conditions.
v. **Summary of the project.**

Name of the Project	"Statue of Oneness" Proposed
Coordinates of Site	22°14'58.11"N. 76° 9'0.72"E
Total Plot Area	1,86,600.00 sq.m. (18.66 ha.)
Proposed Built–Up Area	55100.62 sq.m (A1 - 52346.5 sq. m + A2 = 2754.12 sq.m.)PP has obtained permission from T& CP vide letter 163/JAN-434/NAGRANI/2022Khandwa dated 13/02/2022
Water requirement	1200 KLD Source -Narmada Water Supply It will cater the domestic requirement whereas additional water requirement will be fulfilled by treated water from STP. WRD NOC has been obtained by PP.
Waste Water Generation	660 KLD (650 KLD WATER AND 10 KLD SLUDE)
Treated Waste Water Generation	650 KLD (480 KLD + 170 KLD)
Capacity of STP	800 KLD (600 KLD + 200 KLD) Treatment Concept : SBR (Sequential Batch Reactor) PP has obtained NOC (**344/LO.NI./N.PARI./2022 DATED 25/02/2022**) from **Omkareshwar** Municipal council Khandwa for disposal of extra treated waste water
Solid Waste Generation	13.5TPD PP has obtained NOC (343/LO.NI./N.PARI./2022 dated 25/02/2022) from Omkareshwar Municipal council Khandwa

	for disposal of MSW.
Power requirement Source of Power	5828.93 KVA MPSEB
DG Set	7000 KVA. (4 X 1250 KVA, 2 X 1000 KVA)
UPS	2000 KVA (4 X 500 KVA (1 Stand by Extra)
Solar Panel	711 KW
Parking	A-1 & A-2 site is 1884 ECS each
Height of the Statue	60 M (from ground)
Height of Building	12 M
Railway Station	Omkareshwar Railway Station 11 Km (SW)
Air Port	Indore Airport– 62.63 Km (NW)
Topography	Hilly terrain
Annual Average Rainfall	777.60 mm
Rain Water Harvesting	2 no. of rainwater storage tank has been proposed of 672 Cum (Site A1) and 599 cum (Site A2).
Green belt	In the proposed project 72464.5 Sq.mt. (56,622 Sq.mt. Site A1 + 15842.5 Sq.mt. Site A2) areas is allocated for greenbelt/landscape development in which 1845 trees have been proposed in plantation scheme.
Project Cost	826.98 Cr.

Based on the information submitted at Para i to v above and others, the State Level Environment Impact Assessment Authority (SEIAA) considered the case in its 717th meeting held on 08.04.2022 and decided to accept the recommendations of 562nd SEAC meeting held on dated 29.03.2022.

Hence, Prior Environmental Clearance is accorded under the provisions of EIA Notification dtd. 14th September 2006 & its amendments to the proposed Development for Site A-1 Statue & Museum and Site A-2 Parking "Statue of Oneness" at Village - Mandhata, Tehsil - Punasa, Dist. Khandwa, MP Total Plot Area-1,86,600.00 sq.m. (18.66 ha) 55100.62 sq.m (A1 - 52346.5 sq. m + A2 = 2754.12 sq.m.) by Madhya Pradesh State Tourism Development Corporation Limited, Dist. Bhopal, MP – 462003 subject to the compliance of the Standard Conditions and the following additional Specific Conditions as recommended by SEIAA & SEAC in its meetings.

A. Specific Conditions as recommended by SEIAA

1. The fresh water supply arrangement should be met through Narmada Water suppply as per NOC obtained from WRD and there should no extraction of ground water.
2. PP should ensure linkage with municipal council Omkareshwar Khandwa for disposal of extra treated waste water.
3. For Solid Waste Management eensure linkage with municipal council Omkareshwar Khandwa for final disposal of MSW. Wet Garbage shall be composted in Organic waste convertor. Adequate area shall be provided for solid waste management within the premises which will include area for segregation, composting. The Inert waste from the project will be sent to dumping site.
4. PP should ensure road width, front MOS and side / rear as per MPBVR 2012.
5. **For firefighting:-**
   a. PP should ensure distance of fire station approachable from the project site. fire fighting NOC(440/LO.NI./N.PARI./2022 Omkareshwar dated 10/03/2022) All the required fire fighting arrangement shoud be made avilable onthe project site as per NBC 2005.
   b. The occupancy permit shall be issued by Municipal council only after ensuring that all fire fighting measures are physically in place.
6. PP should ensure to provide car parking total- A-1 & A-2 site is 1884 ECS each.

7. Solar lights provide for common amenities like Street lighting & Garden lighting.

8. Electrical charging points for E-Vehicles shall be provided to promote clean energy

9. PP should ensure to submit half yearly compliance report with photographs of plantation in MP-SEIAA. If PP is failed to upload or submit two consecutive half yearly compliance reports of EC conditions to concerned authority (SEIAA and Regional Office, MoEF&CC, GoI, Bhopal) than prior environmental clearance issued to PP will automatically be treated as cancelled/ revoked as per OM No. 930/SEIAA/2019 dated 30.05.2019 issued by MPSEIAA.

B. Specific Conditions as recommended by SEAC

I Statutory Compliance

i. The project proponent shall obtain all necessary clearance/permission from all relevant agencies including town planning authority before commencement of work. All the construction shall be done in accordance with the local building byelaws.
ii. The approval of the Competent Authority shall be obtained for structural safety of building due to earthquakes, adequacy of firefighting equipment etc as per National Building code including protection measures from lightening etc.
iii. The project proponent shall obtain Consent to Establish/Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State Pollution Control Board/Committee.
iv. The project proponent shall obtain the necessary permission for drawl of ground water/surface water required for the project from the competent authority.
v. A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.
vi. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department, Archiological Survey of India & State Archiological
vii. The conditions stipulated in T&CP approval dated 13/02/22 shalll be complied by PP.
viii. Department shall be obtained, as applicable, by project proponents from the respective competent authorities.
ix. If any central or state recognized monuments falling in the project area the PP should take permission / NOC from the concerned competent authority.
x. The provisions for the solid Waste (Management) Rules, 2016, e-Waste (Management) Rules, 2016, and the Plastics Waste (Management) Rules, 2016 shall be followed.
xi. The project proponent shall follow the ECBC/ECBC-R prescribed by Bureau of Energy Efficiency, Ministry of Power Strictly.
xii. The project area shall be secure through boundary wall and excavated top soil shall not be used in filling of low lying area. The top soil shall be used for greenery development.

II. Air quality monitoring and preservation

i. Notification GSR 94(E) dated: 25/1/2018 MoEF & CC regarding Mandatory implementation of Dust Mitigation Measures for Construction and Demolition Activities for project requiring Environmental Clearance shall be complied with.
ii. A management plan shall be drawn up and implemented to contain the current exceedance in ambient air quality at the site.
iii. The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released covering upwind and downwind directions during the construction period.
iv. Diesel power generating sets as 7000 KVA (4 X 1250 KVA, 2 X 1000 KVA & UPS 2500 KVA (5 X 500 KVA) are proposed as source of backup power should be of enclosed type and conform to rules made under the Environment (Protection) Act, 1986. The height of stack of DG sets should be equal to the height needed for the

combined capacity of all proposed DG sets. Use of low sulphur diesel. The location of the DG sets may be decided with in consultation with State Pollution Control Board.

v. Construction site shall be adequately barricaded before the construction begins. Dust, smoke & other air pollution prevention measures shall be provided for the building as well as the site. These measures shall include screens for the building under construction, continuous dust/ wind breaking wills all around the site plastic/tarpaulin sheet covers shall be provided for vehicles bringing in sand, cement, Murram and other construction materials prone to causing dust polluting at the site as well as taking out debris from the site.

vi. Sand, Murram, loose soil, cement, stored on site shall be covered adequately so as to prevent dust pollution.

vii. Wet jet shall be provided for grinding and stone cutting.

viii. Unpaved surface and loose soil shall be adequately sprinkled with water to suppress dust.

ix. All construction and demolition debris shall be stored at the site (are not dumped on the roads or open spaces outside) before they are properly disposed. All demolition and construction waste shall be managed as per the provisions of the Construction and Demolition Waste Rules, 2016.

x. The diesel generator sets to be used during construction phase shall be low sulphur diesel type and shall conform to Environmental (Protection) prescribed for air and noise emission standards.

xi. The gaseous emission from Diesel power generating sets as 7000 KVA. (4 X 1250 KVA, 2 X 1000 KVA shall be dispersed through adequate stack height as per CPCB standards. Acoustic enclosure shall be provided to the DG sets to mitigate the noise pollution. Low sulphur diesel shall be used. The location of the DG set and exhaust pipe height shall be as per the provisions of the Central Pollution Control Board (CPCB) norms.

xii. For indoor air quality the ventilation provisions as per National Building Code of India.

III Water quality monitoring and preservation

i. The natural drain system should be maintained for ensuring unrestricted flow of water. No construction shall be allowed to obstruct the natural drainage through the site, on wetland and water bodies. Check dams, bio-swales, landscape and other sustainable urban drainage systems (SUDS) are allowed for maintaining the drainage pattern and to harvest rain water.

ii. Buildings shall be designed to follow the natural topography as much as possible Minimum cutting and filling should be done.

iii. The total water requirement during operation phase is 1638 KLD. Whereas fresh water is 851 KLD (634 KLD for A-1 & 217 KLD for A-2). Waste Water Generation-800 KLD (600KLD from A-1 site & 200 KLD from A-2 site) out of which Treated water shall be 650 KLD (480KLD from A-1 site STP & 170 KLD from A-2 site STP) water and 10 KLD sludge. Treated water shall be used for horticulture and flushing purposes.

iv. The quantity of fresh water usage, water recycling and rainwater harvesting shall be measured and recorded to monitor the water balance as projected by the project proponent. The record shall be submitted to the Regional Office, MoEF & CC along with six monthly Monitoring reports.

v. A certificate shall be obtained from the local body supplying water, specifying the total annual water availability with the local authority, the quantity of water already committed the quantity of water allotted to the project under consideration and the balance water available. This should be specified separately for separately for ground water and surface water sources, ensuring that there is no impact on other users.

vi. At least 11% of the open spaces as required by the local building bye-laws shall be previous. Use of Grass pavers, paver blocks with at least 50% opening, landscape etc. would be considered as previous surface.

vii. Installation of dual pipe plumbing for supplying fresh water for drinking, cooking and bathing etc and other for supply of recycled water flushing, landscape irrigation, car washing, thermal cooling, conditioning etc. shall be done.

viii. Use of water saving devices/fixtures (Viz. low flow flushing systems; use of low flow faucets tap aerators etc) for water conservation shall be incorporated in the building plan.

ix. Separation of grey and black water should be done by the use of dual plumbing system. In case of single stack system separate recirculation lines for flushing by giving dual plumbing system be done.

x. Water demand during construction should be reduced by use of pre-mixed concrete, curing agents and other best practices referred.

xi. The local bye-law construction on rain water harvesting should be followed. If local by-law provision is not available, adequate provisions for storage and recharge should be followed as per the Ministry of Urban Development Model Building bylaws, 2016.

xii. The Rain Water storage tanks will be initially done only from the roof top. Runoff from green and other open areas will be done only after permission from CGWB.

xiii. All recharge should be limited to shallow aquifer.

xiv. No ground water shall be used during construction phase of the project.

xv. Any ground water dewatering should be properly managed and shall conform to the approvals and the guidelines of the CGWA in the matter. Formal approval shall be taken from the CGWA for any ground water abstraction or dewatering.

xvi. The quality of fresh water usage, water recycling and rainwater harvesting shall be measured and recorded to monitor the water balance as projected by the project proponent. The recorded shall be submitted to the Regional Office, MoEF & CC along with six monthly Monitoring report.

xvii. Sewage shall be treated in the SBR based 02 nos. of STP Capacity - 800 KLD (600 KLD (A-1 site) + 200 KLD (A-2 site). The treated effluent from STP shall be recycled/re-used for flushing, AC makes up water and gardening. As proposed, no treated water shall be disposed into municipal drain.

xviii. The waste water generated from the project shall be treated in 02 STP of 800 KLD (600 KLD (A-1 site) + 200 KLD (A-2 site). Capacity (based on SBR based technology) and then reused for various purposes. No water body or drainage channels are getting affected in the study area because of this project.

xix. Being located on the close proximity of Narmada River Catchment Area, project shall be Zero Liquid Discharge and also no Municipal Solid Waste or other wastes (such as E-waste, Battery Waste etc) shall find its way to the Narmada River.

xx. PP shall also install Two Online Continous Water Quality Monitoring Stations (one on the upstream of the project site and other on the downstream of the project site) and their results shall be displayed on the banks of Narmada River for awareness.

xxi. The runoff of the proposed project area shall be collected and discharged in the municipal sewer line and be treated in proposed common STP.

xxii. No sewage or untreated effluent water would be discharged through storm water drains.

xxiii. Periodical monitoring of water quality of treated sewage shall be conducted. Necessary measures should be made to mitigate the odour problems from STP.

xxiv. Sludge from the onsite sewage treatment including septic tanks, shall be collected, conveyed and disposed as per the Ministry of Urban Development, Control Public Health and Environmental Engineering Organization (CPHEEO) Manual on Sewerage and Sewage Treatment Systems, 2013.

IV Noise monitoring and prevention

i. Ambient noise levels shall conform to residential area/commercial area/industrial area/silence zone both during day and night as per Noise Pollution (Control and Regulation) Rules, 2000. Incremental pollution loads on the ambient air and noise quality shall be closely monitoring during construction phase. Adequate measures shall

be made to reduce ambient air and noise level during construction phase, so as to conform to the stipulated standards by CPCB/SPCB.

ii. Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.

iii. Acoustic enclosures for DG sets, noise barriers for ground run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.

V Energy Conservation measures

i. The Power would be fulfilled from MPEB. The total maximum demand would be 5828.93 KVA while connected load would be 9260.5 KVA.

ii. The 711 KW Renewal Energy shall be generated through Solar Panel on Parking Area i.e. form A2 Site shall be used in-house.

iii. Energy consumption reduced by use following points.

- Level controller for pumps.
- Timer for street & common lighting.
- Designing of peak & non peak circuits for common area.
- Reduced in load due to using the LED Lights.
- Distribution Transformer are 3 star Rated as per BEE norms.
- Solar powered street lights shall be used to conserve energy.

iv. Compliance with the Energy Conservation Building Code (ECBC) of Bureau of Energy Efficiency shall be ensured. Building in the State which have notified their own ECBC, shall comply with the State ECBC.

v. Outdoor and common area lighting shall be LED.

vi. PP shall explore the possibility of providing e-vehicles/CNG based vehicles from base parking area/station to the proposed museum parking area to avoid vehicular emissions on the hill top and rush of vehicles.

vii. Concept of passive solar design that minimize energy consumption in buildings by using design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design and thermal mass etc. shall be incorporated in the building design. Wall, window, and roof u-values shall be as per ECBC specifications.

viii. Energy Conservation measures like installation of CFIs/LED's for the lighting the area outside the building should be integral part of the project design and should be in place before project commissioning.

ix. Solar, wind or other renewable energy shall be installed to meet electricity generation equivalent to 1% of the demand load or as per the state level /local building bye-laws requirement, which is higher.

x. Solar power shall be used for lighting in the apartment to reduce the power load on grid. Separate electric meter shall be installed for solar power. Solar water heating shall be provided to meet 20% of the hot water demand of the commercial and institutional building or as per the requirement of the local building bye-laws, whichever is higher. Residential buildings are also recommended to meet its hot water demand from solar water heaters, as far as possible.

VI Waste Management

i. Total solid waste generated will be around 13.5 TPD (13 TPD Biodegradable and 0.5 TPD Non-Biodegradable Waste) Biodegradable & Non-Biodegradable waste will be segregated at source in accordance with MSW (M&H) Rules, 2016.

ii. 7771.0 Cu.m. C&D waste would be generated and reused within site for filling and leveling of site as per Norms.

iii. A certificate from the competent authority handling municipal solid wastes, indicating the existing civic capacities of handling and their adequacy to cater to the MSW generated from project shall be obtained.

iv. Disposal of muck during construction phase shall not create any adverse effect on the

neighboring communities and be disposed taking the necessary precautions for general safety and health aspects of people, only in approved sites with the approval of competent authority.

v. Separate wet and dry bins must be provided in each unit and at the ground level for facilitating segregation of waste. Solid waste (0.4 ton/day) shall be segregated into wet garbage and inert materials.

vi. All non-biodegradable waste shall be handed over the authorized recyclers for which a written lie up must be done with the authorized recyclers

vii. Any hazardous waste generated during construction phase, shall be disposed off as per applicable rules and norms with necessary approvals of the State Pollution Control Board.

viii. Use of environment friendly materials in bricks, blocks and other construction materials, shall be required for at least 20% of the construction materials quantity. These include fly ash brick, hollow bricks, AACs, Fly Ash Lime Gypsum block, compressed earth blocks and other environmental friendly materials.

ix. Fly ash should be used as building material in the construction as per the provisions of Fly Ash Notification of September, 1999 and amended as on 27th August, 2003 and 25th January, 2016 Ready mixed concrete must be used in building construction.

x. Any wastes from construction and demolition activities related thereto small be managed so as to strictly conform to the construction and Demolition Rules, 2016.

xi. Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/rules of the regulatory authority to avoid mercury contamination.

VII Green Cover

i. In the proposed project 72464.5 Sq.mt. (56.622 Sq.mt. Site A1 + 15842.5 Sq.mt. Site A2) areas is allocated for greenbelt/landscape development in which 1845 trees have been proposed in plantation scheme. As submitted by PP out of 1398 trees in existence on site 418 trees are proposed to be uprooted. Considering 10 times plantation/tree uprooting, additionally 4180 plants shall have to be planted. Committee after deliberations recommends in situ plantation of 6025 (4180+1845) species shall be carried out for this project. During discussion, PP also informed that additional land of 36.00 ha is allocated on the northern side of the project site A-1 where they are planning thick grén belt development thorugh root zone technology and plantation of bamboo. Thus, in situ plantation of 6025 trees shall be carried out in the proposed project area at site A1 & A2 and additional plantation of bamboo in 4316 numbers in adjacent 36.00 ha land. Hence 10,341 species as mentioned in the plantation scheme shall be planted. Broad leaves plantation shall be preferred on the parking side.

ii. Plantation of native species found on the banks of Narmada River from Amarkantak, MP to Alirajpur, MP shall be preferred through competent agency having knowledge regarding flora & fauna of MP to address the issue of biodiversity, ground water recharge, climate change and minor forest produce.

iii. Also explore possibility to developing a medicinal garden & displaying fossils in proposed museum found in the Narmada River Basin Area to enrich the knowledge of the devotees/visitors.

iv. Since the proposed site is table top of the island and extreme slope is towards the main stream of Narmada River thus highly precisely soil conservation work and vegetation cover shall carried out along the River.

v. No tree can be felled/transplant unless exigencies demand. Where absolute necessary, tree felling shall be with prior permission from the concerned regulatory authority. Old trees should be retained based on girth and age regulations as may be prescribed by the Forest Department. Plantations to be ensured species (cut) to species (Planted).

vi. Where the trees need to be cut with prior permission from the concerned local Authority, Compensatory plantation in the ratio of 1:10 (i.e. planting of 10 trees for every 1 tree that is cut) shall be done and maintained. Plantations to be ensured

species (cut) to species (planted). Area for green belt development shall be provided as per the details provided in the project document.

vii. Topsoil should be stripped to depth of 20 cm from the areas proposed for buildings, roads, paved areas, and external services. It should be stack plied appropriately in designated areas and reapplied during plantation of the proposed vegetations on site.

VIII Transport

i. PP will explore the possibility of providing green vehicles for base parking area to the museum parking area to avoid station vehicular emission at top of the hill.

ii. PP shall explore additional measures proposed for approaching site such as rope way, cable bridge, cable car etc.

iii. A comprehensive mobility plan, as per MoUD best practices guidelines (URDPFI), shall be prepared to include motorized, non-motorized, public and private network. Road should be designed with due consideration for environment and safety of users. The road system can be designed with these basic criteria.
   a. Hierarchy of roads with proper segregation of vehicular and pedestrian traffic
   b. Traffic calming measures.
   c. Proper design of entry and exit points
   d. Parking norms as per local regulation

iv. Vehicles hired for bringing construction material to the site should be in good condition and should have a pollution check certificate and should conform to applicable air and noise emission standards be operated only during non-peak hours.

v. A detailed traffic management and traffic decongesting plan shall be drawn up to ensure that the current level of service of the road within a 05 Kms radius of the project as maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of the development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management and the PWD/competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.

IX Human health issues

i. All workers working at the construction site and involved in loading, unloading, carriage of construction material and construction debris or working in any area with dust pollution shall be provided with dust mask.

ii. For indoor air quality the ventilation provisions as per National Building Code of India.

iii. Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implementation.

iv. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile, STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

v. Occupational health surveillance of the workers shall be done on a regular basis.

vi. A First Aid Room shall be provided in the project both during construction and operations of the project.

X EMP &Corporation Environment Responsibility

i. For Environment Management Plan PP has proposed during construction phase Rs. 742.62 Lakhs as capital and Rs. 53.50 Lakhs as recurring cost for this project. And during operation phase Rs. 1357.83 Lakhs as capital and Rs. 124.00 Lakhs as recurring cost for this project out of which PP has also proposed following activities under Corporate Environment Responsibility (CER) with budget.

Component	Capital Cost in INR	Recurring Cost in INR

Providing Water Coolers	3,00,000.00	1,00,000.00
Provide Solar Street lights in the nearby area	20,00,000.00	3,00,000.00
Support	4,00,000.00	2,00,000.00
Plantation along approach roads in a scientific manner	30,00,000.00	8,00,000.00

ii. The company shall have a well laid down environmental policy duly approved by the Board of Directors. The Environmental policy should prescribe for standard operating procedures to have proper checks and balance and to bring into focus any infringements/deviation/violation of the environmental/forest/wildlife norms/conditions. The company shall have defined system of reporting infringements/deviation/violation of the Environmental/forest/wildlife norms/conditions and/or shareholders/stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six monthly reports.

iii. A separate Environmental Cell both at the project and company head quarter with qualified personnel shall be set up under the control of senior Executive, who will directly to the head of the organization.

iv. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.

XI Miscellaneous

i. The project authorities must strictly adhere to the stipulation made by the MP Pollution Control Board and the State Government.

ii. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the State Expert Appraisal Committee (SEAC)

iii. No further expansion or modification in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).

iv The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon"ble Supreme Court of India/High Courts and any other Court of Law relating to the subject matter.

Standard Conditions:

1. All activities / mitigative measures proposed by PP in Environmental Impact Assessment (if applicable) and approved by SEAC must be ensured.

2. All activities / mitigative measures proposed by PP in Environmental Management Plan and approved by SEAC must be ensured.

3. Project Proponent has to strictly follow the direction/guidelines issued by MoEF, CPCB and other Govt. agencies from time to time.

4. The Ministry or any other competent authority may alter/modify the conditions or stipulate any further condition in the interest of environment protection.

5. The Environmental Clearance shall be valid for a period of seven years from the date of issue of this letter.

6. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.

7. The Project Proponent has to upload soft copy of half yearly compliance report of the stipulated prior environmental clearance terms and conditions on 1st June and 1st December of each calendar year on MoEF & CC web portal - http://www.environmentclearance.nic.in/ or http://www.efclearance.nic.in/ and submit hard copy of compliance report of the stipulated prior environmental clearance terms and conditions to the Regulatory Authority also

8. The Regional Office, MoEF, GoI, Bhopal and MPPCB shall monitor compliance of the stipulated conditions. A complete set of documents including Environment Impact Assessment Report, Environmental Management Plan and other documents information should be given to Regional Office of the MoEF, GoI at Bhopal and MPPCB.

9. The Project Proponent shall inform to the Regional Office, MoEF, GoI, Bhopal and MP PCB regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.

10. In the case of expansion or any change(s) in the scope of the project, the project shall again require prior Environmental Clearance as per EIA notification, 2006.

11. The SEIAA of M.P. 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 Environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.

12. The proponent shall upload the status of compliance of the stipulated EC conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MoEF, the respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; SPM, RSPM, SO2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company and in the public domain.

13. The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the Regional Office of MoEF.

14. A copy of the environmental clearance shall be submitted by the Project Proponent to the Heads of the Local Bodies, Panchayat and municipal bodies as applicable in addition to the relevant officers of the Government who in turn has to display the same for 30 days from the date of receipt.

15. The Project Proponent shall advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been

accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at website of the State Level Environment Impact Assessment Authority (SEIAA) at www.mpseiaa.nic.in and a copy of the same shall be forwarded to the Regional Office, MoEF, GoI, Bhopal.

16. Any appeal against this prior environmental clearance shall lie with the Green Tribunal, if necessary, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

(Shriman Shukla)
Member Secretary

Copy to:-

(1). Principal Secretary, Department of Environment., Government of MP, Mantralaya Vallabh Bhawan, Bhopal.

(2). Member Secretary, SEAC, Research and Development Wing Madhya Pradesh Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony Bhopal-462016.

(3). Member Secretary, Madhya Pradesh Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony, Bhopal-462016.

(4). The Collector, Distt- Khandwa -M.P.

(5). The CMO, Municipal Council Omkareshwar, District Khandwa, MP

(6). Office of the Deputy Director, Town & Country Planning, Opp. Shubham Hospital, Anand Nagar Road, Khandwa (M.P.).

(7). Director (S), Regional office of the MOEF, (Western Region), Kendriya Paryavaran Bhawan, Link Road No. 3, Ravi Shankar Nagar, Bhopal-462016.

(8). Guard file.

(Alok Nayak)
Officer-in-Charge

Nature Protects if She is Protected

ANNEXURE-10

To Whomsoever

Following is the status of till date planted and to be planted on Mandhata island, Omkareshwar.

1	Area of plantation hectare	2.26 ha.
2	Plant species	Neem (1425), Karanj (670), Pipal (125), Bargad (80), Putranjivak (20), Belpatra (50), Madhukamini (20), Kadamb (20)
3	Total plants	2410
4	Percent of survival	90
5	Map of plantation area and location of plantation	Encl.

Schedule of plantation to be done in 2023-24

SN	Duration of plantation	No of plants to be planted	Plant species
1	June 2023	5000	Karanj, Neem, Pipal, Bargad, Belpatra, Dhavad, Anjan, Amaltash, Palash and other forest plant species
2	July 2023	5000	
3	May 2024	10000	
4	June 2024	5000	
5	July 2024	5000	

(Dr. Krapal Singh Verma)
Assistant Director Horticulture

ANNEXURE-11

Consent Order

M.P. Pollution Control Board
E-5, Arera Colony
Paryavaran Parisar, Bhopal - 16 MP
Tele : 0755-2466191, Fax-0755-2463742

RED-LARGE	CTE-Fresh	CONSENT NO: ***	PCB ID: 149649

NO: /MPPCB/IND
Outward No:116022,19/07/2022

Consent No:CTE-56325

To,

The Occupier/ Project Proponent
M/s. "Statue Of Oneness" Proposed Development For Statue & Museum,
Vill- Mandhata kh no 2/1 Part and 7/1 Part,
Tehsil – Punasa, City : Omkareshwar,
District- Khandwa (M.P.), Latitude : 22.2503 Longitude : 76.1505

Subject: Grant of Consent to Establish under section 25 of the Water (Prevention & Control of Pollution) Act,1974 and under section 21 of the Air (Prevention & Control of Pollution) Act,1981

Ref: Your Consent to Establish Application Receipt No. 1169031 Dt. 15/07/2022 and last communication received on Dt.15/07/2022

Without prejudice to the powers of this Board under section 25 of the Water (Prevention & Control of Pollution) Act,1974 and u/s 21 of the Air (Prevention & Control of Pollution) Act,1981 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants Consent to Establish valid for 05 years up to 30-06-2027 for setting up of an Building / infrastructure project at kh no 2/1 Part and7/1 Part,Vill Mandhata, Teh –Punasa, Omkareshwar, District- Khandwa (M.P.) and -

SUBJECT TO THE FOLLOWING CONDITIONS :-

a. Location: Vill- Mandhata 2/1 Part and 7/1 Part, Tehsil – Punasa, City- Omkareshwar, District- Khandwa (M.P.)

b. The capital investment in lakhs: Rs. 82698

c. Project details :

Project details	Qty / year
Development and construction of project for -Statue of oneness	Total area 18.66 hectares
- Total Built Up Area	55100.6 m2 (52346 m2 & 2754 m2)
Utility	
1. DG Sets (For captive use only)	7000 KVA (4 x 1250 KVA+ 1 x 1000 KVA)
2. STP	800 KLD (600 KLD + 200 KLD)

Note :

1. **For any change in above Project proponent shall obtain fresh consent from the Board.**
2. **This consent to establish in no way be taken as measures of proof that the project proponent has not violated any pollution control laws at any time in the past. PP shall comply the direction/ decision of the Hon'ble Court/NGT related to this Project.**

The consent (for operation) as required shall be granted to your Project Proponent after fulfillment of all the conditions mentioned above. For this purpose you shall have to make an application to this Board in the prescribed proforma at least two months before the expected date of commissioning of your Project Proponent. The applicant shall not operate the unit without obtaining consent for operation from the Board and shall not bring in to use any out let for the discharge of effluent and gaseous emission.

Enclosures:-

* Conditions under Water Act
* Conditions under Air Act
* General conditions

eSign

Signature Not Verified
Digitally Signed by : A. A Mishra, Member Secretary
Date: 19/07/2022 12:13:36 PM

Achyut mishra

(Organic Authentication on AADHAR from UIDAI Server)

ACHYUT ANAND MISHRA
Member Secretary

This PDF is BLUEINK.ai in are valid and does not require physical signatures. the certificate can be validated online from sign.mp.nic.in using "TPAY" Number.

Consent Order

M.P. Pollution Control Board
E-5, Arera Colony
Paryavaran Parisar, Bhopal - 16 MP
Tele : 0755-2466191, Fax-0755-2463742

CONDITIONS PERTAINING TO WATER (PREVENTION & CONTROL OF POLLUTION) ACT 1974 :-

1. The daily quantity of sewage shall not exceed 660.000 KL/day

2. Trade Effluent Treatment :- NIL

3. Sewage Treatment :- The applicant shall provide comprehensive sewage treatment system as per the proposal submitted to the Board and maintain the same properly to achieve following standards-

Parameter	Standard limit*	
pH	Between	5.5 – 9.0
Suspended Solids	Not exceed	100 mg/L
BOD 3 Days 270C	Not exceed	30 mg/L
COD	Not exceed	250 mg/L
Oil and grease	Not exceed	10 mg/L
NH4-N	Not exceed	5 mg/l
Fecal Coliform(MPN/100ml)	Not exceed	230 mg/l
PO4-P	Not exceed	2 mg/l

***The operator of the STP shall comply with the standards notified vide G.S.R. 1265(E) under sections 6 and 25 of the Environment (Protection) Act, 1986 by the Ministry of Environment, Forest and Climate Change New Delhi dated 13th October, 2017.**

4. The effluent shall be treated up to prescribed Standards and reuse in the process, for cooling and for green belt devolvement/gardening within premises. Hence zero discharge condition shall be practiced. **In no case treated effluent shall be discharged to any nala/ drain/ water body .**

5. Water meter preferably electromagnetic/ultrasonic type with digital flow recording facilities shall be installed and data shall be submitted online through XGN monthly patrak/statements. The Project Proponent/unit shall also monitor the treated wastewater flow and report the same online through monthly patrak/statements.

Sr	Water Code (Qty in klpd - Kilo Ltr per Day)	WC : 851.000	WWG : 660.000	Water Source
1	Domestic Purpose	851.000	660.000	River

6. For any change in proposed project prior permission of the Board shall be obtained. All authorized discharges shall be consistent with terms and conditions of this consent. Facility expansions, which result new or increased discharges of pollutants must be reported by submission of a fresh consent application for prior permission of the Board

7. All treatment/control facilities/systems installed or used by the applicant shall be regularly maintained in good working order and operate effectively/efficiently to achieve compliance of the terms and conditions of this consent

8. The Consent does not authorize or approve the Construction of any physical structures or facilities or the undertaking of any work in any water course or within its high flood level (HFL) area

9. The specific effluent limitations and pollution control systems applicable to the discharge permitted herein are set forth as above conditions.

10. Compilation of Monitoring data-
i. Samples and measurements taken to meet the monitoring requirements specified above shall be representative of the volume and nature of monitored discharge.
ii. All sampling and analytical methods used to meet the monitoring requirements specified above shall conform to such guidelines unless otherwise specified sampling and analytical methods shall conform to the latest edition of the Indian Standard specifications and where it is not specified the guidelines as per standard methods for the examination of Water and Waste latest edition of the American Public Health Association, New York U.S.A. shall be used.
iii. The applicant shall take samples and measurement to meet the monthly requirements specified above and report online through XGN the same to the Board.

11. Recording of Monitoring Activities & Results-
i. The applicant shall maintain online records of all information resulting from monitoring activities by this Consent.
ii. The applicant shall record for each samples taken pursuant to the requirements of this Consent as follows:
(i) The date, exact place and time of sampling
(ii) The dates on which analysis were performed

(iii)Who performed the analysis?
(iv)The analytical techniques or methods used and
(v)The result of all required analysis

iii. If the applicant monitors any Pollutant more frequently as is by this Consent he shall include the results of such monitoring in the calculation and reporting of values required in the discharge monitoring reports which may be prescribed by the Board.

iv. The applicant shall retain for a minimum of 3 years all records of monitoring activities.

. The period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the applicant or when requested by Central or State Board or the court.

12. Reporting of Monitoring Results:-Monitoring Information required by this Consent shall be summarized and reported by submitting a Discharge Monitoring report and compliance of consent conditions on line to the Board.

13. Limitation of discharge of oil Hazardous Substance in harmful quantities:-
The applicant shall not discharge oil or other hazardous substances in quantities defined as harmful in relevant regulations into natural water course.

14. Disposal of Collected Solid waste/sludge-
All hazardous waste/sludge shall be disposed of as per the Authorization issued under Hazardous & other waste (M&TM) Rules 2016. And/other Solids Sludges, dirt, silt or other pollutant separated from or resulting from treatment shall be disposed of in such a manner as to prevent any pollutant from such materials from entering any such water

15. Provisson for Electric Power Failure-
The applicant shall assure to the consent issuing authority that the applicant has installed or provided for an alternative electric power source sufficient to operate all facilities utilized by the applicant.

16. Prohibition of By pass system of treatment facilities-
The diversion or by-pass of any discharge from facilities utilized by the applicant to maintain compliance with the terms and conditions of this Consent in prohibited except :
i. where unavoidable to prevent loss of life or severe property damage, or
ii. Where excessive storm drainage or run off would damage any facilities necessary for compliance with the terms and conditions of this Consent. The applicant shall immediately notify the consent issuing authorities in writing of each such diversion or by-pass in accordance with the procedure specified above for reporting non-compliance.

Additional Water condition:-

1. The Project Proponent (PP) shall be install 800 KLD (600 + 200) STP for treatment of domestic wastewater up to the prescribed standards and reuse in the flushing through dual plumbing and for green belt development/gardening. **Arrangement for zero discharge to any nala/drain/ river shall be strictly made.**
2. The construction of STP shall be simultaneously with the other infrastructure.
3. The Project Proponent shall submit the network details with layout plan for utilization of treated domestic wastewater within the premises to achieve zero discharge condition.
4. The Operation and maintenance of STP will be carried out by project management cell.
5. The project management shall make arrangement of water meters for measurement of waste water discharge.
6. The PP shall establish a separate environmental cell, headed by senior officer of the Project Operation and maintenance of STP and reporting the compliance to the Board.
7. The PP shall ensure the rain water harvesting with recharging pit..
8. The Project Proponent shall submit environmental statement in Form-V (Rule 14, Environment (Protection) Rules 1986) for every financial year ending 31st March on or before 30th September every year to the Board.
9. The PP shall strictly comply the condition of Environmental clearance (EC) from SEIAA Bhopal dated 15-4-2022.

M.P. Pollution Control Board
E-5, Arera Colony
Paryavaran Parisar, Bhopal - 16 MP
Tele : 0755-2466191, Fax-0755-2463742

CONDITIONS PERTAINING TO AIR (PREVENTION & CONTROL OF POLLUTION) ACT 1981 :-

1. The applicant shall provide comprehensive air pollution control system consisting of control equipments as per the proposal submitted to the Board with reference to generation of emission and same shall be operated & maintained continuously so as to achieve the level of pollutants to the following standards:-

Name of section	Capacity	Stack height(mtrs)	Fuel	Control equipment to be installed	P.M, SO_x, NO_x(mg/NM^3)
D.G. Sets	1 x 1000 KVA	18	HSD 72 L/Hr.	Acoustic enclosure, Muffler,	As per MoEF&CC/CPCB Norms
D.G. Sets	4 x 1250 KVA	18	HSD 90 L/Hr.		
Fugitive Emission during construction and Material Handling	--	--	--	Water Sprinkling, 25 feet curtain around construction area	As per AAQS

2. Ambient air quality at the boundary of the Project Proponent/unit premises shall be monitored and reported to the Board regularly on quarterly basis: The Ambient air quality norms are prescribed in MoEF gazette notification no. GSR/826(E), dated: 16/11/09. Some of the parameters are as follows:
   a. Particulate Matter (less than 10 micron) - 100 µg/m^3 (PM10 µg/m^3 24 hrs. basis)
   b. Particulate Matter (less than 2.5 micron) - 60 µg/m^3 (PM2.5 µg/m^3 24 hrs. basis)
   c. Sulphur Dioxide [SO_2] (24 hrs. Basis) - 80 µg/m^3
   d. Nitrogen Oxides [NOx] (24 hrs. Basis) - 80 µg/m^3
   e. Carbon Monoxide [CO] (8 hrs. Basis) - 2000 µg/m^3

3. The Project Proponent shall take adequate measures for control of noise level generated from industrial activities within the premises less than 75 dB(A) during day time and 70 dB(A) during night time.

4. Project Proponent/Unit shall provide with each stack port hole with safe platform of 1 meter width with support & spiral ladder/ Stepped ladder with hand rail up to monitoring platform as per specifications given in part-III emission regulation of CPCB.

5. The Project Proponent/unit shall make the necessary arrangements for control of the fugitive emission from any source of emission/section/activities.

7. The Project Proponent/ unit shall ensure all necessary arrangements for control of odour nuisance from the activities or process within premises

8. All the internal roads shall be made pucca to control the fugitive emissions of particulate matter generated due to transportation and internal movements.

9. **Plantation** -Project Proponent shall take effective steps for extensive tree plantation of the local tree species as per proposal and as per EC conditions. Plantation of 6025 no in project area and total 37200 trees in project area and on surroundings for densification of trees on the island for environmental and ecological balance.

Additional Air condition:-

1. The Project Proponent shall provide acoustic enclosure with DG-sets and attached to stack of proper height as per the CPCB norms.
2. The Project management shall apply for authorisation under HOWM Rules, 2016 for disposal of waste/used oil generated from DG set under waste category 5.1 used oil & 5.2 wastes containing oil, along with the application of CTO-fresh.
3. The Project proponent shall provide 25 feet high curtains enclosing the area of constructional activities to control fugitive emission.
4. The Project proponent shall store all the raw materials in own premises and its handling shall be in such a way that it does not create any type of nuisance in the nearby vicinity.
5. Roads around and within the project shall be maintain properly to avoid fugitive dust emission during transportation by adopting dust suppression by water sprinkling or any other suitable method.

M.P. Pollution Control Board
E-5, Arera Colony
Paryavaran Parisar, Bhopal - 16 MP
Tele : 0755-2466191, Fax-0755-2463742

GENERAL CONDITIONS:

1. The non hazardous solid waste arresting in the unit premises sweeping, etc. be disposed off scientifically so as not to cause any nuisance/pollution. The applicant shall take necessary permission from civic authorities for disposal to dumping site. If required.

Non Hazardous Solid wastes:-

Type of waste	Quantity	Disposal Mode
SOLID WASTE	405 MT/ month	Solid wastes send to local body vendor.

2. The applicant shall allow the staff of Madhya Pradesh Pollution Control Board and/or their authorized representative, upon the representation of credentials:

a. To enter upon the premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this Consent.

b. To inspect at reasonable times any monitoring equipment or monitoring method required in this Consent

c. To sample at reasonable times any discharge or pollutants

3. This consent / authorisation is transferable in nature, in case of any change in ownership / management, the new owner / partner / directors / proprietor shall immediately apply for the consent with new requisite information.

4. The issuance of this Consent does not convey any property rights in either real or personal property or any exclusive privileges, nor does it authorise any invasion of personal rights.

5. Project Proponent shall install separate electric metering arrangement for running of pollution control devices & record of electricity consumption for running of pollution control equipment shall be maintained and submitted to the Board.

6. This consent is granted in respect of Water pollution control Act 1974 or Air Pollution Control act, 1981.

7. Balance consent/authorisation fee, if any shall be recoverable by the Board even at a later date.

8. The applicant shall submit such information, forms and fees as required by the board not letter than 180 day prior to the date of expiration of this consent/authorisation

9. The Project Proponent/unit shall establish a separate environmental cell, for reporting the environmental compliances.

10. Knowingly making any false statement for obtaining consent or compliance of consent conditions shall result in the imposition of criminal penalties as provided under the section 42(g) of the Water Act or section 38 (g) of the Air Act.

11. After notice and opportunity for the hearing, this consent may be modified, suspended or revoked by the Board in whole or in part during its term for cause including, but not limited to, the following :

(a) Violation of any terms and conditions of this Consent.

(b) Obtaining this Consent by misrepresentation of failure to disclose fully all relevant facts.

(c) A change in any condition that requires temporary or permanent reduction or elimination of the authorized discharge.

12. On violation of any of the above-mentioned conditions the consent granted will automatically be taken as canceled and necessary action will be initiated against the Project Proponent.

Additional condition:-

1. Development work shall be done as per the rules and regulations of Local Authorities viz Municipal Corporation, T&CP so that the development shall be done as per the norms.
2. The project proponent shall strictly implement the conditions of Environmental clearance (EC) issued from SEIAA ,Bhopal dated 15-04-2022.
3. The project Proponent in partnership with the local body ensure segregation of waste at source to facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorized waste pickers or the authorized recyclers.
4. The Bio-degradable wastes shall be processed, treated and disposed off through composting or bio-methanation within the premises as for as possible and the residue waste shall be given to the waste collectors or agency as directed by the local body.
5. The area earmarked for the parking shall be used for parking only.

This Certificate generated from xgn.mp.nic.in are valid and does not require physical signatures, the certificate can be validated online from xgn.mp.nic.in using "TPAI" Number.

M.P. Pollution Control Board
E-5, Arera Colony
Paryavaran Parisar, Bhopal - 16 MP
Tele : 0755-2466191, Fax-0755-2463742

6. The Project management shall explore maximum use the fly ash bricks.
7. The Project management shall make proper arrangement for the treatment of domestic effluent from the temporary labour tents during the construction phase.
8. The PP Shall not allowed dumping of wastes outside the plot premises, which will be generating during construction activity.
9. The wastes will be generating from construction and demolition activity shall be disposed under Construction and Demolition Wastes Management Rules, 2016.
10. The Project Proponent shall develop Rain water harvesting for recharge of ground water through technically qualified Consultant with proper approval from concerned department, and submit the progress report to the Board.
11. The arrangements shall be made for complying the provisions under Plastic Waste Management Rules, 2016; E Waste (Management) Rules, 2016; Bio-Medical Waste Management Rules, 2016; Solid Waste Management Rules, 2016; Construction and Demolition Wastes Management Rules, through providing space and guidance to the residents.
12. The Project proponent shall display the regulations provided in the Guidelines issued by CPCB in March, 2017 on "Environmental Management of Construction and Demolition Waste". The above said guidelines can be found at https://cpcb.nic.in/technical-guidelines-5/.
13. The project proponent shall provide the separate bins for collection of e-waste (phones, TV, CD, Input-output devices etc) and household hazardous wastes (dry cell batteries, cans of pesticides/insecticides, CFLs etc) and the waste shall be given to the authorised agency/ municipal corporation.
14. The burning of road sweepings shall be strictly prohibited in project area and disposal of the same shall be through composting or Municipal Corporation only.

Consent/authorization as required under the Water (Prevention & Control of Pollution) Act,1974 & the Air (Prevention & Control of Pollution) Act,1981 is granted to your Project proponent subject to fulfillment of all the conditions mentioned above. For renewal purpose you shall have to make an application to this Board through XGN at least Six months before the date of expiry of this consent/authorisation. The applicant without valid consent (for operation) of the Board shall not bring in to use any outlet for the discharge of effluent and gaseous emission.

For and on behalf of
M.P. Pollution Control Board

Digitally Signed by CDAC eSign

(Organic Authentication on AADHAR from UIDAI Server)

ACHYUT ANAND MISHRA
Member Secretary

TPAV# BLUEINKOK This PDF is eSigned and does not require physical signatures, the certificate can be validated online from xgn.mp.nic.in using "TPAV" Number.

ANNEXURE-12

Regional Laboratory
M. P. Pollution Control Board
Plot No. 1, Scheme No. 78, Part-II, Aranya, Indore – 452 010
☎ 0731 – **2554337**, Fax : 0731- 4061255 ; **E mail**: regional.labindore@yahoo.com

ANALYSIS REPORT

Report No. 113			Date 27/01/2023
Name of Industry	**M/S L & T Construction (Statue of Oneness Project), Omkareshwar, Dist. Khandwa (M.P.)**		
Date of Sampling	25/01/2023		
Date of Analysis	27/01/2023		
Sample Collected by	Atul Kotiya, Scientist & Akhilesh Mishra, Sampler		
Sample Analysed by	SK Gupta, Chemist		
Sampling Point	Ambient Air Quality	I	Near Main Store West side of Statue of Oneness Project.
		II	East side of Statue of Oneness Project.

S.No.	Parameters	Unit	Result I	Result II
01	Respirable Suspended Particulate Matter (RSPM)	µg/ M³	58.1	65.40
02	Sulphur dioxide (SO_2)	µg/ M³	6.3	6.9
03	Nitrogen dioxide (NOx)	µg/ M³	9.0	10.3

Remark :	☐ Marked parameter exceed prescribed limit.

(Atul Kotiya)
Scientist
Scientist
Regional Laboratory
M.P.P.C.B., INDORE

(S.N. Patil)
Chief Chemist
Chief Chemist & Lab. Incharge
Regional Laboratory
M.P. Pollution Control Board INDORE

ANNEXURE-13

Regional Laboratory
M. P. Pollution Control Board
Plot No. 1, Scheme No. 78, Part-II, Aranya, Indore – 452 010
0731 – 2554337, 4035618 E-mail: regional.labindore@yahoo.com

TEST REPORT

ANALYSIS REPORT FOR WATER & WASTE WATER SAMPLE

Sample From	River Narmada U/S Omkareshwar, Dist. Khandwa (M.P.)				
Contact No					
Sample Description	River water.			Test Report No.	159
Date and Time of Collection	25/01/2022	Type of Sample : Grab	Transportation:- Ice Box with Ice	Sampling Method : Water/ Waste water sample collection Guideline by Central lab M.P. P.C.B., Bhopal	
Date of Receipt	26/01/2023				
Period of Analysis	26-31/01/2023	Sample collected & Analysed by	A.Kotiya Scientist & Akhilesh Mishra, Sampler & SK Gupta, Chemist	Sample volume: 02 Litre	
Date of Report	31/01/2023				

S. No.	Parameters	Unit	Result	Method
01	pH	pH Unit	7.89	APHA,4500H+B
02	Turbidity	N.T.U.	1.0	APHA,2130-B
03	Specific Conductivity	µmho/cm	276	APHA 2510 B
04	Total Solids	mg / L	177	APHA 2540 B
05	Total Dissolved Solids	mg / L	170	APHA 2540 C
06	Suspended Solids	mg / L	07	APHA2540 D
07	Fixed Dissolved Solids	mg / L	118	APHA 2540 E
08	Chloride	mg / L	23.75	APHA,4500-CL-B
09	Dissolved Oxygen	mg / L	7.8	APHA 4500-O-C
10	B.O.D. (3 days, 27 ^{0}C)	mg / L	0.9	IS 3025,part 44 1993
11	C.O.D.	mg / L	07	APHA,5220 B
12	Oil & Grease	mg / L	---	APHA 5520-D
13	Ammo. Nitrogen (as NH3)	mg / L	0.009	APHA 4500-NH3-F
14	Nitrite Nitrogen (as N)	mg / L	ND	APHA 4500-NO2-B
15	Nitrate Nitrogen (as N)	mg / L	0.764	APHA 4500-NO3-B
16	Total Kjehdal Nitrogen	mg / L	2.24	APHA 4500-Norg-C
17	Phosphate (as P)	mg / L	0.016	APHA 4500-P-D
18	Total Alkalinity	mg / L	128	APHA 2320-B
19	T- Hardness (as $CaCO_3$)	mg / L	120	APHA 2340-C
20	Ca- Hardness (as $CaCO_3$)	mg / L	96	APHA 3500-Ca-B
21	Mg- Hardness (as $CaCO_3$)	mg / L	24	APHA 3500-Mg-B
22	Sulphate (as SO_4)	mg / L	3.24	APHA 4500-So4-E
23	Fluoride (as F)	mg / L	0.69	APHA 4500-F-D
24	Sodium (as Na)	mg / L	10.8	APHA 3500-Na-B
25	Potassium (as K)	mg / L	1.5	APHA,3500-K,B
26	Boron (as B)	mg / L	ND	APHA 4500-B-C
27	Residual Chlorine	mg / L	---	APHA 4500-cl B

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No statutory liability accepted for sample not collected by MPPCB.
The result relate only to the sample tested.
Sample will be destroyed after 10 days from the date of issue of test report unless otherwise specified.

(S.N. Patil)
Chief Chemist & Lab Head
Regional Laboratory, Indore

ANNEXURE-14

Regional Laboratory
M. P. Pollution Control Board

Plot No. 1, Scheme No. 78, Part-II, Aranya, Indore – 452 010
☎0731 – **2554337**, 4035618 E-mail: regional.labindore@yahoo.com

TEST REPORT
ANALYSIS REPORT FOR WATER & WASTE WATER SAMPLE

Sample From	River Narmada D/S , Near new road bridge, Omkareshwar, Dist. Khandwa (M.P.)				
Contact No					
Sample Description	River water.			**Test Report No.**	160
Date and Time of Collection	25/01/2022	**Type of Sample :** Grab	**Transportation:-** Ice Box with Ice	**Sampling Method :** Water/ Waste water sample collection Guideline by Central lab M.P. P.C.B., Bhopal	
Date of Receipt	26/01/2023				
Period of Analysis	26-31/01/2023	**Sample collected & Analysed by**	A.Kotiya Scientist & Akhilesh Mishra, Sampler & SK Gupta, Chemist	**Sample volume:** 02 Litre	
Date of Report	31/01/2023				

S. No.	Parameters	Unit	Result	Method
01	pH	pH Unit	8.21	APHA,4500H+B
02	Turbidity	N.T.U.	1.0	APHA,2130-B
03	Specific Conductivity	µmho/cm	288	APHA 2510 B
04	Total Solids	mg / L	181	APHA 2540 B
05	Total Dissolved Solids	mg / L	174	APHA 2540 C
06	Suspended Solids	mg / L	07	APHA2540 D
07	Fixed Dissolved Solids	mg / L	122	APHA 2540 E
08	Chloride	mg / L	38	APHA,4500-CL-B
09	Dissolved Oxygen	mg / L	7.7	APHA 4500-O-C
10	B.O.D. (3 days, 27 °C)	mg / L	1.0	IS 3025,part 44 1993
11	C.O.D.	mg / L	08	APHA,5220 B
12	Oil & Grease	mg / L	---	APHA 5520-D
13	Ammo. Nitrogen (as NH3)	mg / L	0.011	APHA 4500-NH3-F
14	Nitrite Nitrogen (as N)	mg / L	0.002	APHA 4500-NO2-B
15	Nitrate Nitrogen (as N)	mg / L	0.802	APHA 4500-NO3-B
16	Total Kjehdal Nitrogen	mg / L	2.8	APHA 4500-Norg-C
17	Phosphate (as P)	mg / L	0.019	APHA 4500-P-D
18	Total Alkalinity	mg / L	152	APHA 2320-B
19	T- Hardness (as $CaCO_3$)	mg / L	128	APHA 2340-C
20	Ca- Hardness (as $CaCO_3$)	mg / L	100	APHA 3500-Ca-B
21	Mg- Hardness (as $CaCO_3$)	mg / L	28	APHA 3500-Mg-B
22	Sulphate (as SO_4)	mg / L	3.76	APHA 4500-So4-E
23	Fluoride (as F)	mg / L	0.72	APHA 4500-F-D
24	Sodium (as Na)	mg / L	11	APHA 3500-Na-B
25	Potassium (as K)	mg / L	7.0	APHA,3500-K,B
26	Boron (as B)	mg / L	0.002	APHA 4500-B-C
27	Residual Chlorine	mg / L	---	APHA 4500-cl B

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No statutory liability accepted for sample not collected by MPPCB.
The result relate only to the sample tested.
Sample will be destroyed after 10 days from the date of issue of test report unless otherwise specified.

(S.N. Patil)
Chief Chemist & Lab Head
Regional Laboratory, Indore

ANNEXURE-15

NGT के संबंध में

स.क्र.	एनजीटी के बिंदु	एनजीटी बिंदु के सापेक्ष जवाब	Annexure
1.	मध्यप्रदेश शासन द्वारा ओंकारेश्वर पर्वत पर हजारों पेड़ काटे जा चुके है और कटने वाले हैं।	ओंकारेश्वर में मांधाता पर्वत पर लोक निर्माण विभाग सेतु निर्माण परिक्षेत्र अंतर्गत सड़क निर्माण हेतु कुल 1051 पेड़ अनुविभागीय अधिकारी एवं दण्डाधिकारी, अनुभाग पुनासा जिला खण्डवा के पत्र कं/प्रवा/2021/2486 पुनासा दिनांक 10/12/2021 (740 पेड़) व पत्र कं/प्रवा/2021/2343 पुनासा दिनांक 10/11/2021 (311 पेड) द्वारा अनुमति प्राप्त कर वन विभाग के माध्यम से काटे गये है। व मौनी बाबा आश्रम से अस्थाई रपटा कुल लंबाई 520 मीटर में से चैनेज 0 से 290 मीटर (290 मी.) व वैली ब्रिज चैनेज 850 मी. से श्री आदि गुरू शंकराचार्य जी की प्रतिमा स्थापना स्थल चैनेज 2120 मी. (1270 मी.) तक रोड निर्माण किया जा चुका है। रोड निर्माण में मांधाता पर्वत पर 14 मीटर चौडाई में व अधिकतम उचाई 8.50 मीटर में खुदाई की गई है। एवं खुदाई कार्य में प्राप्त मुरूम की मात्रा 2100 घनमीटर, आर्डिनरी रॉक 31920 घनमीटर एवं हार्ड रॉक 27521.92 घनमीटर की खुदाई की गई है। जिसमें से उपयोगी रॉक एवं मुरूम 46130.14 घनमीटर मात्रा निर्माण कार्य में उपयोग की गई एवं 15411.92 घनमीटर सर्विसेबल हार्ड रॉक अनुबंधक को issue की गई । इस कार्यालय के पत्र कं 532/अ.अ. सेतु/ओंकारेश्वर/2022 खण्डवा दिनांक 29/06/2022 द्वारा श्री शंकर एकता न्यास पीठ भोपाल को पत्राचार द्वारा ओंकार पर्वत पर श्री आदि गुरू शंकराचार्य जी की प्रतिमा स्थापना स्थल तक निर्माण किए गए मार्ग के दोनो ओर भी वृक्षा रोपण करने हेतु निवेदन किया गया है वृक्षारोपण कार्य संस्कृति विभाग द्वारा किया जावेगा।	

Dmony
30/1/23
Sub - Engineer
PWD BRIDGE
KHANDWA

2.	वहीं इन्ही भारी भरकम मशीनों को ओंमकार पर्वत पर ले जाने के लिए नर्मदा नदी के बीचों बीच भारी मलबा डालकर कांक्रीट भरकर उसका प्रवाह रोक दिया गया है।	वर्तमान में नर्मदा नदी पर उंचा पुल निर्माणाधीन है, जिसका निर्माण मार्च-2024 तक पूर्ण होने की संभावना है। मांधाता पर्वत पर आचार्य शंकर की मूर्ति एवं संग्रहालय के निर्माण हेतु नर्मदा नदी में 68 रो 1200 एम.एम. पाईप कलवर्ट (अस्थाई रपटा) एवं बैली ब्रिज (25 मी. × 2.50 मी.) का निर्माण पानी के अनवरत प्रवाह के लिए किया गया है। नर्मदा नदी का जल का प्रवाह रोका नही गया है। नदी का जल सामान्यत: रपटे के पाईपो एवं बैली ब्रिज की ओपनिंग से होकर प्रवाहित होता रहता है जो कि 5 टरबाईन चलाये जाने तक रपटे के उपर से पानी नही गुजरता है। एवं 5 से अधिक टरबाइन चलाने पर रपटे के उपर से पानी प्रवाहित होता है। खुदाई कार्य में पोकलेन मशीन का उपयोग किया गया है एवं पहाड पर कटाई करने हेतु ब्लास्टिंग का उपयोग नही किया गया है।	

Pmaly
30/1/23
Sub-Engineer
PWD-BRIDGE
Khandwa

ANNEXURE-16

Project: - *STATUE OF ONENESS, EPC-1 PACKAGE, OMKARESHWAR, MADHYA PRADESH*

"FOUNDATION RECOMMENDATION REPORT"

(Inclusive of Geotechnical investigation report)

L&T Construction *Buildings & Factories*	**Project**	Statue of Oneness, EPC-1					
	Title	Foundation recommendation report (Inclusive of Geotechnical investigation report)					
	Drawing No	O22027-S-PS-1A-DB-0001				**Rev**	0
	ISSUED for	DD stage 1	-	Approved	VSP		29-08-21
		DD stage 2	-	Checked	VSP		29-08-21
		GFC	✔	Prepared	YVKK		29-08-21

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2. STATUE DETAILS 5

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ANNEXURE-I 17

SUPPORTING CALCULATIONS FOR RECOMMENDED NET SAFE BEARING CAPACITIES FOR STATUE FOUNDATION 17

ANNEXURE -II 25

BOREHOLE LOCATION LAYOUT & SOIL INVESTIGATION REPORT 25

1. INTRODUCTION

The Monumental building of "Statue of Oneness, Acharya Shankar Museum and Acharya Shankar International Institute of AdvaitaVedant" is proposed by the Madhya Pradesh State Tourism Development Corporation at Omkareshwar, Madhya Pradesh.

Omkareshwar is located between coordinates 22.2461°N latitude and 76.1503°E longitude. Omkareshwar resembles the shape of Om, one of the most sacred Hindu symbol and is home to the Jyothirlinga Shrine, dedicated to Lord Shiva and place of workship.

The Project Consists of Site A1, Site A2, Site B1, Site B2 and Site C which are having essential buildings with basic amenities, activity centres, and other necessary infrastructural and associated works of international standards.

The Project lies on Mandata Island on the banks of Narmada River in which the Site A1 and Site A2 have been proposed on the one side of River and Rest of the sites have been planned on the other bank of the river. The project location and Mandata island shown below.

Fig 1: Project location and Mandata island

The overall master plan of the sites A1, A2, B1, B2 & C shown is shown below

Fig 2: Over all master plan with different sites

Present scope work covers the site A1 which is construction of Statue and Museum (i.e. EPC 1), Master plan of the same site shown below.

Fig 3: Master plan with current scope (i.e. EPC 1)

The scope of work of this document consists of construction of the Statue of Oneness (i.e Acharya Shankaracharya) which is located in the site A1. Highest point of Statue of Oneness has been proposed at a height of 58.74m from Ground floor level. For the statue, the framings shall be covered with bronze Cladding. At the bottom all-round of statue lotus form has been planned to be made of stone. Its weight and supporting system shall be considered on the statue frame design. Similarly stone cladding and other loads also considered in statue frame design.

This document provides foundation recommendations and settlement analysis of statue of oneness foundation. This report is prepared based on the soil investigation performed by M/s. Indian Geotechnical services Pvt. Ltd.

2. STATUE DETAILS

The Statue is standing on a lotus base which in turn transferring the loads to the foundation through a R.C.C pedestal. The core of the lotus base is thought of a thick concrete mass which will transfer the forces from the Statue to a large pedestal. The legs of the Statue are supported directly on the large pedestal. This large pedestal is transferring the load to the founding strata. Typical details of Statue and its Key components shown below.

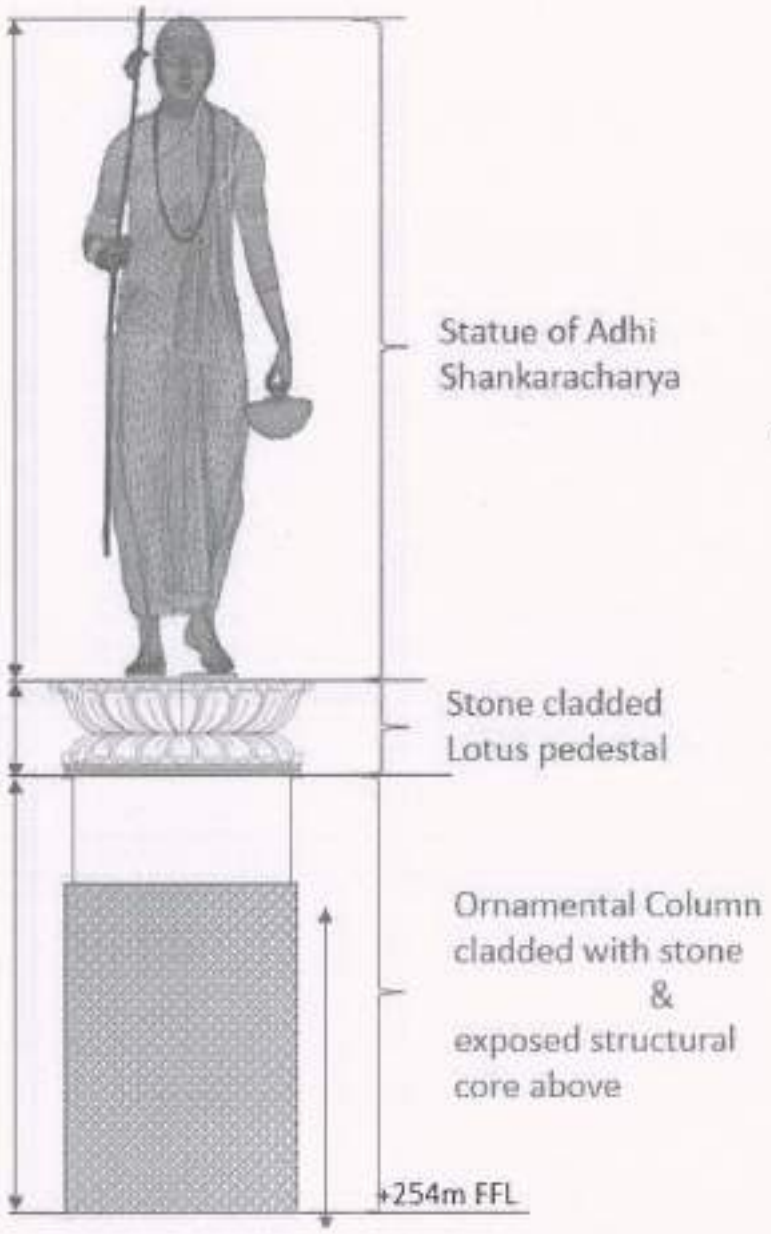


Fig 4: Typical details of Statue and its Key components

The Existing ground level of the proposed statue area is (+) RL 254.0m, however already 4 m weathered rock excavated at statue pedestal location, hence current existing ground level at statue base is (+) RL 250.0 , formed ground level of statue is (+)RL 254.0m and foundation bottom level of statue is (+)RL 249.0m.Typical floor plans and location of statue shown below figures.

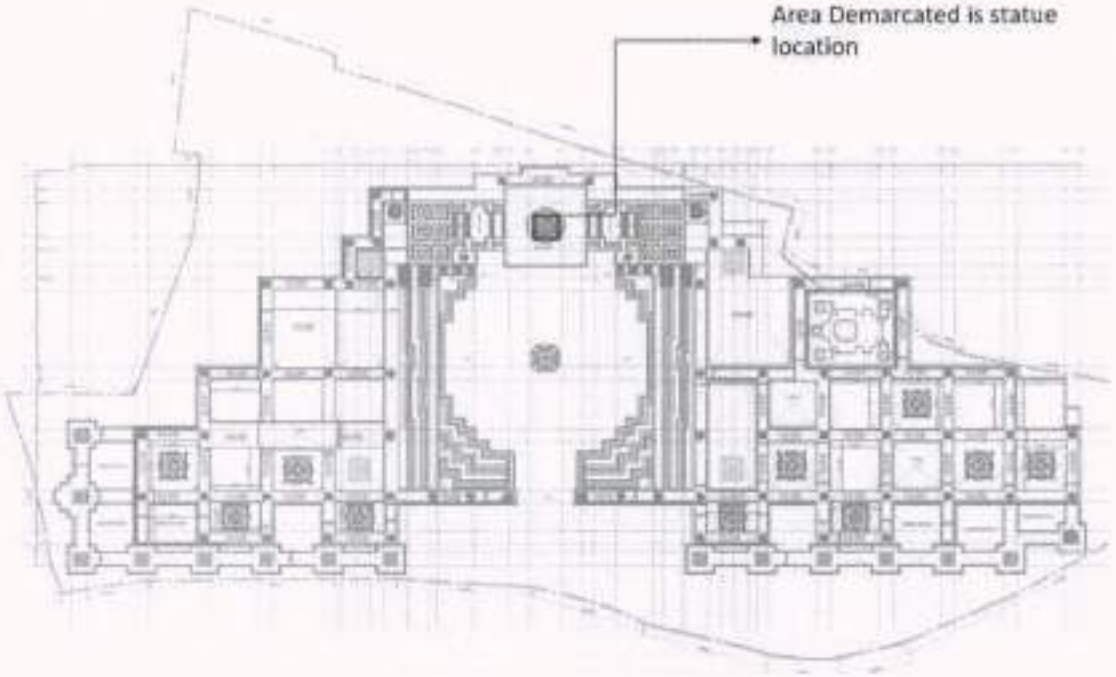


Fig 5: Typical location details of Statue in the master plan

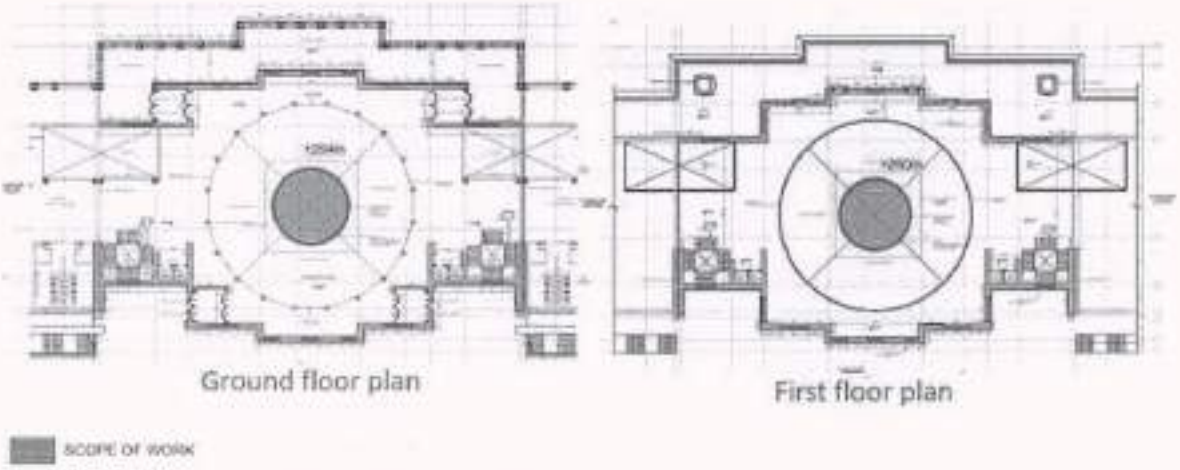


Fig 6: Typical Ground floor and first floor plan of statue

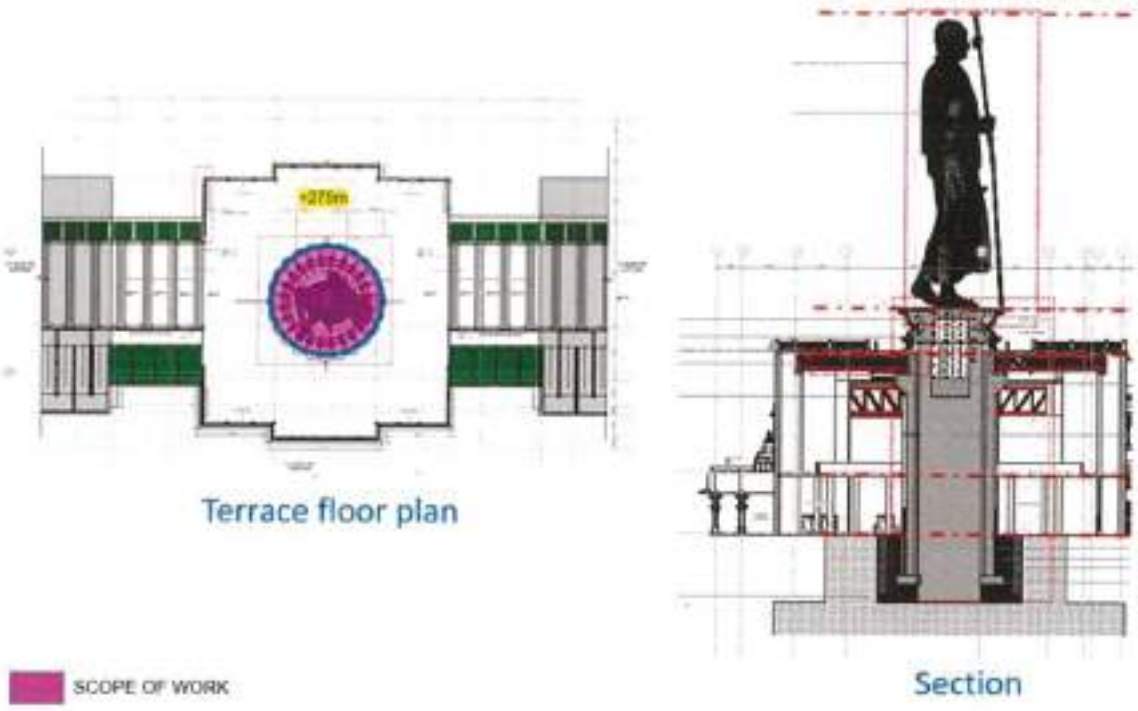


Fig 7: Typical Terrace floor plan and sectional details of statue

Fig 8: Typical aerial view of statue (i.e. present scope of work)

3. SOIL PROFILE

Soil investigations were carried out at site during the period of July -august 2022 (Project Report No. IGS/2022-23/L&T/SOO).

A total of two boreholes were drilled at the statue base location (SBH-1 to SBH-2) of which were conducted up to 50 m depth below existing ground level. Boreholes are key part of a geotechnical investigation as they enable conducting Standard Penetration Test (SPT), collecting rock core recovery (CR) and Rock quality designation (RQD).

Exploratory Drilling in overburden / rock done to obtain rock cores of Nx size by diamond core drilling method using triple tube core barrels, determination of material characteristics (Structure / Color / Texture / Grain size / Rock name), mass characteristics (State of weathering / existing natural discontinuities / faults and folding patterns / fracture state). Logging of Bore Holes for geological and geotechnical assessment of subsurface condition. Summary of boreholes shown below.

Table 1: Summary of boreholes

S.no	Borehole ID	Co-ordinates		Existing ground level(m)	Depth of borehole below EGL(m)
		Easting (m)	Northing (m)		
1	SBH-1	618550.22	2460973.75	250.05	50
2	SBH-2	618549.87	2460966.76	250.05	50

Two In-situ permeability tests in Bed Rock by Double Packer Method conducted in the borehole SBH 1 & SBH 2 to estimate the permeability of rock mass. summary of in situ permeability tests shown below

Table 2: Summary of In- situ permeability tests

S.no	Borehole ID	Location	Depth of test		Average test level(m)
			From (m)	To (m)	
1	SBH-1	Main statue	6.5	8.0	250.05
2	SBH-2		6.5	8.0	250.05

One High-Pressure Dilatometer test (HPD) (up to 200 bar (20000 KPa) pressure) conducted in SBH-1 borehole at every 4 m interval up to 36 m below EGL, to estimate the in-situ deformation modulus and lateral stress of rock mass.

Table 4: Summary of Deformability Tests by means of High-Pressure Dilatometer

S.no	Test Identification no	location	Depth of test (m)	Average test level (m)
1	DT-1	Statue	4.0	246.05
2	DT-2		8.0	242.05
3	DT-3		12.0	238.05
4	DT-4		16.0	234.05
5	DT-5		20.0	230.05
6	DT-6		24.0	226.05
7	DT-7		28.0	222.05
8	DT-8		32.0	218.05
9	DT-9		36.0	214.05

The project area has been explored by two number of drill hole aggregating the depth 100m covering between the ground surfaces to 50m depth (El. 250.050m to El. 200.050m) to know the characteristics of rock mass for foundation design. The description of bore hole given here.

Bore Hole: SBH-01

- Bore Hole SBH-01 drilled vertically down to 50m depth from Excavation level El. 250.050m. Bed rock Porphyritic BASALT encountered from existing excavation level El. 250.050m, in the initial 7.50m depth the bed rock is highly to moderately weathered, followed by slightly weathered, jointed rock.
- Rock in general highly fractured down to 19.50m depth (El. 230.550m), RQD values are in range of 0 % to 24% followed by moderately fractured to slightly fractured down to depth of investigation. i.e 50m depth (El. 200.5050m). Average RQD values below 19.50m depth is about 50% i.e. 'Good' by Triple Tube core barrel.
- Ground water level noticed at 15.00m depth (El. 235.050m). Partial drilling water loss observed throughout drilling.
- The permeability values ranges 20 lugeon between the 6.5m to 8.00m depth indicated some open joints.

Bore Hole: SBH-02

- Bore Hole SBH-02 drilled vertically down to 50m depth from Excavation level El. 250.050m. Bed rock Porphyritic BASALT encountered from existing excavation level El. 250.050m, in the initial 7.50m depth the bed rock is highly to moderately weathered, followed by slightly weathered, jointed rock.
- Rock in general highly fractured down to 15m depth (El. 235.050m) and then 36m to 49.50m depth (El. 214.050 to El. 200.550m), RQD values are in range of 0 % to 24.6%. Between 15m and 36m and below 49.50m depth rock in general is moderately fractured to slightly fractured. Average RQD values between 15m and 36m is 45%i.e. 'Good' by Triple Tube core barrel.
- Ground water level noticed at 15.00m depth (El. 235.050m). Partial drilling water loss observed throughout drilling.
- The permeability values range 20 lugeon between the 6.5m to 8.00m depth indicated some open joints. Generalized soil profile of boreholes shown below

Table 4: Generalized soil profile of SBH-1

Bore hole	Depth (m)		Strata description	Core Recovery (%)	RQD (%)
	From	To			
SBH-1	0	6	Moderately weathered, highly fractured, brown colour, fine grained, Porphyritic BASALT	9.0-16.0	0.0-7.30
	6	7.5	Highly weathered, highly fractured, greyish brown / brown colour, fine grained, Porphyritic BASALT	28.00	0.00
	7.5	25.5	Slightly weathered, highly to moderately fractured, greyish brown / brownish grey colour, fine grained, Porphyritic BASALT	78.60-100.0	0.0-67.30
	25.5	50.0	Slightly weathered, highly to slightly fractured, grey / brownish grey colour, fine grained, Porphyritic BASALT	94.00-100	00.0-92.0

Table 5: Generalized soil profile of SBH-2

Bore hole	Depth (m)	Strata description		RQD (%)

	From	To		Core Recovery (%)	
SBH-2	0	7.50	Moderately weathered, highly fractured, brownish grey colour, fine grained, BASALT	46.60-69.30	0.0-8.0
	7.50	25.50	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, BASALT	88.00-100.00	10.56-56.00
	25.50	50.0	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, BASALT	87.30-100.0	0.0 -74.00

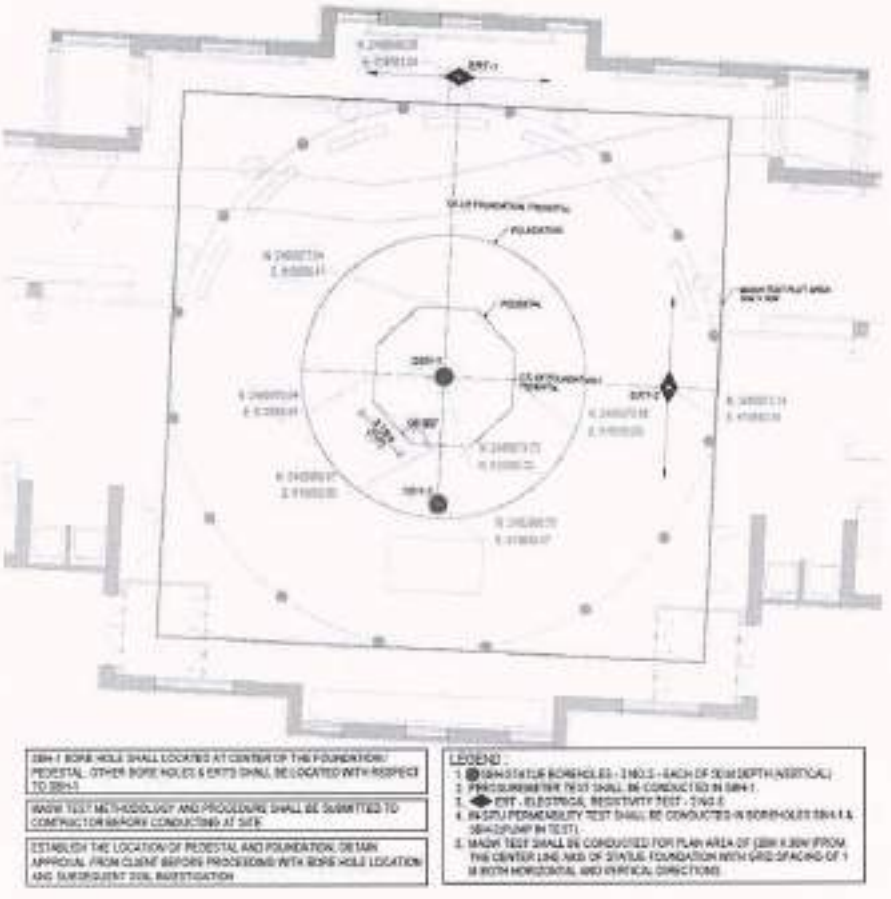


Fig 9: Layout of Geotechnical investigation

Fig 10: Layout of Boreholes

As per the geotechnical report, the present water table is encountered at a depth of 15.0 m below existing ground level during investigation (approximate at RL 235 m). The presence of river close to the site and monsoon rainfall in middle India could cause fluctuations to the groundwater level. For safe bearing capacity calculations, water table considered at founding level RL 249.00 m.

The stratigraphy of the site mainly consists of highly to moderately weathered rock top 7.5 m followed by Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained basalt up to exploration depth i.e 50 m

The Soil Profile for the above-mentioned boreholes along with geotechnical report is Attached in **Annexure-II.**

Additionally High-Pressure Dilatometer test conducted in SBH-1 borehole to estimate the in-situ Elastic modulus values of weathered rock, same can be used for estimating safe bearing settlement of foundations. Elastic modulus values (Es) estimated from pressure meter test shown below table 6.

Table 6: Modulus of Elasticity values from Pressure meter test

S.no	Test Identification no	Location	Depth of test (m)	Average test level RL (m)	Modulus of Elasticity Es (Mpa)
1	DT-1	Statue-SBH -1	4.0	246.05	1261.970
2	DT-2		8.0	242.05	2671.830
3	DT-3		12.0	238.05	1245.730
4	DT-4		16.0	234.05	1543.140
5	DT-5		20.0	230.05	1901.400
6	DT-6		24.0	226.05	1920.940
7	DT-7		28.0	222.05	3787.000
8	DT-8		32.0	218.05	2782.380
9	DT-9		36.0	214.05	3243.370

Note: Detailed Data and curves related to pressure test attached as annexure-II of this document.

4. WATER TABLE

Ground water table was monitored in the boreholes. Ground water was observed at depth of 15 m below ground level i.e RL 235.00. Hence, while estimating safe bearing capacity calculations water table considered at RL 235.00 m.

5. FOUNDATION RECOMMENDATIONS FOR STATUE

Upon review of soil investigation report, based on contour map and borehole details, loads from the statue, Raft foundation suggested as a foundation system for the statue. foundation details and depths shown below.

Table 7: Foundation details of Statue

S.no	Structure	Existing ground level (m)	Present Excavated ground level (m)	Foundation bottom	Foundation type	Foundation size (m)
1	Statue of Oneness (SOO)	RL 254.00	RL 250.00	RL 249.00	Raft -circular	15.575

Safe bearing capacities calculated by using IS 13365 (PART-1: 2003) and IS 12070 codes codes and allowable settlement of 12 mm considered for weathered basalt rock. Soil profile at founding depth varying from highly to moderately weathered basalt rock. Foundation recommendations provided below table 8 for statue foundation and supporting calculations for safe bearing capacities presented in annexure -I of this document.

Table 8: Foundation recommendation for Statue

S.no	Structure	Borehole ID	Existing ground level (m)	Bottom level of Raft foundation(m)	Safe bearing capacity (T/m2)	Settlement (mm)
1	Statue of Oneness (SOO)	SBH-1 & 2	RL 254.0	RL 249.0	85	3

6. REFERENCES

The references used for preparation of this report are listed below

- Geotechnical Investigation report submitted by M/s.Indian Geotechnical services Pvt.Ltd
- IS 13365(part 1): 1998 (Reaffirmed 2003) - Code of practice for determination of rock mass rating.
- IS 12070: 1987 (Reaffirmed 2005) - Code of practice for determination of sbc of shallow foundations on rocks.
- IS 6403: 1981 (Reaffirmed 2002) - Code of practice for determination of bearing capacity of shallow foundations
- IS: 1498: Classification and identification of Soils for engineering purposes
- IS: 1904 – 1986 – "Code of Practice for Design and Construction of Foundations in Soils:General Requirements" – Third Revision
- IS: 2131: Method of Standard Penetration Test for soils
- IS 1893 (2002), Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1 - General Provisions and Buildings, Bureau of Indian

Standards, New Delhi.

- IS: 8009(I) Code of practice for calculation of settlement of foundation (Part-I) Shallow foundations subjected to symmetrical static vertical loads
- IS 456: Plain and Reinforced Concrete – Code of Practice
- Krishnan, M.D. (1986), "Geology of India & Burma", CBS Publishers, New Delhi.
- IS: 1893 (Part 1):2016: Criteria for Earthquake Resistant Design of Structures – GeneralProvisions and Buildings
- Foundation Analysis and Design (Fifth edition) by Joseph. E. Bowles.

7. ENCLOSURES

The following documents are attached in support of the foundation recommendations given in Table -E &I.

I. Supporting calculations for recommended Net Safe bearing capacity for Statue structure.

II. Geotechnical Investigation Report

ANNEXURE-I

SUPPORTING CALCULATIONS FOR RECOMMENDED NET SAFE BEARING CAPACITIES FOR STATUE FOUNDATION

1a. SBC CALCULATIONS BASED ON RMR VALUE FOR SBH-1 BOREHOLE:

Boreholes applicable	=	SBH-1
Type of Foundation	=	Raft (Circular)
Footing size	=	15.575 m dia
Depth of Foundation (Df)	=	R.L 249.00 m
Founding Strata	=	Moderately weathered Basalt Rock
Ground water table	=	RL 249.0

The net safe bearing pressure has been calculated based on determining Average R.M.R from within depth below foundation level equal to width of the foundation.

Net safe bearing has been obtained based on correlation with R.M.R (Table.3 of IS:12070 -1987).

The Average R.M.R and respective Net Safe Bearing Pressure based on SBH-1 is as shown in the table below.

RMR CALCULATIONS As per IS 13365 (Part 1) - 2003 _ ANNEX B)

S.no	Properties of Rock	Values	Units	RMR
1	Average Compressive Strength of Rock	56	Mpa	7
2	Average RQD	0-14		3
3	Spacing of Discontinuities	Very close		5
4	Condition of Discontinuities	slickensided wall rock surface		10
5	Ground Water Condition	Damp		10
6	Orientation of discontinuities	Favourable		-7
Rock classification				POOR
Rock Mass Rating				28
Net safe bearing capacity based on average RMR value of 25 as per IS 12070, Table 3				90 T/m2

Net safe bearing capacity based RMR calculations is 90 T/m2.

1b. SBC CALCULATIONS BASED ON UNCONFINED COMPRESSIVE STREGTH FOR SBH-1 BOREHOLE:

Footing size	=	15.575 m dia circular footing
Depth of Foundation, (D)	=	RL: 249.00
Existing ground level	=	RL 254.00
Founding strata	=	Moderately weathered basalt Rock
Ground water table	=	Considered at foundation level RL 249.00

For calculations purpose average value of unconfined compressive strength of rock core considered as qc = 56 Mpa.

Conservatively Nj (empirical coefficient depending on the spacing of discontinuities) assumed as 0.1. (Ref 5)

Net safe bearing based on UCS $qs = qc\ Nj$

$= 56*0.1$

$= 56$ Mpa.

$= 560$ T/m2

Based on the UCS value recommended Net safe bearing capacity is 560 T/m2.

For statue foundation design minimum Net safe bearing capacity considered based on above two methods, same shown below.

S.no	Type of Method	Net safe bearing capacity (T/m2)	Net safe bearing capacity (i.e Min of two methods) T/m2	Borehole reference
1	Based on RMR	90	90	SBH-1
2	Based on UCS	560		

2a. SBC CALCULATIONS BASED ON RMR VALUE FOR SBH-2 BOREHOLE:

Boreholes applicable	=	SBH-2
Type of Foundation	=	Raft (Circular)
Footing size	=	15.575 m dia
Depth of Foundation (Df)	=	R.L 249.00 m
Founding Strata	=	Moderately weathered Basalt Rock
Ground water table	=	RL 249.0

The net safe bearing pressure has been calculated based on determining Average R.M.R from within depth below foundation level equal to width of the foundation.

Net safe bearing has been obtained based on correlation with R.M.R (Table.3 of IS:12070 -1987).

The Average R.M.R and respective Net Safe Bearing Pressure based on SBH-2 is as shown in the table below.

RMR CALCULATIONS As per IS 13365 (Part 1) - 2003 _ ANNEX B)

S.no	Properties of Rock	Values	Units	RMR
1	Average Point load Compressive Strength of Rock	5.35	Mpa	**12**
2	Average RQD	0-14		**3**
3	Spacing of Discontinuities	Very close		**5**
4	Condition of Discontinuities	slickensided wall rock surface		**10**
5	Ground Water Condition	Damp		**10**
6	Orientation of discontinuities	Favourable		**-7**
Rock classification				**POOR**
Rock Mass Rating				**33**
Net safe bearing capacity based on average RMR value of 33 as per IS 12070, Table 3				**112.9 T/m2**

Net safe bearing capacity based RMR calculations is 112T/m2.

2b. SBC CALCULATIONS BASED ON UNCONFINED COMPRESSIVE STREGTH FOR SBH-2 BOREHOLE:

Footing size	=	15.575 m dia circular footing
Depth of Foundation, (D)	=	RL: 249.00
Existing ground level	=	RL 254.00
Founding strata	=	Moderately weathered basalt Rock
Ground water table	=	Considered at foundation level RL 249.00

For SBH-2 borehole unable conduct UCS test on rock samples as size of rock cores less 76 mm and rock is highly weathered condition hence point load strength index test conducted on rock core samples.

Unconfined compressive strength of rock core correlated from point load strength index test as per IS 8764-2008 code to estimate safe bearing capacity of rock.

The uniaxial compressive strength of rock may be predicted from the following correlation:

$$q_c = 22\, I_s(50)$$

where

q_c = **uniaxial compressive strength in MN/m^2 (kgf/cm^2), and**

$I_s(50)$ = **corrected point load strength.**

Unconfined compressive strength of rock core as qc = 22 x I_{50} Mpa.

Average Point load Compressive Strength of Rock as lab test data I_{50} = 5.35 Mpa (as per SBH-2)

qc = 22 x I_{50} Mpa = 22*5.35 = 117.7 Mpa

Conservatively Nj (empirical coefficient depending on the spacing of discontinuities) assumed as 0.1. (Ref 5)

Net safe bearing based on UCS qs = qc Nj

= 117.7 *0.1

= 11.77 Mpa.

= 1177 T/m2

Based on the UCS value recommended Net safe bearing capacity is 1177 T/m2.

For statue foundation design minimum Net safe bearing capacity considered based on above two methods, same shown below.

S.no	Type of Method	Net safe bearing capacity (T/m2)	Net safe bearing capacity (i.e. Min of two methods) T/m2	Reference borehole
1	Based on RMR	112	112	SBH-2
2	Based on UCS	1177		

3. SBC CALCULATIONS BASED ON PRESSURE METER TEST RESULTS

The pressure meter allows for a direct determination of the strength of a rock mass including the effect of discontinuities and weathering for the design of foundations on poor rock. Using an approximate factor of safety of 3 the following equation shall be used

$$q_{na} = \frac{1}{3} [{}_vD_f + K_d (P_L - {}_vD_f)]$$

where

q_{na} = net safe bearing pressure (t/m²),
P_L = limit pressure determined by the pressure meter (t/m²),
$_v$ = unit weight of soil or rock (t/m³),
D_f = depth of foundation (m),
$_vD_f$ = overburden pressure (t/m²), and
K_d = constant given in Table 5.

TABLE 5 VALUE OF K_d

Depth of Footing	K_d
Load at rock surface (zero depth)	0·8
Radius* of foundation unit	2·0
4 × radius of foundation unit	3·6
10 × radius of foundation unit	5·0

*Equivalent radial dimensions.

Limiting pressure from pressure meter at founding level and below P_L = 200 kg/cm2
= 2000 T/m2

Depth of foundation below EGL = 5 m (RL 254.0-RL 249.0)

Unit weight of rock = 2.60 T/m2

Kd = 1.57 (interpolation done between zero depth to Radius of foundation depth)

Interpolation to estimate Kd value for 5 m depth of foundation as follows

Depth of foundation	Kd
0 m	0.8
7.7875 m (radius of foundation = 15.575/2)	2.0
5 m	1.57

q ns = 1/3 (2.6*5 +1.57*(2000-2.65*5))

= 1044 T/m2

Net safe bearing capacity based on pressure meter test results = 1044 T/m2

Conclusion:

Net safe bearing capacity based on various methods summarized below

S.no	Type of Method	Net safe bearing capacity (T/m2)	Net safe bearing capacity (i.e. Min of two methods) T/m2	Reference borehole
1	Based on RMR	90	90	
	Based on UCS	560		SBH-1
2	Based on RMR	112	112	
	Based on UCS	1177		SBH-2
3	Based on pressure meter test	1044	1044	SBH-1

Net safe bearing capacity (i.e. Based on RMR) considered as average based on the boreholes SBH-1 and SBH-2 = (90+112)/2 = 202 /2 = 101 T/m2.

Recommended Net safe bearing capacity for design of Statue foundation = 85 T/m2

Settlements estimated up to 2B width of foundation below founding level considering Net safe bearing capacity of 85 T/m2.

A.2 Settlement calculation

i. Immediate Settlement

$$\Delta H_1 = q_0 B' (\frac{1-\mu^2}{E}) m I_s I_f r \text{ (As per J E Bowels)}$$

Where, ΔH_1 = Immediate settlement

B = Dia. of circular footing = 15.575 m = Equivalent width = 13.79 m

B' = B/2 =13.79/2= 6.89 (for center)

E = Young's modulus of Rock in kN/m^2 (as per pressure meter test results)

I_1 and I_2 = Influence factors

$$I_s = I_1 + (\frac{1-2\mu}{1-\mu}) I_2$$

m = Number of corners contributing to settlement (4 for center)

I_f = Depth factor =0.8

m = Number of corners contributing to settlement (4 for center)

q_0 = Intensity of contact pressure in kN/m^2 at the top of considered soil layer (assuming 1H: 2V distribution)

z_{f1} = Depth to the top of soil layer considered

μ = Poisson's ratio = 0.2

r = Rigidity factor = 0.8

Settlement calculation:

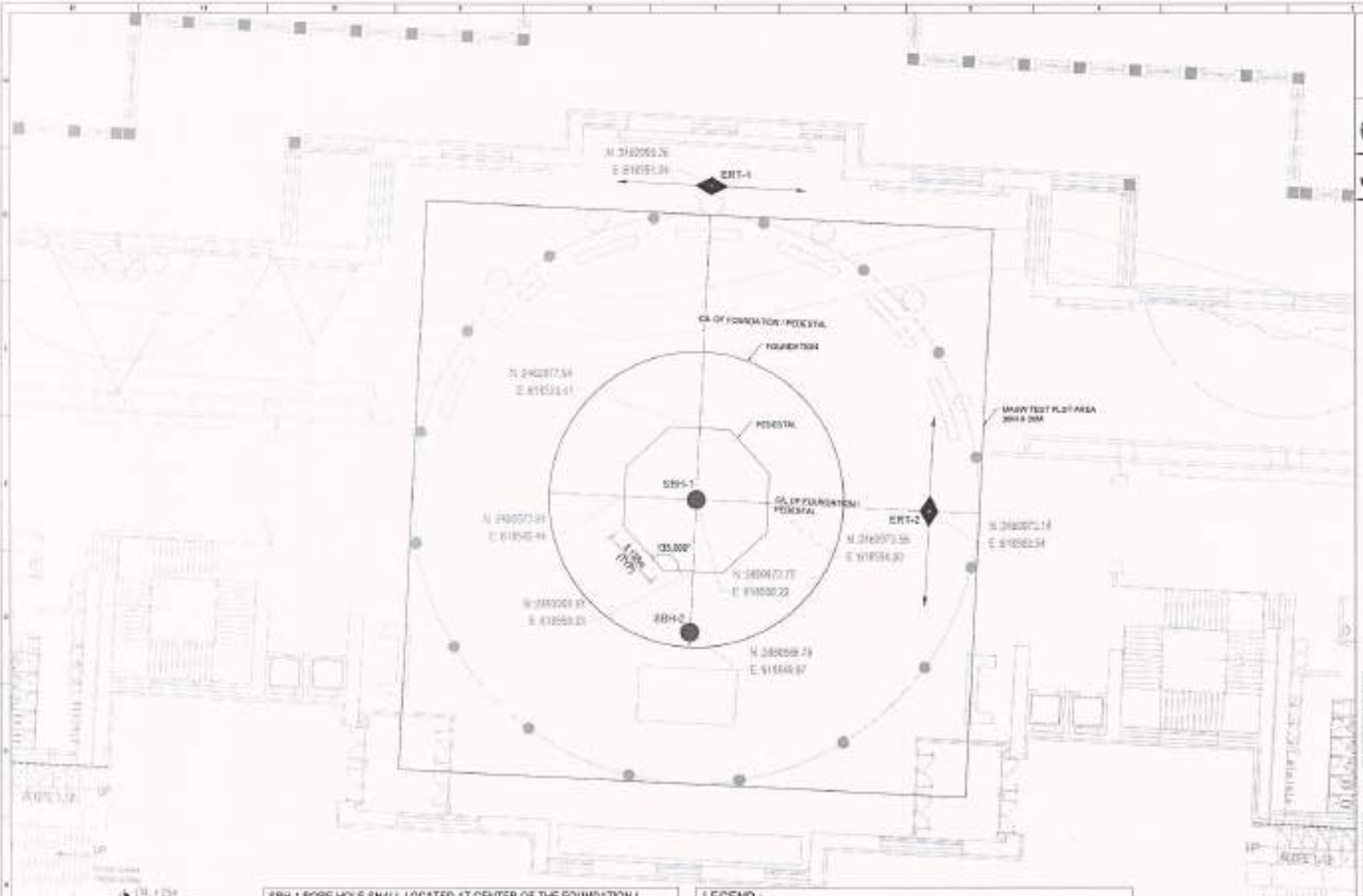
Depth to soil layer (m)		Thickness of soil layer, H (m)	q_0 (kN/m^2)	E (kN/m^2) From pressure meter test	I_1	I_2	I_s	ΔH_i (m)
Top	Bottom							
249.0	246.0	3.0	850.00	1261970	0.038	0.069	0.090	0.001
246.0	242.0	4.0	573.38	2671830	0.063	0.078	0.121	0.001
242.0	238.0	4.0	373.97	1245730	0.063	0.078	0.121	0.001
238.0	234.0	4.0	263.02	1543140	0.063	0.078	0.121	0.000
234.0	230.0	4.0	195.01	1901400	0.063	0.078	0.121	0.000
230.0	226.0	4.0	150.34	1920940	0.063	0.078	0.121	0.000
226.0	222.0	4.0	119.42	3787000	0.063	0.078	0.107	0.000
222.0	218.0	4.0	97.15	2782380	0.063	0.078	0.107	0.000

Total settlement, $\Delta H = 3$ mm < 12 mm

Hence recommended Net safe bearing capacity based on shear and settlement criteria = 85 T/m2.

ANNEXURE -II

BOREHOLE LOCATION LAYOUT & SOIL INVESTIGATION REPORT



SBH-1 BORE HOLE SHALL LOCATED AT CENTER OF THE FOUNDATION / PEDESTAL. OTHER BORE HOLES & ERT'S SHALL BE LOCATED WITH RESPECT TO SBH-1

MASW TEST METHODOLOGY AND PROCEDURE SHALL BE SUBMITTED TO CONTRACTOR BEFORE CONDUCTING AT SITE

ESTABLISH THE LOCATION OF PEDESTAL AND FOUNDATION, OBTAIN APPROVAL FROM CLIENT BEFORE PROCEEDING WITH BORE HOLE LOCATION AND SUBSEQUENT SOIL INVESTIGATION

LEGEND :

1. SBH-STATUE BOREHOLES - 2 NO.S - EACH OF 50 M DEPTH (VERTICAL)
2. PRESSUREMETER TEST SHALL BE CONDUCTED IN SBH-1.
3. ERT - ELECTRICAL RESISTIVITY TEST - 2 NO.S
4. IN-SITU PERMEABILITY TEST SHALL BE CONDUCTED IN BOREHOLES SBH-1 & SBH-2(PUMP IN TEST).
5. MASW TEST SHALL BE CONDUCTED FOR PLAN AREA OF (36M X 36M)FROM THE CENTER LINE AXIS OF STATUE FOUNDATION WITH GRID SPACING OF 1 M BOTH HORIZONTAL AND VERTICAL DIRECTIONS.

ERT-1

L&T Construction

STATUE OF ONENESS

SCHEMATIC DESIGN (SD)- MM

GEOTECHNICAL

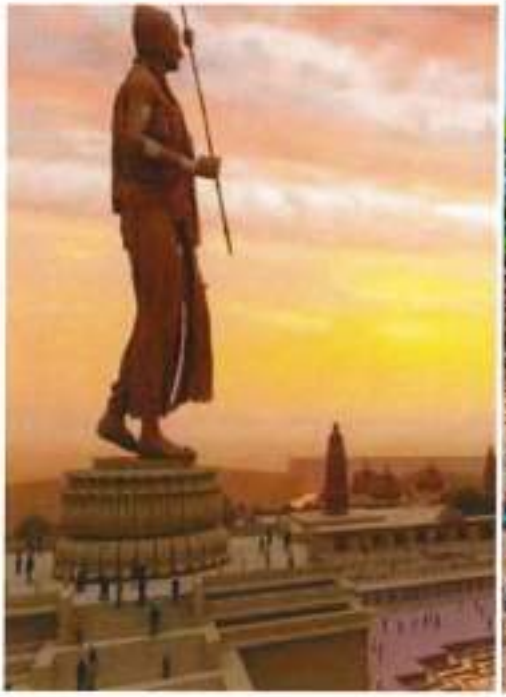
O22027	S	PS	1A	SI	0001	
SCALE	1:100			Sheet	A1	Rev. No. A

STATUE & PEDESTAL
LAYOUT OF BOREHOLES & ERT LOCATIONS

FACTUAL GEOTECHNICAL INVESTIGATION REPORT FOR

"PROPOSED STATUE OF ONENESS"

STATE OF MADHYA PRADESH



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AUGUST 2022

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1.0 INTRODUCTION

Madhya Pradesh's culture and tourism department (Owner) has decided to build a multi-metal statue of Shankaracharya on Mandhata Parvat hill facing the river Narmada. The site is a river island in the Narmada about 4 km by 2 km in size. It is also a hill that is surrounded by waters of the Narmada on all sides. Which is located in the district of Khandwa, Madhya Pradesh.

Owner have awarded the work to "**M/s L & T Construction (Buildings and Factories group)** (Contractor / Our Client)".

It was decided to conduct the **"Geotechnical Investigation (Exploratory Core Drilling, field and laboratory testing)"** at the project site for delineating the subsurface condition.

Geotechnical investigation is an essential preliminary step for civil engineering design and construction works and primarily, the objects for conducting such investigations are as follows:

- ***Suitability*** - to assess the general suitability of the site;
- ***Design*** - to enable an adequate and economic design;
- ***Construction*** - to plan the most feasible method of construction, to foresee and provide against difficulties and delays that may arise during construction due to ground, groundwater.

The ground is naturally variable and often the nature of these variations is not known in advance. In order to evaluate properly the nature of the ground and groundwater and to achieve the objectives of the site investigation, it is essential that the work be planned, suitable methods be adopted, undertaken and supervised by experienced personnel.

In order to collect data and achieve the project objectives, studies and site Investigations were conducted. Main purpose of these studies was to obtain the relevant geotechnical design data including sub-surface profile (soil/rock interface), classification, behavior and engineering properties.

M/s L&T Ltd. has appointed ***M/s Indian Geotechnical Services, New Delhi*** to conduct Geotechnical Investigation works. M/s Indian Geo-technical Services (IGS) carried out the investigations, field tests, sampling and laboratory testing as defined in Terms of Reference and as per the instructions of Contractor and Design Consultants.

Field work, in-situ tests were carried out, during July – August 2022. Laboratory tests are carried out on selected rock samples to determine the design parameters, confirming to relevant specifications and the guidelines received from time to time from Contractor and Design Consultants.

The report includes the comprehensive field and laboratory test data and interpretations of the test results.

2.0 PLANNING OF GEOTECHNICAL INVESTIGATION

Geotechnical Investigation work has been done for delineating the subsurface condition at Proposed Statue and bridge Location. The scope of the present studies, as laid down in the terms of reference of this investigation work, is as under:

(i) ***"Exploratory Drilling"*** in overburden / rock, obtain rock cores of Nx size by diamond core drilling method using triple tube core barrels, determination of material characteristics (Structure / Color / Texture / Grain size / Rock name), mass characteristics (State of weathering / existing natural discontinuities / faults and folding patterns / fracture state). Logging of Bore Holes for geological and geotechnical assessment of subsurface condition.

(ii) Conducting "***In-situ permeability tests"*** in Bed Rock by Double Packer Method to estimate the permeability of rock mass;

(iii) Conducting ***"Deformability Tests"*** by means of High Pressure Dilatometer test (HPD) up to 200 bar (20000 KPa) pressure in rock to estimate the in-situ deformation modulus and lateral stress of rock mass;

(iv) Conducting ***"Laboratory Tests"*** on selected Rock Core Samples as per standard specifications, Terms of Reference to get the engineering properties of rock;

2.1 Details of Field work / In-situ Testing / Laboratory Testing

All borehole locations, Coordinates and ground levels, Test locations and depths were provided by M/s L&T.

Figure 1 : Site / Borehole Location on Google Plan

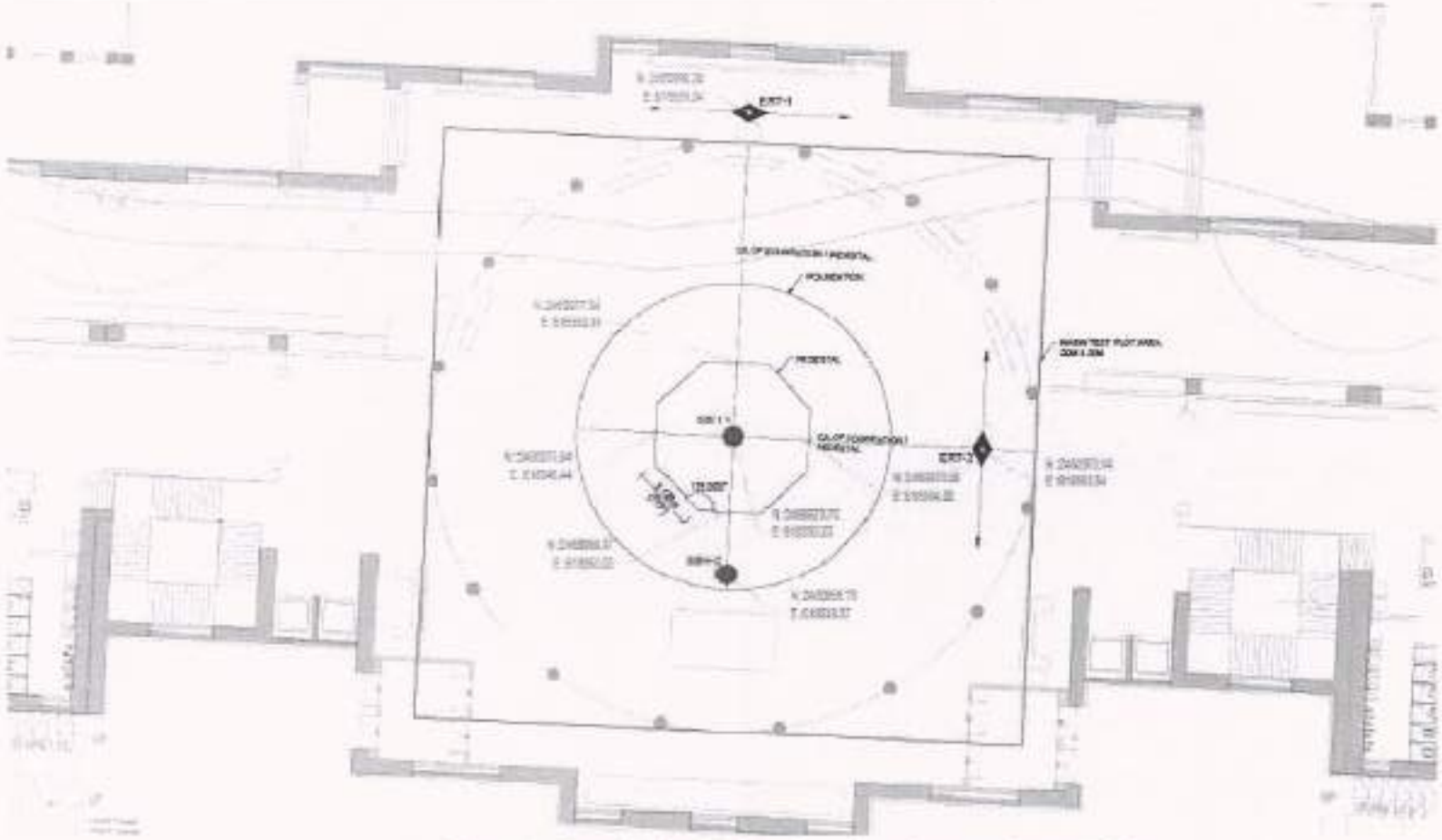


Figure 2 : Bore holes / Other Test Locations on Layout Plan

2.1.1 Exploratory Boreholes

Total 02 boreholes (Vertical) to a depth of 50m below the existing grade level (Excavation level) were planned at Main Statue Location to assess the subsurface conditions at Project Site.

Borehole locations plan is attached as Annexure – A.

Table No. 1: Summary of Boreholes

Sr. No.	Borehole Identification No.	Easting (m)	Northing (m)	Existing Ground level (m)	Depth of Borehole below EGL (m)	Inclination from vertical (Degree)
1	SBH-01	618550.220	2460973.750	250.050	50.00	0°
2	SBH-02	618549.870	2460966.760	250.050	50.00	0°

2.1.2 In-Situ permeability Tests

In-situ permeability tests in Bed Rock were conducted by Double Packer Method to estimate the permeability of rock mass. Summary is as below;

Table No. 2: Summary of In-situ permeability Tests

Borehole Identification No.	Location	Depth of Test		Average Test Level (m)
		From (m)	To (m)	
SBH-01	Main Statue	6.50	8.00	242.800
SBH-02	Main Statue	6.50	8.00	242.800

2.1.3 Deformability Tests by means of High Pressure Dilatometer

Deformability Tests by means of performing High Pressure Dilatometer test (HPD) up to 20MPa (200 kg/cm^2) pressure in rock were conducted as per IS: IS 12955- (Part-2)-1990 at different depths in Borehole SBH-01 to estimate the in-situ deformation modulus and lateral stress of rock mass.

Table No. 3: Summary of Deformability Tests by means of High Pressure Dilatometer

Test Identification No.	Borehole Identification No.	Location	Depth of Test (m)	Average Test Level (m)
DT-1	SBH-01	Statue	4.00	246.050
DT-2			8.00	242.050
DT-3			12.00	238.050
DT-4			16.00	234.050
DT-5			20.00	230.050
DT-6			24.00	226.050
DT-7			28.00	222.050
DT-8			32.00	218.050
DT-9			36.00	214.050

2.1.4 Schedule of Laboratory Testing (Rock Samples)

Following laboratory tests as per relevant Codes / Standards were conducted on selected rock core samples from boreholes. All Samples were selected by M/s L&T official at site and laboratory test schedule was approved.

Table No. 4: Summary of Laboratory Tests

Sl. No.	Test Description	Relevant Code / Standard
1	Point load strength tests on rock cores / rock lumps	IS: 8764
2	Uni-axial Compressive Strength (Wet & Dry), Elastic Modulus and Poisson's ratio	IS: 9143 - 1979, 9221
3	Specific gravity, Porosity, Water Absorption	IS: 1330 – 1991, IS:1121 (Part 1),
4	Bulk Density (Dry & Saturated)	IS: 13030 – 1991
5	Slake Durability Index	ASTM – D4644, IS: 10050
6	Petrography Examination	IS: 1125
7	Tri-Axial Tests	IS: 13047, 1991

3.0 METHODOLOGY & TYPE OF EQUIPMENT

3.1 Exploratory Core Drilling

For Core Drilling work, drilling rig was installed at the specified borehole locations. Stability of rig was ensured by making level ground. Drilling was advanced by rotary core drilling method using triple tube core barrels as per the guidelines of IS: 6926-1996. ***A triple tube core barrel and Nx (NMLC) sized bits*** are used for drilling and recovering rock cores.

The work of drilling was carried out by RD-60 core drilling rig, Rock Drill India make hydraulic feed, engine driven, mounted on skids dully provided with rotary head, using impregnated diamond bits.

The water circulation was made from Triplex water pumps of Voltas Royal Bean make Model TD-200 having suitable feeding capacity for drilling up to required depths.

The all other accessories such as drilling rods of Bw sizes with casing pipes of size HX/ NX sizes along with triple tube core barrels etc. was provided as required for the drill holes.

1. Rotary drilling machine was assembled at site and was shifted and erected at the borehole location.
2. Rotating triple tube core barrels, provided with commercial diamond bits are used for rotary drilling and simultaneously obtaining the rock cores or samples.
3. All consumables (Drilling accessories) were purchased from Genuine Dealers – like Rockdril India Limited) only.
4. After inserting casing pipe through soil overburden the drilling bit fixed to the lower end of drill rods with barrel, is rotated by a suitable chuck and always kept in firm contact with the bottom of the borehole.
5. Water is pumped continuously down the hole through drill rods, and the fluid returns to the surface in the annular space between the rods and the side of the hole, and so the protective casing may not be generally necessary. The mud returning upwards brings the cuttings to the surface.
6. After reaching the drill rods attached with the cutting bit attain its full depth another piece (extension rod) will be attached and continue the drilling.
7. The casing pipe of diameter (Hx / Nx Size) if necessary was driven up to the required depth / level as the bore hole is advanced depending upon the rock conditions.

3.2 Rock Core Samples / Borehole Logs / Rock Classification

Core Samples were extracted by the application of a continuous pressure at one end of the core with the barrel held horizontally without vibration.

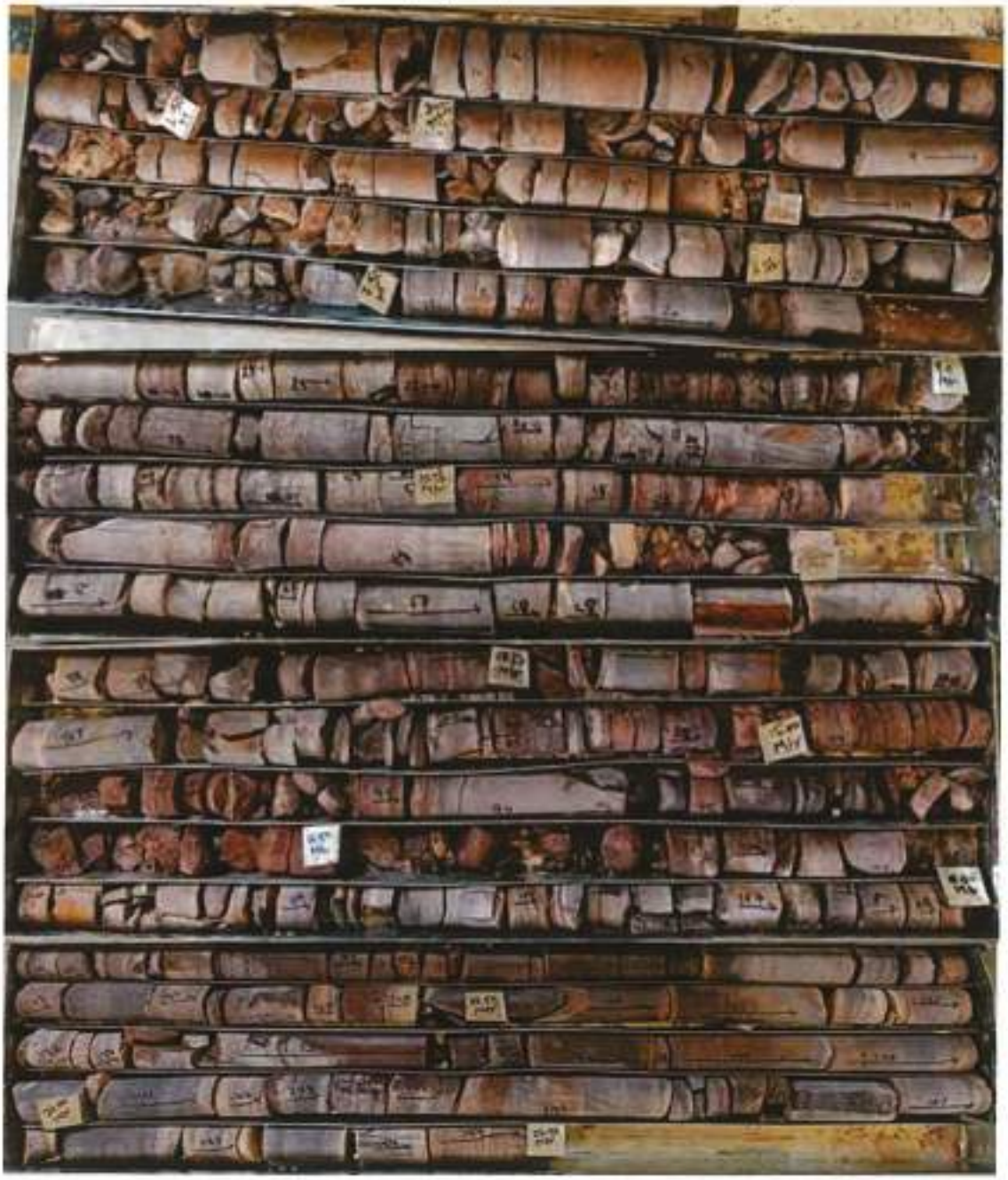
Immediately after with drawl from the core barrel, the cores were placed in a tray and transferred into boxes specially prepared for the purpose. The boxes are made of good quality wooden boards. Recovered rock cores were numbered serially as specified in IS: 4078-1980. Rock core recovery and Rock Quality Designation (RQD)

were computed for every run length drilled. The description of the core samples was recorded.

Figure 3 : Drilling in Progress at Site at SBH-01 & SBH-02

Photographs of rock core boxes were taken immediately after drilling. Also, the rock was classified in the field by an experienced geologist.

Rock Core Photographs (SBH-01: 0.00 to 50.00m)



Rock Core Photographs (SBH-02: 0.00 to 50.00m)

Figure 4 : Photographs of Core Boxes of SBH-01 & SBH-02

3.2.1 Scale of Weathering Grades of Rock Mass

Rock classification in terms of weathering and state of fractures and strength is carried out in the following manner. Tabulations given in below explain it briefly.

Table No. 5: Scale of Weathering Grades of Rock Mass

Terms	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering.	II
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones	IV
Completely Weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

As per IS 4464

It should be understood that all grades of weathering may not be seen in a given rock mass and that in some cases a particular grade may be present to a very small extent. Distribution of the various weathering grades of rock material in the rock mass may be related to the porosity of the rock material and the presence of open discontinuities of all types in the rock mass.

3.2.2 Relation between RQD and IN-SITU ROCK QUALITY

Rock quality is further measured by frequency of natural joints in rock mass. Rock Quality Designation (RQD) is used to define state of fractures or massiveness of rock. Following table defines the quality of rock mass.

Table No. 6: Relation between RQD and IN-SITU ROCK QUALITY

RQD CLASSIFICATION	RQD (%)
Excellent	90 to 100
Good	75 to < 90
Fair	50 to < 75
Poor	25 to < 50
Very Poor	00 to < 25

3.2.3 Classification of Rock with respect to Compressive Strength

Rock is also classified by strength of intact rock cores collected during drilling. Rock

Unconfined Compressive strength (UCS) is used to define strength of rock. Classification of rocks given in Table 2 of Appendix-2 of IRC: 78-2014 is reproduced below;

Table No. 7: Classification of Rock with respect to Compressive Strength

ROCK TYPE	UNCONFINED COMPRESSIVE STRENGTH (UCS) in MPa
Extremely Strong	> 200
Very Strong	100 to 200
Strong	50 to 100
Moderately strong	12.5 to 50
Moderately Weak	5 to 12.5
Weak	1.25 to 5
Very Weak	< 1.25

3.2.4 Rock Mass Rating (RMR Value)

Rock Mass Rating (RMR) of jointed rock masses, may be worked out based on IS 13365 (part I). Rock Mass Rating parameters are reproduced from annex B of IS 13365 (part I) below for ready reference.

Table No. 8: Rock Mass Rating Values

Strength of intact rock material (MPa)

	Compressive Strength (MPa)	Rating	Basis
Exceptionally Strong	>250	15	UCS value data of specific borehole from laboratory test is used in RMR
Very Strong	100-250	12	
Strong	50-100	7	
Average	25-50	4	
Weak	10-25	2	
Very Weak	2-10	1	
Extremely Weak	<2	0	

Rock quality designation (RQD)

	RQD (%)	Rating	Basis
Excellent	90-100	20	RQD values of specific borehole below given depth from relevant borehole is used in RMR
Good	75-90	17	
Fair	50-75	13	
Poor	25-50	8	
Very Poor	<25	3	

Spacing of discontinuities

	Spacing, (m)	Rating	Basis
Very Wide	>2	20	Spacing of discontinuities of specific borehole from field
Wide	0.6-2	15	

	Spacing, (m)	Rating	Basis
Moderate	0.2-0.6	10	observations is used in RMR
Close	0.06-0.2	8	
Very Close	<0.06	5	

**Condition of discontinuities*

Very rough and unweathered rock wall rock, tight and discontinuous, no separation	rough and slightly weathered wall rock surface, separation < 1 mm	slightly rough and moderately to highly weathered wall rock surface, separation < 1 mm	Slickensided wall rock surface or 1-5 mm thick gauge or 1-5 mm wide opening, continuous discontinuity	5 mm thick soft gauge 5 mm wide continuous discontinuity
30	25	20	10	0

**** This parameter depends on number of other parameters related to joints;***

a) joint smoothness, b) Joint alteration (weathering and filling), c) Joint size, d) Joint Persistence and e) joint Separation.

Ref: **RMR classification of rock masses (Bieniawski, 1989).**

Condition of discon-tinuities	Length, persistence	< 1 m	1 - 3 m	3 - 10 m	10 - 20 m	> 20 m
	Rating	6	4	2	1	0
	Separation	none	< 0.1 mm	0.1 - 1 mm	1 - 5 mm	> 5 mm
	Rating	6	5	4	1	0
	Roughness	very rough	rough	slightly rough	smooth	slickensided
	Rating	6	5	3	1	0
	Infilling (gouge)	none	Hard filling		Soft filling	
		-	< 5 mm	> 5 mm	< 5 mm	> 5 mm
	Rating	6	4	2	2	0
	Weathering	unweathered	slightly w.	moderately w.	highly w.	decomposed
	Rating	6	5	3	1	0

Ground water condition

This parameter is very important for tunnels, in case there are open joints, inflow of water will be high and will affect the stability of rock-mass.

Ref: **RMR classification of rock masses (Bieniawski, 1989).**

Ground water	Inflow per 10 m tunnel length	none	< 10 litres/min	10 - 25 litres/min	25 - 125 litres/min	> 125 litres /min
	p_w / σ1	0	0 - 0.1	0.1 - 0.2	0.2 - 0.5	> 0.5
	General conditions	completely dry	damp	wet	dripping	flowing
	RATING	15	10	7	4	0

Rating Adjustment for Discontinuity Orientations

Strike and Dip Orientations of Discontinuities	Very Favorable	Favorable	Fair	Unfavorable	Very Unfavorable

Strike and Dip Orientations of Discontinuities		Very Favorable	Favorable	Fair	Unfavorable	Very Unfavorable
Ratings	Tunnels and mines	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

Rock Mass Classes determined from Total rating

Classification No	I	II	III	IV	V
Description of Rock	Very Good	Good	Fair	Poor	Very Poor
R M R	100-81	80-61	60-41	40-21	20-0

MEANING OF ROCK MASS CLASSES					
Average Standup Time	20 Yr for 15 m span	1 Yr for 10 m span	1 wk for 5 m span	10 hr for 2.5 m span	30 min for 1 m
Cohesion of Rock mass (KPa)	> 400	300 – 400	200 – 300	100 – 200	< 100
Friction angle of Rock mass (deg)	> 45	35 – 45	25 – 35	15 – 25	< 15

3.3 In-situ Permeability Tests in Bed Rock

In-situ permeability Test is rock was conducted by double packer method as per IS: 5529 (Part 2 Tests in Bed Rock).

The following table describes the conditions typically associated with different Lugeon Values, as well as the typical precision for reporting these values (Quiñones-Rozo, 2010)

Lugeon Range	Classification	Hydraulic Conductivity Range (cm/sec)	Condition of Rock Mass Discontinuities	Reporting Precision (Lugeons)
<1	Very Low	$< 1 \times 10^{-5}$	Very tight	<1
1-5	Low	1×10^{-5} - 6×10^{-5}	Tight	± 0
5-15	Moderate	6×10^{-5} - 2×10^{-4}	Few partly open	± 1
15-50	Medium	2×10^{-4} - 6×10^{-4}	Some open	± 5
50-100	High	6×10^{-4} - 1×10^{-3}	Many open	± 10
>100	Very High	$> 1 \times 10^{-3}$	Open closely spaced or voids	>100

Figure 5 : In-situ permeability Test in progress (SBH-01)

3.4 Deformability Tests by means of High Pressure Dilatometer

The aim of the High Pressure Dilatometer (HPD) tests is to determine

- In-situ deformation modulus of rock
- In-situ shear modulus of rock
- Limiting pressure of In-situ rock

The in-situ deformation modulus of rock using an expanding probe (dilatometer) to exert pressure on the wall of a drill hole. The resulting diametrical expansion (dilation) will be determined from measurements of the volumetric expansion of the probe. Deformability characteristics of the rock mass at the dilatometer location will be calculated from the relation between pressure and dilation.

3.4.1 Equipment Required

- Data logger for recording of pressure in Mpa & displacement in mm
- HQ sonde is the main assembly contains rubber membrane, pressure transducer and displacement transducers
- Water pump – 20 lit capacities and able to produce maximum pressure of 20 Mpa
- High pressure water feeding hose – 100 m length
- Electrical cable – 100 m length
- Drilling rods of AW size for lowering the HQ sonde at required depth
- Measuring tape – 3m

* The equipment will be of OYO Corporation, Japan

3.4.2 Calibration

- Calibrating the displacement output

  For calibration, following steps will be carried out
- Detach the rubber tube from the sonde.
- Connect the sonde to the indicator by cable, and the POWER switch put in "ON" position.
- As indicated in Fig. 5, cover the sonde with calibration ring.

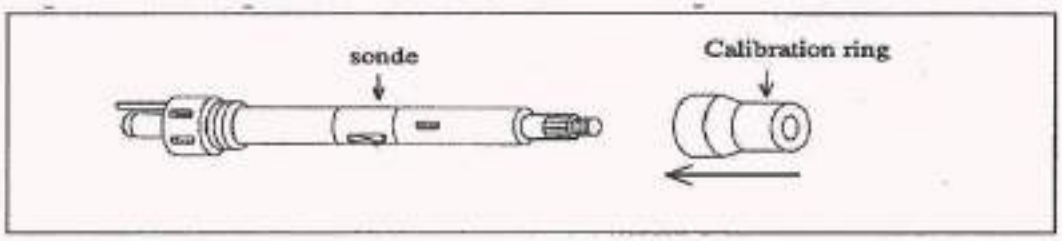


Figure 6 : Covering the sonde with the calibration ring

- Arrangement of contact of section of the calibration ring with its inner diameter getting smaller.

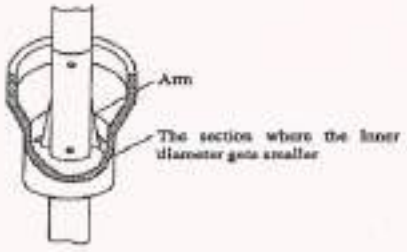


Figure 7 : Calibration using calibration ring (position 1)

- At this time, adjust R.B. (shown on data logger) trimmer by turning it through the use of trimmer adjusting rod so that the display value of the radius on the Indicator may indicate "0.00" mm.
- Then, arrange the arm to contact the section of the calibration ring with it's inner diameter getting larger.

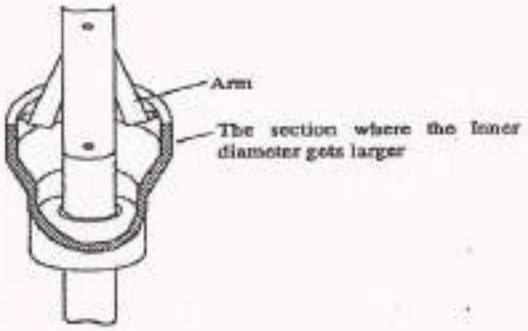


Figure 8 : Calibration using the calibration ring (position 2)

- At this time, adjust R.G. (shown on data logger) trimmer by turning it through the use of trimmer adjusting rod so that the display value will show "10.00" mm.
- Calibration the pressure output

Connect each of the system constituting the unit as illustrated in the Figure below.

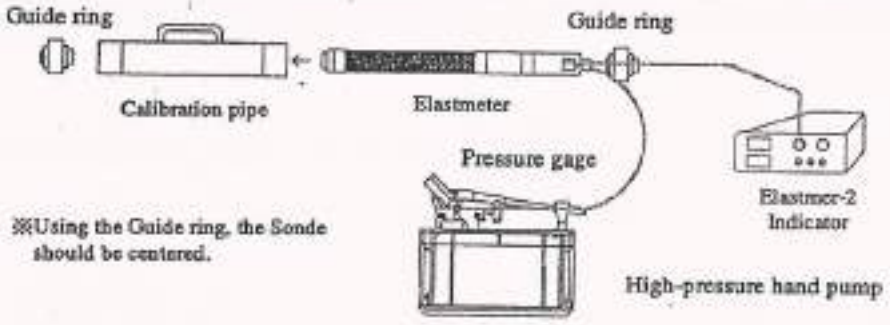


Figure 9 : Calibrating the pressure output

- Adjust P.B. (shown on data logger) trimmer by turning it through the use of trimmer adjusting rod (one of the typical accessories) so that the display value of the pressure on the indicator under the standby where no pressure has been loaded, may read "0.00" Mpa.
- Then, load the pressure approximately 15 MPa by using the high-pressure hand pump and adjust P.G. (shown on data logger) trimmer by turning it through the use of trimmer adjusting rod so that the display value on the indicator may be rendered identical to the reference value on the pressure gauge.
- Measuring the variation with the thickness of the rubber tube resulting from the various pressure loading on the rubber tube:

The function of elastmeter is to exert the pressure on borehole wall via rubber tube. Rubber will indicate the variation with its thickness influenced by the pressure varying the Rubber tube thickness. The outer diameter of elastmeter is 70 mm.

As the thickness variation is caused for loading pressure exceeding 1 MPa, the required correction will be for the data for pressure exceeding 1 MPa. For carrying out the correction, take steps described below to measure the variation volume with the thickness of rubber.

- As indicated in Fig. 8, insert the elastmeter into the calibration pipe. As for the calibration pipe, use the Nx size calibration pipe.
- To get the rubber tube fitted for it use, repeat the pressurization and the depressurization more than three times in advance.
- Carrying the depressurization once, then raise the pressure to 1 MPa, read the display value (Rp1) with the displacement for that pressure, and record it on the data sheet.
- Raise the pressure in steps of 0.5 MPa, and record the display value (Rp) with the displacement for each case.
- Repeat the above step till the pressurization reaches the pressure of 20 Mpa.

3.4.3 Test Procedure

- Arrange beforehand to let the cable and the high-pressure water feeding tube linked to the rod reducer, and the fix the cable and high-pressure water feeding tube to the sonde.
- Connect the cable to the probe of this instrument.
- Set POWER switch in "ON" position,
- Set POWER switch in "ON" position, stand-by for 2 minutes as warm-up time.
- Connect the high-pressure water feeding tube to the high-pressure hand pump.
- Carrying calibration with the Sonde. For details, refer to "6.0 CALIBRATION".
- Insert the sonde into the borehole.
- The tests may be spaced either at equal intervals or at specified locations in pre-selected geological formations or beds. Generally, a log of deformability should be taken at regular interval along the length of the test hole pertinent to design. For example, a 1, 2 or 5 m test interval may be specified depending on test hole lengths and required resolution.
- Upon setting the Sonde at the measuring point, load the pressure on the sonde using the high pressure hand pump according to the pressure loading pattern set planned in advance, so as to load the pressure on the rubber tube for getting it inflated. Record the relationship, between the pressure ("P in MPa") and the displacement ("Rn in mm").
- At the time of shifting the sonde to next position after finish with the measurement, observe displacement volume being displayed on the indicator, confirm the shrinking of rubber tube, and only then proceed to shift to next location.
- At each successive in the same borehole, start the measurement with the deepest location followed by the shallower location. Such a procedure will serve to prevent jamming of the probe.
- At time of lifting up the sonde, pull the cable a little and high-pressure water feeding pump such as they may not slacken, and then proceed to lift it up.
- Upon completing the lifting of the sonde, wash it with water.

3.4.4 Interpretation of results

- Calculating the cross section with the rubber tube

For calculating the outer diameter of the rubber tube (used for the elastmeter) from its inner diameter, it is required to determine beforehand the cross section of the rubber tube.

The procedures for such determination are given below.

- In the measurement with the thickness variation concerned with the rubber tube as referred to in "6.3", determine the value by adding "23.5 mm" to the indicated value of the displacement (RP1) under the pressure at 1 MPa. The value thus determined corresponds to the inner diameter of the rubber tube under the status where no thickness variation volume will arise influenced by the pressure on the rubber tube.
- The outer diameter of the rubber tube is rendered equivalent to the inner diameter of the calibration pipe, and assuming it is expressed by "R", the cross section of the rubber tube can be expressed by the following formula:

  $S = \pi\{R^2 - (R_{P1} + 23.5)^2\}$

- At time of the actual measurement, since "S/ π" ("π" denotes the ratio of circle circumference to its radius) is used in the correction formula, determine the following and record the eventual value determined.

  $S/\pi = \{R^2 - (R_{P1} + 23.5)^2\}$

3.4.5 Determining the inner radius (Ri):

The measured value (Rn) indicates the variation of the volume with the inner radius of rubber tube. Actual inner radius (Ri) of rubber tube is determined by adding the reference radius which is already calibrated to Rn.

Ri = Rn + 23.5 mm

3.4.6 Determining the thickness correction with rubber tube (PG, Rs, R):

With pressure the rubber tube gets inflated and the variation with respect to its thickness arises from the following two causes:

1) Pressure

2) The rubber tube getting inflated

Accordingly, corrections are required with the variation in volumes due to the above two causes above. For the thickness variation caused by pressure, as mentioned in the above relevant correction relates to the thickness variation volume already determined as mentioned in section "6.3".

Thickness correction volume (PG) against pressure (P) can be expressed by the following formula:

PG = (P-1) / k = P' / k

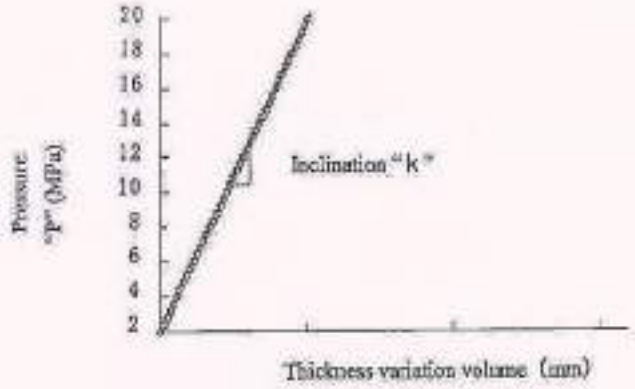


Figure 10 : PG corrected straight line

Thus, the reference inner radius (Rs) of rubber tube is expressed as follows:

Rs = Ri – PG

For the thickness variation caused by rubber tube inflated, as mentioned in the cross section of rubber tube is always constant, the thickness variation can be converted into the outer diameter. Assuming the cross section is represented by "S",

R = ((Rs)2 + S/π))1/2

(Remarks: For "S/π", the value determined in the calculation of cross section of rubber tube as described in "8.1" is the one to be used.) Based on the measurement results arranged as above, delineate the P-R curve.

3.4.7 Calculating the Ground coefficient value (K):

K value can be defined as the slope of the deformation curve (the linear section) on the stress-deformation plot as indicated in Fig 3.

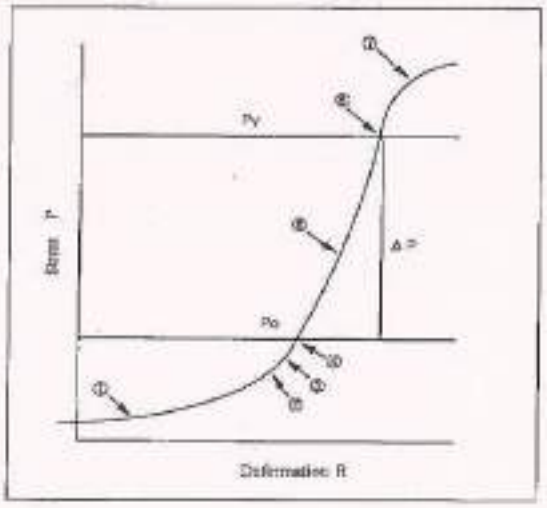


Figure 11 : Model diagram of measurement results

$K = \Delta P / \Delta R$ (MPa)

In other words, K value is the load strength against the unit displacement volume.

3.4.8 Calculating the Elasticity modulus value (E):

E value is the elasticity modulus of the strata to determine this value is from the measurement results through application of the elastmeter system.

The stress distribution is a two-dimensional and the stress is within the elasticity limit. The horizontal strain in the plane in the direction of the radius is met, from this the elasticity coefficient (E) can be expressed using the following formula.

$E = (1 + \mu)*r*K$

Where, "μ" represents Poisson's ratio, "K" represents the K value determined before, and "r" represents the intermediate radius for the section used to calculate K value. For case of the soft ground, the Poisson's ratio can be considered in the approximate ranges of 0.3 to 0.5 while in case of the rock, it can be considered to be in the range of 0.3 to 0.4.

3.4.9 Calculating the Shear modulus value (G):

The Shear modulus can be computed using the relation $G = E/ 2(1+\mu)$

Where,

G = Shear modulus

μ = Poisson's ratio

E = Elasticity modulus

Figure 12 : Dilatometer test in Progress at Site

3.5 Laboratory Testing Procedure on Rock Samples

Laboratory Tests on rock core samples were conducted as per relevant Standards in NABL Accredited / laboratory approved by M/s L&T and Design Consultants:

Laboratory Tests on rock core samples were conducted as per relevant Standards:

Preparation of Test Specimens: The rock core specimens for various laboratory tests were prepared in accordance with relevant provisions of IS: 9179-1979. Rock cores of Nx size were cut to proper length, meeting the requirements of the requisite length / diameter ratio and their ends planed and polished using polishing and lapping machine.

Bulk Density: The test was conducted as per IS: 13030-1991 "Method of Test for Laboratory Determination of Water Content, Porosity, Density & Related Properties of Rock Material". The test was conducted on the prepared rock core samples. 3 representative rock cores for each rock sample were used for evaluation of bulk density based on average of 3 tests. The following formula was used for calculation of bulk density: Bulk Density = Bulk Sample Mass / Bulk Sample Volume.

Water Content at Saturation: The prepared rock core specimens were immersed in water at room temperature for 72 hours for determination of water content at saturation for the rock core samples. As per Clause 3.1.4.1 of IS:1121 (Part 1)-1974 "Methods of Test for Determination of Strength Properties of Natural Building Stones, Part 1: Compressive Strength", the rock core specimens are required to be immersed in water for 72 hours for determination of water content at saturation of the rock core samples.

Porosity: The test was conducted as per IS: 13030-1991 "Method of Test for Laboratory Determination of Water Content, Porosity, Density & Related Properties of Rock Material". The test was conducted on the prepared rock core samples. 3 representative rock cores for each rock sample were used for evaluation of porosity based on average of 3 tests. The following formula was used for calculation of porosity: Porosity = Pore (Volume of Soil / Bulk Volume of Sample) x 100.

Uniaxial Compressive Strength (Wet & Dry), Elastic Modulus and Poisson's ratio (IS: 9143, 9221): The unconfined compressive strength of the rock core specimen was calculated by dividing the maximum load carried by the specimen during the test by the average cross-sectional area. Average of three tests was used to arrive at a representative value of unconfined compressive strength (dry condition) of a rock sample. Elastic modulus and Poisson's ratio is performed similarly to the unconfined compressive test discussed above except that deformation is monitored as a function of load. Axial and circumferential deformations were determined from data obtained by electrical resistance strain gauges.

Point Load Strength Index tests on rock cores (IS: 8764): The cylindrical cores were tested axially keeping the length to diameter ratio of 0.30 to 1.0. The load was applied to the specimen such that failure occurred within 10-60 seconds and the failure load P was recorded. The The Point Load Strength Index was determined using the failure load.

Tri-axial Compression: Triaxial tests are conducted in laboratory to determine shear strength parameters of rock. Conventional triaxial compression tests are carried out on rock core samples of Nx size, with length to diameter ratio of 2. Saturated specimens are tested in a Hoek's Triaxial Cell. The triaxial cell is an apparatus, in which the test specimen is enclosed in an impermeable flexible polyurethane membrane and is placed between two hardened platens, one of which is spherically seated. There is an arrangement for applying constant lateral fluid (oil) pressure to the specimen in the triaxial cell. After enclosing the specimen in the triaxial cell, the cell is placed in a compression testing machine. The rock specimen under constant lateral hydraulic pressure is loaded axially to failure. The specimens are tested under different lateral/confining pressures.

After the testing all rock samples under different confining pressures, the normal stress at failure versus confining pressure (strength envelop) is plotted. The modified failure envelope, which is the 'best-fit' of the tested data, is drawn. For drawing this 'best-fit', or the modified failure envelop, based on experience and observations, some samples may have to be rejected. Different permutations and combinations of considered and ignored samples may have to be considered to estimate different sets of shear strength parameters. The one most rationally/ cogently argued, and in coherence with the overall response of the rock, is recommended for adoption. In the sense of Coulomb's failure theory, the apparent cohesion (**c**) and the friction angle (Φ) are computed using the following formulae:

Φ = arc sin [(m-1) / (m+1)]

c = b [(1- sin Φ) / 2 cos Φ]

where,

c = apparent cohesion,

Φ = friction angle,

m = slope of the modified failure envelop, and

b = intercept of the failure envelop on the axial stress axis.

Slake Durability Index (IS: 10050, ASTM – D4644): A representative sample of each rock type comprised of ten rock core lumps, each with a mass of 40-60 g, to give a total sample mass of 450-600 g. The sample was placed in clean drum and dried to a constant mass at a temperature of 105° C. The trough was filled with slaking fluid viz. water to a level 20 mm below the drum axis and the drum was rotated for 200 revolutions during a period of 10 minutes. The drum was removed from the trough, followed by removal of lid. Drum plus retained portion of the sample was dried to a constant mass at 105° C. The above steps for slaking for 10 minutes and drying were repeated. The slake durability index was calculated as percentage ratio of final dry mass to initial dry mass.

Petrography Examination (IS: 1125): The Study on petrography of rock samples has to be carried out as per Method II in IS: 2386 (part-8) 1963.

4.0 GEOLOGICAL INFORMATION

The proposed Site is a river island in the Narmada about 4 km by 2 km in size. It is also a hill that is surrounded by waters of the Narmada on all sides.

Present study, area is located on igneous formation (basalts) in general, having less porosity. This layer is underlined The peninsular shield of India was considered to be seismically stable intra-plate region, far away from the Himalayan plate boundary (Khan, 2009). However, several isolated areas of the Peninsula are known to have experienced low to moderate level of seismicity in the recent past and the Central India Tectonic Zone (CITZ) is one of them. One of the largest earthquakes in the study area was the Satpura earthquake of 14th March 1938, with magnitude (Ms) 6.3, which occurred near Khandwa within the CITZ. The CITZ is a conspicuous feature in India and at present is under the compressional forces of the Himalayan orogeny (Kaila, 1986).It is a zone of fractures belonging to early Precambrian, Cretaceous and post Deccan trap period (Kaila et al., 1989). This zone is dissected by several E-W/ENE–WSW trending faults. The Son Narmada South fault (NSF) is one of them and is considered to be seismically active (Fig.1) by the granitic basement, which also has low porosity the study area is situated major approximately at latitude 22.25° N and 76.15° E it is ~1.5 km away to the reservoirs of India in S-E direction which is located approximately at latitude 22° 17' N and longitude 76° 28' E, and lying at a distance of~40 km from the Son-Narmada south fault in the CITZ. Since geological faults and formations play a major role in triggering the seismic activity.

Table 9 : Geological successions of Khandwa District

AGE	FORMATION	LITHOLOGY
Pleistocene to Recent	-	*Laterite /Black CottonSoils*
Cretaceous to Eocene	**Deccan Trap**	**Basaltic Flows with intertrappeans**
----------	**Un-conformity**	----------
Upper-Precambrian To lower Paleozoic	Vindhyan Super Group	Quartzite, Sand stone shale & Conglomerate
----------	**Un-conformity**	----------
Upper-Precambrian	Bijawar Group	Dolomite, Chert breccia, Quartzite & Conglomerate.
----------	**Un-conformity**	----------
Lower-Precambrian	Archean	Granite/Granite Gneisses

Reference : DISTRICT SURVEY REPORT OF KHANDWA DISTRICT AS PER NOTIFICATION NO. S.O. 141(E) NEW DELHI, THE 15TH JANUARY, 2016 OF MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

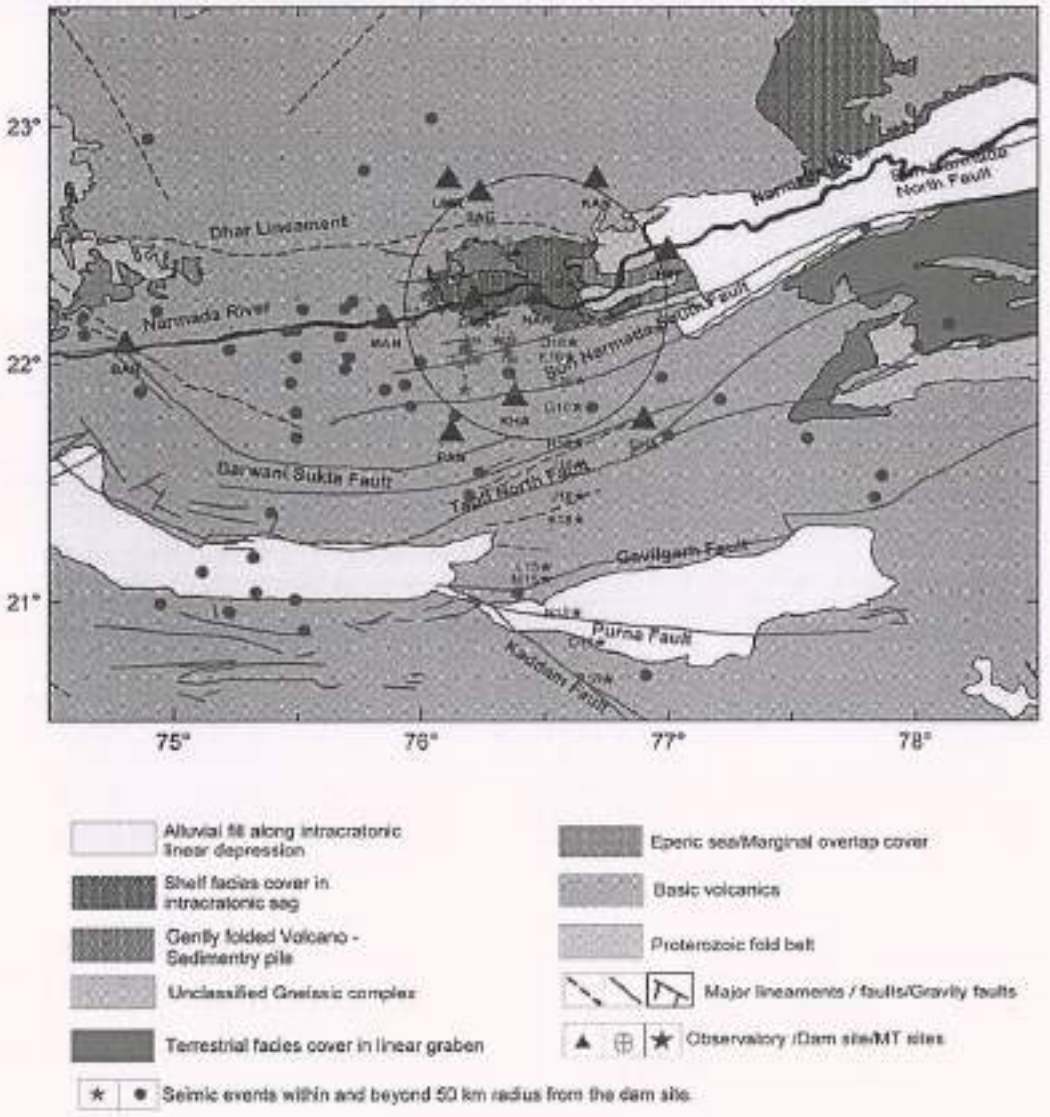


Figure 13. Detailed geological map of the study area

Showing major seismotectonic and geological features along with the epicenters of recorded seismic events in the area of Indira Sagar reservoir site, which is very close to our stady area Madhya Pradesh (GSI, 2000). Seismic events (stars) within the radius of 50km from the dam site are shown in the black circle.

Reference : Deciphering the seismicity pattern from MEQ study at Indira Sagar reservoir area, Madhya Pradesh, India by G.Dhanunjaya Naidu*, Sachin Khupat and D.K.Awasthi

5.0 GEOTECHNICAL ASSESSMENT / FINDINGS OF INVESTIGATIONS

5.1 Sub-Surface Conditions based on Borehole Information

5.1.1 Important Objectives

- The main objectives are to summarize surface geological, subsurface geotechnical studies to work out with the following important attributes: lithology, joints, discontinuities, permeability, stratigraphy, geological setting, and structure of the area.
- Classification of rock mass according to the Rock Mass Rating (RMR), Rock Mass Quality, (Q) system, Geological Strength Index (GSI) during excavation to provide inputs for mechanism of ground improvement during excavation, assessment of cut slope stability analysis of hill slope during additional loading.
- To know the possible details of unpleasant geological surprises such as highly jointed, folded weak zones and water in rushes etc, and
- Analysis and interpretation of subsurface core of 01 bore holes in rock from field investigation and laboratory testing data of drilled borehole.

5.1.2 Sub-surface Conditions

The project area has been explored by two no. of drill hole aggregating the depth 100m covering between the ground surfaces to 50m depth (El. 250.050m to El. 200.050m) to know the characteristics of rock mass for foundation design. The description of bore hole given under here:

Table No. 10: Sub-Surface Conditions (Summary)

Bore Hole	Depth (m)		Strata Description	Core Recovery (%)	RQD (%)
	From	To			
SBH-01	0.00	6.00	Moderately weathered, highly fractured, brown colour, fine grained, Porphyritic BASALT	16.00 – 9.00	0.00 – 7.300
	6.00	7.50	Highly weathered, highly fractured, greyish brown / brown colour, fine grained, Porphyritic BASALT	28.00	0.00
	7.50	25.50	Slightly weathered, highly to moderately fractured, greyish brown / brownish grey colour, fine grained, Porphyritic BASALT	78.60 – 100.0	0.00 – 67.30
	25.50	50.00	Slightly weathered, highly to slightly fractured, grey / brownish grey colour, fine grained, Porphyritic BASALT	94.00 – 10.00	8.00 – 92.00

Bore Hole	Depth (m)		Strata Description	Core Recovery (%)	RQD (%)
	From	To			
SBH-02	0.00	7.50	Moderately weathered, highly fractured, brownish grey colour, fine grained, BASALT	46.60 – 69.30	0.00 – 8.00
	7.50	25.50	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, BASALT	88.00–100.00	10.60– 56.00
	25.50	50.00	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, BASALT	87.30–100.00	0.00 – 74.00

Bore Hole: SBH-01

Bore Hole SBH-01 drilled vertically down to 50m depth from Excavation level El. 250.050m. Bed rock ***Porphyritic BASALT*** encountered from existing excavation level El. 250.050m, in the initial 7.50m depth the bed rock is highly to moderately weathered, followed by slightly weathered, jointed rock.

Rock in general highly fractured down to 19.50m depth (El. 230.550m), RQD values are in range of 0 % to 24% followed by moderately fractured to slightly fractured down to depth of investigation. i.e 50m depth (El. 200.5050m). Average RQD values below 19.50m depth is about 50% i.e. 'Good' by Triple Tube core barrel.

Ground water level noticed at 15.00m depth (El. 235.050m). Partial drilling water loss observed throughout drilling.

The permeability values ranges 20 lugeon between the 6.5m to 8.00m depth indicated some open joints.

Bore Hole: SBH-02

Bore Hole SBH-01 drilled vertically down to 50m depth from Excavation level El. 250.050m. Bed rock ***Porphyritic BASALT*** encountered from existing excavation level El. 250.050m, in the initial 7.50m depth the bed rock is highly to moderately weathered, followed by slightly weathered, jointed rock.

Rock in general highly fractured down to 15m depth (El. 235.050m) and then 36m to 49.50m depth (El. 214.050 to El. 200.550m), RQD values are in range of 0 % to 24.6%. Between 15m and 36m and below 49.50m depth rock in general is moderately fractured to slightly fractured. Average RQD values between 15m and 36m is 45%i.e. 'Good' by Triple Tube core barrel.

Ground water level noticed at 15.00m depth (El. 235.050m). Partial drilling water loss observed throughout drilling.

The permeability values ranges 20 lugeon between the 6.5m to 8.00m depth indicated some open joints.

5.2 In-situ Permeability Test Results

Detailed In-situ permeability test results are given in **Annexure - C**; summary is tabulated as below;

Table No. 11: Summary of In-situ permeability test results

Borehole No.	Location	Depth of Test		Average Test Level (m)	Lugeon value		Lugeon value	Remarks
		From (m)	To (m)		Maximum	Minimum		
SBH-01	Main Statue	6.50	8.00	242.800	21.09	18.01	**20.23**	Fractured Rock mass (Some open joints)
SBH-02	Main Statue	6.50	8.00	242.800	22.75	18.91	**20.61**	

Interpretation of Test Results

Lugeon Range	Classification	Hydraulic Conductivity Range (cm/sec)	Condition of Rock Mass Discontinuities	Reporting Precision (Lugeons)
<1	Very Low	$< 1 \times 10^{-5}$	Very tight	<1
1-5	Low	$1 \times 10^{-5} - 6 \times 10^{-5}$	Tight	± 0
5-15	Moderate	$6 \times 10^{-5} - 2 \times 10^{-4}$	Few partly open	± 1
15-50	Medium	$2 \times 10^{-4} - 6 \times 10^{-4}$	Some open	± 5
50-100	High	$6 \times 10^{-4} - 1 \times 10^{-3}$	Many open	± 10
>100	Very High	$> 1 \times 10^{-3}$	Open closely spaced or voids	>100

5.3 Deformability Tests Results by means of High Pressure Dilatometer

The Modulus of Elasticity E as well as Shear Modulus G values for the boreholes are tabulated in table no. 12. The Modulus of elasticity, E value ranges from 1.25 x 10^4 kg/cm^2 to 3.79 x 10^4 kg/cm^2 (Average Value 2.26 x 10^4 kg/cm^2) Shear Modulus, G values ranges from 4.79 x 10^3 kg/cm^2 to 12.50 x 10^3 kg/cm^2 (Average Value 8.64 x 10^3 kg/cm^2)

Summary of High Pressure Dilatometer test results are as below;

Table No.12: Summary of the High Pressure Dilatometer test results

Sr No	Bore Hole Number	Depth, m	Poisson's Ratio	ΔP = P2 - P1		ΔR = R2 - R1		K = (ΔP/ΔR)	Intermediate Radius	Modulus of Elasticity, E		Shear Modulus, G	Limit Pressure, P_l
				P2	P1	R2	R1			Mpa	kg/cm^2	kg/cm^2	kg/cm^2
1	SBH-1	4.00	0.30	20.00	1.00	38.84	38.08	25.00	38.83	1261.97	1.26E+04	4.85E+03	200
2		8.00	0.30	20.00	1.00	37.94	37.59	54.29	37.86	2671.83	2.67E+04	1.03E+04	200
3		12.00	0.30	20.00	1.00	38.39	37.63	25.00	38.33	1245.73	1.25E+04	4.79E+03	200
4		16.00	0.30	20.00	1.00	38.21	37.60	31.15	38.11	1543.14	1.54E+04	5.94E+03	200
5		20.00	0.30	20.00	1.00	37.87	37.38	38.78	37.72	1901.40	1.90E+04	7.31E+03	200
6		24.00	0.30	20.00	1.00	37.82	37.34	39.58	37.33	1920.94	1.92E+04	7.39E+03	200
7		28.00	0.30	20.00	1.00	38.37	38.12	76.00	38.33	3787.00	3.79E+04	1.46E+04	200
8		32.00	0.30	20.00	1.00	38.33	37.99	55.88	38.30	2782.38	2.78E+04	1.07E+04	200
9		36.00	0.30	20.00	1.00	38.15	37.86	65.52	38.08	3243.37	3.24E+04	1.25E+04	200

Detailed Data and curves are attached as ANNEXURE – D.

5.4 Laboratory Test Results (Rock Samples)

The rock samples selected as per schedule were transported and tested in our NABL Accredited laboratory in New Delhi. All the tests were conducted as per relevant IS codes / ASTM. Test Results in detail are presented in Annexure-E.

Table No. 13: Summary of laboratory Test Results

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
4	0.00-1.50	2.61	2.62	0.85	2.75	0.050	--	--	45.48	--	--	--	--	--	--	--	93.93
5		--	2.65	--	--	--	2.70	--	--	--	--	--	--	--	--	--	
6		--	2.58	--	--	--	--	1.92	--	--	--	--	--	--	--	--	
7	1.50-3.00	2.62	2.63	0.83	2.75	0.046	2.25	--	--	--	--	--	--	--	--	--	--
8	3.00-4.50	--	2.55	--	--	--	--	1.34	--	--	--	--	--	--	--	--	--
9		2.65	2.65	0.78	2.74	0.034	--	--	70.35	54.29	0.22	--	--	--	--	--	97.83
11		--	2.69	--	--	--	8.55	--	--	--	--	--	--	--	--	--	
12	3.00-4.50	--	2.66	--	--	--	--	4.19	--	--	--	--	--	--	--	--	

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
13		2.66	2.66	0.79	2.75	0.034	2.84	--	--	--	--	--	--	--	--	--	
14	4.50-6.00	2.63	2.64	0.82	2.75	0.042	--	--	54.95	33.12	0.21	--	--	--	--	--	--
15		--	2.67	--	--	--	--	6.42	--	--	--	--	--	--	--	--	--
17	7.50-9.00	2.69	2.69	0.41	2.73	0.015	10.80	--	--	73.69	0.12	--	--	--	--	--	95.69
20		--	2.68	--	--	--	--	--	121.25	--	--	--	--	--	--	--	
21		--	2.69	--	--	--	--	--	--	--	--	217.54	127.48	0.11	--	--	
25		--	2.62	--	--	--	--	2.87	--	--	--	--	--	--	--	--	
37	9.00-10.50	2.67	2.67	0.71	2.74	0.027	--	--	84.43	44.68	0.22	--	--	--	--	--	--
67	12.00-13.50	2.68	2.68	0.54	2.74	0.023	--	--	163.33	68.03	0.16	--	--	--	--	--	--
71		--	2.66	--	--	--	--	--	--	--	--	115.45	73.24	0.18	--	--	--
77	13.50-15.00	--	2.69	--	--	--	9.66	--	--	--	--	--	--	--	--	--	--
81		2.69	2.69	0.44	2.73	0.015	--	--	--	--	--	213.99	115.12	0.14	--	--	--

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
96	15.00-16.50	2.69	2.69	0.42	2.73	0.015	10.59	--	--	--	--	--	--	--	--	--	--
107	16.50-18.00	--	2.68	--	--	--	8.69	--	--	--	--	--	--	--	--	--	--
134	19.50-21.00	2.67	2.67	0.57	2.74	0.027	--	--	--	--	--	148.07	73.06	0.11	--	--	97.58
136,138 & 139		2.67	2.67	0.47	2.74	0.027	--	--	--	--	--	--	--	--	12.74	63.28°	
158	22.50-24.00	2.68	2.68	0.49	2.73	0.019	--	--	--	--	--	172.87	87.78	0.17	--	--	--
163		--	2.67	--	--	--	--	--	--	--	--	144.40	--	--	--	--	--
169	24.00-25.50	--	2.67	--	--	--	--	7.76	--	--	--	--	--	--	--	--	--
170		--	2.68	--	--	--	--	8.73	--	--	--	--	--	--	--	--	--
195	25.50-27.00	--	2.67	--	--	--	--	--	--	--	--	148.59	54.35	0.18	--	--	--
196		--	2.68	--	--	--	--	--	--	--	--	159.65	--	--	--	--	--
197	27.00-28.50	2.66	2.66	0.65	2.74	0.030	--	4.33	--	--	--	--	--	--	--	--	--

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
211	28.50-30.00	--	2.66	--	--	--	--	--	--	--	--	141.36	42.41	0.21	--	--	--
215		--	2.62	--	--	--	--	--	--	--	--	41.12	16.32	0.24	--	--	--
217& 2123	30.00-31.50	2.69	2.69	0.38	2.73	0.015	--	--	--	--	--	216.52	105.98	0.12	14.71	62.23°	--
229	31.50-33.00	--	2.67	--	--	--	--	--	--	--	--	156.03	93.32	0.14	--	--	--
236& 240	33.00-34.50	2.65	2.65	0.75	2.74	0.034	--	--	--	--	--	70.42	30.22	0.20	9.52	60.36°	--
260	36.00-37.50	--	2.68	--	--	--	--	--	--	--	--	211.11	75.87	0.12	--	--	--
269	37.50-39.00	--	2.68	--	--	--	--	--	--	--	--	162.94	59.74	0.16	--	--	--
Minimum		**2.61**	**2.55**	**0.38**	**2.73**	**0.02**	**2.25**	**1.34**	**45.48**	**33.12**		**41.12**	**16.32**	**0.11**	**9.52**	**60.36**	**93.93**
Average		**2.66**	**2.66**	**0.62**	**2.74**	**0.03**	**7.04**	**4.70**	**89.97**	**54.76**	**0.19**	**154.67**	**73.45**	**0.16**	**12.32**	**61.96**	**96.26**
Maximum				**0.85**		**0.05**					**0.22**			**0.24**			

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
Borehole No. SBH-02																	
1	0.00-1.50	2.69	2.69	0.46	2.73	0.015	--	--	148.95	--	--	--	--	--	--	--	--
7	1.50-3.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	94.42
8		--	2.58	--	--	--	--	1.36	--	--	--	--	--	--	--	--	
9		2.68	2.68	0.62	2.74	0.023	5.80	--	--	--	--	--	--	--	--	--	
12	4.50-6.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	96.92
13		2.68	2.68	0.42	2.73	0.019	6.80	--	--	--	--	--	--	--	--	--	
14		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
15		--	2.69	--	--	--	7.22	--	--	--	--	--	--	--	--	--	
17, 22, 23	6.00-7.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	95.13
25	6.00-7.50	2.68	2.68	0.55	2.73	0.019	5.79	--	--	--	--	--	--	--	--	--	
27		--	2.56	--	--	--	--	1.23	--	--	--	--	--	--	--	--	

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
35, 36	7.50-9.00	2.67	2.67	0.66	2.73	0.023	--	--	--	--	--	104.58	56.34	0.14	--	--	94.69
38, 41		--	2.62	--	--	--	1.91	--	--	--	--	--	--	--	--	--	
43	9.00-10.50	2.61	2.62	0.85	2.73	0.043	--	--	54.71	23.91	0.21	--	--	--	--	--	--
51		--	2.69	--	--	--	7.10	--	--	--	--	--	--	--	--	--	--
52, 56, 57, 62	10.50-12.00	2.64	2.65	0.82	2.74	0.035	--	--	--	--	--	74.95	24.18	0.19	--	--	97.98
69	12.00-13.50	2.69	2.69	0.48	2.73	0.016	--	--	138.47	67.00	0.15	--	--	--	--	--	--
70		--	2.65	--	--	--	2.87	--	--	--	--	--	--	--	--	--	--
79	13.50-15.00	2.68	2.68	0.59	2.74	0.023	--	--	125.40	85.61	0.12	99.35	72.38	0.21	--	--	--
84, 86	15.00-16.50	2.67	2.68	0.77	2.74	0.024	--	--	--	--	--	--	--	--	10.51	61.14°	--
92		--	2.69	--	--	--	--	--	--	--	--	192.26	--	--	--	--	--
96	16.50-18.00	--	2.65	--	--	--	--	--	--	--	--	91.33	--	--	--	--	--
100		2.63	2.64	0.75	2.74	0.039	--	--	--	--	--	72.51	35.10	0.14	--	--	--

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
108 , 110, 115	18.00-19.50	2.68	2.68	0.58	2.73	0.019	--	--	--	--	--	--	--	--	13.69	61.40°	--
125	19.50-21.00	2.66	2.66	0.66	2.74	0.031	--	--	--	--	--	97.70	45.55	0.19	--	--	--
137	21.00-22.50	2.68	2.68	0.42	2.73	0.019	--	--	--	--	--	189.47	69.29	0.12	--	--	--
152	22.50-24.00	2.67	2.67	0.62	2.74	0.027	--	--	--	--	--	99.00	--	--	--	--	--
161	24.00-25.50	2.65	2.65	0.69	2.74	0.034	--	--	--	--	--	80.92	38.01	0.16	--	--	--
187	27.00-28.50	2.56	2.57	0.87	2.76	0.072	--	--	--	--	--	36.77	28.63	0.17	--	--	--
201	28.50-30.00	2.68	2.68	0.46	2.73	0.019	--	--	--	--	--	160.80	54.89	0.15	--	--	--
204	30.00-31.50	2.69	2.69	0.38	2.73	0.015	--	--	--	--	--	266.78	--	--	--	--	--
213	31.50-33.00	--	--	--	--	--	--	--	--	--	--	--	--	--	15.65	60.87°	--
217		2.69	2.69	0.49	2.74	0.019	--	--	--	--	--	--	--	--			--
232	33.00-34.50	2.67	2.67	0.54	2.73	0.023	--	--	--	--	--	110.77	51.44	0.19	--	--	--

Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
									Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
							Un-Soaked	Soaked	Un-Soaked			Soaked			Soaked		
236	34.50-36.00	2.66	2.66	0.58	2.74	0.031	--	--	--	--	--	104.51	50.26	0.21	--	--	--
261	36.00-37.50	2.67	2.67	0.52	2.73	0.023	--	5.59	--	--	--	--	--	--	--	--	--
290	40.50-42.00	2.59	2.60	0.84	2.75	0.057	--	--	--	--	--	43.80	--	--	--	--	--
	Minimum	**2.56**	**2.56**	**0.38**	**2.73**	**0.02**	**1.91**	**1.23**	**54.71**	**23.91**		**36.77**	**24.18**	**0.12**	**10.51**	**60.36**	**94.42**
	Average	**2.66**	**2.66**	**0.61**	**2.74**	**0.03**	**5.36**	**12.25**	**116.88**	**58.84**	**0.16**	**114.09**	**47.82**	**0.17**	**13.28**	**61.96**	**95.83**
	Maximum			**0.87**		**0.07**					**0.21**			**0.21**			

Note: Laboratory test results (UCS/E value) gives values of intact rock sample, however the values shall be suitably reduced while using for rock mass.

Petrography

Borehole No. : **SBH-1** **Sample No.** : **10**

Type of Rock : **BASALT** **Sample Depth (m)** : **3.00 – 4.50**

Description:

It is a fine grained, massive, hard, compact and non-porphyritic to sparsely porphyritic or moderately to highly porphyritic in nature basaltic lava sample. It is the volcanic equivalent rock of plutonic rock Gabbro. The sample is vesicular, pose amygdular, fragmentary and paleo-weathered top zone. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The sample rock is part of Deccan blood basalt of Khandwa region..

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	fine Grained
5	Color	Black to reddish brown color cores
6	Mineral Composition	The main minerals are plagioclase, yroxene, olivine, ±Quartz, feldspar
7	Nature of Rock	Innocuous Basalt
8	General Physical Condition	Hard,

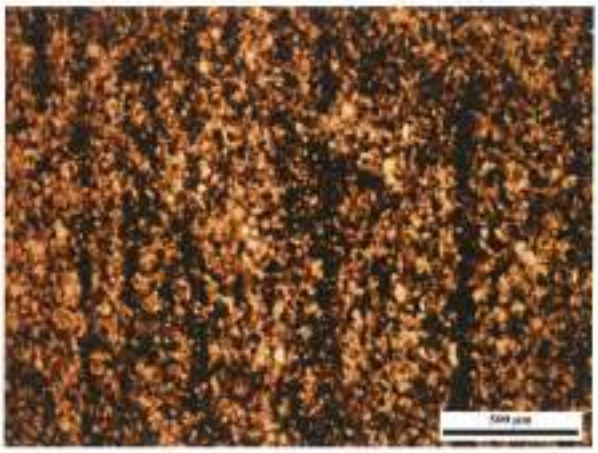


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

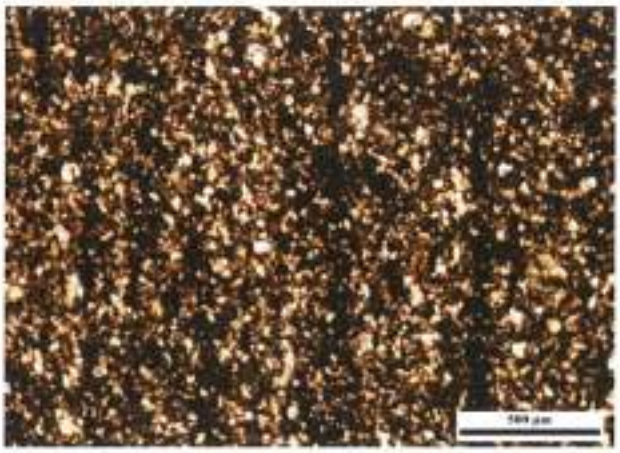


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	**:**	**SBH-1**	**Sample No.**	**:**	**16**
Type of Rock	**:**	**BASALT**	**Sample Depth (m)**	**:**	**6.00 – 7.50**

Description:

It is a fine grained, massive, hard, compact and non-porphyritic to sparsely porphyritic or moderately to highly porphyritic in nature basaltic lava sample. It is the volcanic equivalent rock of plutonic rock Gabbro. The sample is vesicular, pose amygdular, fragmentary and paleo-weathered top zone. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The sample rock is part of Deccan blood basalt of Khandwa region.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	fine Grained
5	Color	Black to reddish brown color cores
6	Mineral Composition	The main minerals are plagioclase, pyroxene, olivine, ±Quartz, feldspar
7	Nature of Rock	Innocuous Basalt
8	General Physical Condition	Hard

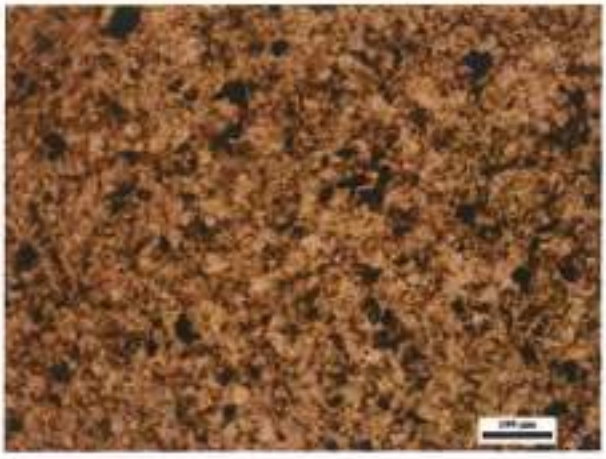


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

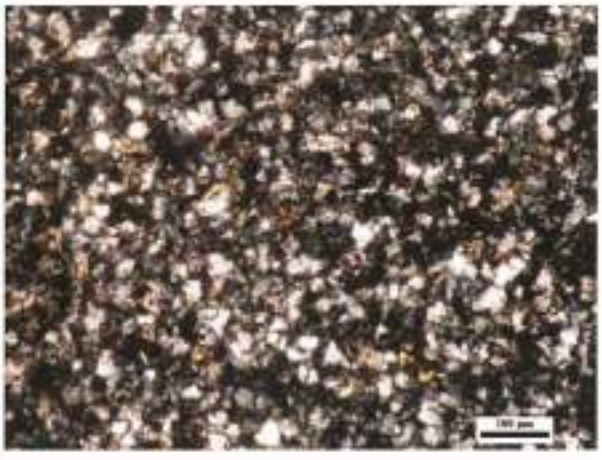


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	**:**	**SBH-1**	**Sample No.**	**:**	**77**
Type of Rock	**:**	**BASALT**	**Sample Depth (m)**	**:**	**13.50 – 15.00**

Description:

It is a fine grained, massive, hard, compact and non-porphyritic to sparsely porphyritic or moderately to highly porphyritic in nature basaltic lava sample. It is the volcanic equivalent rock of plutonic rock Gabbro. The sample is vesicular, pose amygdular, fragmentary and paleo-weathered top zone. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The sample rock is part of Deccan blood basalt of Khandwa region.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	fine Grained
5	Color	Black to reddish brown color cores
6	Mineral Composition	The main minerals are plagioclase, pyroxene, olivine, ±Quartz, feldspar
7	Nature of Rock	Innocuous Basalt
8	General Physical Condition	Hard

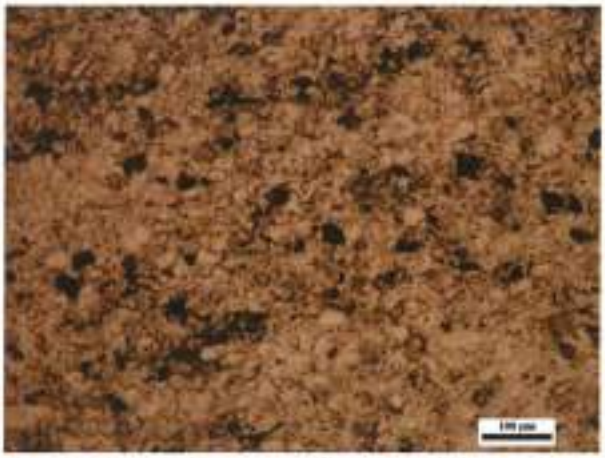


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

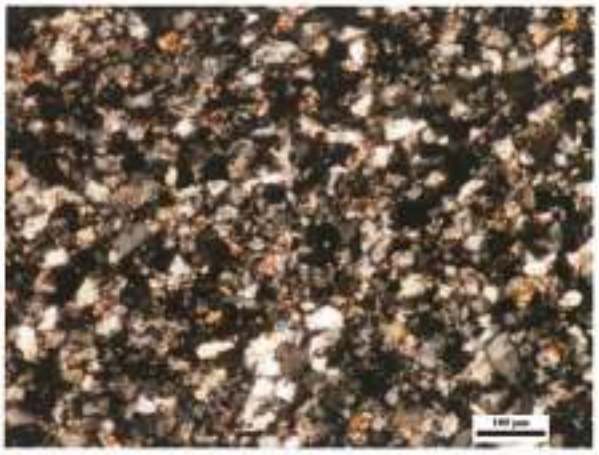


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	**:**	**SBH-1**	**Sample No.**	**:**	**163**
Type of Rock	**:**	**BASALT**	**Sample Depth (m)**	**:**	**22.50 – 24.00**

Description:

It is a fine grained, massive, hard, compact and non-porphyritic to sparsely porphyritic or moderately to highly porphyritic in nature basaltic lava sample. It is the volcanic equivalent rock of plutonic rock Gabbro. The sample is vesicular, pose amygdular, fragmentary and paleo-weathered top zone. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The sample rock is part of Deccan blood basalt of Khandwa region. The sample is well jointed, joint is clearly visible as long streak showing infiltration of surface runoff.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	fine Grained
5	Color	Black to reddish brown color cores
6	Mineral Composition	The main minerals are plagioclase, pyroxene, olivine, ±Quartz, feldspar, biotite
7	Nature of Rock	Innocuous Basalt
8	General Physical Condition	Hard

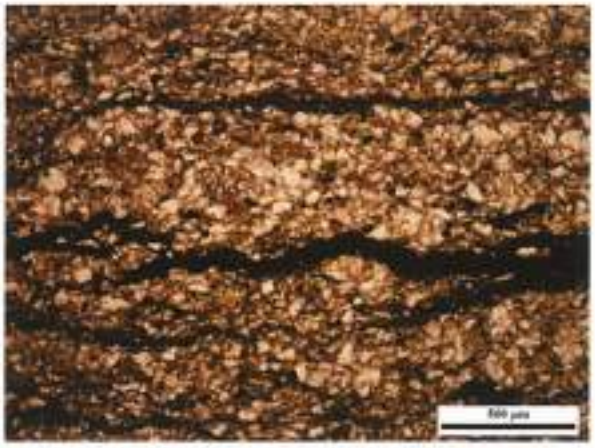


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

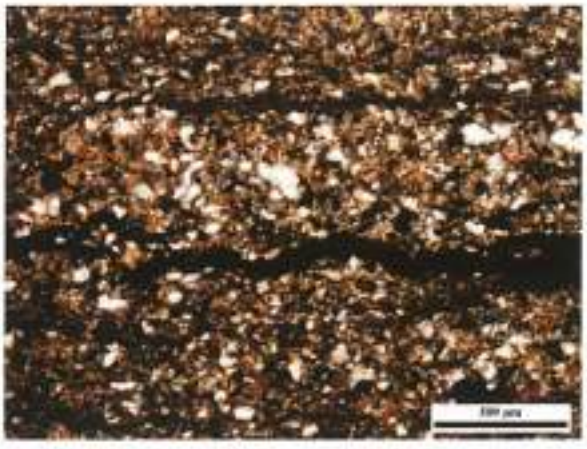


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No. : **SBH-1** **Sample No.** : **197**

Type of Rock : **BASALT** **Sample Depth (m)** : **27.00 – 28.50**

Description:

It is a fine grained, massive, hard, compact and non-porphyritic to sparsely porphyritic or moderately to highly porphyritic in nature basaltic lava sample. It is the volcanic equivalent rock of plutonic rock Gabbro. The sample is vesicular, pose amygdular, fragmentary and paleo-weathered top zone. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The sample rock is part of Deccan blood basalt of Khandwa region.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	fine Grained
5	Color	Black to reddish brown color cores
6	Mineral Composition	The main minerals are plagioclase, pyroxene, olivine, ±Quartz, feldspar
7	Nature of Rock	Innocuous Basalt
8	General Physical Condition	Hard

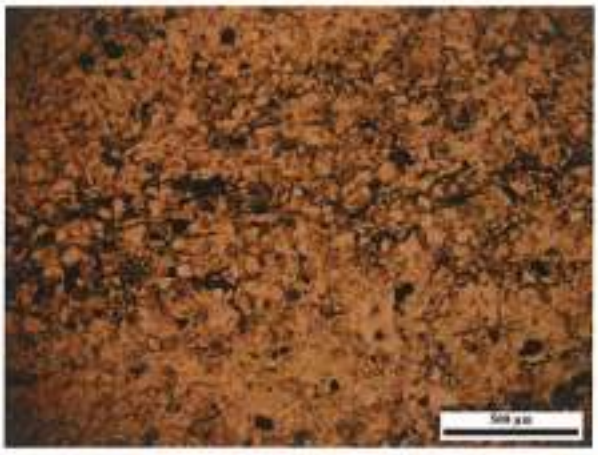


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

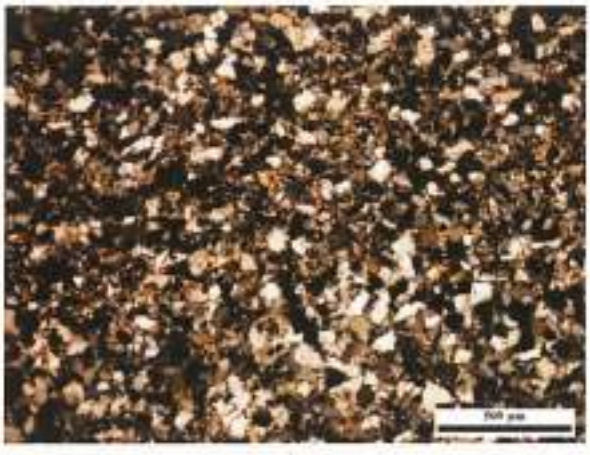


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Remarks:

1. Basalt is mainly composed of plagioclase laths, pyroxene, olivine, feldspar and quartz. Some minerals like biotite, chlorite, hematite, and pyrite are also usually present in basalt with due course of P/T conditions.
2. Basaltic lava may be black, blue, purple, red, or gray. Dark brown or reddishness usually owe their colour to dissolution of unstable Fe-Mg rich minerals.
3. Reddish and purple varieties owe their colour to the presence of hematite (iron oxide), and green varieties owe theirs to the presence of much chlorite, a green micaceous clay mineral.
4. Basalt poses amygdular occur due to escaping of gases and porphyritic texture.
5. The mica present in the sample have been sericite into clay mineral due to weathering

Borehole No. : **SBH-1** **Sample No.** : **265**

Sample Depth (m) : **36.00 – 37.50**

Type of Rock : **Gneiss (Part of Deccan Flood Basalt)**

Description:

It is a fine grained, massive, hard, compact and thinly foliated metamorphic rock of plutonic origin Granite rock. It is highly weathered rock the signs of weathering are also visible in thin section in the form of thin straight streaks of leached Fe-Mg rich minerals (olivine-pyroxene). The main minerals are plagioclase, Quartz, K-feldspar, muscovite flakes, biotite. The sample rock is part of Deccan flood basalt of Khandwa region.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, anhedral
2	Particle Surface	Crystalline
3	Texture	Foliated
4	Grain Size	fine Grained
5	Color	Gray color
6	Mineral Composition	The main minerals are plagioclase, Quartz, K-feldspar, muscovite flakes, biotite
7	Nature of Rock	Innocuous Gneiss It is part of Deccan Flood Basalt
8	General Physical Condition	Hard,

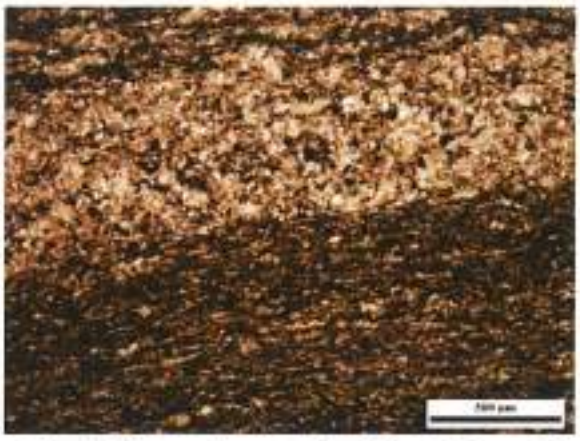


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

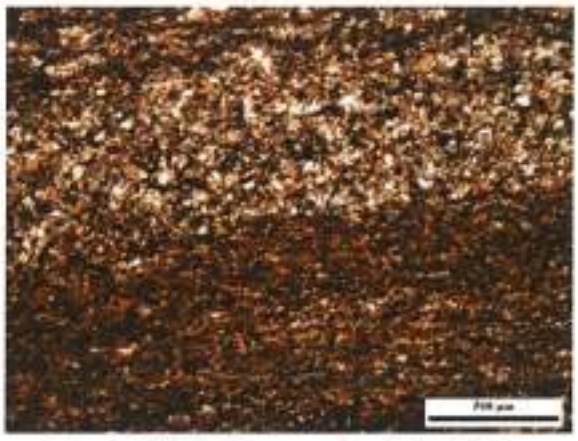


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Remarks:

1. Gneiss is mainly composed of plagioclase laths, pyroxene, olivine, feldspar and quartz. Some minerals like biotite, chlorite, hematite, and pyrite are also usually present in basalt with due course of P/T conditions.
2. Gneiss, green, or gray. Dark brown or reddishness usually owe their color to dissolution of unstable Fe-Mg rich minerals.
3. Reddish and purple varieties owe their color to the presence of hematite (iron oxide), and green varieties owe theirs to the presence of much chlorite, a green micaceous clay mineral.
4. The rock sample is thinly foliated porphyritic granitic gneiss
5. Weathered portions and fractured zones of granite and gneisses when saturated from moderate aquifers. These rocks are exposed in the north eastern part of the Khandwa district falling in Baldi block

Borehole No.	**:**	**SBH-2**	**Sample No.**	**:**	**14**
Type of Rock	**:**	**PICRITE BASALT**	**Sample Depth (m)**	**:**	**4.50 – 6.00**

Description:

The dominant constituent of the sample is pyroxene, olivine and hornblende with minor amount of quartz, feldspar. The pyroxene minerals show deep blue interference colour, with purple shown by olivine minerals, pale yellow by epidote and creamy white by feldspar. In the picrite-basalts the pyroxene phenocrysts have an optic axial angle of from 55° to 60°. In the basaltic flows the angle varies from 45° to 52°. It seems that the phenocryst boundaries are slightly weathered due to seepage of surface water.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, Euhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	Medium Grained
5	Color	Black/dark gray colored
6	Mineral Composition	The main minerals Pyroxene, olivine, hornblende.
7	Nature of Rock	Innocuous Picrite Basalt
8	General Physical Condition	Hard,

Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

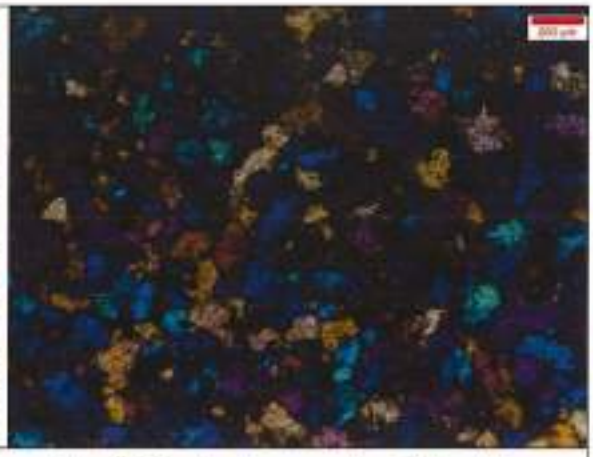


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	:	**SBH-2**	**Sample No.**	:	**50**
Type of Rock	:	**PICRITE BASALT**	**Sample Depth (m)**	:	**9.00 – 10.50**

Description:

The dominant constituent of the sample is pyroxene, olivine and hornblende with minor amount of quartz, feldspar. The pyroxene minerals show deep blue interference colour, with purple shown by olivine minerals, pale yellow by epidote and creamy white by feldspar. In the picrite-basalts the pyroxene phenocrysts have an optic axial angle of from 55° to 60°. In the basaltic flows the angle varies from 45° to 52°. It seems that the phenocryst boundaries are slightly weathered due to seepage of surface water.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, Euhedral
2	Particle Surface	Crystalline
3	Texture	
4	Grain Size	Medium Grained
5	Color	Black/dark gray colored
6	Mineral Composition	The main minerals Pyroxene, olivine, hornblende.
7	Nature of Rock	Innocuous Picrite Basalt
8	General Physical Condition	Hard,

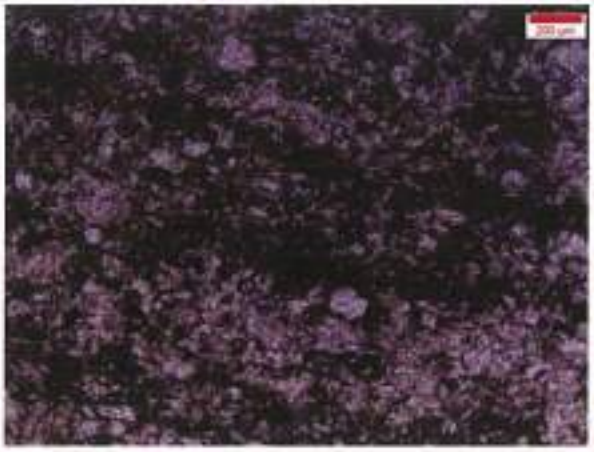


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

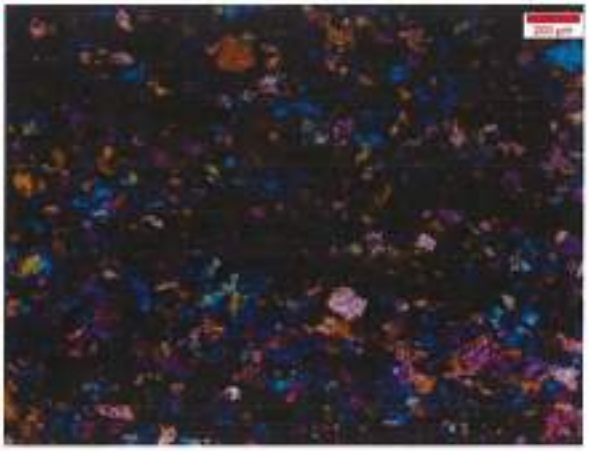


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	:	**SBH-2**	**Sample No.**	:	**134**
Type of Rock	:	**PICRITE BASALT**	**Sample Depth (m)**	:	**21.00 – 22.50**

Description:

The dominant constituent of the sample is pyroxene, olivine and hornblende with minor amount of quartz, feldspar. The pyroxene minerals show deep blue interference colour, with purple shown by olivine minerals, pale yellow by epidote and creamy white by feldspar. In the picrite-basalts the pyroxene phenocrysts have an optic axial angle of from 55° to 60°. In the basaltic flows the angle varies from 45° to 52°. It seems that the phenocryst boundaries are slightly weathered due to seepage of surface water.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, Euhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	Medium Grained
5	Color	Black/dark gray colored
6	Mineral Composition	The main minerals Pyroxene, olivine, hornblende.
7	Nature of Rock	Innocuous Picrite Basalt
8	General Physical Condition	Hard

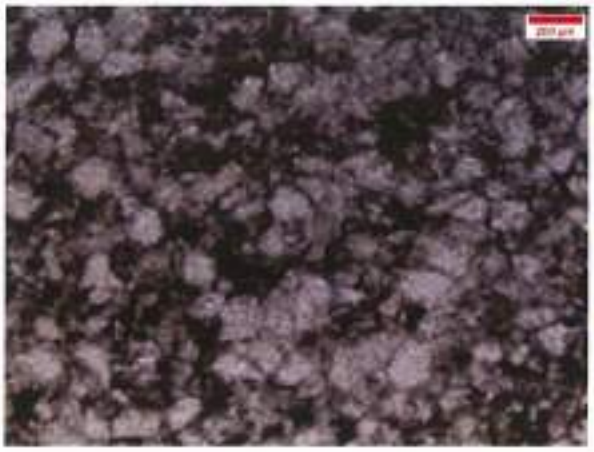


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

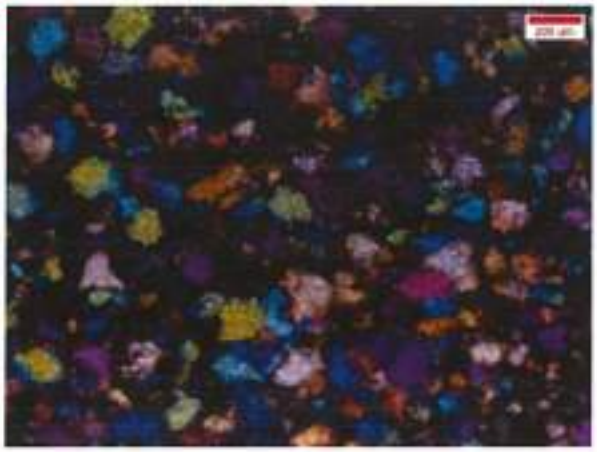


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	:	**SBH-2**	**Sample No.**	:	**195**
Type of Rock	:	**PICRITE BASALT**	**Sample Depth (m)**	:	**28.50 – 30.00**

Description:

The dominant constituent of the sample is pyroxene, olivine and hornblende with minor amount of quartz, feldspar. The pyroxene minerals show deep blue interference colour, with purple shown by olivine minerals, pale yellow by epidote and creamy white by feldspar. In the picrite-basalts the pyroxene phenocrysts have an optic axial angle of from 55° to 60°. In the basaltic flows the angle varies from 45° to 52°. It seems that the phenocryst boundaries are slightly weathered due to seepage of surface water.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, Euhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	Medium Grained
5	Color	Black/dark gray colored
6	Mineral Composition	The main minerals Pyroxene, olivine, hornblende.
7	Nature of Rock	Innocuous Picrite Basalt
8	General Physical Condition	Hard

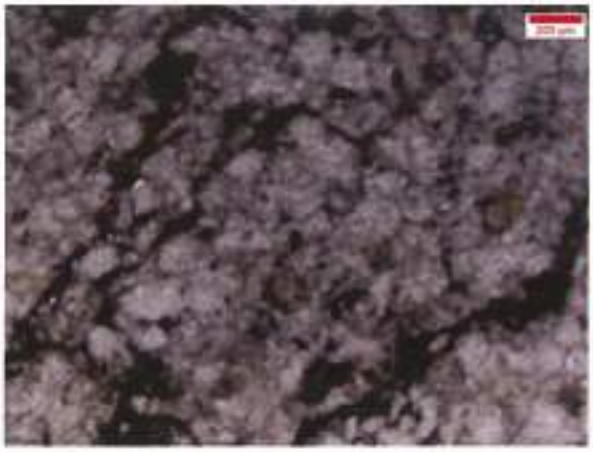


Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

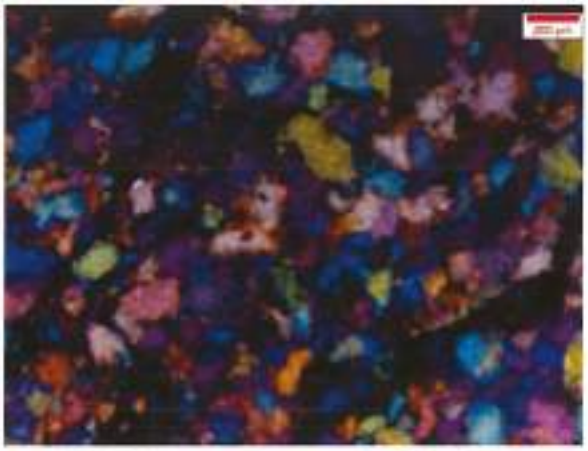


Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Borehole No.	:	**SBH-2**	**Sample No.**	:	**264**
Type of Rock	:	**PICRITE BASALT**	**Sample Depth (m)**	:	**37.50 – 39.00**

Description:

The dominant constituent of the sample is pyroxene, olivine and hornblende with minor amount of quartz, feldspar. The pyroxene minerals show deep blue interference colour, with purple shown by olivine minerals, pale yellow by epidote and creamy white by feldspar. In the picrite-basalts the pyroxene phenocrysts have an optic axial angle of from 55° to 60°. In the basaltic flows the angle varies from 45° to 52°. It seems that the phenocryst boundaries are slightly weathered due to seepage of surface water.

Petrographic Details:

S. No.	Particulars	
1	Shape of Crystal	Subhedral, Euhedral
2	Particle Surface	Crystalline
3	Texture	Porphyritic
4	Grain Size	Medium Grained
5	Color	Black/dark gray colored
6	Mineral Composition	The main minerals Pyroxene, olivine, hornblende.
7	Nature of Rock	Innocuous Picrite Basalt
8	General Physical Condition	Hard

Fig:1 Photomicrograph of the thin section under plane polarised light (PPL)

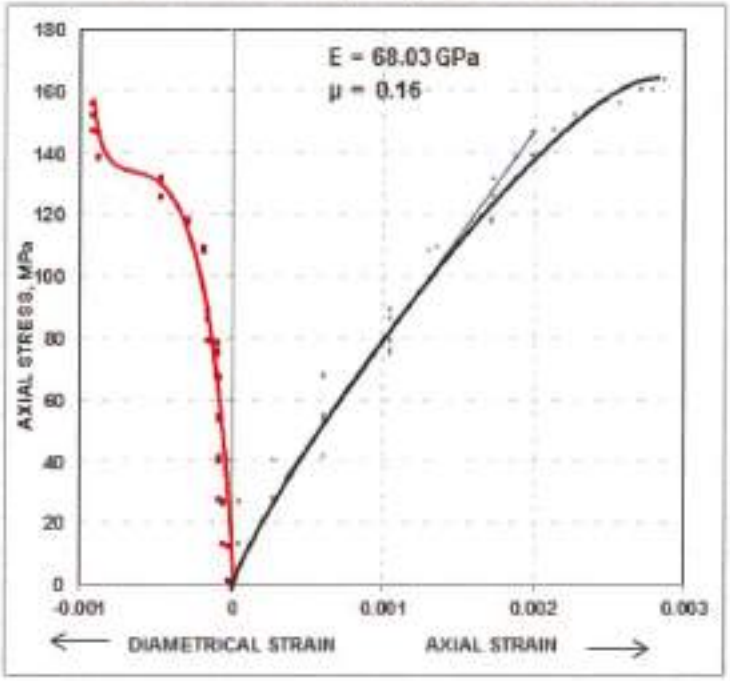
Fig:2 Photomicrograph of the thin section under cross polarised light (CPL)

Remarks:

1. The rock is a sample of Picrite Basalt
2. It is olivine rich rock with pyroxene mineral with opaque minerals.
3. The sample also have straight contact with other crystals, with some triple junctions making an interfacial angle of 120°
4. It is a variety of high-magnesium olivine basalt that is very rich in the mineral olivine. It is dark with yellow-green olivine phenocrysts (20-50%).
5. The origin of these picrite-basalts is due to differentiation by crystal settling followed by freezing and extrusion, seems to be supported by this study. (K.K Misra, 1971, and Krishnamurthy et, al. 1977)

FEW LABORATORY TESTING PHOTOGRAPHS

Modulus of elasticity and poisson's ratio curve



Modulus of elasticity and poisson's ratio curve at depth of 12.00 to 13.50m

Sample No. 67

Before Test

After Test

Photographs of Sample (Tr-Axial Test)

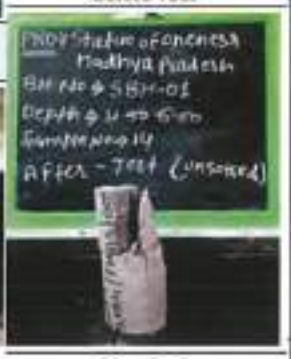
Before Test

After Test

UCS

After Test

Before Test



POINT LOAD

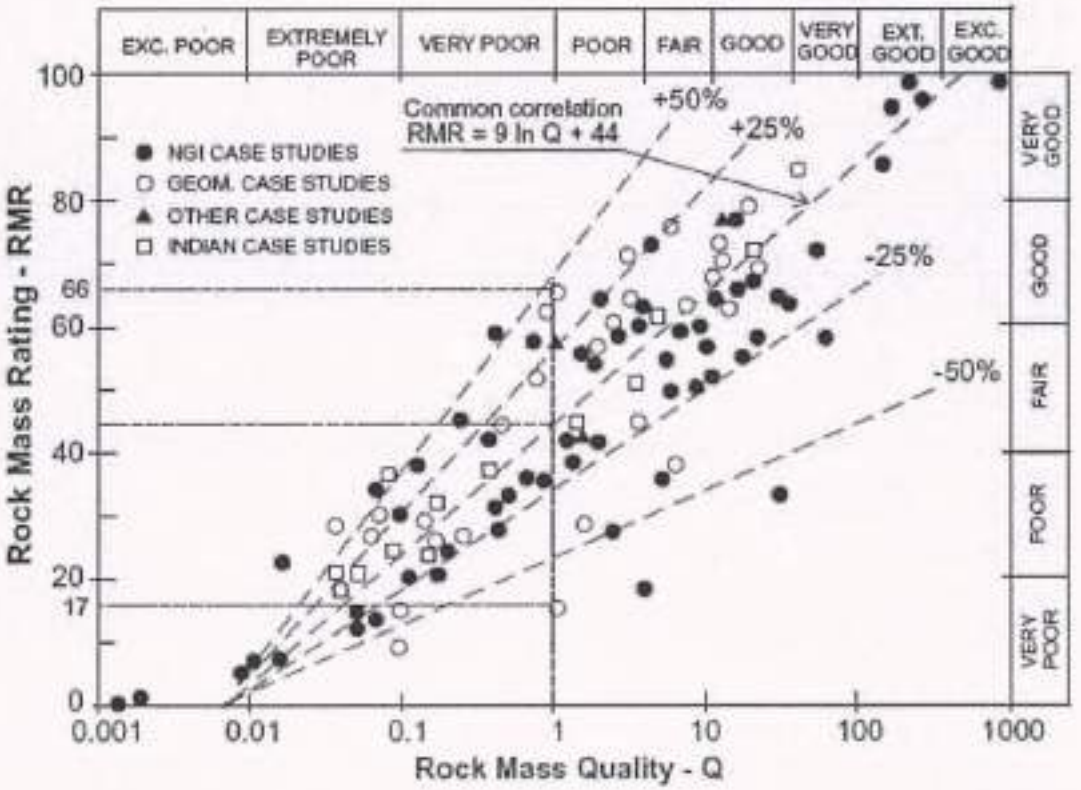
Before Test

After Test

5.5 Estimated RMR and Q value

Rock Mass Rating (RMR) of jointed rock masses, is worked out based on IS 13365 (part I).

Q is estimated as RMR=9 ln Q+44, which is a common correlation. Correlation between the RMR and Q-values according to Bieniawski (1989). Obviously for Q = 1, RMR varies from less than 20 to more than 60. Note that the Q system applies logarithmic scale while RMR has a linear one.



Correlation between the RMR and Q-values according to Bieniawski (1989) (left), using the figure of Palmström (2009) (right). Obviously for Q = 1, RMR varies from less than 20 to more than 60. Note that the Q system applies logarithmic scale while RMR has a linear one.

Researchers advocate adoption of both RMR and Q-systems of rock mass classifications simultaneously at the project sites and then use the above relationship to validate the results.

Table 14: Estimated Rock Mass rating (RMR) & Approximate Q Value

Depth (M)		Elevation (M)		Uni Axial Strength Rating	RQD %	RQD Rating	Spacing of Disc. (cm)	Condition of Disc.	GWC Rating	Basic RMR	Orientation of Disc.	RMR Rating	Class of Rock	Category of Rock	Q-Value	Category of Rock
From	To	From	To				Rating	Rating								
Bore Hole No. SBH-01		El. (M)		=	250.05	m										
1.50	3.00	248.55	247.05	4	0.00	3	5	10	10	32	-7	25	IV	Poor	0.12	Very Poor
3.00	4.50	247.05	245.55	7	0.00	3	5	10	10	35	-7	28	IV	Poor	0.17	Very Poor
4.50	6.00	245.55	244.05	7	0.00	3	5	10	10	35	-7	28	IV	Poor	0.17	Very Poor
6.00	7.50	244.05	242.55	12	0.00	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
7.50	9.00	242.55	241.05	12	14.60	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
9.00	10.50	241.05	239.55	7	16.00	3	5	10	10	35	-7	28	IV	Poor	0.17	Very Poor
10.50	12.00	239.55	238.05	12	21.30	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
12.00	13.50	238.05	236.55	12	24.00	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
13.50	15.00	236.55	235.05	12	8.60	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
15.00	16.50	235.05	233.55	12	12.00	3	5	10	4	34	-7	27	IV	Poor	0.15	Very Poor
16.50	18.00	233.55	232.05	12	0.00	3	5	10	4	34	-7	27	IV	Poor	0.15	Very Poor
18.00	19.50	232.05	230.55	12	16.60	3	5	10	4	34	-7	27	IV	Poor	0.15	Very Poor
19.50	21.00	230.55	229.05	12	67.30	13	10	25	7	67	-2	65	II	Good	10.31	Good
21.00	22.50	229.05	227.55	12	44.00	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
22.50	24.00	227.55	226.05	12	62.00	13	10	25	7	67	-2	65	II	Good	10.31	Good
24.00	25.50	226.05	224.55	12	36.00	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
25.50	27.00	224.55	223.05	12	31.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
27.00	28.50	223.05	221.55	12	73.30	13	10	25	7	67	-2	65	II	Good	10.31	Good

Depth (M)		Elevation (M)		Uni Axial Strength Rating	RQD %	RQD Rating	Spacing of Disc. (cm)	Condition of Disc.	GWC Rating	Basic RMR	Orientation of Disc.	RMR Rating	Class of Rock	Category of Rock	Q-Value	Category of Rock
From	To	From	To				Rating	Rating								
28.50	30.00	221.55	220.05	12	35.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
30.00	31.50	220.05	218.55	12	76.60	17	15	25	7	76	0	76	II	Good	35.01	Good
31.50	30.50	218.55	219.55	12	57.30	13	10	25	7	67	-2	65	II	Good	10.31	Good
33.00	34.50	217.05	215.55	12	50.00	13	10	20	7	62	-2	60	III	Fair	5.92	Fair
34.50	36.00	215.55	214.05	12	39.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
36.00	37.50	214.05	212.55	12	62.00	13	10	25	7	67	-2	65	II	Good	10.31	Good
37.50	39.00	212.55	211.05	12	22.00	3	5	20	7	47	-7	40	IV	Poor	0.64	Very Poor
39.00	40.50	211.05	209.55	12	40.60	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
40.50	42.00	209.55	208.05	12	32.60	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
42.00	43.50	208.05	206.55	12	45.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
43.50	45.00	206.55	205.05	12	8.00	3	5	20	7	47	-7	40	IV	Poor	0.64	Very Poor
45.00	46.50	205.05	203.55	12	20.00	3	5	20	7	47	-7	40	IV	Poor	0.64	Very Poor
46.50	48.00	203.55	202.05	12	56.60	13	10	25	7	67	-2	65	II	Good	10.31	Good
48.00	49.50	202.05	200.55	12	63.30	13	10	25	7	67	-2	65	II	Good	10.31	Good
Bore Hole No. SBH-02		**El. (M)**		=	**250.05**	m										
1.50	3.00	248.55	247.05	4	0.00	3	5	10	10	32	-7	25	IV	Poor	0.12	Very Poor
3.00	4.50	247.05	245.55	12	0.00	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
4.50	6.00	245.55	244.05	12	0.00	3	5	10	10	40	-7	33	IV	Poor	0.29	Very Poor
6.00	7.50	244.05	242.55	4	0.00	3	5	10	10	32	-7	25	IV	Poor	0.12	Very Poor
7.50	9.00	242.55	241.05	4	12.60	3	5	10	10	32	-7	25	IV	Poor	0.12	Very Poor
9.00	10.50	241.05	239.55	7	14.60	3	5	20	10	45	-7	38	IV	Poor	0.51	Very Poor

Depth (M)		Elevation (M)		Uni Axial Strength Rating	RQD %	RQD Rating	Spacing of Disc. (cm)	Condition of Disc.	GWC Rating	Basic RMR	Orientation of Disc.	RMR Rating	Class of Rock	Category of Rock	Q-Value	Category of Rock
From	To	From	To				Rating	Rating								
10.50	12.00	239.55	238.05	7	10.60	3	5	20	10	45	-7	38	IV	Poor	0.51	Very Poor
12.00	13.50	238.05	236.55	7	24.60	3	5	20	10	45	-7	38	IV	Poor	0.51	Very Poor
13.50	15.00	236.55	235.05	7	16.60	3	5	20	10	45	-7	38	IV	Poor	0.51	Very Poor
15.00	16.50	235.05	233.55	12	38.00	8	8	20	4	52	-7	45	III	Fair	1.12	Poor
16.50	18.00	233.55	232.05	7	56.00	13	10	20	4	54	-2	52	III	Fair	2.43	Poor
18.00	19.50	232.05	230.55	7	44.60	8	8	20	4	47	-7	40	IV	Poor	0.64	Very Poor
19.50	21.00	230.55	229.05	7	49.30	8	8	20	7	50	-7	43	III	Fair	0.89	Very Poor
21.00	22.50	229.05	227.55	12	29.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
22.50	24.00	227.55	226.05	7	29.30	8	8	20	7	50	-7	43	III	Fair	0.89	Very Poor
24.00	25.50	226.05	224.55	7	47.30	8	8	20	7	50	-7	43	III	Fair	0.89	Very Poor
25.50	27.00	224.55	223.05	4	44.60	8	8	20	7	47	-7	40	IV	Poor	0.64	Very Poor
27.00	28.50	223.05	221.55	4	36.00	8	8	20	7	47	-7	40	IV	Poor	0.64	Very Poor
28.50	30.00	221.55	220.05	12	49.30	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
30.00	31.50	220.05	218.55	15	43.30	8	8	20	7	58	-7	51	III	Fair	2.18	Poor
31.50	33.00	218.55	217.05	12	54.60	13	10	20	7	62	-2	60	III	Fair	5.92	Fair
33.00	34.50	217.05	215.55	12	60.60	13	10	20	7	62	-2	60	III	Fair	5.92	Fair
34.50	36.00	215.55	214.05	12	44.00	8	8	20	7	55	-7	48	III	Fair	1.56	Poor
36.00	37.50	214.05	212.55	12	7.30	3	5	20	7	47	-7	40	IV	Poor	0.64	Very Poor
37.50	39.00	212.55	211.05	12	8.00	3	5	20	7	47	-7	40	IV	Poor	0.64	Very Poor
39.00	40.50	211.05	209.55	4	0.00	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor
40.50	42.00	209.55	208.05	4	7.30	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor

Depth (M)		Elevation (M)		Uni Axial Strength Rating	RQD %	RQD Rating	Spacing of Disc. (cm)	Condition of Disc.	GWC Rating	Basic RMR	Orientation of Disc.	RMR Rating	Class of Rock	Category of Rock	Q-Value	Category of Rock
From	To	From	To				Rating	Rating								
42.00	43.50	208.05	206.55	4	0.00	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor
43.50	45.00	206.55	205.05	4	0.00	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor
45.00	46.50	205.05	203.55	4	0.00	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor
46.50	48.00	203.55	202.05	4	0.00	3	5	20	7	39	-7	32	IV	Poor	0.26	Very Poor
48.00	49.50	202.05	200.55	4	73.00	13	10	20	7	54	-2	52	III	Fair	2.43	Poor
49.50	50.00	200.55	200.05	4	74.00	13	10	20	7	54	-2	52	III	Fair	2.43	Poor

for INDIAN GEOTECHNICAL SERVICES

AJAY KUMAR GARG
Geotechnical Consultant / Partner

ANNEXURES

ANNEXURE – A	Borehole Location Plan
ANNEXURE – B	Detailed Core logs
ANNEXURE – C	In-situ Permeability Test Results
ANNEXURE – D	Pressuremeter Test Results and Curves
ANNEXURE – E	Laboratory Testing Results
ANNEXURE – F	Core Box Photographs

Borehole Location Plan

INDIAN GEOTECHNICAL SERVICES
(AN ISO 9001:2008 CERTIFIED COMPANY)
ENGINEERS & CONSULTANTS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

INDIAN GEOTECHNICAL SERVICES

NEW DELHI

AN ISO: 9001 - 2008 CERTIFIED COMPANY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PRADESH

Borehole No. SBH-1

CO-ORDINATES : E: 818550.220
N: 2460973.750

DATE STARTED : 11/07/2022
DATE COMPLETED : 30/07/2022

TOTAL DEPTH : 35.00m

GROUND ELEVATION (m): 256.000

NAGLE WITH HORIZONTAL : 90°
DRILLING METHOD : Hydraulic Rotary Drilling
TYPE OF CORE BARREL : Triple Tube Core Barrel

Depth (m)	Elevation (m)	Lithology: Description	Lithology: Log	Test Depth (m)	Rock Core Pcs Nos	Size of core pieces (%): > 10mm	10 to 35mm	35 - 75mm	75 - 150mm	> 150mm	Structure Condition Description	Percent Core Recovery (%): 0.00 - 15.00	15.00 - 30.00	30.00 - 60.00	60.00 - 75.00	85.00 - 100.00	RQD (%)	Type of bit	Joint Frequency / m	Size of hole	Casing	Depth of water level (m)	Penetration Rate (min/m)	Colour of return water	Drill Water Loss	Special Observations
1.500	248.550	Moderately weathered, highly fractured, brown colour, fine grained, **Porphyritic BASALT**		0.00 - 1.50	1-6	73.15	3.70	12.96	10.18	-	Very closely spaced joints					72.00	7.30	IMP	>15	NX	NX		16.39	Brown	Partial	Bed rock encountered at existing ground level.
3.000	247.050			1.50 - 3.00	7-7	83.33	-	16.67	-	-						16.00	0.00	IMP	>15	NX	NX		37.50	Brown	Partial	Partial water loss noticed upto drilled depth.
4.500	245.550			3.00 - 4.50	8-13	70.27	-	16.52	11.11	-						90.00	0.00	IMP	>15	NX	-		16.80	Brown	Partial	
6.000	244.050			4.50 - 6.00	14-15	79.56	-	7.15	13.27	-						65.30	0.00	IMP	>15	NX	-		16.36	Brown	Partial	
7.500	242.550	Highly weathered, highly fractured, greyish brown / brown colour, fine grained, **Porphyritic BASALT**		6.00 - 7.50	16	85.24	4.76	-	-	-						28.00	0.00	IMP	>15	NX	-		27.70	Brown	Partial	
9.000	241.050			7.50 - 9.00	17-35	25.19	-	50.37	24.44	-						90.00	14.60	IMP	>15	NX	-		16.66	Brown	Partial	
10.500	239.550			9.00 - 10.50	36-53	38.92	5.52	25.53	40.03	-						90.60	16.00	IMP	>15	NX	-		15.00	Brown	Partial	
12.000	238.050			10.50 - 12.00	54-61	49.58	-	17.61	19.21	13.61						83.30	21.30	IMP	>15	NX	-		15.62	Brown	Partial	
13.500	236.550			12.00 - 13.50	62-76	37.41	2.72	17.69	42.18	-						98.00	24.00	IMP	>15	NX	-		15.00	Brown	Partial	
15.000	235.050			13.50 - 15.00	77-88	51.65	3.30	33.93	11.03	-						78.60	8.60	IMP	>15	NX	-	15.00m	16.75	Brown	Partial	
16.500	233.550	Slightly weathered, highly to moderately fractured, greyish brown / brownish grey colour, fine grained, Porphyritic BASALT		15.00 - 16.50	89-98	57.15	-	30.01	-	12.85						93.30	12.00	IMP	>15	NX	-		17.64	Brown	Partial	
18.000	232.050			16.50 - 18.00	99-110	67.55	-	32.67	-	-						100.00	0.00	IMP	>15	NX	-		18.60	Brown	Partial	
19.500	230.550			18.00 - 19.50	111-128	42.00	4.00	26.67	27.33	-						100.00	16.60	IMP	>15	NX	-		16.00	Brown	Partial	
21.000	229.050			19.50 - 21.00	129-140	21.33	2.67	8.67	42.00	25.33	Closely to moderately spaced joints					100.00	67.30	IMP	8 - 5	NX	-		15.95	Brown	Partial	
22.500	227.550			21.00 - 22.50	141-155	22.80	2.67	26.80	35.33	14.00						100.00	44.00	IMP	10 - 8	NX	-		15.95	Brown	Partial	
24.000	226.050			22.50 - 24.00	156-169	20.67	1.33	10.00	16.00	52.00						100.00	62.00	IMP	5 - 3	NX	-		15.95	Brown	Partial	
25.500	224.550			24.00 - 25.50	167-185	12.67	4.00	26.00	29.33	28.00						100.00	36.00	IMP	15 - 8	NX	-		15.95	Brown	Partial	

INDIAN GEOTECHNICAL SERVICES

NEW DELHI

AN ISO 9001 - 2008 CERTIFIED COMPANY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PRADESH

Borehole No. SBH-1

CO-ORDINATES : E: 818550.220
N: 2460973.750

DATE STARTED : 11/07/2022
DATE COMPLETED : 30/07/2022

TOTAL DEPTH : 50.00m

GROUND ELEVATION (m): 250.050

ANGLE WITH HORIZONTAL : 90°
DRILLING METHOD : Hydraulic Rotary Drilling
TYPE OF CORE BARREL : Triple Tube Core Barrel

Depth (m)	Elevation (m)	Lithology: Description	Lithology: Log	Test Depth (m)	Rock Core Piece No.	Size of core pieces (%): <10mm	10 to 25mm	25 - 75mm	75 - 190mm	>190mm	Structure Condition Description	Percent Core Recovery (%): 0.00 - 19.99	20.00 - 39.99	40.00 - 59.99	60.00 - 79.99	80.00 - 100.00	RQD (%)	Type of bit	Joint Frequency / m	Size of hole	Casing	Depth of water level(m)	Maximum Hole Inclination (mm/mtr)	Colour of return water	Drill Water Loss	Special Observations
27.000	223.050	Slightly weathered, highly to slightly fractured, grey / brownish grey colour, fine grained, **Porphyritic BASALT**		25.50 - 27.00	186-196	18.15	-	22.39	6.39	53.17	Closely to moderately spaced joints					95.80	31.30	NMP	15 - 8	Nx	-		15.78	Brown	Partial	
28.500	221.550			27.00 - 28.50	197-206	6.84	-	4.76	27.21	59.18						98.00	73.30	NMP	8 - 5	Nx	-		14.28	Brown	Partial	
30.000	220.050			28.50 - 30.00	206-216	16.00	-	8.67	48.00	27.33						100.00	35.30	NMP	15 - 8	Nx	-		16.38	Brown	Partial	
31.500	218.550			30.00 - 31.50	217-224	11.33	-	6.00	6.00	76.67						100.00	76.60	NMP	8 - 1	Nx	-		14.42	Brown	Partial	
33.000	217.050			31.50 - 33.00	225-235	8.67	-	10.00	47.33	34.00						100.00	57.30	NMP	8 - 5	Nx	-		14.28	Brown	Partial	
34.500	215.550			33.00 - 34.50	236-243	16.05	-	4.76	33.33	42.89						98.00	50.00	NMP	8 - 5	Nx	-		15.88	Brown	Partial	
36.000	214.050			34.50 - 36.00	244-257	5.33	-	13.33	52.67	28.67						100.00	39.30	NMP	15 - 8	Nx	-		15.89	Brown	Partial	
37.500	212.550			36.00 - 37.50	258-267	22.45	-	2.72	49.56	29.25						96.00	62.00	NMP	8 - 5	Nx	-		30.00	Brown	Partial	
39.000	211.050			37.50 - 39.00	268-280	36.89	-	30.21	32.90	-						99.30	22.00	NMP	>15	Nx	-		27.27	Brown	Partial	
40.500	209.550			39.00 - 40.50	281-294	15.33	-	20.00	36.67	28.00						100.00	40.60	NMP	15 - 8	Nx	-		28.84	Brown	Partial	
42.000	208.050			40.50 - 42.00	295-309	19.73	-	28.23	39.46	11.58						98.00	32.60	NMP	15 - 8	Nx	-		26.41	Brown	Partial	
43.500	206.550			42.00 - 43.50	310-323	16.00	-	38.67	24.00	27.33						100.00	45.30	NMP	15 - 8	Nx	-		28.84	Brown	Partial	
45.000	205.050			43.50 - 45.00	324-342	24.11	-	61.70	14.18	-	Very closely spaced joints					94.00	8.00	NMP	>15	Nx	-		33.33	Brown	Partial	
46.500	203.550			45.00 - 46.50	343-361	10.67	-	57.33	12.00	20.00						100.00	20.00	NMP	>15	Nx	-		33.33	Brown	Partial	
48.000	202.050			46.50 - 48.00	362-371	4.67	-	18.00	21.33	64.00	Moderately spaced joints					100.00	56.60	NMP	8 - 5	Nx	-		33.07	Brown	Partial	
49.500	200.550			48.00 - 49.50	372-378	9.33	-	3.33	16.67	76.67						100.00	63.30	NMP	8 - 5	Nx	-		24.19	Brown	Partial	
50.000	200.050			49.50 - 50.00	379-388	58.06	-	-	9.03	22.92	Widely Spaced Joints					96.00	92.00	NMP	<1	Nx	-		25.88	Brown	Partial	

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Porphyritic BASALT Rock

INDIAN GEOTECHNICAL SERVICES

NEW DELHI

AN ISO: 9001 - 2008 CERTIFIED COMPANY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PRADESH

Borehole No. SBH-2

CO-ORDINATES : E: 618540.870
N: 2460956.760

DATE STARTED : 02/09/2022
DATE COMPLETED : 10/09/2022

TOTAL DEPTH : 35.00m

GROUND ELEVATION (m): 250.05

ANGLE WITH HORIZONTAL : 90°
DRILLING METHOD : Hydraulic Rotary Drilling
TYPE OF CORE BARREL : Triple Tube Core Barrel

Depth (m)	Elevation (m)	Lithology: Description	Lithology: Log	Test Depth (m)	Rock Core Piece No	Size of core pieces (%): > 100mm	Size of core pieces (%): 100 to 85mm	Size of core pieces (%): 85 - 11mm	Size of core pieces (%): 10 - 1.0mm	Size of core pieces (%): > 1.0mm	Structure Condition Description	Percent Core Recovery (%): 0.00 - 19.99	Percent Core Recovery (%): 20.00 - 39.99	Percent Core Recovery (%): 40.00 - 59.99	Percent Core Recovery (%): 60.00 - 79.99	Percent Core Recovery (%): 80.00 - 100.00	RQD (%)	Type of bit	Joint Frequency / m	Size of hole	Casing	Depth of water level(m)	Penetration Rate (min/5cm)	Colour of return water	Drill Water Loss	Special Observations
1.500	248.550	Moderately weathered, highly fractured, brownish grey colour, fine grained, BASALT		0.00 - 1.50	1-6	42.46	-	27.52	30.02	-	Very closely to closely spaced joints					53.30	8.60	IMP	>15	NX	No		19.75	Brown	Partial	Bad rock encountered at existing ground level.
3.000	247.050			1.50 - 3.00	7-9	75.00	-	12.50	12.50	-						48.00	0.00	IMP	>15	NX	No		15.02	Brown	Partial	Partial water loss noticed upto drilled depth.
4.500	245.550			3.00 - 4.50	10-11	78.54	-	10.01	11.44	-						46.60	0.00	IMP	>15	NX	No upto 3.50m		15.63	Brown	Partial	
6.000	244.050			4.50 - 6.00	12-15	69.28	-	20.48	10.24	-						58.60	0.00	IMP	>15	NX	-		16.66	Brown	Partial	
7.500	242.550			6.00 - 7.50	16-27	47.60	-	45.21	7.70	-						69.30	0.00	IMP	>15	NX	-		16.33	Brown	Partial	
9.000	241.050	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, BASALT		7.50 - 9.00	28-41	37.28	-	44.17	6.52	13.11						96.60	12.60	IMP	>15	NX	-		16.00	Brown	Partial	
10.500	239.550			9.00 - 10.50	42-51	43.18	-	30.45	26.36	-						88.00	14.60	IMP	>15	NX	-		15.90	Brown	Partial	
12.000	238.050			10.50 - 12.00	52-64	43.70	-	44.44	-	11.85						90.60	10.60	IMP	>15	NX	-		15.62	Brown	Partial	
13.500	236.550			12.00 - 13.50	65-74	46.00	-	17.33	36.67	-						100.00	24.60	IMP	>15	NX	-		16.75	Brown	Partial	
15.000	235.050			13.50 - 15.00	75-82	56.41	-	25.72	-	17.88						93.30	16.60	IMP	>15	NX	-	15.00m	15.90	Brown	Partial	
16.500	233.550			15.00 - 16.50	83-92	35.00	-	14.67	33.61	16.23						98.60	38.00	IMP	15 - 8	NX	-		15.60	Brown	Partial	
18.000	232.050			16.50 - 1.00	93-105	13.33	-	19.33	43.33	24.00	Closely to moderately spaced joints					100.00	56.00	IMP	8 - 5	NX	-		16.00	Brown	Partial	
19.500	230.550			1.00 - 19.50	106-115	28.92	-	13.88	17.94	39.34						96.60	44.60	IMP	15 - 8	NX	-		16.00	Brown	Partial	
21.000	229.050			19.50 - 21.00	116-127	17.69	-	19.73	30.61	31.97						98.60	49.30	IMP	15 - 8	NX	-		17.64	Brown	Partial	
22.500	227.550			21.00 - 22.50	128-138	28.67	-	16.67	30.00	24.67						100.00	29.30	IMP	15 - 8	NX	-		16.66	Brown	Partial	
24.000	226.050			22.50 - 24.00	139-152	28.67	-	26.00	35.33	12.00						100.00	29.30	IMP	15 - 8	NX	-		15.00	Brown	Partial	
25.500	224.550			24.00 - 25.50	153-163	-	-	13.64	53.03	34.85						88.60	47.30	IMP	15 - 8	NX	-		15.00	Brown	Partial	

INDIAN GEOTECHNICAL SERVICES

NEW DELHI

AN ISO: 9001 - 2008 CERTIFIED COMPANY

GEOLOGICAL LOG OF DRILL HOLE

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PRADESH

Borehole No. SBH-2

CO-ORDINATES : E: 618549.870
N: 3460966.760

DATE STARTED : 02/08/2022
DATE COMPLETED : 10/08/2022

TOTAL DEPTH : 50.00m

GROUND ELEVATION (m): 250.05

NAGLE WITH HORIZONTAL : 90°
DRILLING METHOD : Hydraulic Rotary Drilling
TYPE OF CORE BARREL : Triple Tube Core Barrel

Depth (m)	Elevation (m)	Lithology: Description	Lithology: Log	Test Depth (m)	Rock Core Piece No.	Size of core pieces (%): < 9mm	10 to 25mm	26 - 74mm	75 - 150mm	> 150mm	Structure Condition Description	Percent Core Recovery (%): 0.00 - 19.99	20.00 - 39.99	40.00 - 59.99	60.00 - 79.99	80.00 - 100.00	RQD (%)	Type of bit	Joint Frequency / m	Size of hole	Casing	Depth of water level(m)	Penetration Rate (min/cm)	Colour of return water	Drill Water Loss	Special Observations
27.000	223.050	Slightly weathered, highly to moderately fractured, brownish grey colour, fine grained, **BASALT**		25.50 - 27.00	164-178	15.33	-	28.00	56.67	-	Closely to moderately spaced joints					100.00	44.60	BIT	15 - 6	Rx	I		15.55	Brown	Partial	
28.500	221.550			27.00 - 28.50	179-192	28.10	-	26.54	31.55	10.74						99.30	36.00	WP	15 - 6	Nx	I		15.78	Brown	Partial	
30.000	220.050			28.50 - 30.00	193-202	23.81	-	8.84	42.86	24.49						96.00	49.30	BIT	15 - 6	Nx	I		15.55	Brown	Partial	
31.500	218.550			30.00 - 31.50	203-212	25.33	-	16.00	21.33	27.33						100.00	43.30	WP	15 - 6	Nx	I		16.30	Brown	Partial	
33.000	217.050			31.50 - 33.00	213-221	13.33	-	2.67	32.67	51.33						100.00	54.60	BIT	6 - 5	Nx	I		15.55	Brown	Partial	
34.500	215.550			33.00 - 34.50	222-233	13.33	-	6.33	49.33	28.00						100.00	60.60	WP	6 - 5	Nx	I		14.26	Brown	Partial	
36.000	214.050			34.50 - 36.00	234-245	16.00	-	27.33	30.67	26.00						100.00	44.00	BIT	15 - 6	Nx	I		20.69	Brown	Partial	
37.500	212.550			36.00 - 37.50	246-259	46.58	-	39.05	14.37	-	Very closely spaced joints					96.40	7.30	BIT	>15	Nx	I		21.42	Brown	Partial	
39.000	211.050			37.50 - 39.00	260-265	61.82	-	22.91	15.27	-						87.30	8.00	WP	>15	Nx	I		20.00	Brown	Partial	
40.500	209.550			39.00 - 40.50	266-276	56.41	-	24.39	19.29	-						93.30	0.00	BIT	>15	Nx	I		21.42	Brown	Partial	
42.000	208.050			40.50 - 42.00	277-292	33.78	-	46.90	20.32	-						86.60	7.30	WP	>15	Nx	I		21.42	Brown	Partial	
43.500	206.550			42.00 - 43.50	293-307	30.33	-	46.67	-	-						95.30	0.00	WP	>15	Nx	I		23.07	Brown	Partial	
45.000	205.050			43.50 - 45.00	308-322	38.03	-	41.97	-	-						95.30	0.00	WP	>15	Nx	I		23.07	Brown	Partial	
46.500	203.550			45.00 - 46.50	323-329	76.22	-	23.78	-	-						95.30	0.00	BIT	>15	Nx	I		21.42	Brown	Partial	
48.000	202.050			46.50 - 48.00	330-337	64.39	-	35.62	-	-						97.33	0.00	WP	>15	Nx	I		23.07	Brown	Partial	
49.500	200.550			48.00 - 49.50	338-350	33.13	-	33.13	31.75	-	Widely spaced joints					96.60	73.00	WP	6 - 5	Nx	I		21.42	Grey	Partial	
50.000	200.050			49.50 - 50.00	351-353	79.67	-	4.67	-	24.67						100.00	74.00	WP	6 - 5	Nx	I		20.69	Grey	Partial	

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BASALT Rock

ANNEXURE - C

PACKER TEST RESULTS (SBH-01 & SBH-2)

INDIAN GEOTECHNICAL SERVICES

PROJECT FORM FOR PRESENTATION OF DATA OF IN - SITU PERMEABILITY TESTS IN BED ROCK

Date : 01. 08. 2022

1) Project : Geotechnical Investigations works for State of Oneness project at Madhya Pradesh
2) Drill hole no.: SBH-01
3) Location : Statue Location
4) Chainage :
5) Collar Height (above ground level) : 17 Cm
6) Height of the water swivel above the collar of the hole : 3.42m
7) Type of drilling : Rotary
8) Diameter of drill hole : Nx
9) Total depth of hole : 50m
10) Depth tested from 6.00 m to 7.50 m total 1.50 m
11) Depth of the ground water : 15.0m
12) Size of the drill rod / pipe : Bw
13) Note (If any) :
14) Effective head (m) : 11.090

TEST SECTION		METER READING OF WATER INTAKE (in Ltr.)				WATER INTAKE LITERS							
FROM	TO	INITIAL READING	READING AFTER 5 MIN.	READING AFTER 10 MIN.	READING AFTER 15 MIN.	FIRST 5 MIN. (Col. 4 - 3)	SECOND 5 MIN. (Col. 5 - 4)	THIRD 5 MIN. (Col. 6 - 5)	INTAKE IN LAST 10 MINUTES (8 + 9)	WATER INTAKE Ltr./m/min.	WATER PRESSURE AT COLLAR Kg / Cm2	Total effective Pressue (MPA)	LUGEON VALUE
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6.00	7.50	50350.00	50378.00	50407.00	50438.00	28.00	29.00	31.00	60.00	4.00000	1.00	0.2109	18.97
6.00	7.50	50445.00	50485.00	50526.00	50569.00	40.00	41.00	43.00	84.00	5.60000	2.00	0.3109	18.01
6.00	7.50	50580.00	50644.00	50709.00	50774.00	64.00	65.00	65.00	130.00	8.66667	3.00	0.4109	21.09
6.00	7.50	50780.00	50822.00	50863.00	50907.00	42.00	41.00	44.00	85.00	5.66667	2.00	0.3109	18.23
6.00	7.50	50915.00	50945.00	50978.00	51009.00	30.00	31.00	33.00	64.00	4.26667	1.00	0.2109	20.23

Data format as per 5529 Part - II

INDIAN GEOTECHNICAL SERVICES

PROJECT FORM FOR PRESENTATION OF DATA OF IN - SITU PERMEABILITY TESTS IN BED ROCK

Date : 10. 08. 2022

1) Project : Geotechnical Investigations works for State of Oneness project at Madhya Pradesh
2) Drill hole no.: SBH-02
3) Location : Statue Location
4) Chainage :
5) Collar Height (above ground level) : 15 Cm
6) Height of the water swivel above the collar of the hole : 3.38m
7) Type of drilling : Rotary
8) Diameter of drill hole : Nx
9) Total depth of hole : 50m
10) Depth tested from 6.00 m to 7.50 m total 1.50 m
11) Depth of the ground water : 15.0m
12) Size of the drill rod / pipe : Bw
13) Note (If any) :
14) Effective head (m) : 11.030

TEST SECTION		METER READING OF WATER INTAKE (in Ltr.)				WATER INTAKE LITERS							
FROM	TO	INITIAL READING	READING AFTER 5 MIN.	READING AFTER 10 MIN.	READING AFTER 15 MIN.	FIRST 5 MIN. (Col. 4 - 3)	SECOND 5 MIN. (Col. 5 - 4)	THIRD 5 MIN. (Col. 6 - 5)	INTAKE IN LAST 10 MINUTES (8 + 9)	WATER INTAKE Ltr./m/min.	WATER PRESSURE AT COLLAR Kg / Cm2	Total effective Pressue (MPA)	LUGEON VALUE
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6.00	7.50	51050.00	51080.00	51110.00	51142.00	30.00	30.00	32.00	62.00	4.13333	1.00	0.2103	19.65
6.00	7.50	51150.00	51192.00	51235.00	51280.00	42.00	43.00	45.00	88.00	5.86667	2.00	0.3103	18.91
6.00	7.50	51295.00	51363.00	51433.00	51503.00	68.00	70.00	70.00	140.00	9.33333	3.00	0.4103	22.75
6.00	7.50	51512.00	51559.00	51604.00	51650.00	47.00	45.00	46.00	91.00	6.06667	2.00	0.3103	19.55
6.00	7.50	51660.00	51690.00	51722.00	51755.00	30.00	32.00	33.00	65.00	4.33333	1.00	0.2103	20.61

Data format as per 5529 Part - II

INDIAN GEOTECHNICAL SERVICES

PERMEABILITY TEST RESULTS

DRILL HOLE NO. : SBH-01

1) Project : State of Unity project at Kevadia Gujrat
2) Location : SBH-01
3) Co-ordinates : E: 618550.220, N: 2460973.750
4) Ground Elevation (m) : 250.050
5) Collar Height (above ground level) : 17 Cm
6) Type of drilling : Rotary
7) Diameter of drill hole : Nx
8) Total depth of hole : 50.00 m
9) Depth of the ground water : 15.00m
10) Size of the drill rod / pipe : Bw

INTERPRETATION OF WATER TEST DATA									
DEPTH OF TEST		LUGEON VALUE AT						FLOW TYPE AS PER TABLE 1 OF IS: 5529 (PART2)	LUGEON VALUE
FROM (m)	TO (m)	Low Pressure	Medium Pressure	High Pressure	Medium Pressure	Low Pressure	GRAPH		
6.00	7.50	18.97	18.01	21.09	18.23	20.23		DILATION (Group - C)	20.23

INDIAN GEOTECHNICAL SERVICES

PERMEABILITY TEST RESULTS

DRILL HOLE NO. : SBH-02

1) Project : State of Unity project at Kevadia Gujrat
2) Location : SBH-02
3) Co-ordinates : E: 618549.870, N: 2460966.760
4) Ground Elevation (m) : 250.050
5) Collar Height (above ground level) : 15Cm
6) Type of drilling : Rotary
7) Diameter of drill hole : Nx
8) Total depth of hole : 50.00 m
9) Depth of the ground water : 15.00m
10) Size of the drill rod / pipe : Bw

INTERPRETATION OF WATER TEST DATA									
DEPTH OF TEST		LUGEON VALUE AT						FLOW TYPE AS PER TABLE 1 OF IS: 5529 (PART2)	LUGEON VALUE
FROM (m)	TO (m)	Low Pressure	Medium Pressure	High Pressure	Medium Pressure	Low Pressure	GRAPH		
6.00	7.50	19.65	18.91	22.75	19.55	20.61		DILATION (Group - C)	20.61

ANNEXURE - C

PRESSUREMETER TEST RESULTS / CURVES (SBH-01)

INDIAN GEOTECHNICAL SERVICES

Summary of the High Pressure Dilatometer test results

Borehole No. SBH-01

Sr No	Depth, m	Poisson's Ratio	ΔP = P2 - P1		ΔR = R2 - R1		K = (ΔP/ΔR)	Intermediate Radius	Modulus of Elasticity, E		Shear Modulus, G	Limit Pressure, Pl
			P2	P1	R2	R1			MPa	kg/cm²	kg/cm²	kg/cm²
1	4	0.3	20	1	38.84	38.08	25.00	38.83	1261.97	1.26E+04	4.85E+03	200
2	8	0.3	20	1	37.94	37.59	54.29	37.86	2671.83	2.67E+04	1.03E+04	200
3	12	0.3	20	1	38.39	37.63	25.00	38.33	1245.73	1.25E+04	4.79E+03	200
4	16	0.3	20	1	38.21	37.6	31.15	38.11	1543.14	1.54E+04	5.94E+03	200
5	20	0.3	20	1	37.87	37.38	38.78	37.72	1901.40	1.90E+04	7.31E+03	200
6	24	0.3	20	1	37.82	37.34	39.58	37.33	1920.94	1.92E+04	7.39E+03	200
7	28	0.3	20	1	38.37	38.12	76.00	38.33	3787.00	3.79E+04	1.46E+04	200
8	32	0.3	20	1	38.33	37.99	55.88	38.3	2782.38	2.78E+04	1.07E+04	200
9	36	0.3	20	1	38.15	37.86	65.52	38.08	3243.37	3.24E+04	1.25E+04	200

INDIAN GEOTECHNICAL SERVICES

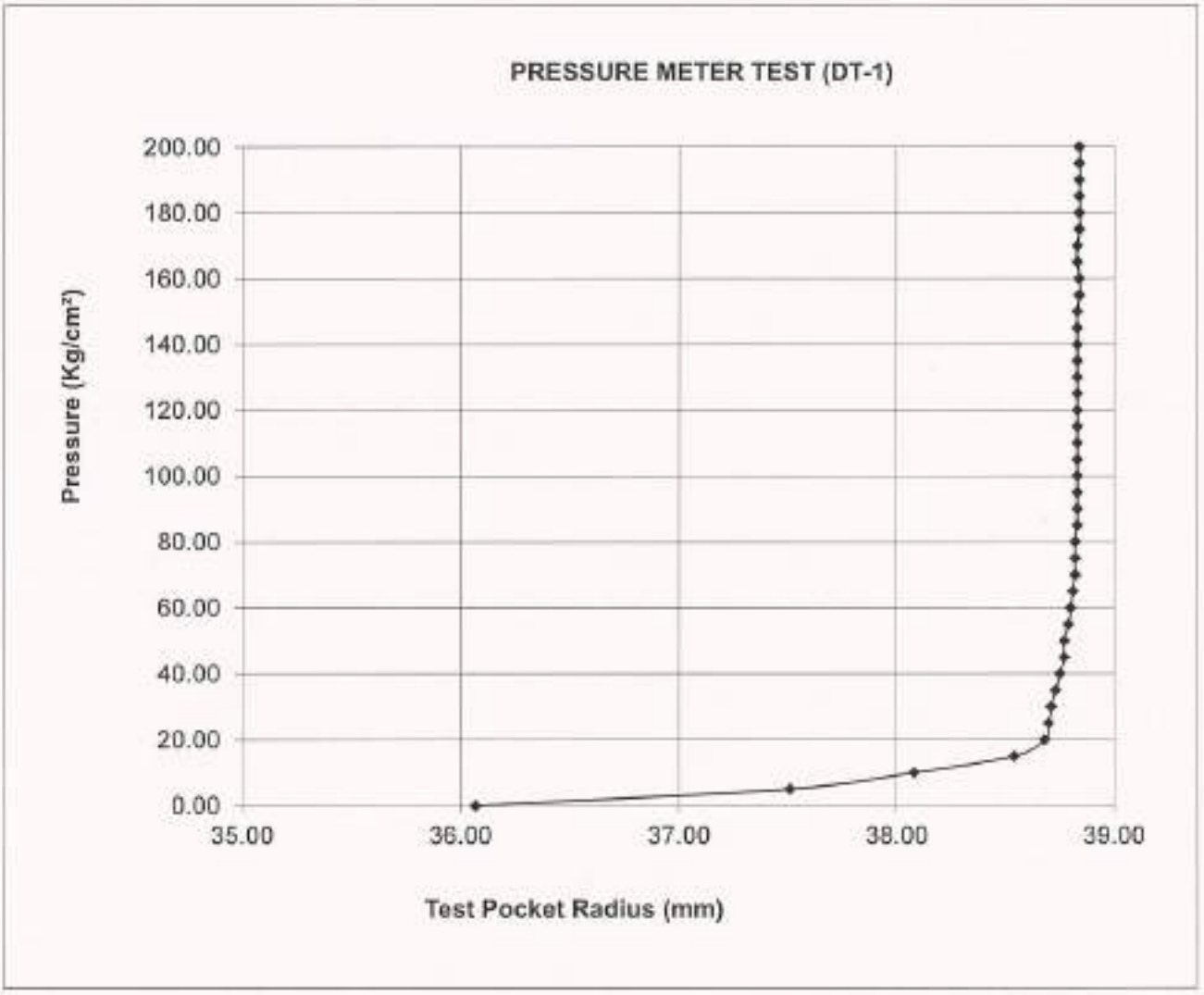
PRESSUREMETER DATA SHEET (DT-1)

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	4.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Highly to Moderately weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P\K	Reference (Inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.19	23.31	-0.02	23.33	36.07
2	0.50	5.00	1.99	25.49	-0.01	25.50	37.51
3	1.00	10.00	2.83	26.33	0.00	26.33	38.08
4	1.50	15.00	3.51	27.01	0.01	27.00	38.54
5	2.00	20.00	3.71	27.21	0.02	27.19	38.68
6	2.50	25.00	3.75	27.25	0.03	27.22	38.70
7	3.00	30.00	3.78	27.28	0.04	27.24	38.71
8	3.50	35.00	3.82	27.32	0.05	27.27	38.73
9	4.00	40.00	3.86	27.36	0.06	27.30	38.75
10	4.50	45.00	3.89	27.39	0.07	27.32	38.77
11	5.00	50.00	3.91	27.41	0.08	27.33	38.77
12	5.50	55.00	3.94	27.44	0.09	27.35	38.79
13	6.00	60.00	3.96	27.46	0.10	27.36	38.80
14	6.50	65.00	3.99	27.49	0.11	27.38	38.81
15	7.00	70.00	4.01	27.51	0.12	27.39	38.82
16	7.50	75.00	4.02	27.52	0.13	27.39	38.82
17	8.00	80.00	4.04	27.54	0.14	27.40	38.82
18	8.50	85.00	4.06	27.56	0.15	27.41	38.83
19	9.00	90.00	4.07	27.57	0.16	27.41	38.83
20	9.50	95.00	4.08	27.58	0.17	27.41	38.83
21	10.00	100.00	4.09	27.59	0.18	27.41	38.83
22	10.50	105.00	4.10	27.60	0.19	27.41	38.83
23	11.00	110.00	4.11	27.61	0.20	27.41	38.83
24	11.50	115.00	4.12	27.62	0.21	27.41	38.83
25	12.00	120.00	4.13	27.63	0.22	27.41	38.83
26	12.50	125.00	4.14	27.64	0.23	27.41	38.83
27	13.00	130.00	4.15	27.65	0.24	27.41	38.83
28	13.50	135.00	4.16	27.66	0.25	27.41	38.83
29	14.00	140.00	4.17	27.67	0.26	27.41	38.83
30	14.50	145.00	4.18	27.68	0.27	27.41	38.83
31	15.00	150.00	4.19	27.69	0.28	27.41	38.83
32	15.50	155.00	4.21	27.71	0.29	27.42	38.84
33	16.00	160.00	4.22	27.72	0.30	27.42	38.84
34	16.50	165.00	4.22	27.72	0.31	27.41	38.83
35	17.00	170.00	4.23	27.73	0.32	27.41	38.83
36	17.50	175.00	4.25	27.75	0.33	27.42	38.84
37	18.00	180.00	4.26	27.76	0.34	27.42	38.84
38	18.50	185.00	4.27	27.77	0.35	27.42	38.84
39	19.00	190.00	4.28	27.78	0.36	27.42	38.84
40	19.50	195.00	4.29	27.79	0.37	27.42	38.84
41	20.00	200.00	4.30	27.80	0.38	27.42	38.84
Membrane Calibration Constants				Thickness Correction K :Mn/m2/mm=50			

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	4.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Highly to Moderately weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-2)

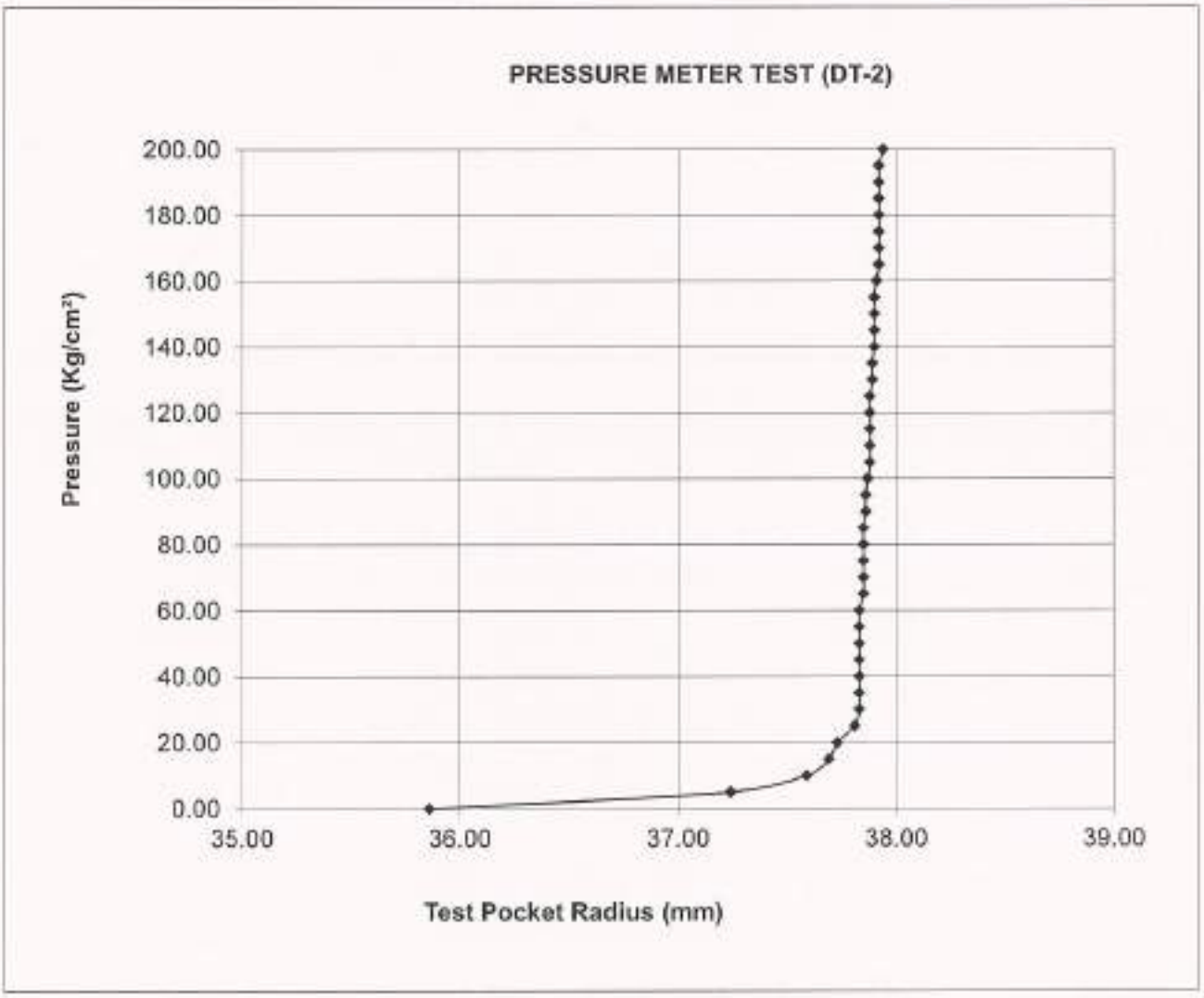
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	8.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P\K	Reference (inner Radius) Rs =RI-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.51	22.99	-0.02	23.01	35.86
2	0.50	5.00	1.59	25.09	-0.01	25.10	37.24
3	1.00	10.00	2.12	25.62	0.00	25.62	37.59
4	1.50	15.00	2.28	25.78	0.01	25.77	37.69
5	2.00	20.00	2.35	25.85	0.02	25.83	37.73
6	2.50	25.00	2.48	25.98	0.03	25.95	37.81
7	3.00	30.00	2.51	26.01	0.04	25.97	37.83
8	3.50	35.00	2.53	26.03	0.05	25.98	37.83
9	4.00	40.00	2.54	26.04	0.06	25.98	37.83
10	4.50	45.00	2.55	26.05	0.07	25.98	37.83
11	5.00	50.00	2.56	26.06	0.08	25.98	37.83
12	5.50	55.00	2.57	26.07	0.09	25.98	37.83
13	6.00	60.00	2.58	26.08	0.10	25.98	37.83
14	6.50	65.00	2.61	26.11	0.11	26.00	37.85
15	7.00	70.00	2.62	26.12	0.12	26.00	37.85
16	7.50	75.00	2.63	26.13	0.13	26.00	37.85
17	8.00	80.00	2.64	26.14	0.14	26.00	37.85
18	8.50	85.00	2.65	26.15	0.15	26.00	37.85
19	9.00	90.00	2.67	26.17	0.16	26.01	37.86
20	9.50	95.00	2.68	26.18	0.17	26.01	37.86
21	10.00	100.00	2.71	26.21	0.18	26.03	37.87
22	10.50	105.00	2.73	26.23	0.19	26.04	37.88
23	11.00	110.00	2.74	26.24	0.20	26.04	37.88
24	11.50	115.00	2.75	26.25	0.21	26.04	37.88
25	12.00	120.00	2.77	26.27	0.22	26.05	37.88
26	12.50	125.00	2.78	26.28	0.23	26.05	37.88
27	13.00	130.00	2.80	26.30	0.24	26.06	37.89
28	13.50	135.00	2.81	26.31	0.25	26.06	37.89
29	14.00	140.00	2.83	26.33	0.26	26.07	37.90
30	14.50	145.00	2.84	26.34	0.27	26.07	37.90
31	15.00	150.00	2.86	26.36	0.28	26.08	37.90
32	15.50	155.00	2.87	26.37	0.29	26.08	37.90
33	16.00	160.00	2.89	26.39	0.30	26.09	37.91
34	16.50	165.00	2.91	26.41	0.31	26.10	37.92
35	17.00	170.00	2.93	26.43	0.32	26.11	37.92
36	17.50	175.00	2.94	26.44	0.33	26.11	37.92
37	18.00	180.00	2.95	26.45	0.34	26.11	37.92
38	18.50	185.00	2.96	26.46	0.35	26.11	37.92
39	19.00	190.00	2.97	26.47	0.36	26.11	37.92
40	19.50	195.00	2.98	26.48	0.37	26.11	37.92
41	20.00	200.00	3.01	26.51	0.38	26.13	37.94

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50	

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	8.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-3)

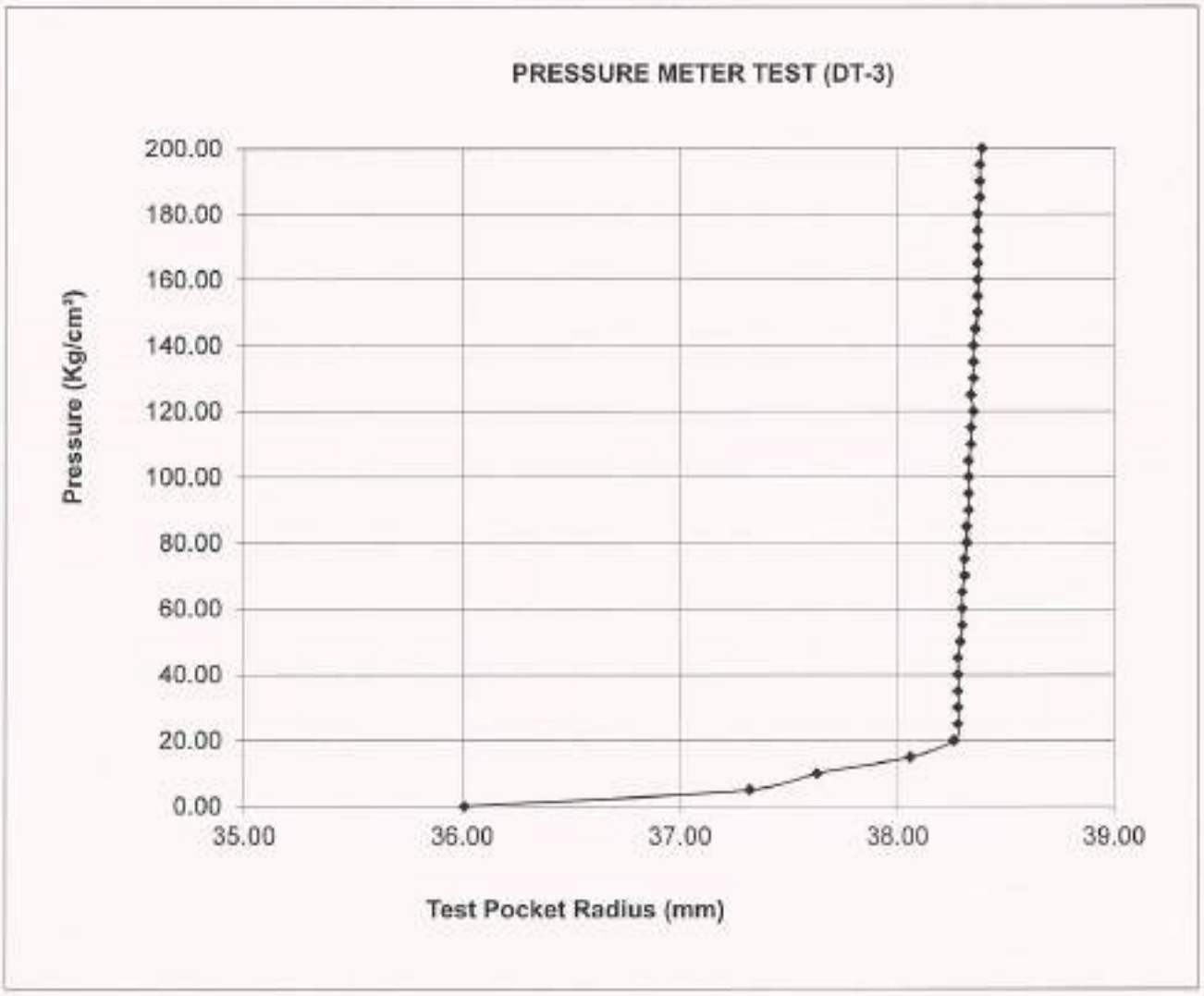
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	12.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P/K	Reference (inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.28	23.22	-0.02	23.24	36.01
2	0.50	5.00	1.71	25.21	-0.01	25.22	37.32
3	1.00	10.00	2.18	25.68	0.00	25.68	37.63
4	1.50	15.00	2.82	26.32	0.01	26.31	38.06
5	2.00	20.00	3.11	26.61	0.02	26.59	38.26
6	2.50	25.00	3.15	26.65	0.03	26.62	38.28
7	3.00	30.00	3.17	26.67	0.04	26.63	38.28
8	3.50	35.00	3.18	26.68	0.05	26.63	38.28
9	4.00	40.00	3.19	26.69	0.06	26.63	38.28
10	4.50	45.00	3.20	26.70	0.07	26.63	38.28
11	5.00	50.00	3.22	26.72	0.08	26.64	38.29
12	5.50	55.00	3.24	26.74	0.09	26.65	38.30
13	6.00	60.00	3.25	26.75	0.10	26.65	38.30
14	6.50	65.00	3.27	26.77	0.11	26.66	38.30
15	7.00	70.00	3.29	26.79	0.12	26.67	38.31
16	7.50	75.00	3.30	26.80	0.13	26.67	38.31
17	8.00	80.00	3.32	26.82	0.14	26.68	38.32
18	8.50	85.00	3.33	26.83	0.15	26.68	38.32
19	9.00	90.00	3.35	26.85	0.16	26.69	38.33
20	9.50	95.00	3.37	26.87	0.17	26.70	38.33
21	10.00	100.00	3.38	26.88	0.18	26.70	38.33
22	10.50	105.00	3.39	26.89	0.19	26.70	38.33
23	11.00	110.00	3.41	26.91	0.20	26.71	38.34
24	11.50	115.00	3.42	26.92	0.21	26.71	38.34
25	12.00	120.00	3.44	26.94	0.22	26.72	38.35
26	12.50	125.00	3.44	26.94	0.23	26.71	38.34
27	13.00	130.00	3.47	26.97	0.24	26.73	38.35
28	13.50	135.00	3.48	26.98	0.25	26.73	38.35
29	14.00	140.00	3.49	26.99	0.26	26.73	38.35
30	14.50	145.00	3.51	27.01	0.27	26.74	38.36
31	15.00	150.00	3.53	27.03	0.28	26.75	38.37
32	15.50	155.00	3.55	27.05	0.29	26.76	38.37
33	16.00	160.00	3.56	27.06	0.30	26.76	38.37
34	16.50	165.00	3.57	27.07	0.31	26.76	38.37
35	17.00	170.00	3.58	27.08	0.32	26.76	38.37
36	17.50	175.00	3.59	27.09	0.33	26.76	38.37
37	18.00	180.00	3.60	27.10	0.34	26.76	38.37
38	18.50	185.00	3.62	27.12	0.35	26.77	38.38
39	19.00	190.00	3.63	27.13	0.36	26.77	38.38
40	19.50	195.00	3.64	27.14	0.37	26.77	38.38
41	20.00	200.00	3.66	27.16	0.38	26.78	38.39

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	12.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-4)

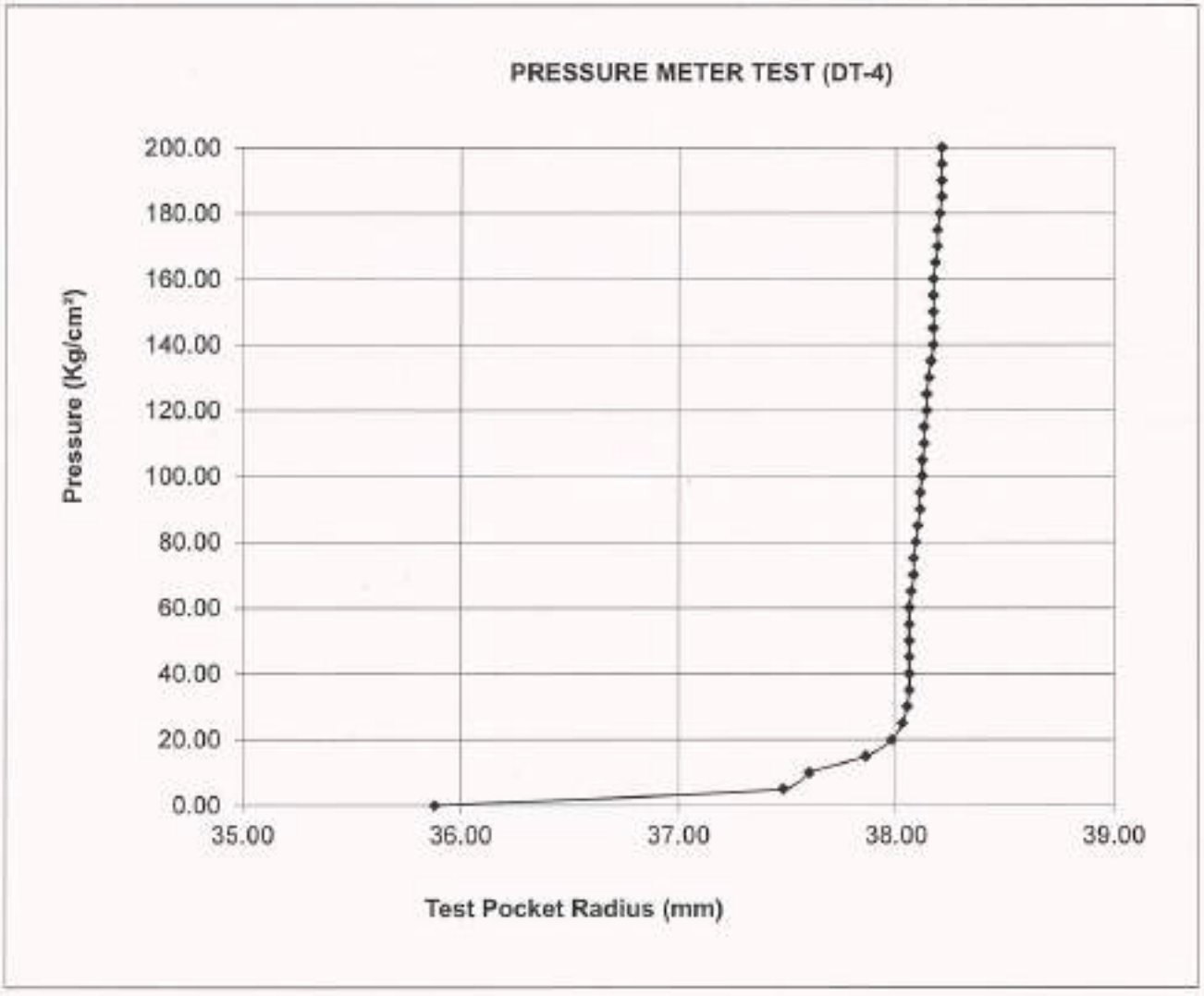
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	16.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= PVK	Reference (Inner Radius) Rs =RI-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.48	23.02	-0.02	23.04	35.88
2	0.50	5.00	1.96	25.45	-0.01	25.46	37.48
3	1.00	10.00	2.13	25.63	0.00	25.63	37.60
4	1.50	15.00	2.53	26.03	0.01	26.02	37.86
5	2.00	20.00	2.71	26.21	0.02	26.19	37.98
6	2.50	25.00	2.79	26.29	0.03	26.26	38.03
7	3.00	30.00	2.83	26.33	0.04	26.29	38.05
8	3.50	35.00	2.85	26.35	0.05	26.30	38.06
9	4.00	40.00	2.86	26.36	0.06	26.30	38.06
10	4.50	45.00	2.87	26.37	0.07	26.30	38.06
11	5.00	50.00	2.88	26.38	0.08	26.30	38.06
12	5.50	55.00	2.89	26.39	0.09	26.30	38.06
13	6.00	60.00	2.91	26.41	0.10	26.31	38.06
14	6.50	65.00	2.93	26.43	0.11	26.32	38.07
15	7.00	70.00	2.95	26.45	0.12	26.33	38.08
16	7.50	75.00	2.97	26.47	0.13	26.34	38.08
17	8.00	80.00	2.99	26.49	0.14	26.35	38.09
18	8.50	85.00	3.02	26.52	0.15	26.37	38.10
19	9.00	90.00	3.04	26.54	0.16	26.38	38.11
20	9.50	95.00	3.05	26.55	0.17	26.38	38.11
21	10.00	100.00	3.07	26.57	0.18	26.39	38.12
22	10.50	105.00	3.08	26.58	0.19	26.39	38.12
23	11.00	110.00	3.11	26.61	0.20	26.41	38.13
24	11.50	115.00	3.12	26.62	0.21	26.41	38.13
25	12.00	120.00	3.14	26.64	0.22	26.42	38.14
26	12.50	125.00	3.15	26.65	0.23	26.42	38.14
27	13.00	130.00	3.17	26.67	0.24	26.43	38.15
28	13.50	135.00	3.20	26.70	0.25	26.45	38.16
29	14.00	140.00	3.22	26.72	0.26	26.46	38.17
30	14.50	145.00	3.23	26.73	0.27	26.46	38.17
31	15.00	150.00	3.24	26.74	0.28	26.46	38.17
32	15.50	155.00	3.25	26.75	0.29	26.46	38.17
33	16.00	160.00	3.27	26.77	0.30	26.47	38.17
34	16.50	165.00	3.29	26.79	0.31	26.48	38.18
35	17.00	170.00	3.31	26.81	0.32	26.49	38.19
36	17.50	175.00	3.33	26.83	0.33	26.50	38.19
37	18.00	180.00	3.35	26.85	0.34	26.51	38.20
38	18.50	185.00	3.37	26.87	0.35	26.52	38.21
39	19.00	190.00	3.38	26.88	0.36	26.52	38.21
40	19.50	195.00	3.39	26.89	0.37	26.52	38.21
41	20.00	200.00	3.40	26.90	0.38	26.52	38.21

Membrane Calibration Constants | Thickness Correction K :Mn/m2/mm=50

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	16.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Slightly weathered, Highly fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-5)

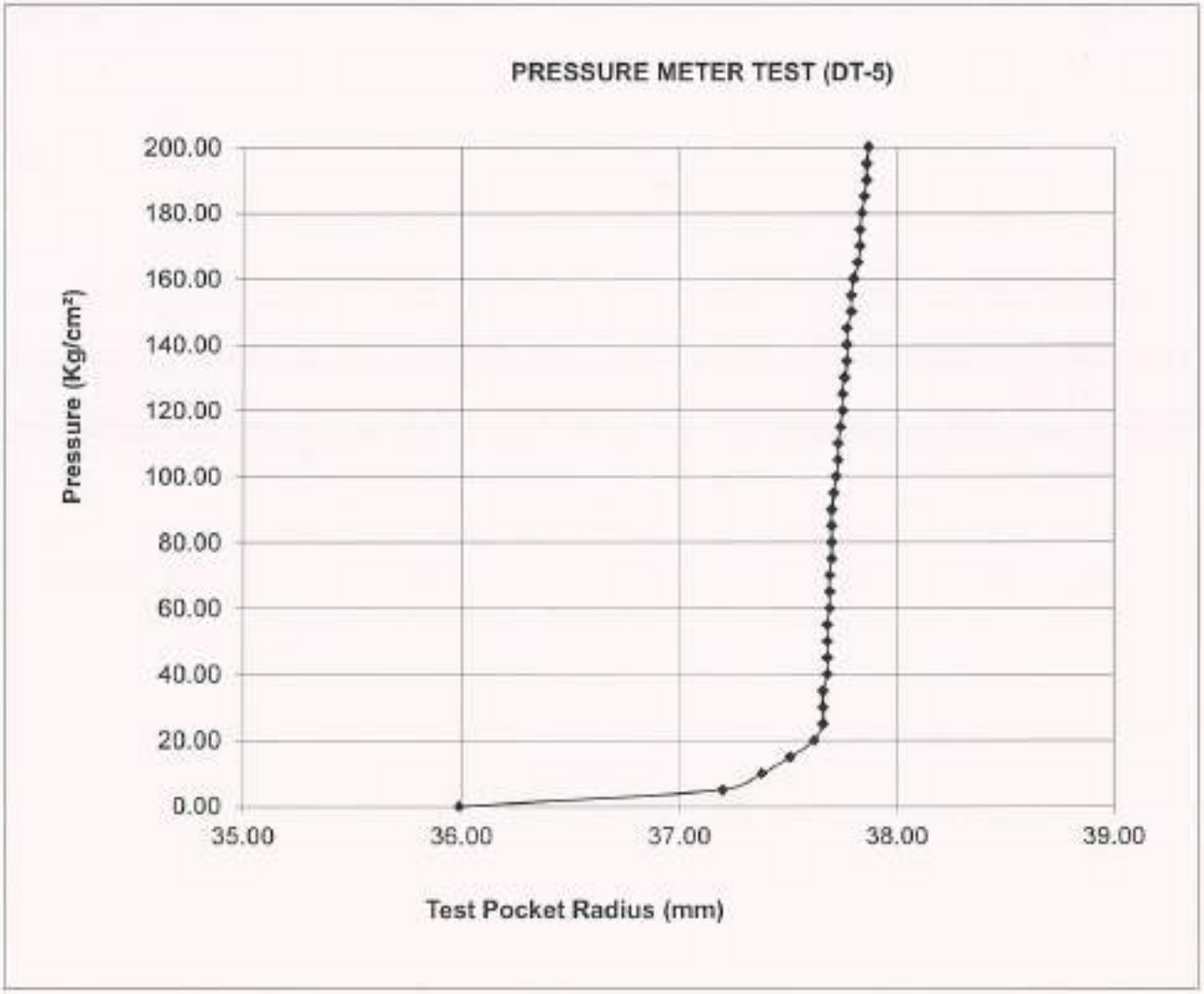
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	20.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= Pi/K	Reference (inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.31	23.19	-0.02	23.21	35.99
2	0.50	5.00	1.53	25.03	-0.01	25.04	37.20
3	1.00	10.00	1.81	25.31	0.00	25.31	37.38
4	1.50	15.00	2.02	25.52	0.01	25.51	37.51
5	2.00	20.00	2.18	25.68	0.02	25.66	37.62
6	2.50	25.00	2.25	25.75	0.03	25.72	37.66
7	3.00	30.00	2.27	25.77	0.04	25.73	37.66
8	3.50	35.00	2.28	25.78	0.05	25.73	37.66
9	4.00	40.00	2.31	25.81	0.06	25.75	37.68
10	4.50	45.00	2.33	25.83	0.07	25.76	37.68
11	5.00	50.00	2.34	25.84	0.08	25.76	37.68
12	5.50	55.00	2.35	25.85	0.09	25.76	37.68
13	6.00	60.00	2.37	25.87	0.10	25.77	37.69
14	6.50	65.00	2.38	25.88	0.11	25.77	37.69
15	7.00	70.00	2.39	25.89	0.12	25.77	37.69
16	7.50	75.00	2.41	25.91	0.13	25.78	37.70
17	8.00	80.00	2.42	25.92	0.14	25.78	37.70
18	8.50	85.00	2.43	25.93	0.15	25.78	37.70
19	9.00	90.00	2.45	25.95	0.16	25.79	37.70
20	9.50	95.00	2.47	25.97	0.17	25.80	37.71
21	10.00	100.00	2.49	25.99	0.18	25.81	37.72
22	10.50	105.00	2.52	26.02	0.19	25.83	37.73
23	11.00	110.00	2.53	26.03	0.20	25.83	37.73
24	11.50	115.00	2.55	26.05	0.21	25.84	37.74
25	12.00	120.00	2.57	26.07	0.22	25.85	37.75
26	12.50	125.00	2.59	26.09	0.23	25.86	37.75
27	13.00	130.00	2.61	26.11	0.24	25.87	37.76
28	13.50	135.00	2.63	26.13	0.25	25.88	37.77
29	14.00	140.00	2.65	26.15	0.26	25.89	37.77
30	14.50	145.00	2.66	26.16	0.27	25.89	37.77
31	15.00	150.00	2.69	26.19	0.28	25.91	37.79
32	15.50	155.00	2.71	26.21	0.29	25.92	37.79
33	16.00	160.00	2.73	26.23	0.30	25.93	37.80
34	16.50	165.00	2.77	26.27	0.31	25.96	37.82
35	17.00	170.00	2.79	26.29	0.32	25.97	37.83
36	17.50	175.00	2.81	26.31	0.33	25.98	37.83
37	18.00	180.00	2.83	26.33	0.34	25.99	37.84
38	18.50	185.00	2.85	26.35	0.35	26.00	37.85
39	19.00	190.00	2.87	26.37	0.36	26.01	37.86
40	19.50	195.00	2.89	26.39	0.37	26.02	37.86
41	20.00	200.00	2.91	26.41	0.38	26.03	37.87

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50	

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	20.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-6)

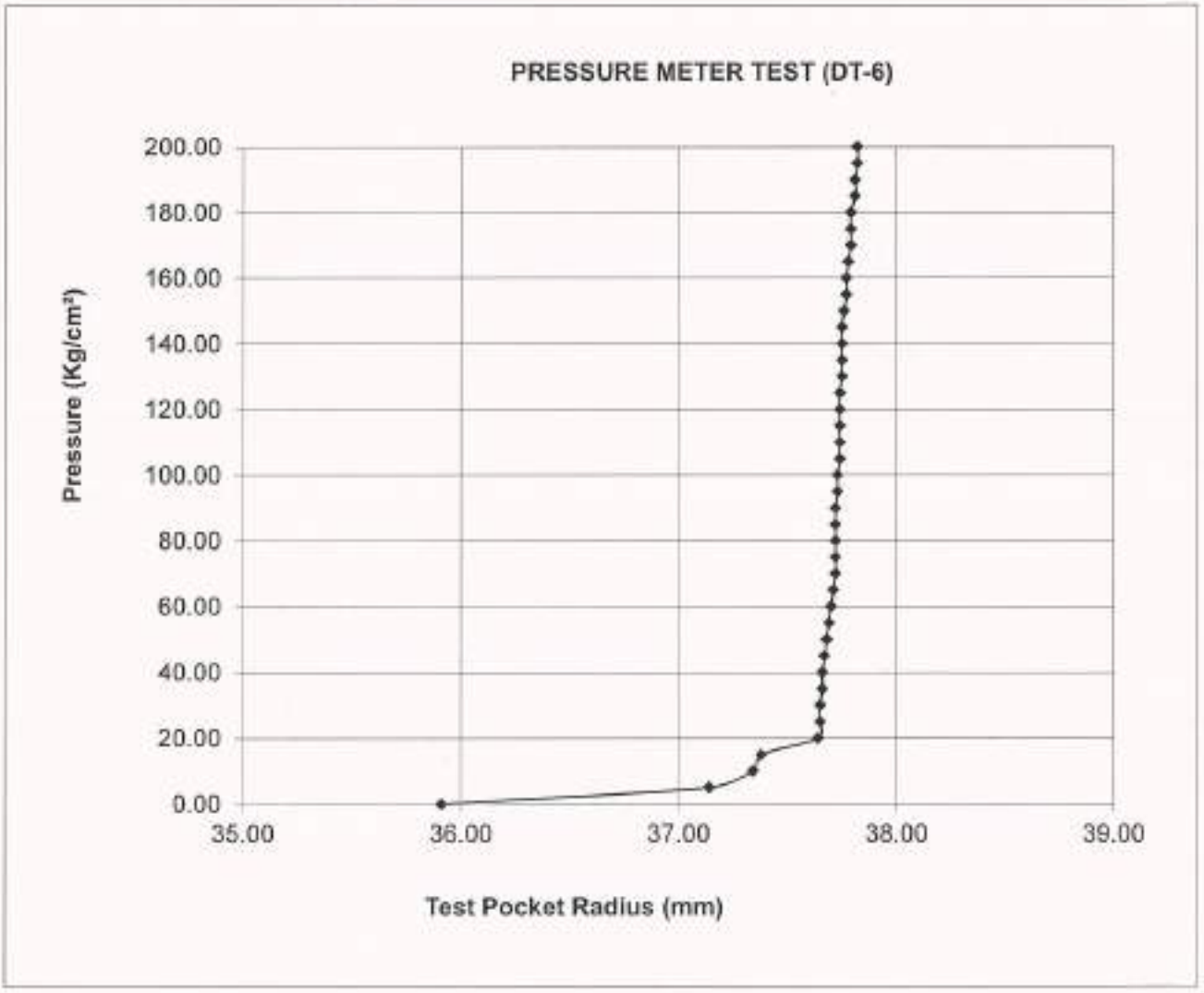
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	24.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P\K	Reference (inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.44	23.06	-0.02	23.08	35.91
2	0.50	5.00	1.44	24.94	-0.01	24.95	37.14
3	1.00	10.00	1.75	25.25	0.00	25.25	37.34
4	1.50	15.00	1.83	25.33	0.01	25.32	37.38
5	2.00	20.00	2.21	25.71	0.02	25.69	37.64
6	2.50	25.00	2.24	25.74	0.03	25.71	37.65
7	3.00	30.00	2.25	25.75	0.04	25.71	37.65
8	3.50	35.00	2.27	25.77	0.05	25.72	37.66
9	4.00	40.00	2.29	25.79	0.06	25.73	37.66
10	4.50	45.00	2.31	25.81	0.07	25.74	37.67
11	5.00	50.00	2.33	25.83	0.08	25.75	37.68
12	5.50	55.00	2.36	25.86	0.09	25.77	37.69
13	6.00	60.00	2.39	25.89	0.10	25.79	37.70
14	6.50	65.00	2.41	25.91	0.11	25.80	37.71
15	7.00	70.00	2.43	25.93	0.12	25.81	37.72
16	7.50	75.00	2.44	25.94	0.13	25.81	37.72
17	8.00	80.00	2.45	25.95	0.14	25.81	37.72
18	8.50	85.00	2.46	25.96	0.15	25.81	37.72
19	9.00	90.00	2.47	25.97	0.16	25.81	37.72
20	9.50	95.00	2.49	25.99	0.17	25.82	37.73
21	10.00	100.00	2.51	26.01	0.18	25.83	37.73
22	10.50	105.00	2.53	26.03	0.19	25.84	37.74
23	11.00	110.00	2.54	26.04	0.20	25.84	37.74
24	11.50	115.00	2.55	26.05	0.21	25.84	37.74
25	12.00	120.00	2.56	26.06	0.22	25.84	37.74
26	12.50	125.00	2.57	26.07	0.23	25.84	37.74
27	13.00	130.00	2.59	26.09	0.24	25.85	37.75
28	13.50	135.00	2.60	26.10	0.25	25.85	37.75
29	14.00	140.00	2.62	26.12	0.26	25.86	37.75
30	14.50	145.00	2.63	26.13	0.27	25.86	37.75
31	15.00	150.00	2.65	26.15	0.28	25.87	37.76
32	15.50	155.00	2.67	26.17	0.29	25.88	37.77
33	16.00	160.00	2.69	26.19	0.30	25.89	37.77
34	16.50	165.00	2.71	26.21	0.31	25.90	37.78
35	17.00	170.00	2.73	26.23	0.32	25.91	37.79
36	17.50	175.00	2.74	26.24	0.33	25.91	37.79
37	18.00	180.00	2.76	26.26	0.34	25.92	37.79
38	18.50	185.00	2.79	26.29	0.35	25.94	37.81
39	19.00	190.00	2.81	26.31	0.36	25.95	37.81
40	19.50	195.00	2.83	26.33	0.37	25.96	37.82
41	20.00	200.00	2.84	26.34	0.38	25.96	37.82

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	24.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-7)

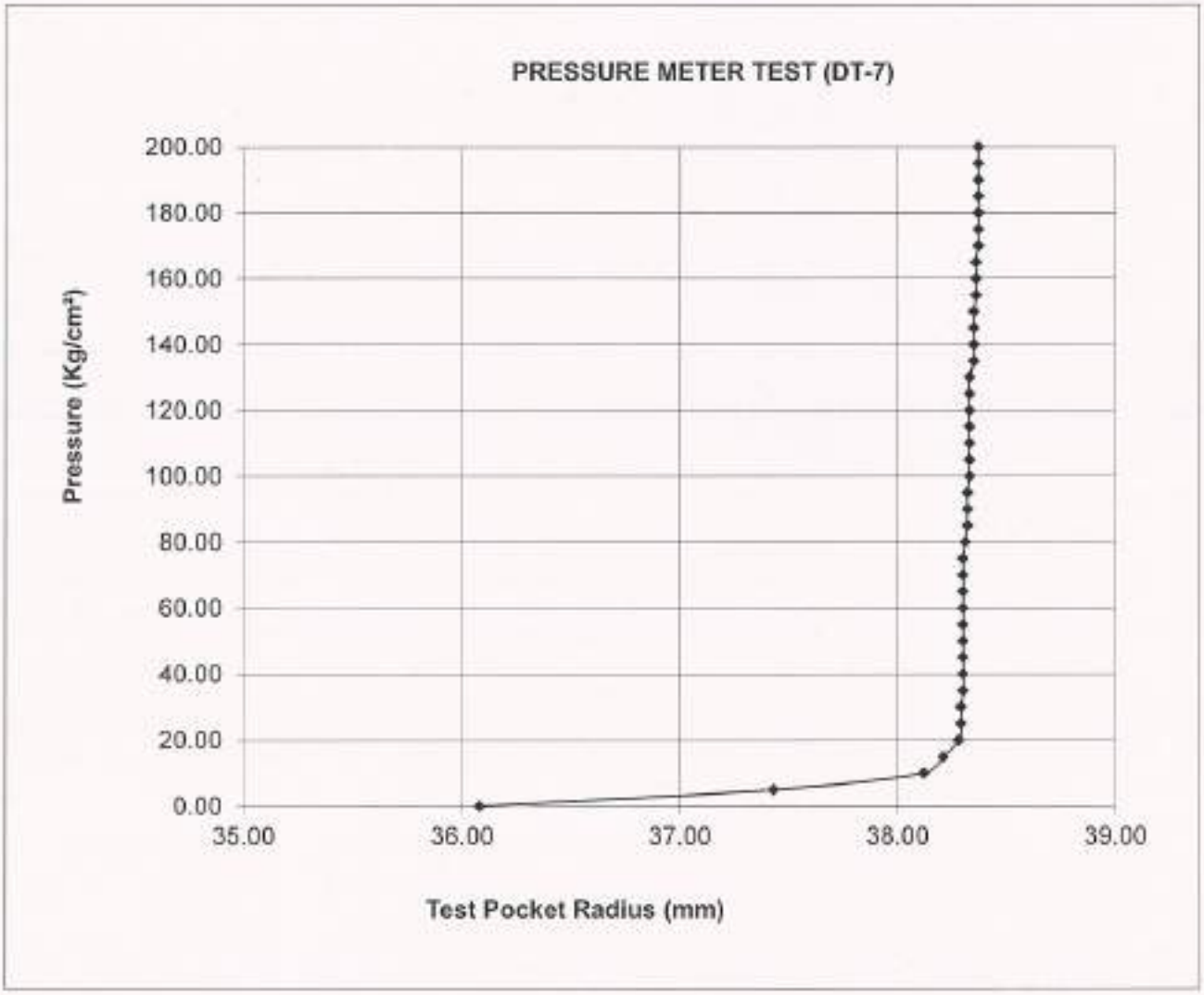
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	28.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately to slightly fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P\K	Reference (Inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.17	23.33	-0.02	23.35	36.08
2	0.50	5.00	1.88	25.38	-0.01	25.39	37.43
3	1.00	10.00	2.89	26.39	0.00	26.39	38.12
4	1.50	15.00	3.03	26.53	0.01	26.52	38.21
5	2.00	20.00	3.14	26.64	0.02	26.62	38.28
6	2.50	25.00	3.17	26.67	0.03	26.64	38.29
7	3.00	30.00	3.18	26.68	0.04	26.64	38.29
8	3.50	35.00	3.20	26.70	0.05	26.65	38.30
9	4.00	40.00	3.21	26.71	0.06	26.65	38.30
10	4.50	45.00	3.22	26.72	0.07	26.65	38.30
11	5.00	50.00	3.23	26.73	0.08	26.65	38.30
12	5.50	55.00	3.24	26.74	0.09	26.65	38.30
13	6.00	60.00	3.25	26.75	0.10	26.65	38.30
14	6.50	65.00	3.27	26.77	0.11	26.66	38.30
15	7.00	70.00	3.28	26.78	0.12	26.66	38.30
16	7.50	75.00	3.29	26.79	0.13	26.66	38.30
17	8.00	80.00	3.31	26.81	0.14	26.67	38.31
18	8.50	85.00	3.33	26.83	0.15	26.68	38.32
19	9.00	90.00	3.34	26.84	0.16	26.68	38.32
20	9.50	95.00	3.35	26.85	0.17	26.68	38.32
21	10.00	100.00	3.37	26.87	0.18	26.69	38.33
22	10.50	105.00	3.38	26.88	0.19	26.69	38.33
23	11.00	110.00	3.39	26.89	0.20	26.69	38.33
24	11.50	115.00	3.40	26.90	0.21	26.69	38.33
25	12.00	120.00	3.41	26.91	0.22	26.69	38.33
26	12.50	125.00	3.42	26.92	0.23	26.69	38.33
27	13.00	130.00	3.44	26.94	0.24	26.70	38.33
28	13.50	135.00	3.47	26.97	0.25	26.72	38.35
29	14.00	140.00	3.48	26.98	0.26	26.72	38.35
30	14.50	145.00	3.49	26.99	0.27	26.72	38.35
31	15.00	150.00	3.51	27.01	0.28	26.73	38.35
32	15.50	155.00	3.53	27.03	0.29	26.74	38.36
33	16.00	160.00	3.54	27.04	0.30	26.74	38.36
34	16.50	165.00	3.55	27.05	0.31	26.74	38.36
35	17.00	170.00	3.57	27.07	0.32	26.75	38.37
36	17.50	175.00	3.59	27.09	0.33	26.76	38.37
37	18.00	180.00	3.59	27.09	0.34	26.75	38.37
38	18.50	185.00	3.61	27.11	0.35	26.76	38.37
39	19.00	190.00	3.62	27.12	0.36	26.76	38.37
40	19.50	195.00	3.63	27.13	0.37	26.76	38.37
41	20.00	200.00	3.64	27.14	0.38	26.76	38.37

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50	

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	28.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately to slightly fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-8)

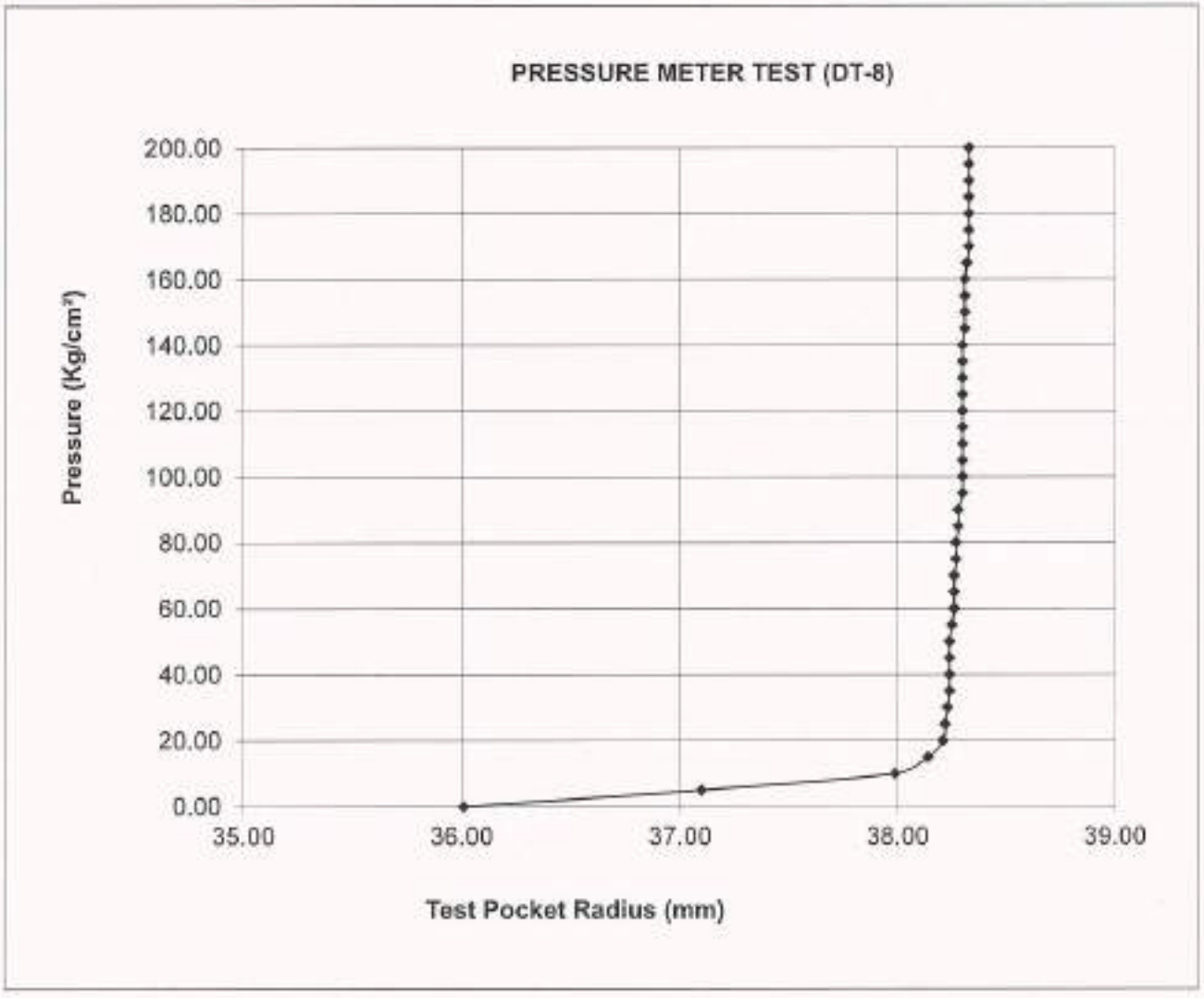
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	32.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= PVK	Reference (inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.28	23.22	-0.02	23.24	36.01
2	0.50	5.00	1.39	24.89	-0.01	24.90	37.10
3	1.00	10.00	2.71	26.21	0.00	26.21	37.99
4	1.50	15.00	2.93	26.43	0.01	26.42	38.14
5	2.00	20.00	3.04	26.54	0.02	26.52	38.21
6	2.50	25.00	3.07	26.57	0.03	26.54	38.22
7	3.00	30.00	3.09	26.59	0.04	26.55	38.23
8	3.50	35.00	3.11	26.61	0.05	26.56	38.24
9	4.00	40.00	3.12	26.62	0.06	26.56	38.24
10	4.50	45.00	3.13	26.63	0.07	26.56	38.24
11	5.00	50.00	3.15	26.65	0.08	26.57	38.24
12	5.50	55.00	3.17	26.67	0.09	26.58	38.25
13	6.00	60.00	3.19	26.69	0.10	26.59	38.26
14	6.50	65.00	3.21	26.71	0.11	26.60	38.26
15	7.00	70.00	3.22	26.72	0.12	26.60	38.26
16	7.50	75.00	3.24	26.74	0.13	26.61	38.27
17	8.00	80.00	3.25	26.75	0.14	26.61	38.27
18	8.50	85.00	3.28	26.78	0.15	26.63	38.28
19	9.00	90.00	3.29	26.79	0.16	26.63	38.28
20	9.50	95.00	3.32	26.82	0.17	26.65	38.30
21	10.00	100.00	3.33	26.83	0.18	26.65	38.30
22	10.50	105.00	3.35	26.85	0.19	26.66	38.30
23	11.00	110.00	3.36	26.86	0.20	26.66	38.30
24	11.50	115.00	3.37	26.87	0.21	26.66	38.30
25	12.00	120.00	3.38	26.88	0.22	26.66	38.30
26	12.50	125.00	3.39	26.89	0.23	26.66	38.30
27	13.00	130.00	3.40	26.90	0.24	26.66	38.30
28	13.50	135.00	3.41	26.91	0.25	26.66	38.30
29	14.00	140.00	3.42	26.92	0.26	26.66	38.30
30	14.50	145.00	3.44	26.94	0.27	26.67	38.31
31	15.00	150.00	3.45	26.95	0.28	26.67	38.31
32	15.50	155.00	3.46	26.96	0.29	26.67	38.31
33	16.00	160.00	3.47	26.97	0.30	26.67	38.31
34	16.50	165.00	3.49	26.99	0.31	26.68	38.32
35	17.00	170.00	3.51	27.01	0.32	26.69	38.33
36	17.50	175.00	3.52	27.02	0.33	26.69	38.33
37	18.00	180.00	3.53	27.03	0.34	26.69	38.33
38	18.50	185.00	3.54	27.04	0.35	26.69	38.33
39	19.00	190.00	3.55	27.05	0.36	26.69	38.33
40	19.50	195.00	3.57	27.07	0.37	26.70	38.33
41	20.00	200.00	3.58	27.08	0.38	26.70	38.33

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50

INDIAN GEOTECHNICAL SERVICES

NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	32.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022



INDIAN GEOTECHNICAL SERVICES

PRESSUREMETER DATA SHEET (DT-9)

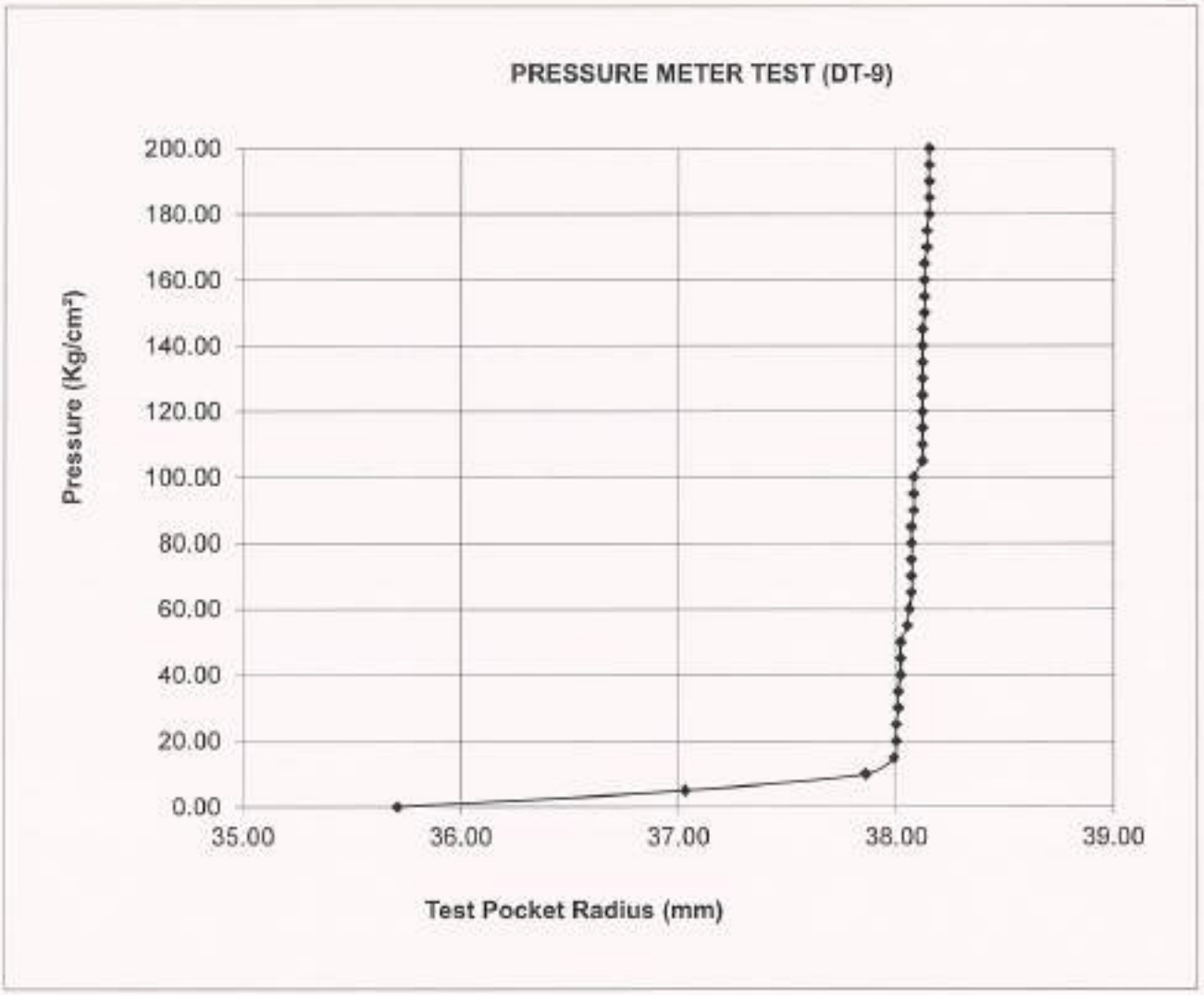
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	36.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022

Sr No.	Pressure P (MPa)	Pressure P (Kg/cm²)	Displacement (Display Value) Rn (mm)	Inner Radius (Display Value) Ri=Rn+23.5 (mm)	Thickness (Correction Volume) PG= P/K	Reference (inner Radius) Rs =Ri-PG (mm)	Test Pocket (Radius) R=SQRT(Rs² +S/π) (mm)
1	0.00	0.00	-0.74	22.76	-0.02	22.78	35.71
2	0.50	5.00	1.28	24.78	-0.01	24.79	37.03
3	1.00	10.00	2.51	26.01	0.00	26.01	37.86
4	1.50	15.00	2.71	26.21	0.01	26.20	37.99
5	2.00	20.00	2.74	26.24	0.02	26.22	38.00
6	2.50	25.00	2.75	26.25	0.03	26.22	38.00
7	3.00	30.00	2.78	26.28	0.04	26.24	38.01
8	3.50	35.00	2.79	26.29	0.05	26.24	38.01
9	4.00	40.00	2.81	26.31	0.06	26.25	38.02
10	4.50	45.00	2.82	26.32	0.07	26.25	38.02
11	5.00	50.00	2.83	26.33	0.08	26.25	38.02
12	5.50	55.00	2.88	26.38	0.09	26.29	38.05
13	6.00	60.00	2.91	26.41	0.10	26.31	38.06
14	6.50	65.00	2.93	26.43	0.11	26.32	38.07
15	7.00	70.00	2.94	26.44	0.12	26.32	38.07
16	7.50	75.00	2.96	26.45	0.13	26.32	38.07
17	8.00	80.00	2.96	26.46	0.14	26.32	38.07
18	8.50	85.00	2.97	26.47	0.15	26.32	38.07
19	9.00	90.00	2.99	26.49	0.16	26.33	38.08
20	9.50	95.00	3.01	26.51	0.17	26.34	38.08
21	10.00	100.00	3.02	26.52	0.18	26.34	38.08
22	10.50	105.00	3.08	26.58	0.19	26.39	38.12
23	11.00	110.00	3.09	26.59	0.20	26.39	38.12
24	11.50	115.00	3.11	26.61	0.21	26.40	38.12
25	12.00	120.00	3.12	26.62	0.22	26.40	38.12
26	12.50	125.00	3.13	26.63	0.23	26.40	38.12
27	13.00	130.00	3.14	26.64	0.24	26.40	38.12
28	13.50	135.00	3.15	26.65	0.25	26.40	38.12
29	14.00	140.00	3.16	26.66	0.26	26.40	38.12
30	14.50	145.00	3.17	26.67	0.27	26.40	38.12
31	15.00	150.00	3.19	26.69	0.28	26.41	38.13
32	15.50	155.00	3.20	26.70	0.29	26.41	38.13
33	16.00	160.00	3.21	26.71	0.30	26.41	38.13
34	16.50	165.00	3.22	26.72	0.31	26.41	38.13
35	17.00	170.00	3.24	26.74	0.32	26.42	38.14
36	17.50	175.00	3.25	26.75	0.33	26.42	38.14
37	18.00	180.00	3.27	26.77	0.34	26.43	38.15
38	18.50	185.00	3.28	26.78	0.35	26.43	38.15
39	19.00	190.00	3.29	26.79	0.36	26.43	38.15
40	19.50	195.00	3.31	26.81	0.37	26.44	38.15
41	20.00	200.00	3.32	26.82	0.38	26.44	38.15

Membrane Calibration Constants	Thickness Correction K :Mn/m2/mm=50	

INDIAN GEOTECHNICAL SERVICES

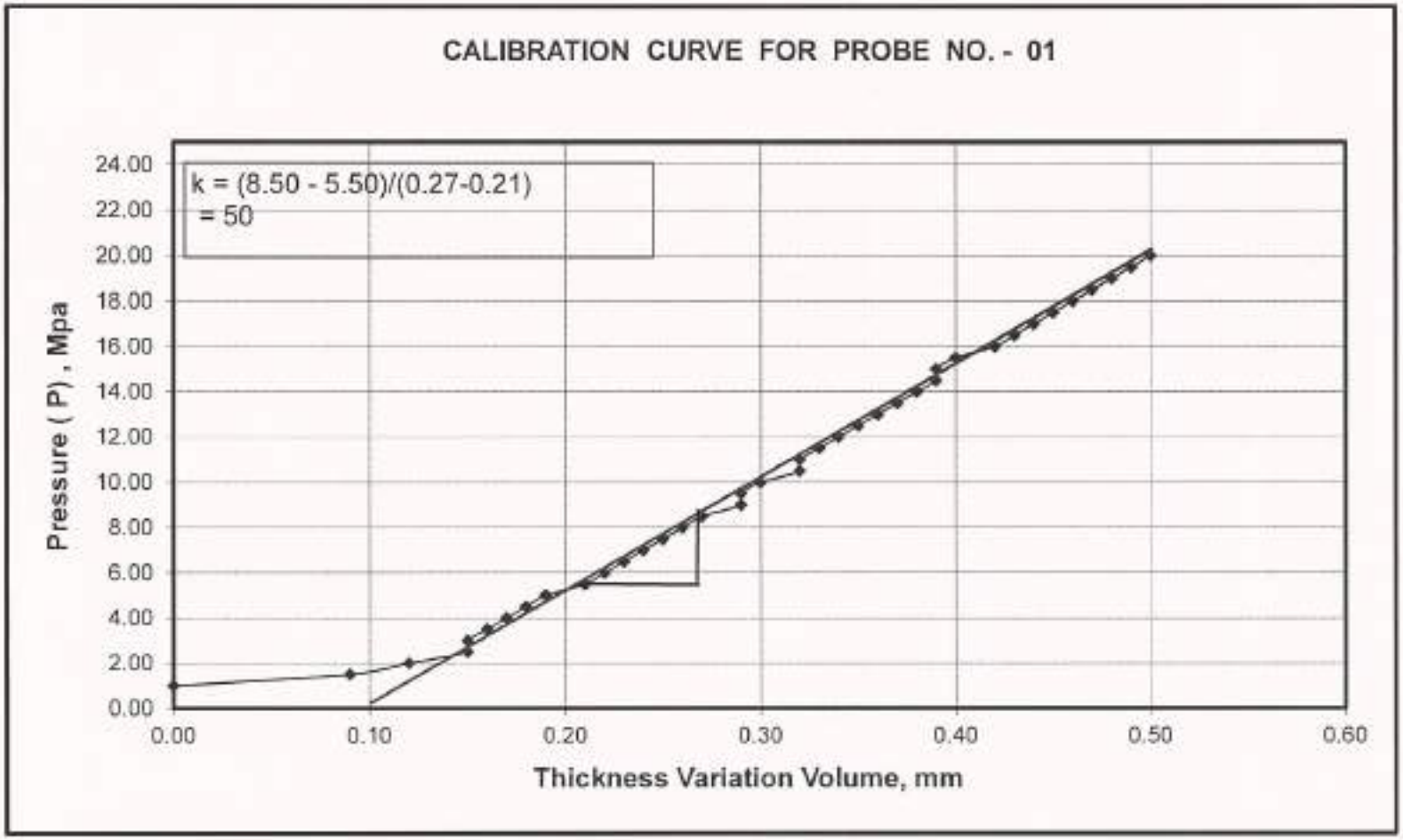
NAME OF WORK	GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH		
NAME OF CLIENT	Larsen & Toubro Limited	SIZE OF BOREHOLE (mm)	Nx
BOREHOLE NO.	SBH-01	LOCATION	Statue
CASING (m)	3.00	TEST DEPTH (m)	36.00
RL (m)	250.05	FINAL DEPTH (m)	50.00
TYPE OF STRATA	Fresh, Moderately fractured Porphyritic BASALT	DATE	01. 08. 2022



Calibration Data Sheet

Probe No 1 **Date** 01-08-2022

Sr No	Pressure P (Mpa)	Displacement Rp (mm)	Pressure Variation P' = P - 1	Thickness Correction Volume R' = Rp - Rp1
1	0.00	-1.44	-	-
2	0.50	0.92	-	-
3	1.00	2.72	0.00	0.00
4	1.50	2.81	0.50	0.09
5	2.00	2.84	1.00	0.12
6	2.50	2.87	1.50	0.15
7	3.00	2.87	2.00	0.15
8	3.50	2.88	2.50	0.16
9	4.00	2.89	3.00	0.17
10	4.50	2.90	3.50	0.18
11	5.00	2.91	4.00	0.19
12	5.50	2.93	4.50	0.21
13	6.00	2.94	5.00	0.22
14	6.50	2.95	5.50	0.23
15	7.00	2.96	6.00	0.24
16	7.50	2.97	6.50	0.25
17	8.00	2.98	7.00	0.26
18	8.50	2.99	7.50	0.27
19	9.00	3.01	8.00	0.29
20	9.50	3.01	8.50	0.29
21	10.00	3.02	9.00	0.30
22	10.50	3.04	9.50	0.32
23	11.00	3.04	10.00	0.32
24	11.50	3.05	10.50	0.33
25	12.00	3.06	11.00	0.34
26	12.50	3.07	11.50	0.35
27	13.00	3.08	12.00	0.36
28	13.50	3.09	12.50	0.37
29	14.00	3.10	13.00	0.38
30	14.50	3.11	13.50	0.39
31	15.00	3.11	14.00	0.39
32	15.50	3.12	14.50	0.40
33	16.00	3.14	15.00	0.42
34	16.50	3.15	15.50	0.43
35	17.00	3.16	16.00	0.44
36	17.50	3.17	16.50	0.45
37	18.00	3.18	17.00	0.46
38	18.50	3.19	17.50	0.47
39	19.00	3.20	18.00	0.48
40	19.50	3.21	18.50	0.49
41	20.00	3.22	19.00	0.50


CALIBRATION CURVE FOR PROBE NO. - 01
k = (8.50 - 5.50)/(0.27-0.21)
= 50
Pressure (P) , Mpa
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Thickness Variation Volume, mm

ANNEXURE - E

Laboratory Testing Results (SBH-01)

INDIAN GEOTECHNICAL SERVICES

New Delhi

SUMMARY OF LABORATORY TEST RESULTS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No.	Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
										Unsoaked			Soaked			Soaked		
								Unsoaked	Soaked	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
SBH-1	4	0.00-1.50	2.61	2.62	0.85	2.75	0.050	--	--	45.48	--	--	--	--	--	--	--	
	5		--	2.65	--	--	--	2.70	--	--	--	--	--	--	--	--	--	93.93
	6		--	2.58	--	--	--	--	1.92	--	--	--	--	--	--	--	--	
	7	1.50-3.00	2.62	2.63	0.83	2.75	0.046	2.25	--	--	--	--	--	--	--	--	--	--
	8	3.00-4.50	--	2.55	--	--	--	--	1.34	--	--	--	--	--	--	--	--	--
	9		2.65	2.65	0.78	2.74	0.034	--	--	70.35	54.29	0.22	--	--	--	--	--	
	11		--	2.69	--	--	--	8.55	--	--	--	--	--	--	--	--	--	97.83
	12		--	2.66	--	--	--	--	4.19	--	--	--	--	--	--	--	--	
	13		2.66	2.66	0.79	2.75	0.034	2.84	--	--	--	--	--	--	--	--	--	
	14	4.50-6.00	2.63	2.64	0.82	2.75	0.042	--	--	54.95	33.12	0.21	--	--	--	--	--	--
	15		--	2.67	--	--	--	--	6.42	--	--	--	--	--	--	--	--	--
	17	7.50-9.00	2.69	2.69	0.41	2.73	0.015	10.80	--	--	73.69	0.12	--	--	--	--	--	
	20		--	2.68	--	--	--	--	--	121.25	--	--	--	--	--	--	--	
	21		--	2.69	--	--	--	--	--	--	--	--	217.54	127.48	0.11	--	--	95.69
	25		--	2.62	--	--	--	--	2.87	--	--	--	--	--	--	--	--	
	37	9.00-10.50	2.67	2.67	0.71	2.74	0.027	--	--	84.43	44.68	0.22	--	--	--	--	--	--
	67	12.00-13.50	2.68	2.68	0.54	2.74	0.023	--	--	163.33	68.03	0.16	--	--	--	--	--	--
	71		--	2.66	--	--	--	--	--	--	--	--	115.45	73.24	0.18	--	--	--

INDIAN GEOTECHNICAL SERVICES

New Delhi

SUMMARY OF LABORATORY TEST RESULTS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No.	Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
										Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
								Unsoaked	Soaked	Unsoaked			Soaked			Soaked		
SBH-1	77	13.50-15.00	--	2.69	--	--	--	9.66	--	--	--	--	--	--	--	--	--	--
	81		2.69	2.69	0.44	2.73	0.015	--	--	--	--	--	213.99	115.12	0.14	--	--	--
	96	15.00-16.50	2.69	2.69	0.42	2.73	0.015	10.59	--	--	--	--	--	--	--	--	--	--
	107	16.50-18.00	--	2.68	--	--	--	8.89	--	--	--	--	--	--	--	--	--	--
	134	19.50-21.00	2.67	2.67	0.57	2.74	0.027	--	--	--	--	--	148.07	73.06	0.11	--	--	97.58
	136,138 & 139		2.67	2.67	0.47	2.74	0.027	--	--	--	--	--	--	--	--	12.74	63.28°	
	158	22.50-24.00	2.68	2.68	0.49	2.73	0.019	--	--	--	--	--	172.87	87.78	0.17	--	--	--
	163		--	2.67	--	--	--	--	--	--	--	--	144.40	--	--	--	--	--
	169	24.00-25.50	--	2.67	--	--	--	--	7.76	--	--	--	--	--	--	--	--	--
	170		--	2.68	--	--	--	--	8.73	--	--	--	--	--	--	--	--	--
	195	25.50-27.00	--	2.67	--	--	--	--	--	--	--	--	148.59	54.35	0.18	--	--	--
	196		--	2.68	--	--	--	--	--	--	--	--	159.65	--	--	--	--	--
	197	27.00-28.50	2.66	2.66	0.65	2.74	0.030	--	4.33	--	--	--	--	--	--	--	--	--
	211	28.50-30.00	--	2.66	--	--	--	--	--	--	--	--	141.36	42.41	0.21	--	--	--
	215		--	2.62	--	--	--	--	--	--	--	--	41.12	16.32	0.24	--	--	--
	217&2123	30.00-31.50	2.69	2.69	0.38	2.73	0.015	--	--	--	--	--	216.52	105.98	0.12	14.71	62.23°	--
	229	31.50-33.00	--	2.67	--	--	--	--	--	--	--	--	156.03	93.32	0.14	--	--	--
	236&240	33.00-34.50	2.65	2.65	0.75	2.74	0.034	--	--	--	--	--	70.42	30.22	0.20	9.52	60.36°	--
	260	36.00-37.50	--	2.68	--	--	--	--	--	--	--	--	211.11	75.87	0.12	--	--	--
	269	37.50-39.00	--	2.68	--	--	--	--	--	--	--	--	162.94	59.74	0.16	--	--	--

INDIAN GEOTECHNICAL SERVICES

New Delhi

SUMMARY OF LABORATORY TEST RESULTS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No.	Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
										Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
								Unsoaked	Soaked	Unsoaked			Soaked			Soaked		
SBH-2	1	0.00-1.50	2.69	2.69	0.46	2.73	0.015	–	–	148.95	–	–	–	–	–	–	–	–
	7	1.50-3.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	94.42
	8		–	2.58	–	–	–	–	1.36	–	–	–	–	–	–	–	–	
	9		2.68	2.68	0.62	2.74	0.023	5.80	–	–	–	–	–	–	–	–	–	
	12	4.50-6.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	96.92
	13		2.68	2.68	0.42	2.73	0.019	6.80	–	–	–	–	–	–	–	–	–	
	14		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	15		–	2.69	–	–	–	7.22	–	–	–	–	–	–	–	–	–	
	17	6.00-7.50	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	95.13
	22		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	23		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	25		2.68	2.68	0.55	2.73	0.019	5.79	–	–	–	–	–	–	–	–	–	
	27		–	2.56	–	–	–	–	1.23	–	–	–	–	–	–	–	–	–
	35	7.50-9.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	94.69
	36		2.67	2.67	0.66	2.73	0.023	–	–	–	–	–	104.58	56.34	0.14	–	–	
	38		–	2.62	–	–	–	1.91	–	–	–	–	–	–	–	–	–	
	41		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	43	9.00-10.50	2.61	2.62	0.85	2.73	0.043	–	–	54.71	23.91	0.21	–	–	–	–	–	–
	51		–	2.69	–	–	–	7.10	–	–	–	–	–	–	–	–	–	–
	52	10.50-12.00	2.64	2.65	0.82	2.74	0.035	–	–	–	–	–	74.95	24.18	0.19	–	–	97.98
	56		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	57		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	62		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
	69	12.00-13.50	2.69	2.69	0.48	2.73	0.016	–	–	138.47	67.00	0.15	–	–	–	–	–	–
	70		–	2.65	–	–	–	2.87	–	–	–	–	–	–	–	–	–	

INDIAN GEOTECHNICAL SERVICES

New Delhi

SUMMARY OF LABORATORY TEST RESULTS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

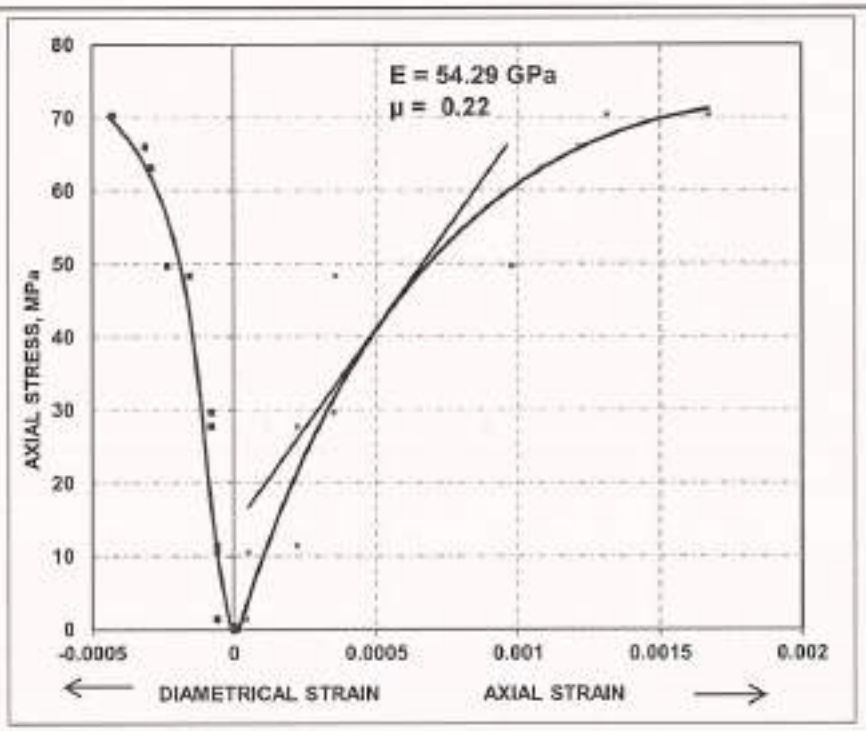
Borehole No.	Sample No.	Depth of sample (m)	Dry density (gm/cc) (IS: 13030 – 1991)	Bulk density (gm/cc) (IS: 13030 – 1991)	Water absorption % (IS: 1121- Part 1)	Specific gravity (IS: 13030 – 1991)	Porosity (IS: 13030 – 1991)	Point Load Strength Index (MPa) (IS: IS: 8764)		Uniaxial Compressive Strength with Elastic Modulus and Poisson's ratio (IS: 9143, 9221)						Tri-Axial test (IS: 13047, 1991)		Slake Durability Index of rock
										Unsoaked			Soaked			Soaked		
								Unsoaked	Soaked	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Uni-axial compressive strength (MPa)	Modulus of elasticity, E (GPa)	Poisson's ratio, μ	Cohesion c (MPa)	Angle of internal friction (degree)	
SBH-2	79	13.50-15.00	2.68	2.68	0.59	2.74	0.023	–	–	125.40	85.61	0.12	99.35	72.38	0.21	–	–	–
	84	15.00-16.50	–	–	–	–	–	–	–	–	–	–	–	–	–	10.51	61.14°	–
	86		2.67	2.68	0.77	2.74	0.024	–	–	–	–	–	–	–	–			–
	92		–	2.69	–	–	–	–	–	–	–	–	192.26	–	–	–	–	–
	96	16.50-18.00	–	2.65	–	–	–	–	–	–	–	–	91.33	–	–	–	–	–
	100		2.63	2.64	0.75	2.74	0.039	–	–	–	–	–	72.51	35.10	0.14	–	–	–
	108	18.00-19.50	–	–	–	–	–	–	–	–	–	–	–	–	–	13.69	61.40°	–
	110		–	–	–	–	–	–	–	–	–	–	–	–	–			–
	115		2.68	2.68	0.58	2.73	0.019	–	–	–	–	–	–	–	–			–
	125	19.50-21.00	2.66	2.66	0.66	2.74	0.031	–	–	–	–	–	97.70	45.55	0.19	–	–	–
	137	21.00-22.50	2.68	2.68	0.42	2.73	0.019	–	–	–	–	–	189.47	69.29	0.12	–	–	–
	152	22.50-24.00	2.67	2.67	0.62	2.74	0.027	–	–	–	–	–	99.00	–	–	–	–	–
	161	24.00-25.50	2.65	2.65	0.69	2.74	0.034	–	–	–	–	–	80.92	38.01	0.16	–	–	–
	187	27.00-28.50	2.56	2.57	0.87	2.76	0.072	–	–	–	–	–	36.77	28.63	0.17	–	–	–
	201	28.50-30.00	2.68	2.68	0.46	2.73	0.019	–	–	–	–	–	160.80	54.89	0.15	–	–	–
	204	30.00-31.50	2.69	2.69	0.38	2.73	0.015	–	–	–	–	–	266.78	–	–	–	–	–
	213	31.50-33.00	–	–	–	–	–	–	–	–	–	–	–	–	–	15.65	60.87°	–
	217		2.69	2.69	0.49	2.74	0.019	–	–	–	–	–	–	–	–			–
	232	33.00-34.50	2.67	2.67	0.54	2.73	0.023	–	–	–	–	–	110.77	51.44	0.19	–	–	–
	234	34.50-36.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	236		2.66	2.66	0.58	2.74	0.031	–	–	–	–	–	104.51	50.26	0.21	–	–	–
	261	36.00-37.50	2.67	2.67	0.52	2.73	0.023	–	5.59	–	–	–	–	–	–	–	–	–
	290	40.50-42.00	2.59	2.60	0.84	2.75	0.057	–	–	–	–	–	43.80	–	–	–	–	–

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

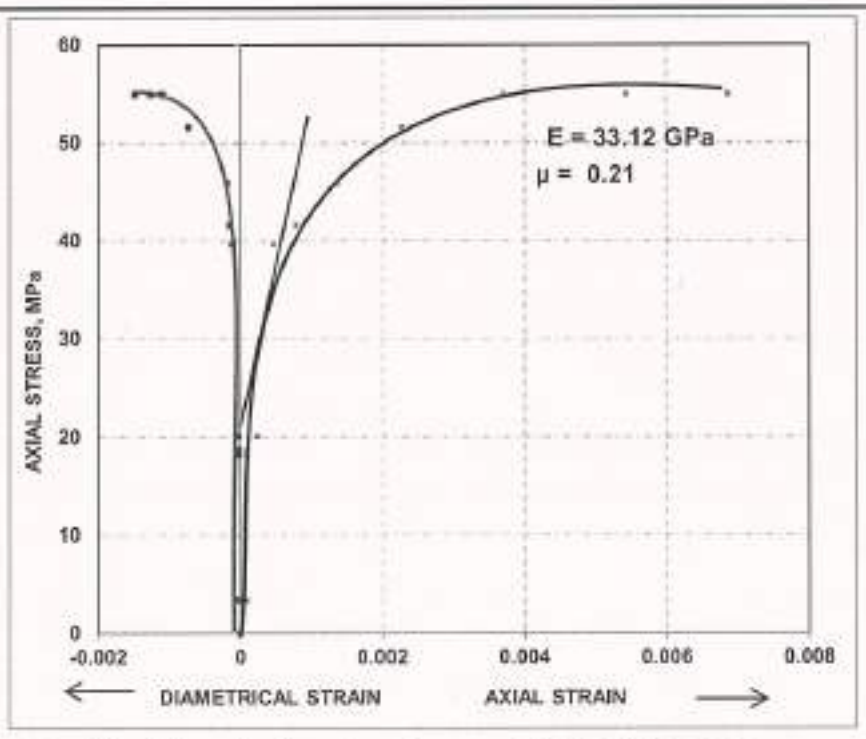


Modulus of elasticity and poisson's ratio curve at depth of 3.00 to 4.50m

Sample No. 9

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 4.50 to 6.00m

Sample No. 14

Before Test

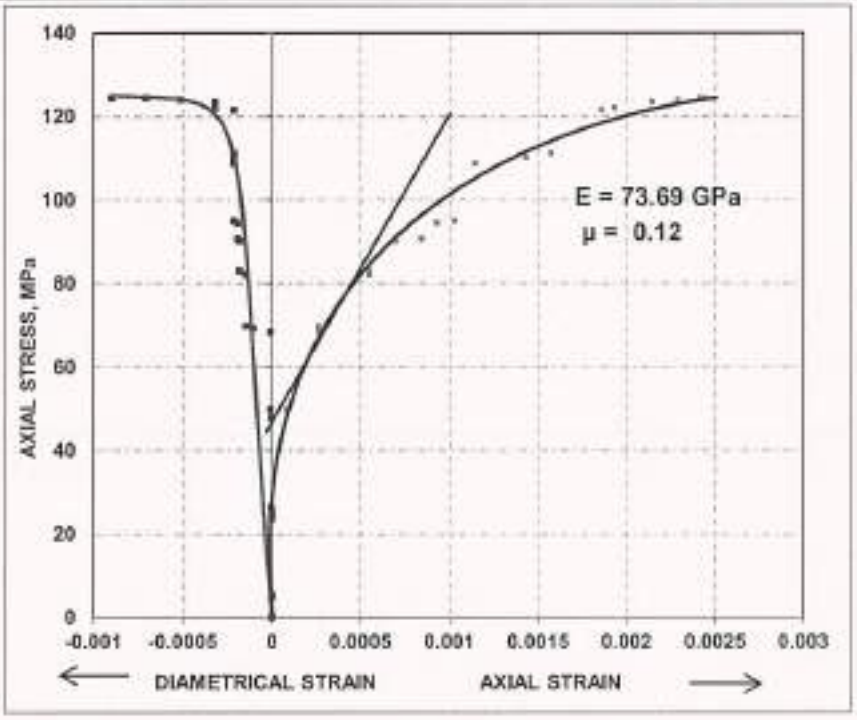
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

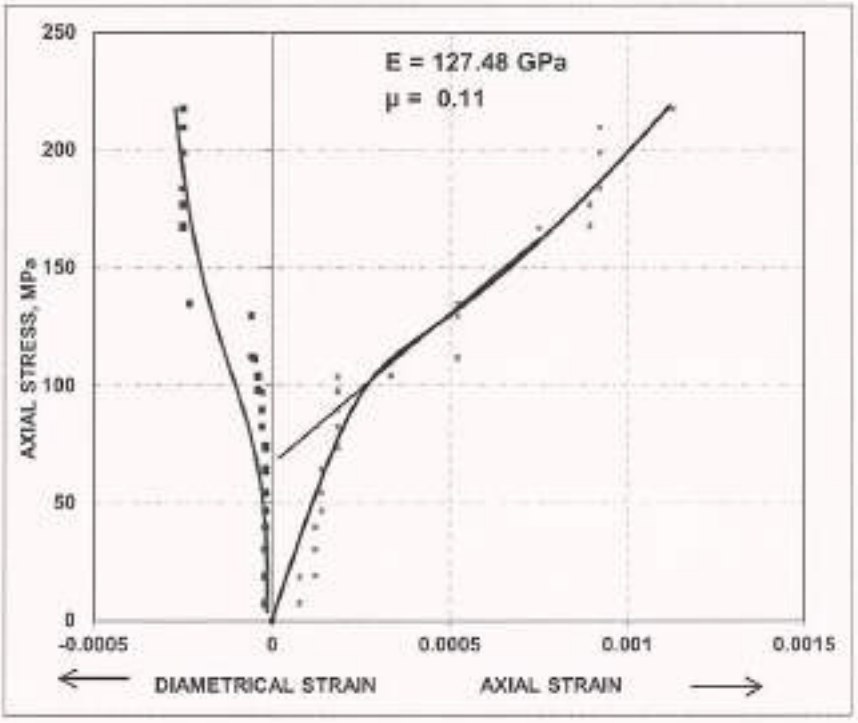


Modulus of elasticity and poisson's ratio curve at depth of 7.50 to 9.00m

Sample No. 20

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 7.50 to 9.00m

Sample No. 21

Before Test

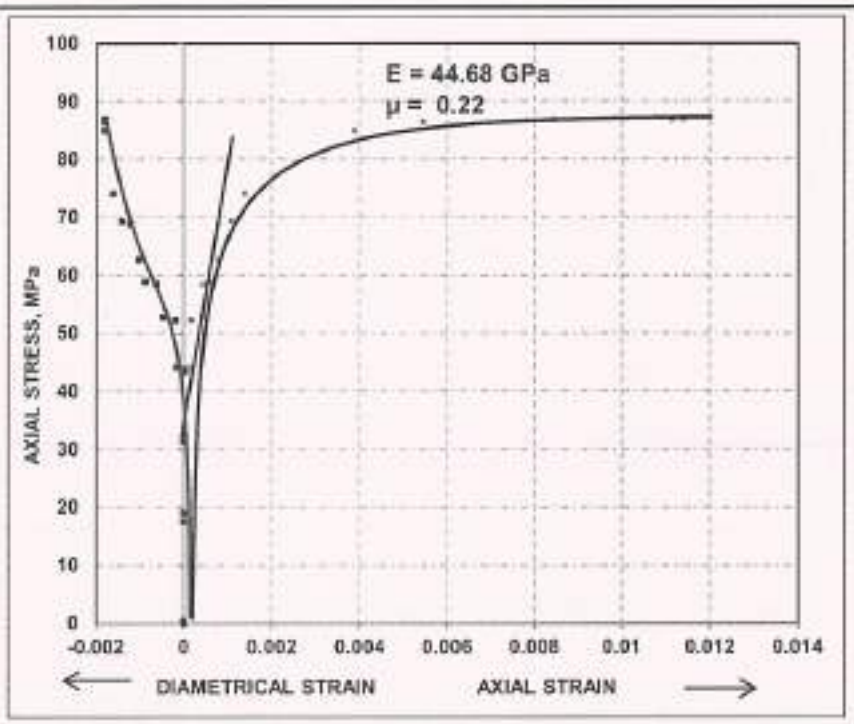
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

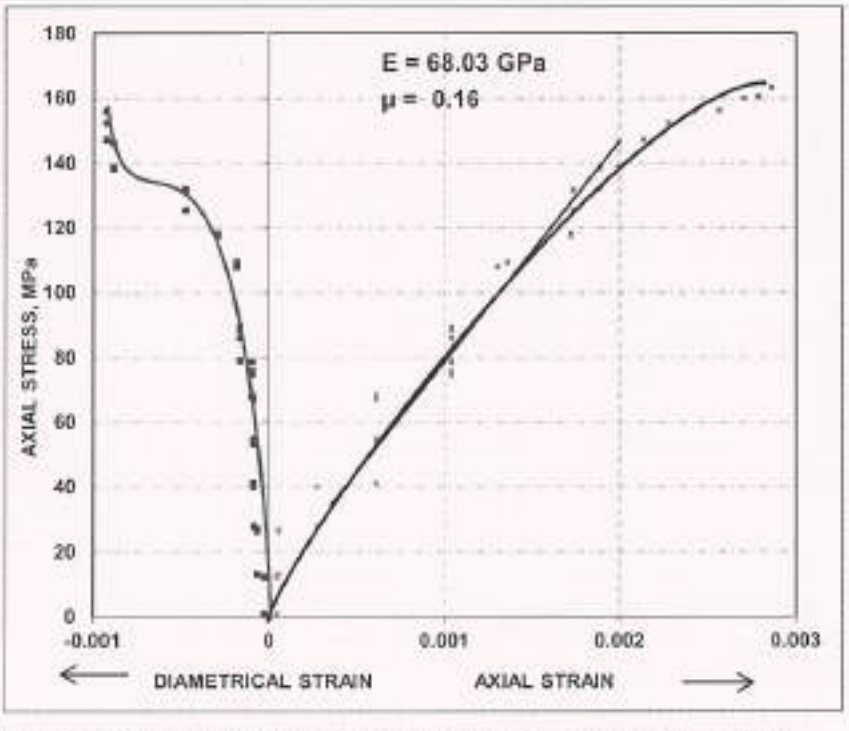


Modulus of elasticity and poisson's ratio curve at depth of 9.00 to 10.50m

Sample No. 37

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 12.00 to 13.50m

Sample No. 67

Before Test

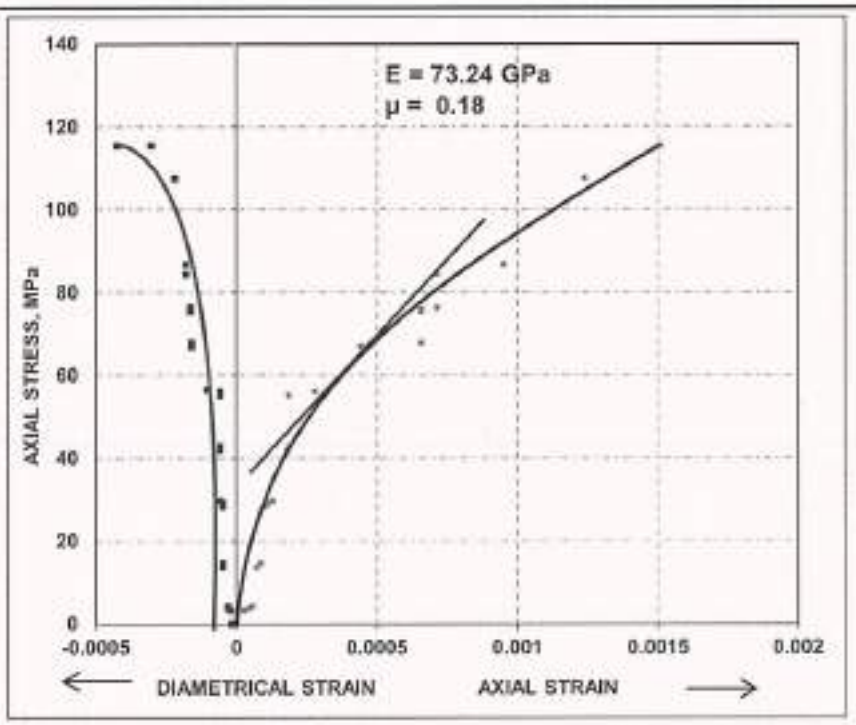
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

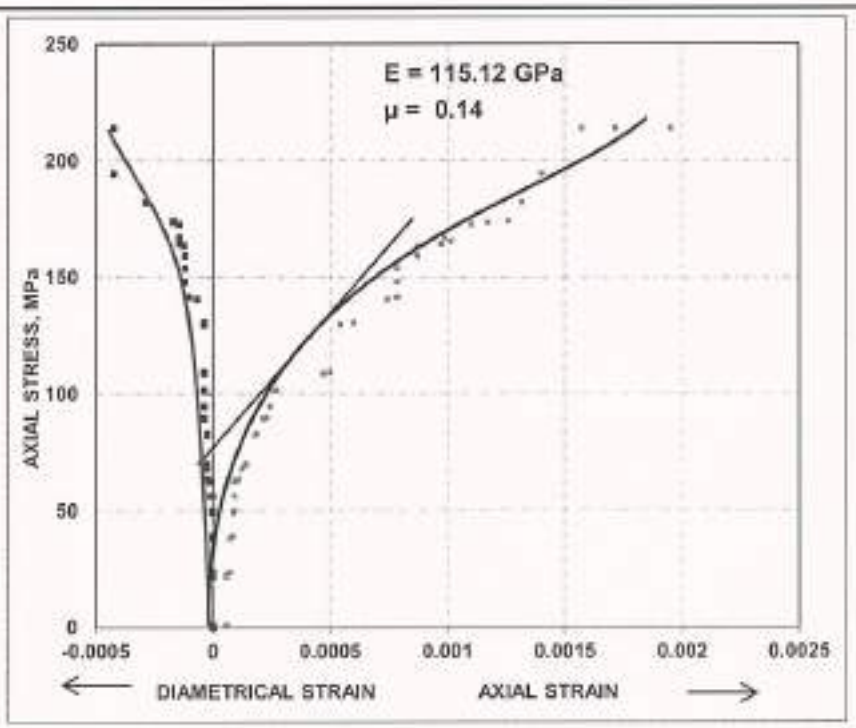


Modulus of elasticity and poisson's ratio curve at depth of 12.50 to 13.50m

Sample No. 71

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 13.50 to 15.00m

Sample No. 81

Before Test

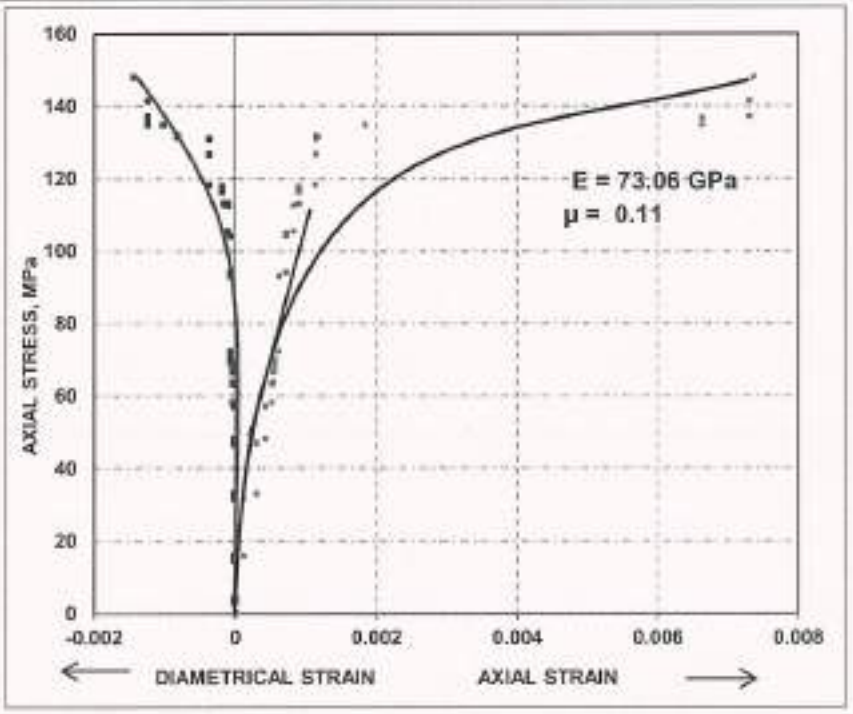
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

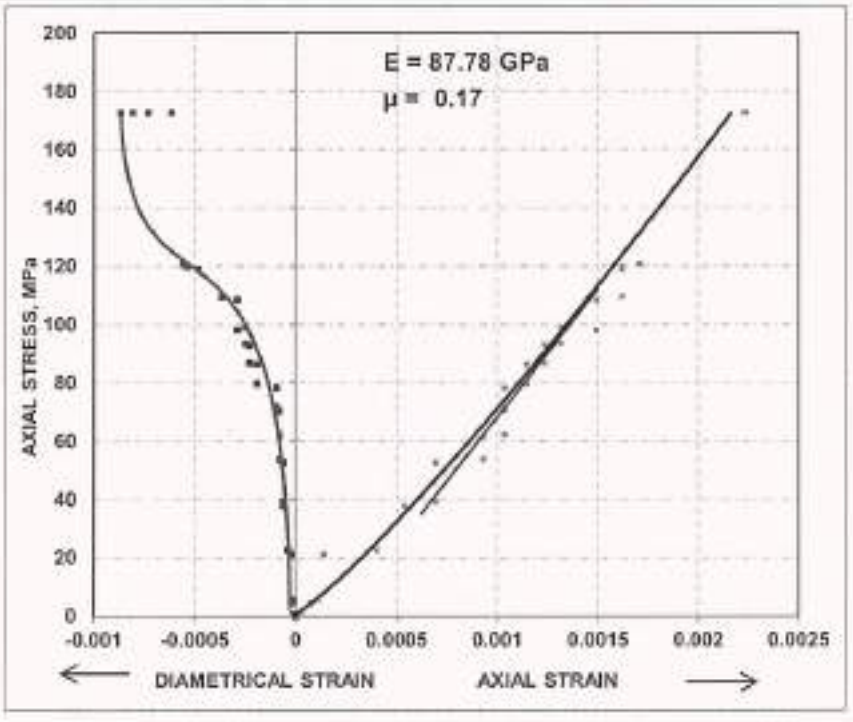


Modulus of elasticity and poisson's ratio curve at depth of 19.50 to 21.00m

Sample No. 134

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 22.50 to 24.00m

Sample No. 158

Before Test

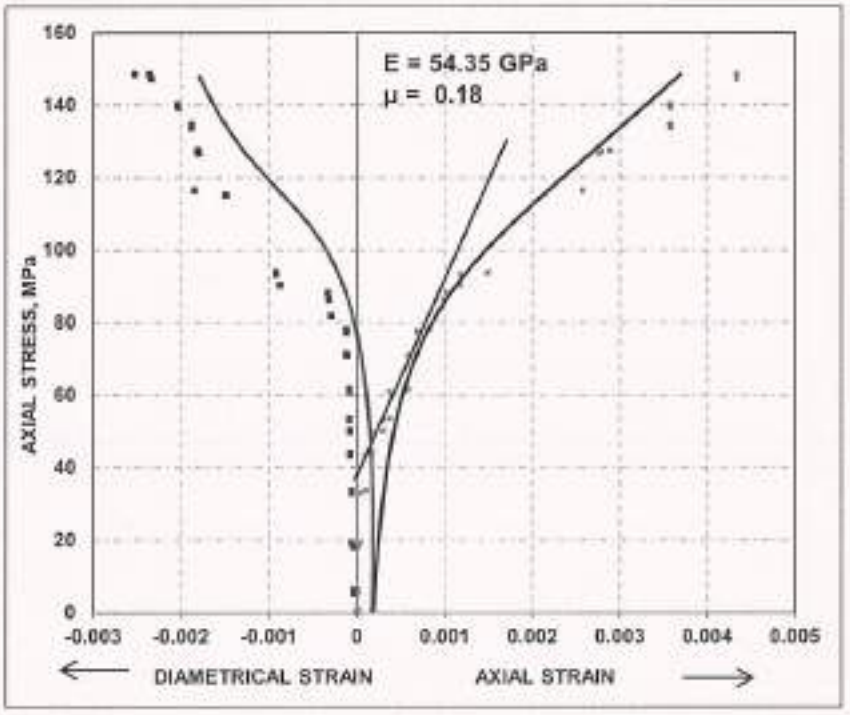
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

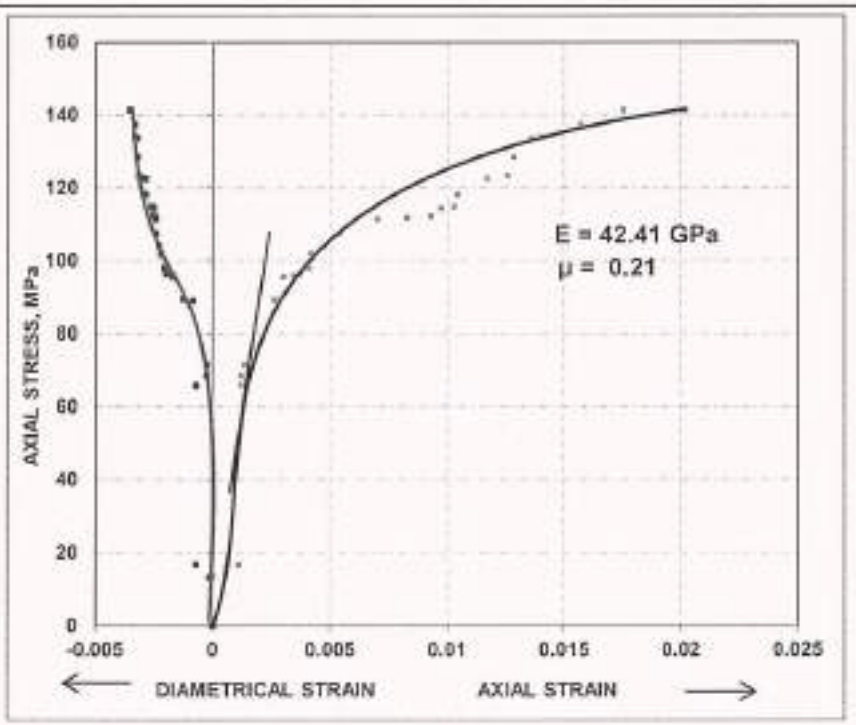


Modulus of elasticity and poisson's ratio curve at depth of 25.50 to 27.00m

Sample No. 195

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 28.50 to 30.00m

Sample No. 211

Before Test

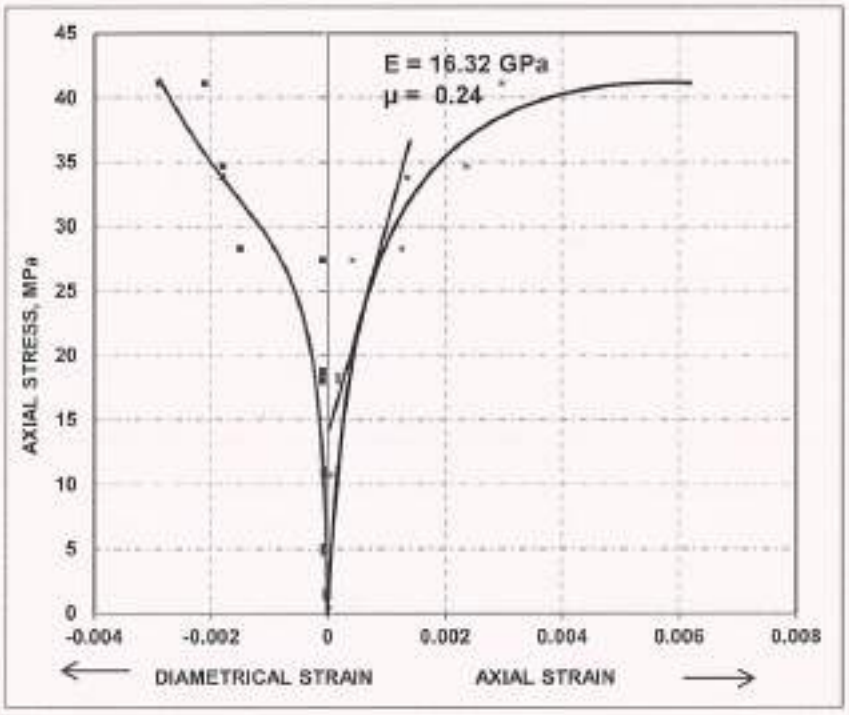
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

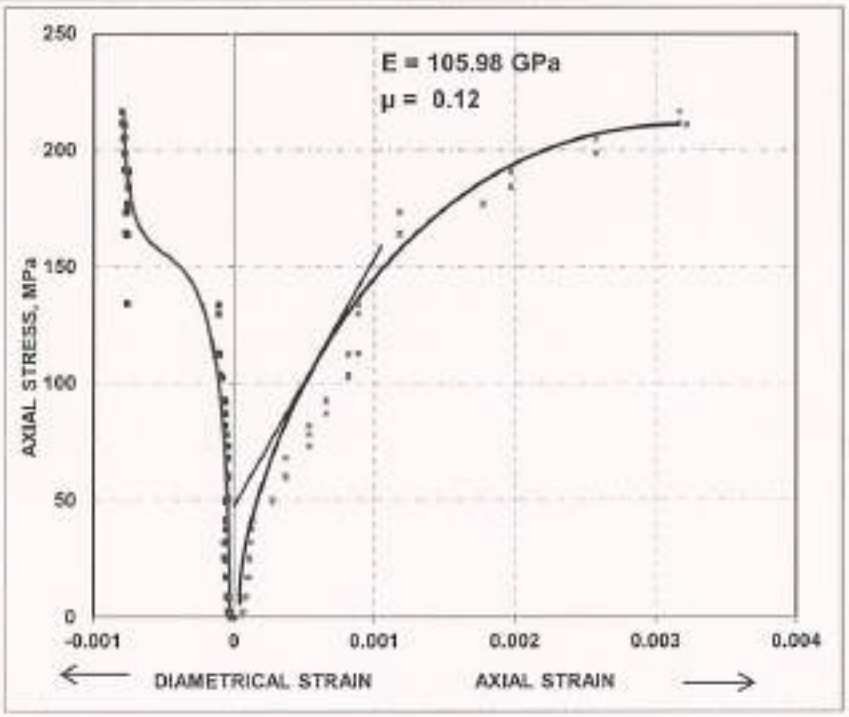


Modulus of elasticity and poisson's ratio curve at depth of 28.50 to 30.00m

Sample No. 215

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 30.00 to 31.50m

Sample No. 217

Before Test

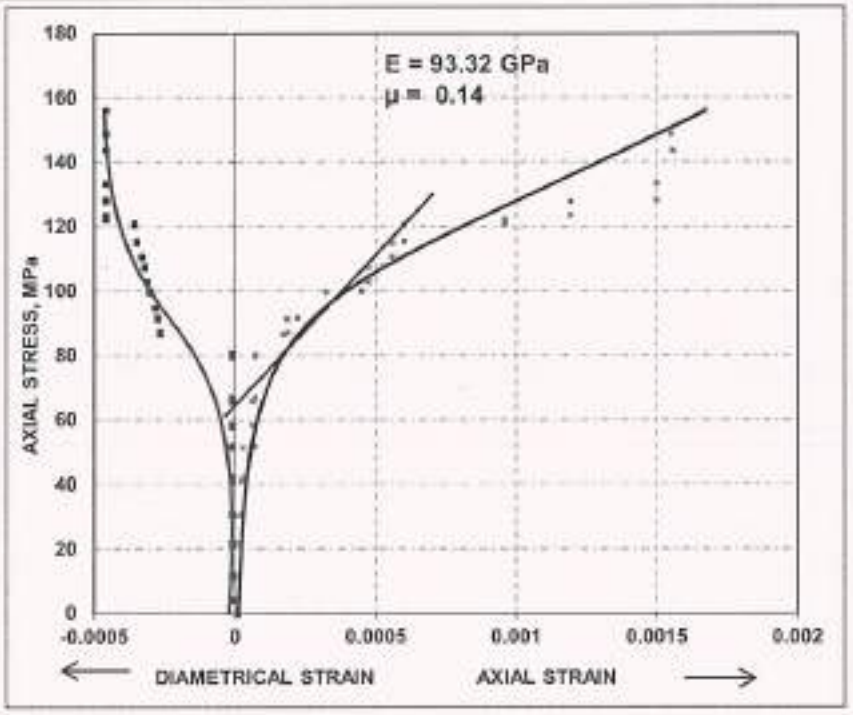
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

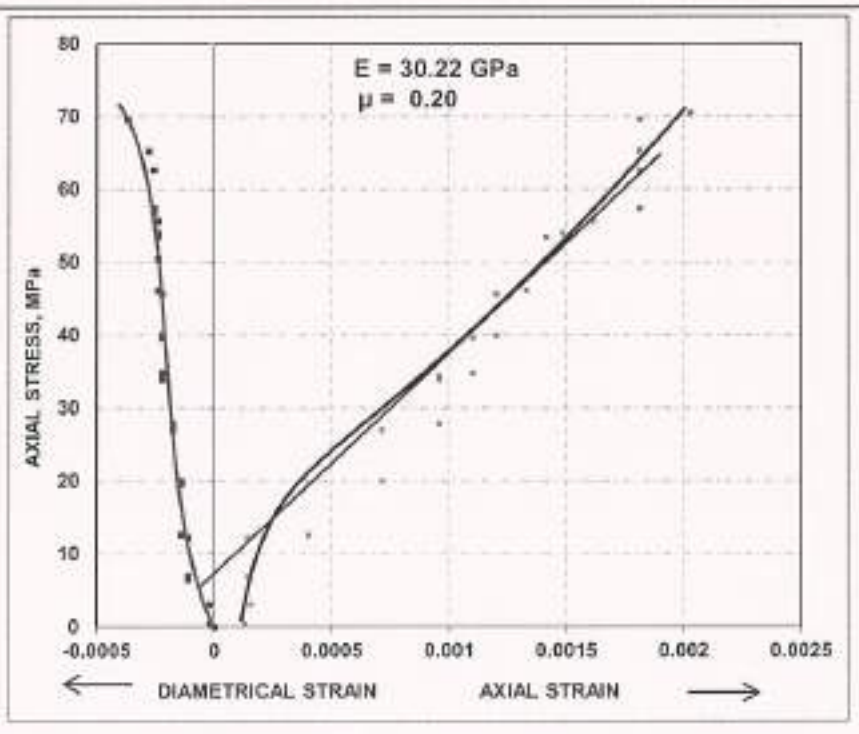


Modulus of elasticity and poisson's ratio curve at depth of 31.50 to 33.00m

Sample No. 229

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 33.00 to 34.50m

Sample No. 240

Before Test

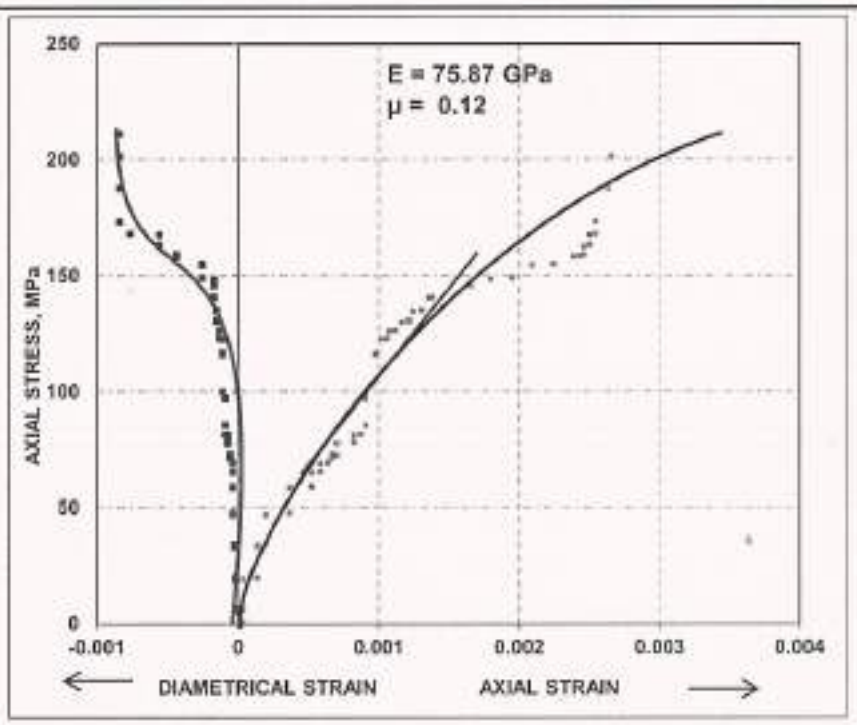
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-01

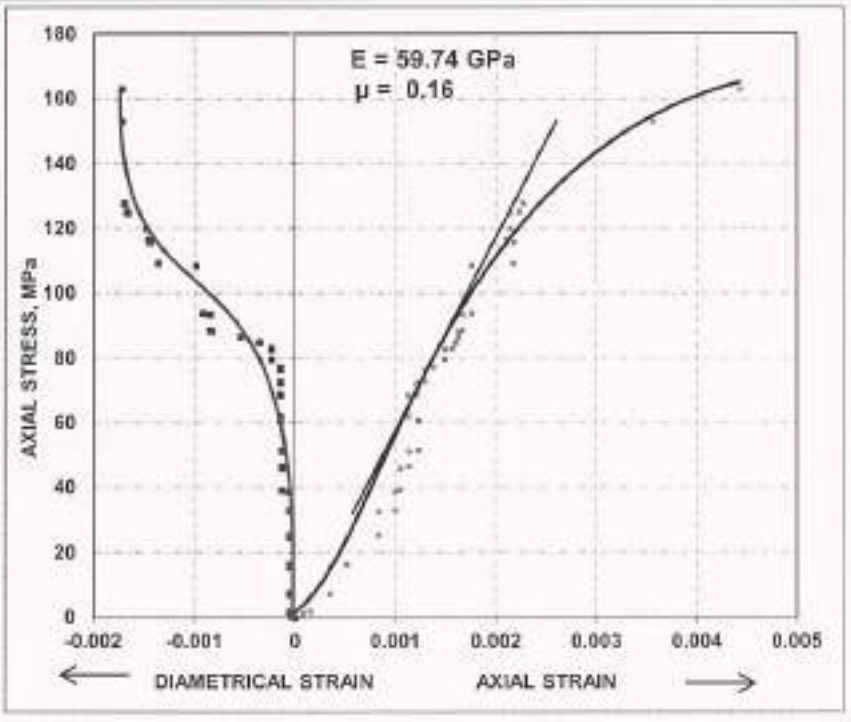


Modulus of elasticity and poisson's ratio curve at depth of 36.00 to 37.50m

Sample No. 260

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 33.00 to 34.50m

Sample No. 269

Before Test

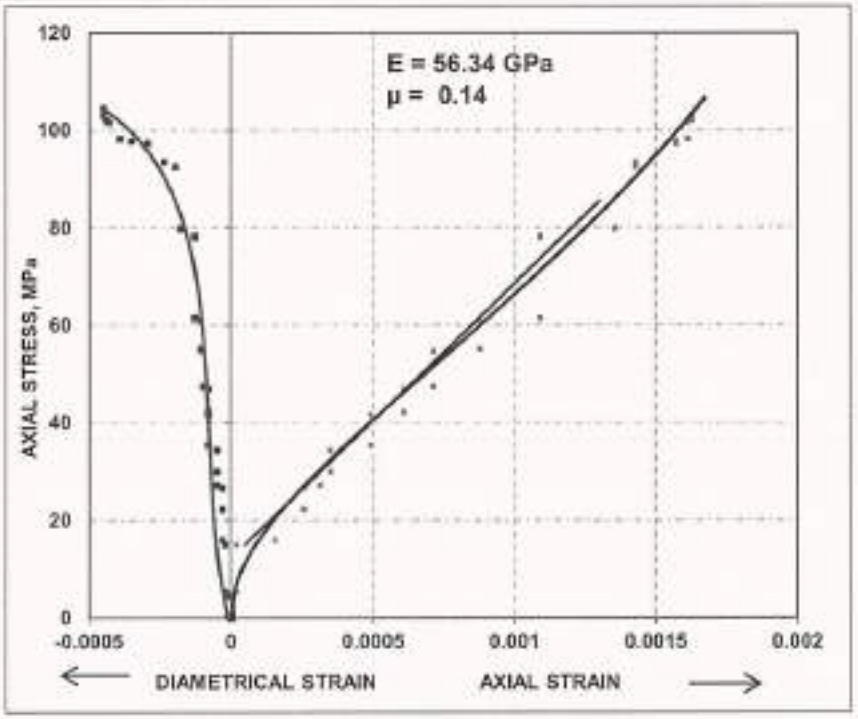
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

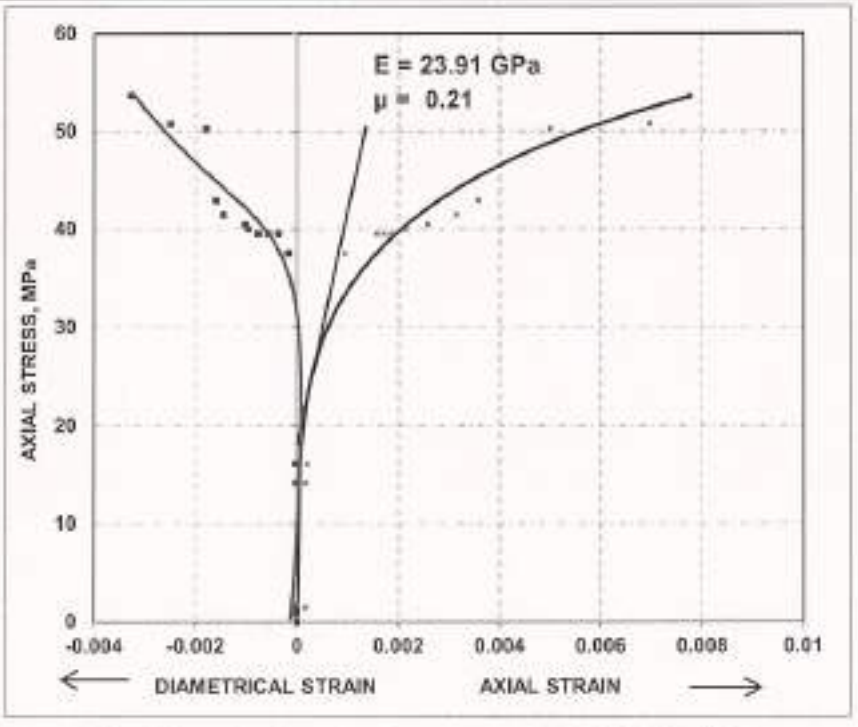


Modulus of elasticity and poisson's ratio curve at depth of 7.50 to 9.00m

Sample No. 36

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 9.00 to 10.50m

Sample No. 43

Before Test

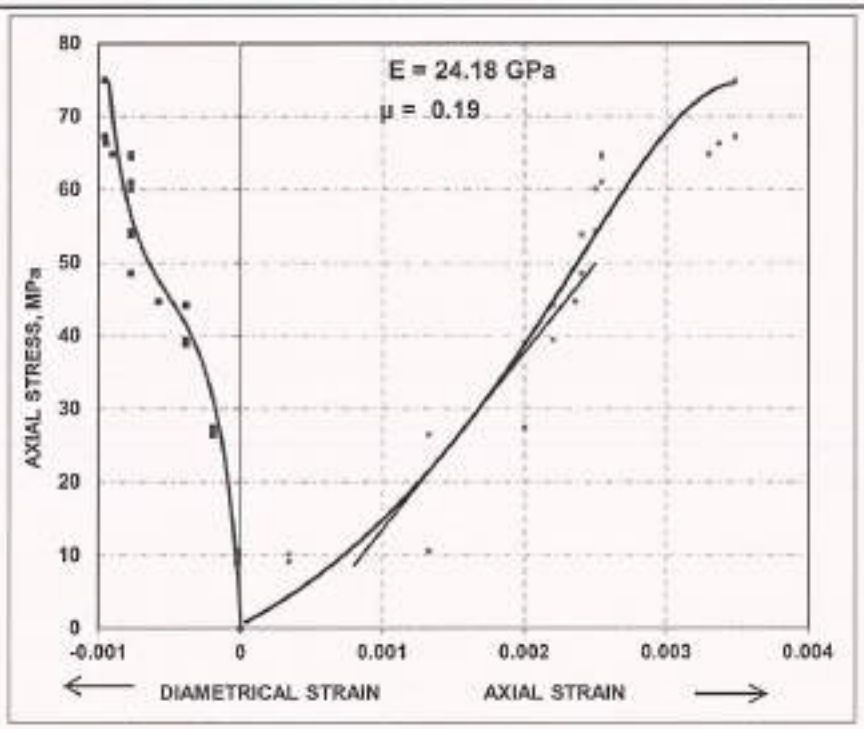
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

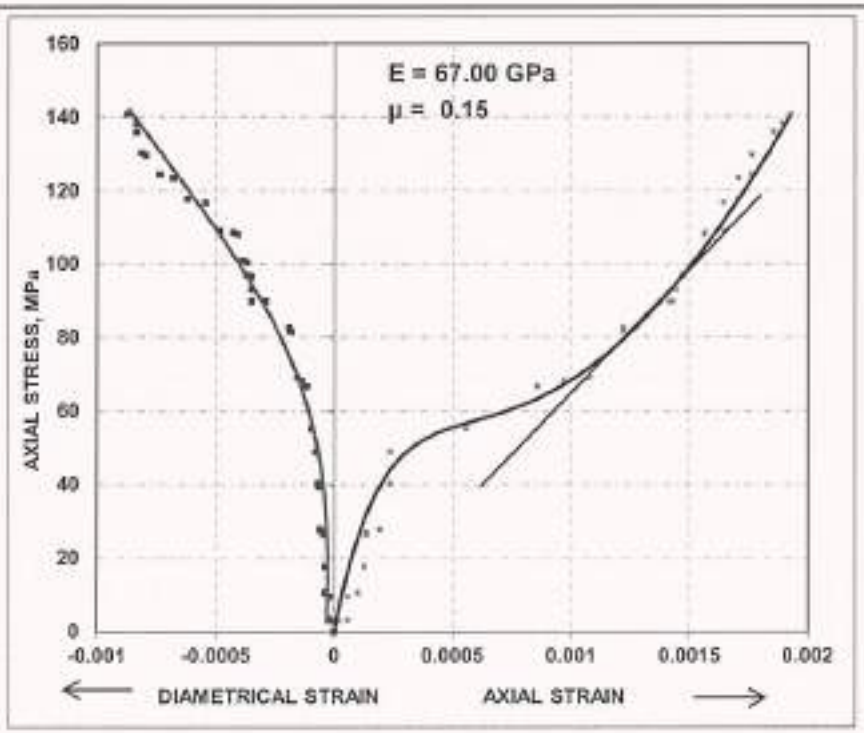


Modulus of elasticity and poisson's ratio curve at depth of 10.50 to 12.00m

Sample No. 52

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 12.00 to 13.50m

Sample No. 69

Before Test

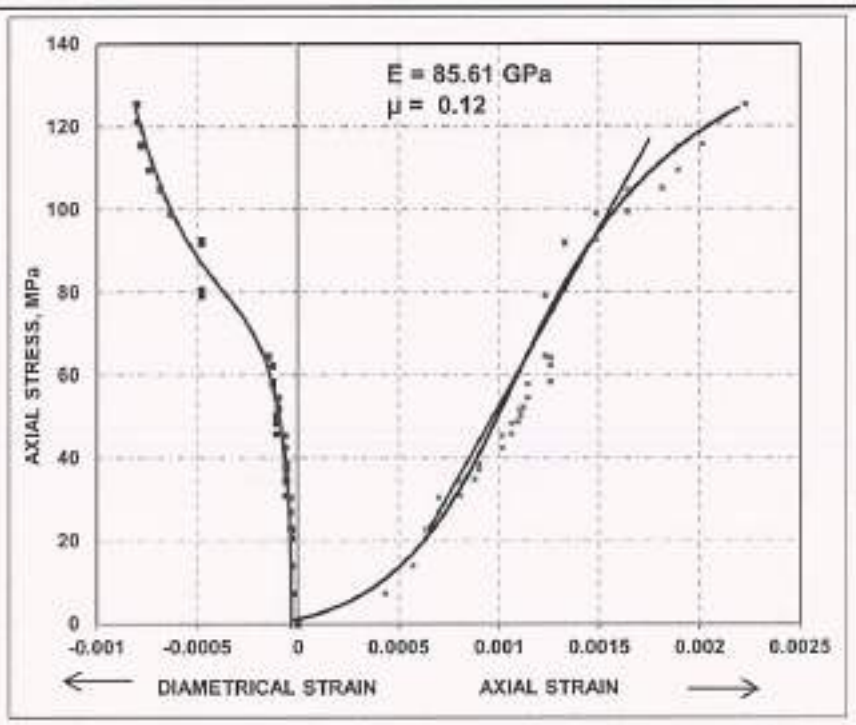
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

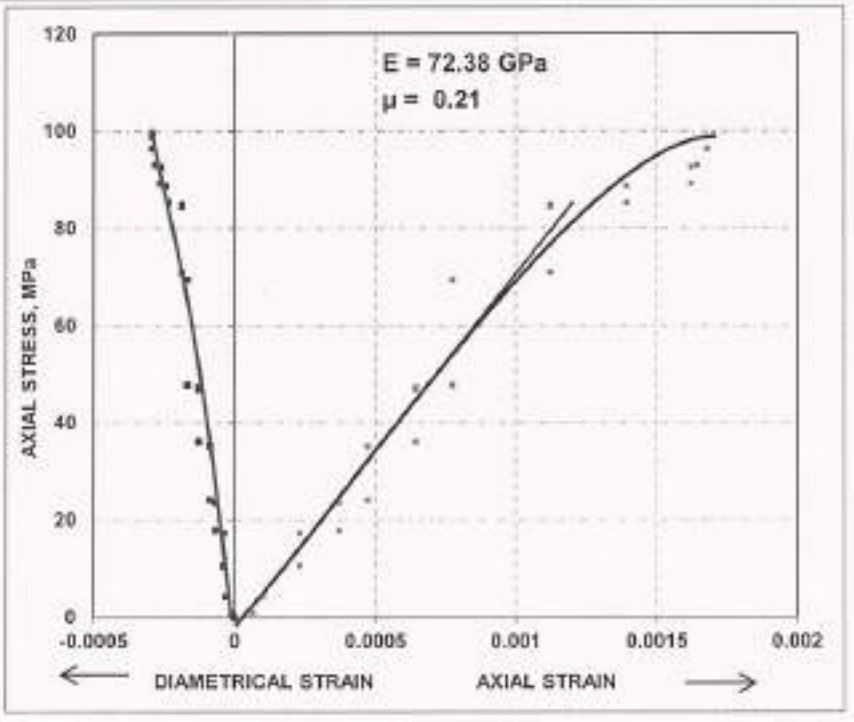


Modulus of elasticity and poisson's ratio curve at depth of 13.50 to 15.00m

Sample No. 79

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 13.50 to 15.00m

Sample No. 79

Before Test

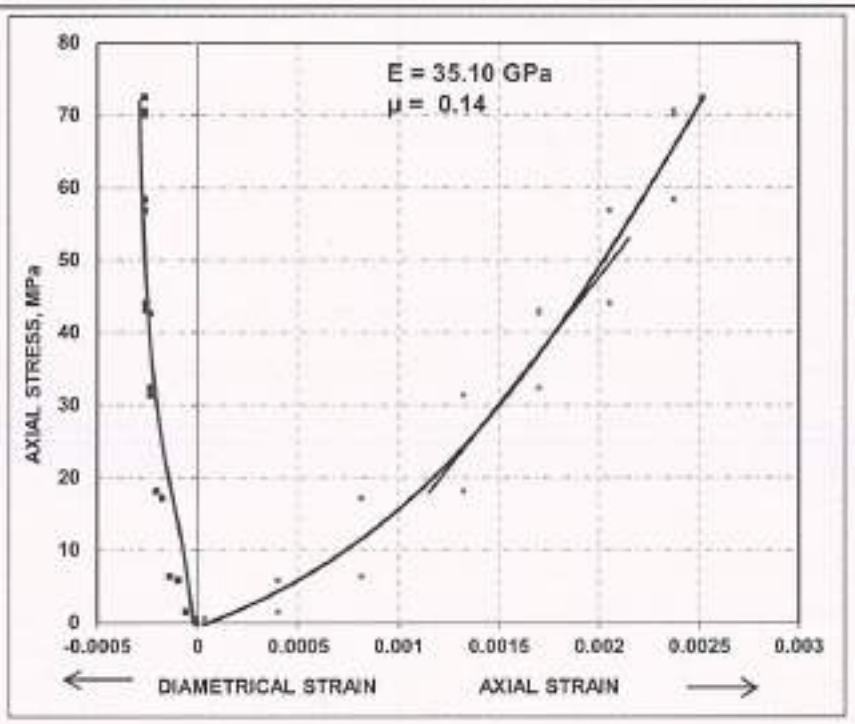
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

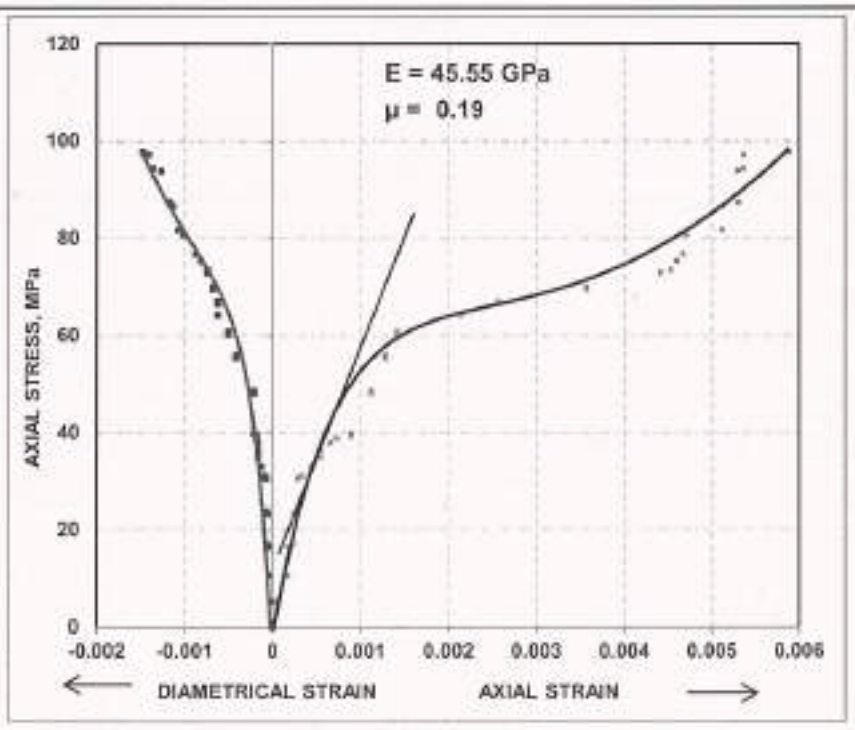


Modulus of elasticity and poisson's ratio curve at depth of 16.50 to 18.00m

Sample No. 100

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 19.50 to 21.00m

Sample No. 125

Before Test

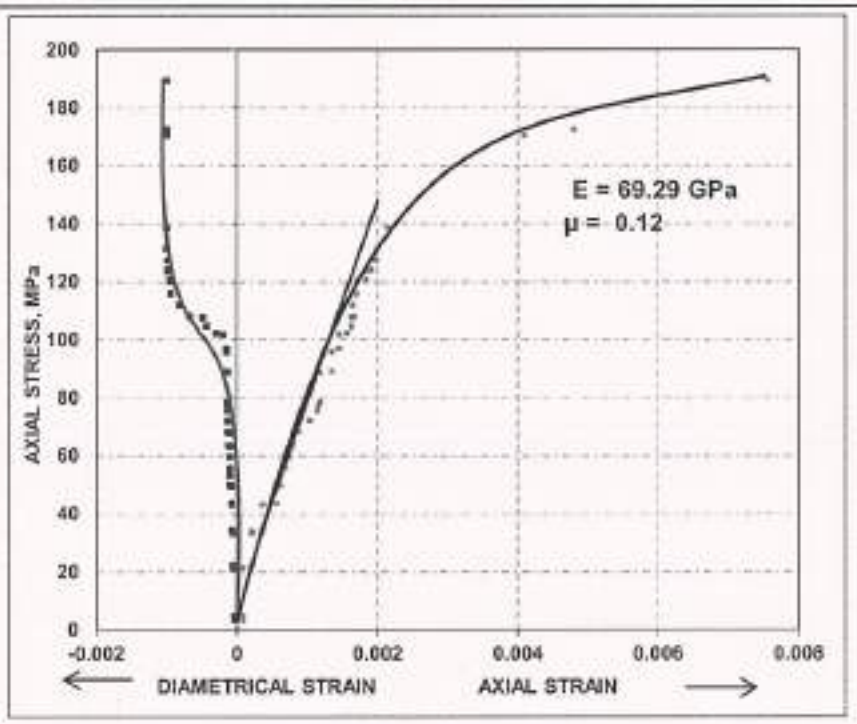
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

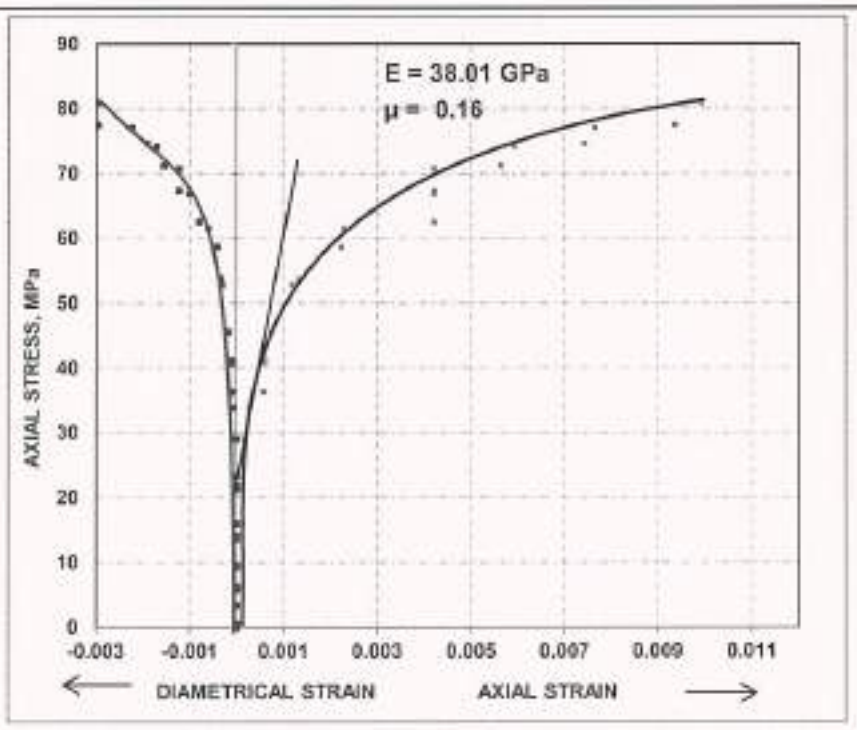


Modulus of elasticity and poisson's ratio curve at depth of 21.00 to 20.50m

Sample No. 137

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 24.00 to 25.50m

Sample No. 161

Before Test

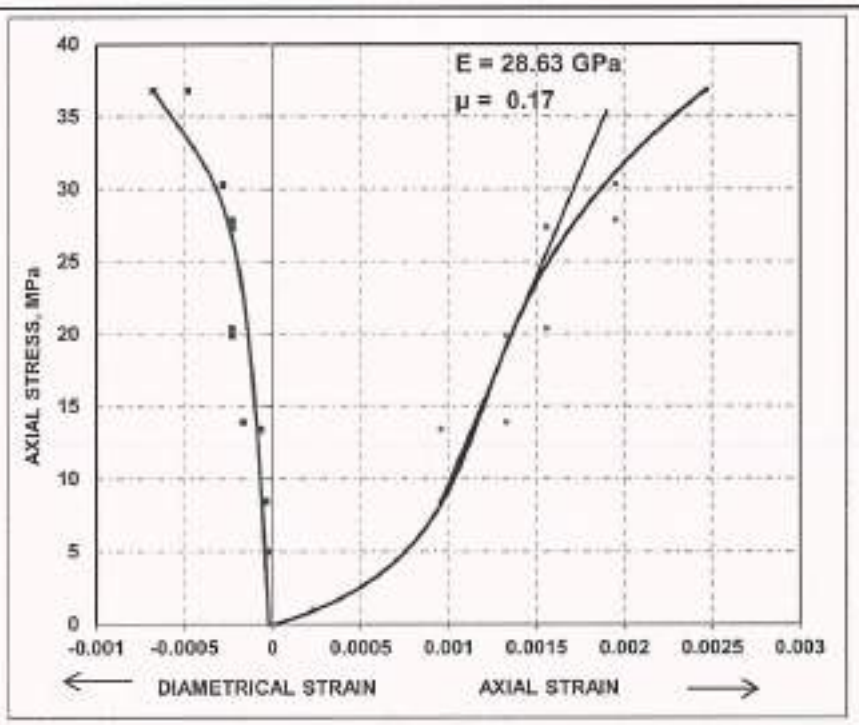
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

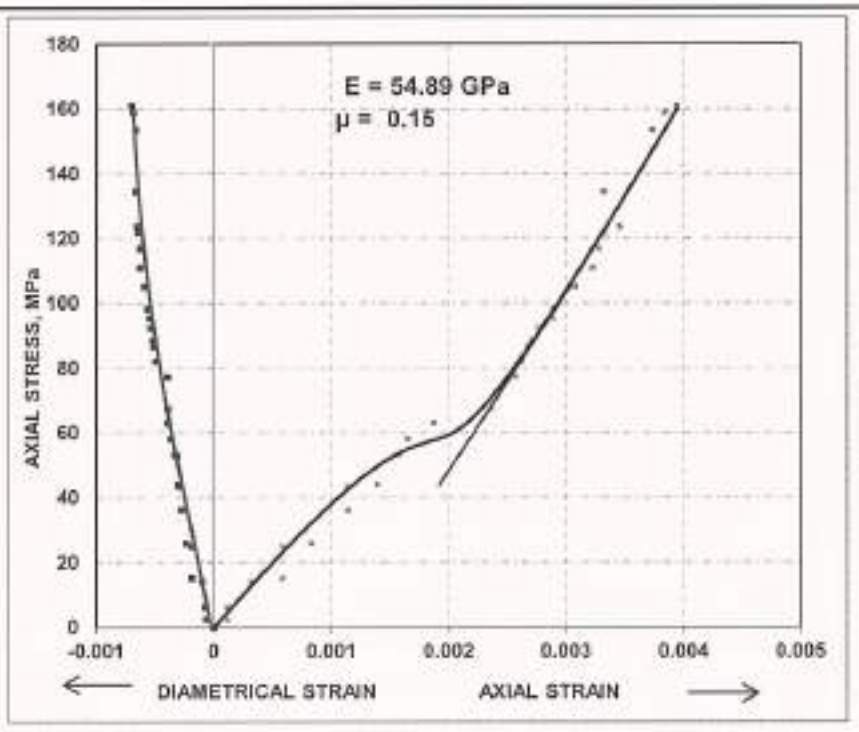


Modulus of elasticity and poisson's ratio curve at depth of 27.00 to 28.50m

Sample No. 187

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 28.50 to 30.00m

Sample No. 201

Before Test

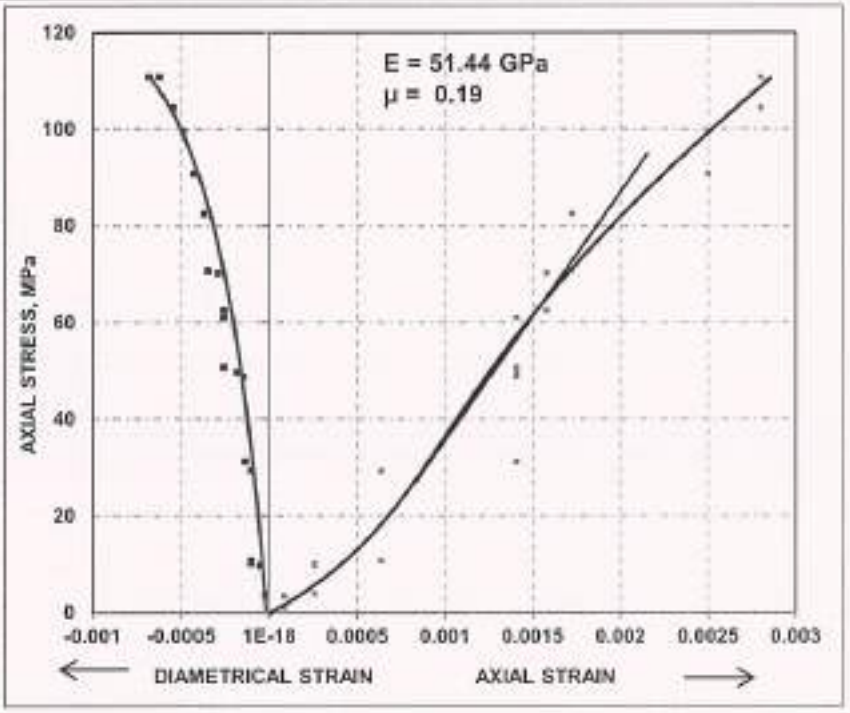
After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

MODULUS OF ELASTICITY & POISSON'S RATIO OF ROCK

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

BOREHOLE No. SBH-02

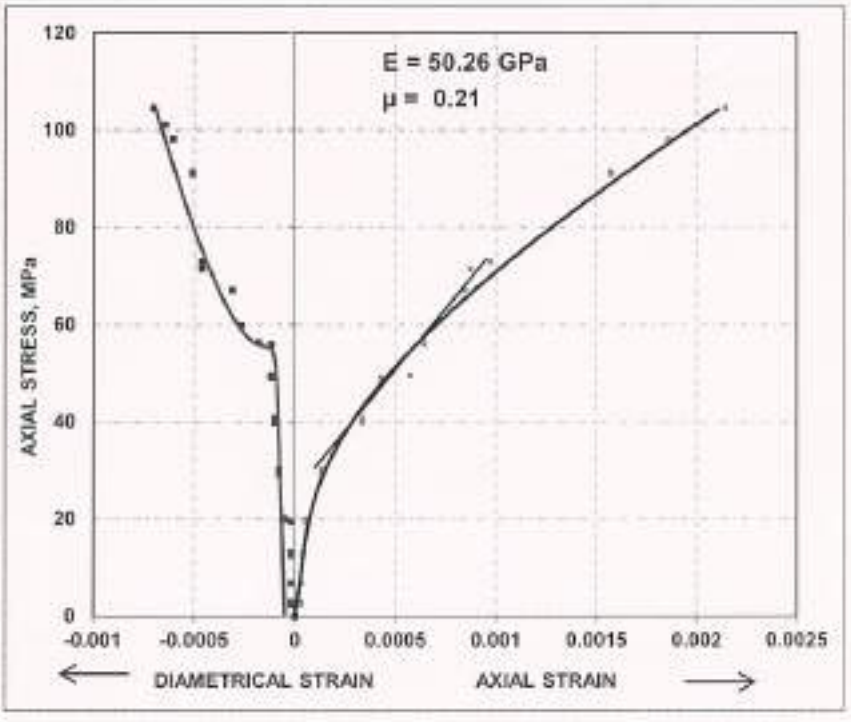


Modulus of elasticity and poisson's ratio curve at depth of 33.00 to 34.50m

Sample No. 232

Before Test

After Test



Modulus of elasticity and poisson's ratio curve at depth of 34.50 to 36.00m

Sample No. 236

Before Test

After Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-1		
Sample Depth (m)	19.50-21.00		
Sample No.	136 / 138 / 139		
Rock type	**Porphyritic BASALT**		
Dia of sample (m)	0.052	0.052	0.052
Area (m^2) $A = (\pi/4)D^2$	0.0021	0.0021	0.0021
Load (KN)	300.40	378.60	450.20
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	142.21	179.24	213.13

Test Results	
Angle of internal friction ϕ	**63.28°**
Cohesion "c" MPa	**12.74**

Photographs of Sample

Before Test

After Test

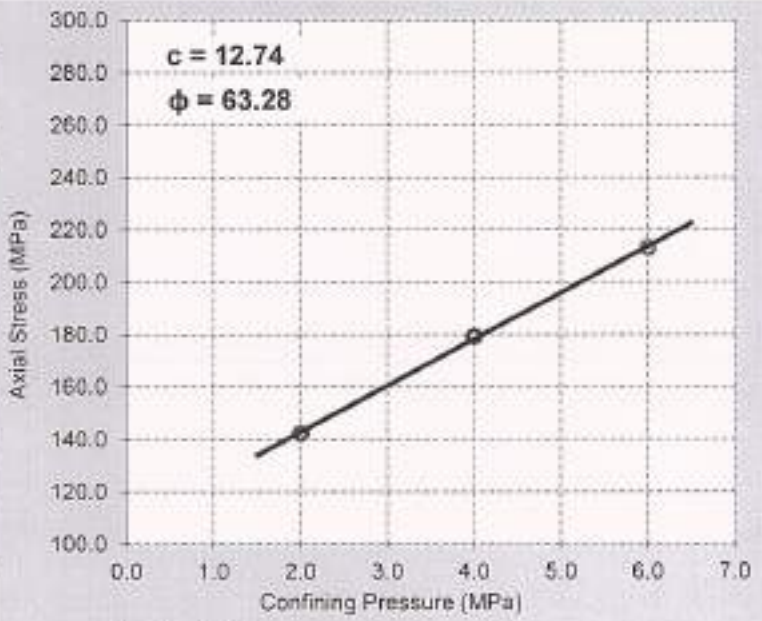


Fig-1:- Axial stress versus confining pressure

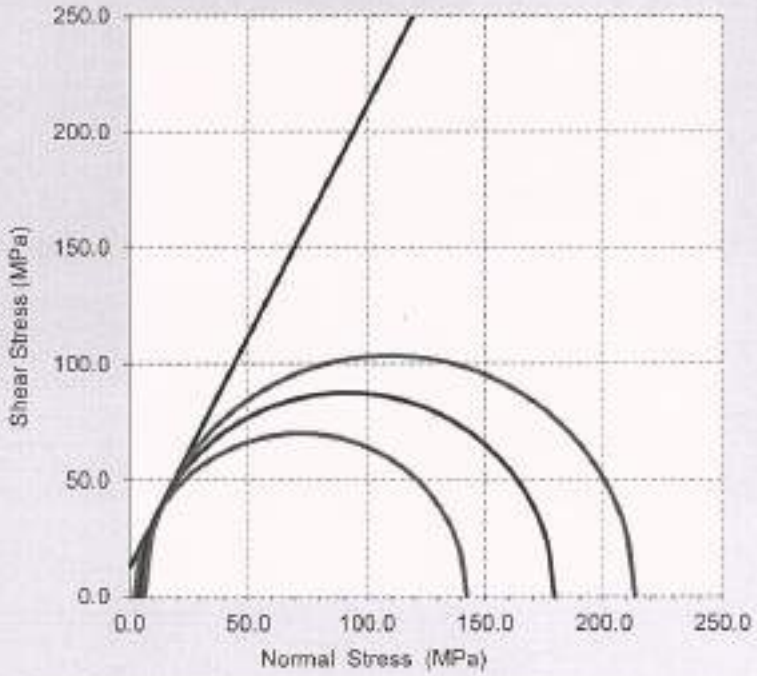


Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

INDIAN GEOTECHNICAL SERVICES
New Delhi

TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-1		
Sample Depth (m)	30.00-31.50		
Sample No.	217 / 223		
Rock type	**Porphyritic BASALT**		
Dia of sample (m)	0.055	0.055	0.055
Area (m^2) A= (π/4)D^2	0.0023	0.0023	0.0023
Load (KN)	351.50	435.80	504.30
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	150.56	186.67	216.02

Test Results	
Angle of internal friction ϕ	62.23°
Cohesion "c" MPa	14.71

Photographs of Sample

Before Test

After Test

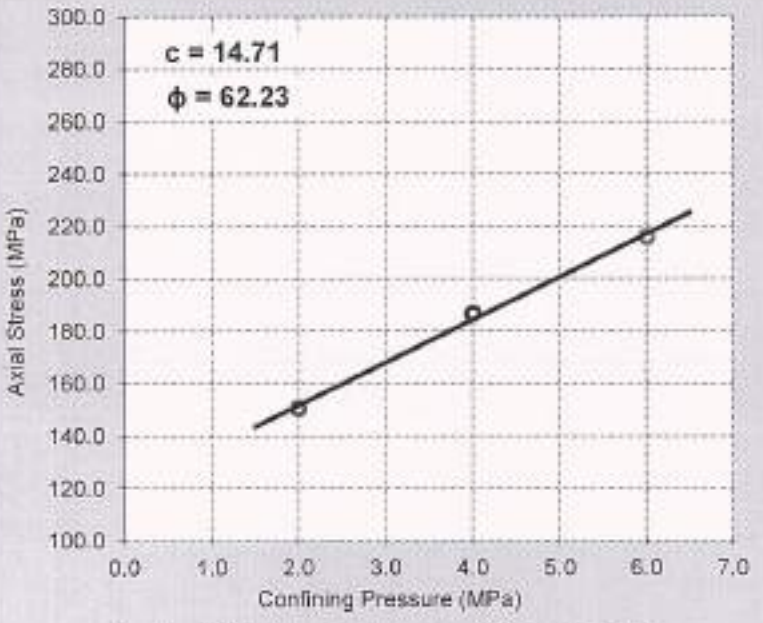


Fig-1:- Axial stress versus confining pressure

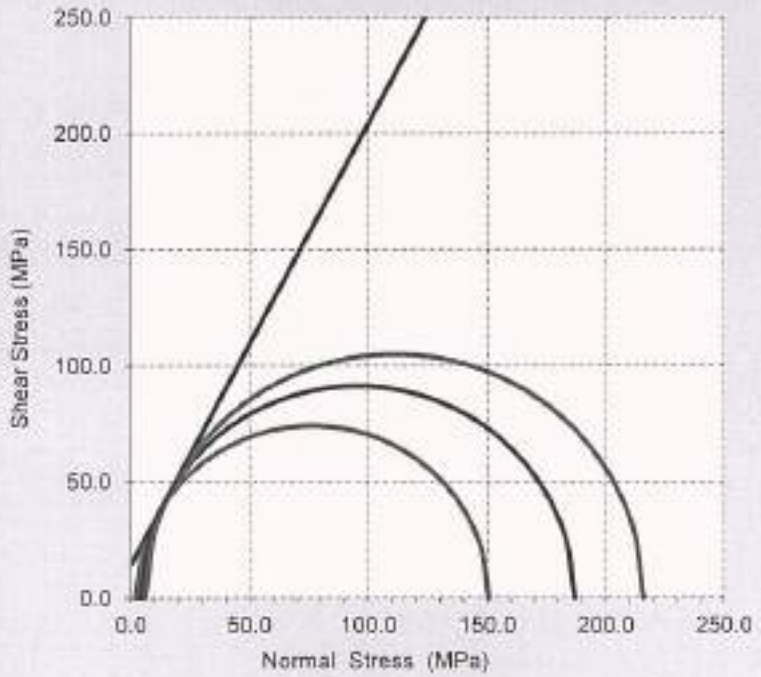


Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

INDIAN GEOTECHNICAL SERVICES
New Delhi

TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-1		
Sample Depth (m)	33.00-34.50		
Sample No.	236 / 240		
Rock type	**Porphyritic BASALT**		
Dia of sample (m)	0.055	0.055	0.055
Area (m^2) $A = (\pi/4)D^2$	0.0023	0.0023	0.0023
Load (KN)	236.50	298.80	370.10
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	101.16	127.80	158.30

Test Results	
Angle of internal friction ϕ	60.36°
Cohesion "c" MPa	9.52

Photographs of Sample

Before Test

After Test

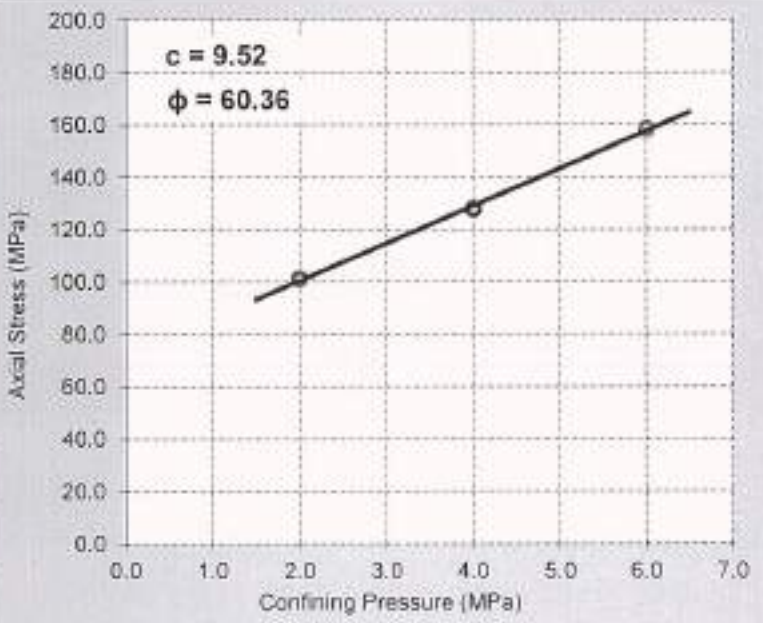


Fig-1:- Axial stress versus confining pressure

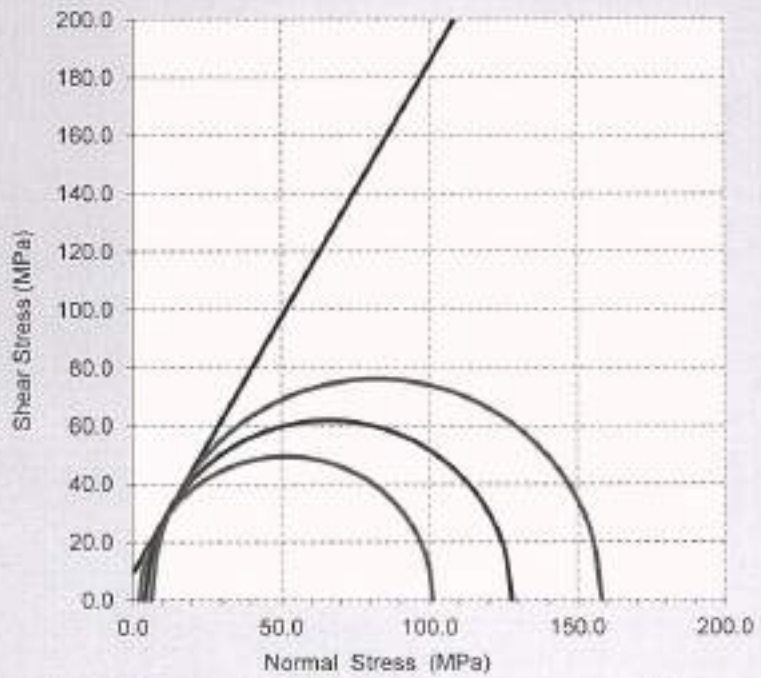


Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

INDIAN GEOTECHNICAL SERVICES
New Delhi

TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-2		
Sample Depth (m)	15.00-16.50		
Sample No.	84 / 86		
Rock type	**BASALT**		
Dia of sample (m)	0.051	0.051	0.051
Area (m^2) $A = (\pi/4)D^2$	0.0021	0.0021	0.0021
Load (KN)	232.10	291.80	356.90
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	112.38	141.29	172.81
Test Results			
Angle of internal friction ϕ		**61.14°**	
Cohesion "c" MPa		**10.51**	

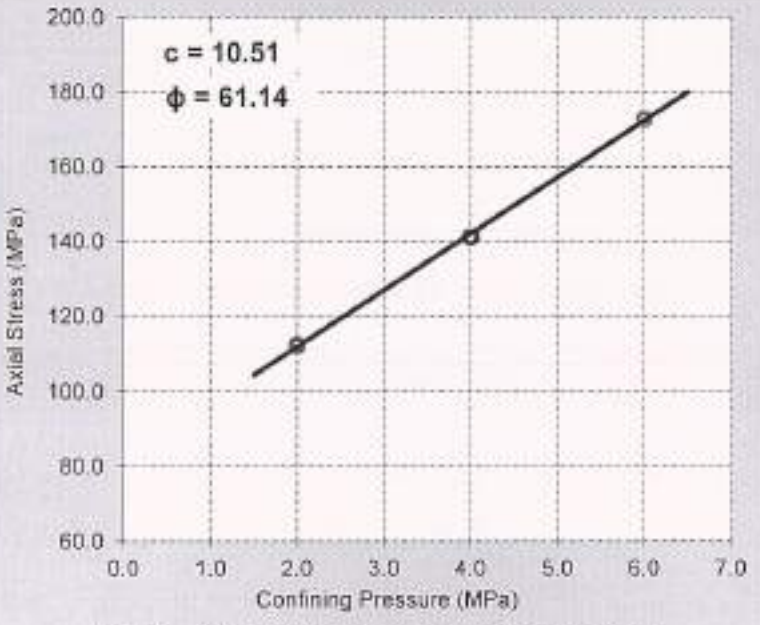


Fig-1:- Axial stress versus confining pressure

Photographs of Sample

Before Test

After Test

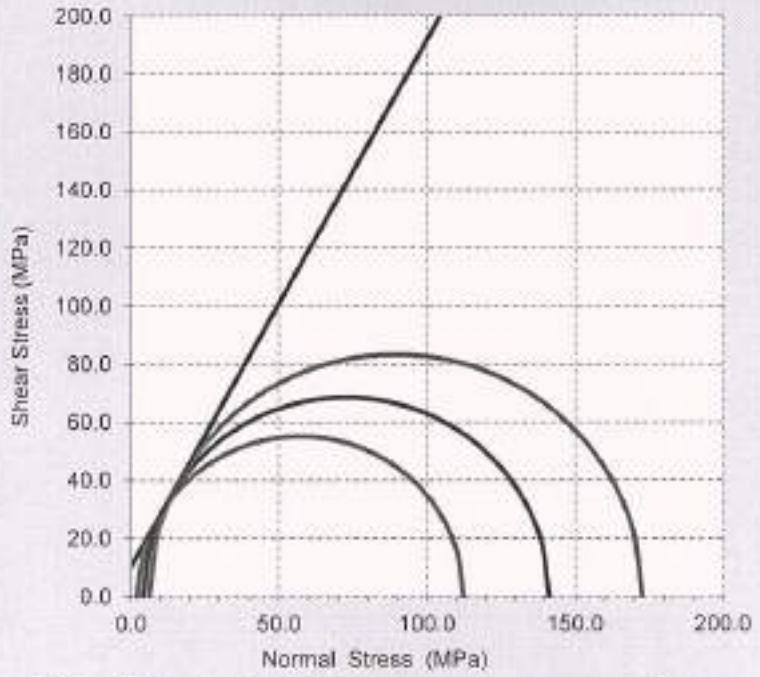


Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

INDIAN GEOTECHNICAL SERVICES
New Delhi

TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-2		
Sample Depth (m)	18.00-19.50		
Sample No.	108 / 110 / 115		
Rock type	**BASALT**		
Dia of sample (m)	0.051	0.051	0.051
Area (m^2) A= (π/4)D^2	0.0020	0.0020	0.0020
Load (KN)	284.40	344.20	410.60
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	138.78	167.97	200.37

Test Results	
Angle of internal friction ϕ	61.40°
Cohesion "c" MPa	13.69

Photographs of Sample

Before Test

After Test

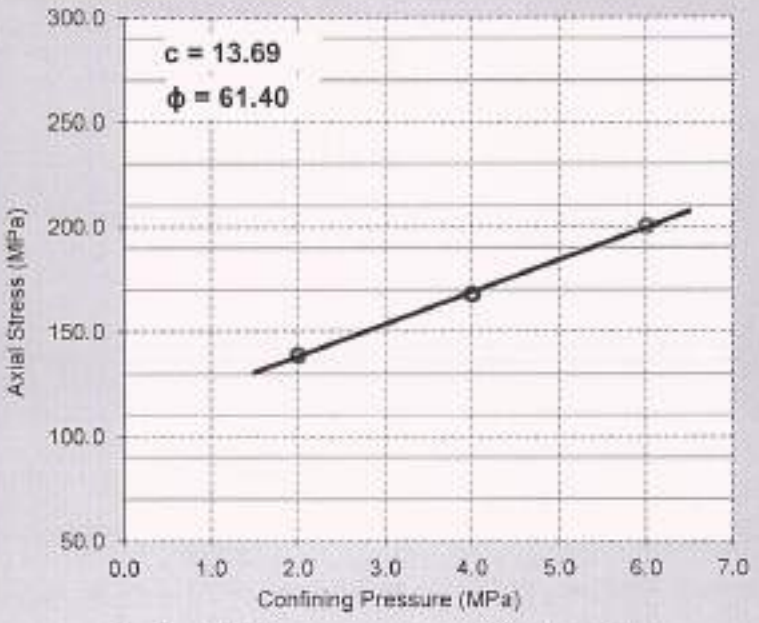


Fig-1:- Axial stress versus confining pressure

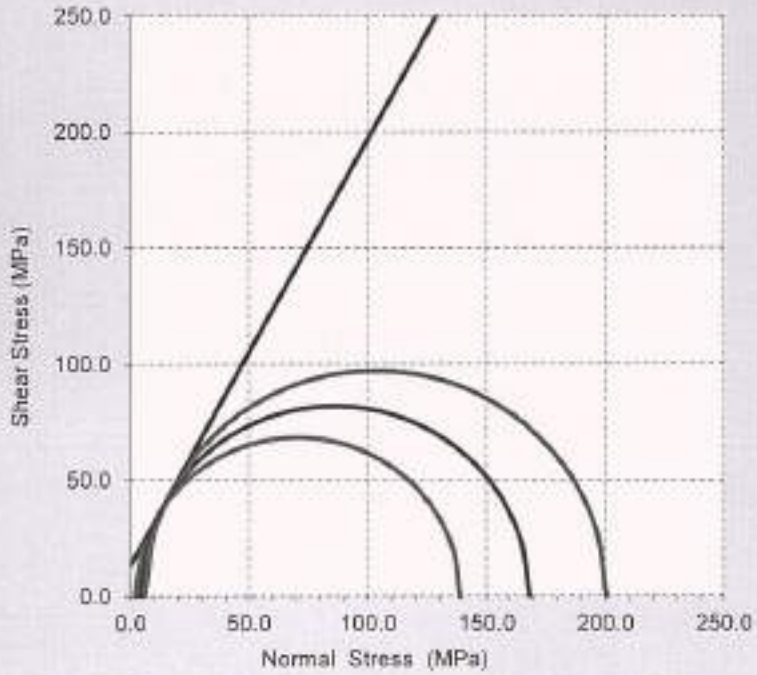


Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

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TRIAXIAL COMPRESSION TEST
IS: 13047 (1991)

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

STRUCTURE: PROPOSED STATUE OF ONENESS

Sample Details			
Borehole No.	SBH-2		
Sample Depth (m)	31.50-33.00		
Sample No.	213 / 217		
Rock type	**BASALT**		
Dia of sample (m)	0.051	0.051	0.051
Area (m^2) A= $(\pi/4)D^2$	0.0020	0.0020	0.0020
Load (KN)	302.40	372.80	423.10
Confining Pressure (MPa)	2.00	4.00	6.00
Axial Stress (MPa)	148.50	183.07	207.77

Test Results	
Angle of internal friction ϕ	60.87°
Cohesion "c" MPa	15.65

Photographs of Sample

Before Test

After Test

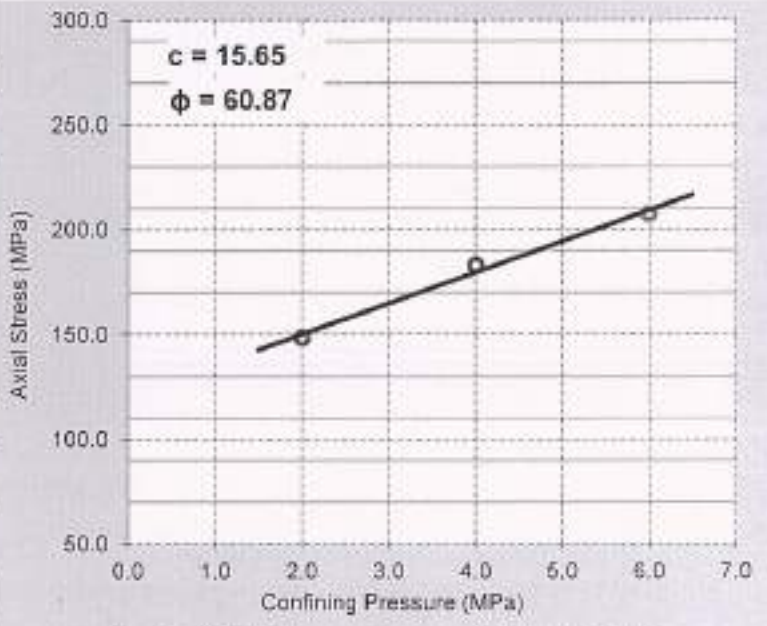

Fig-1:- Axial stress versus confining pressure

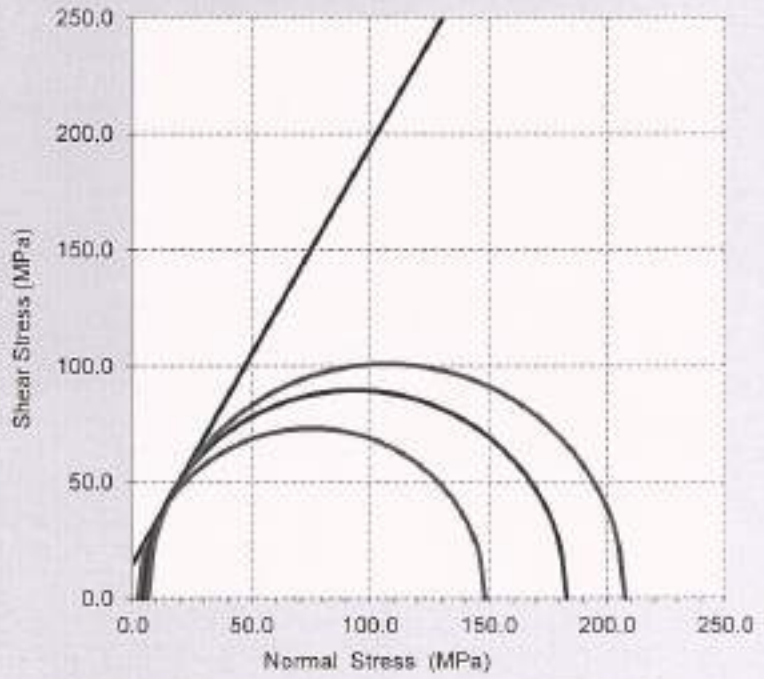

Fig-2:- (Mohr-Coulomb) shear stress versus normal stress

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

Before Test

Before Test

Before Test

After Test

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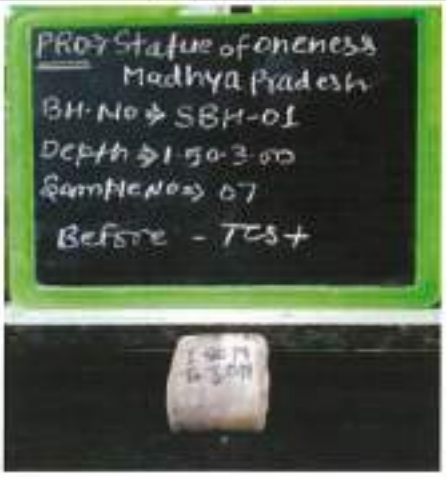
After Test



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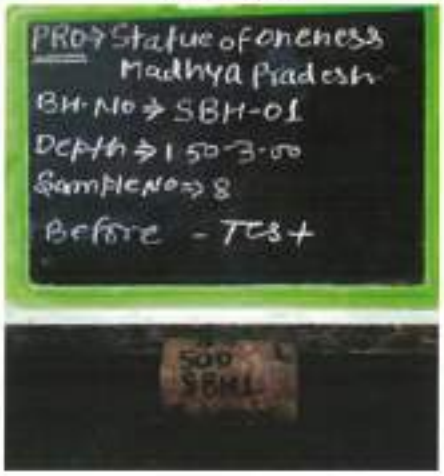

Before Test

Before Test

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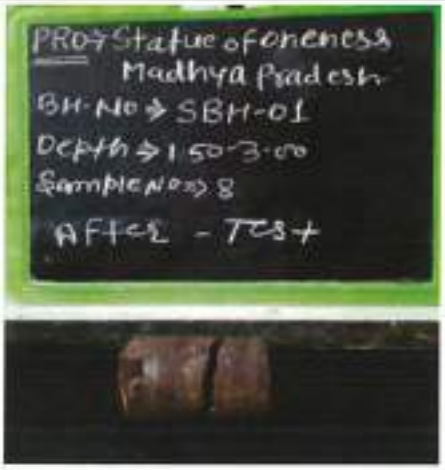
LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

After Test



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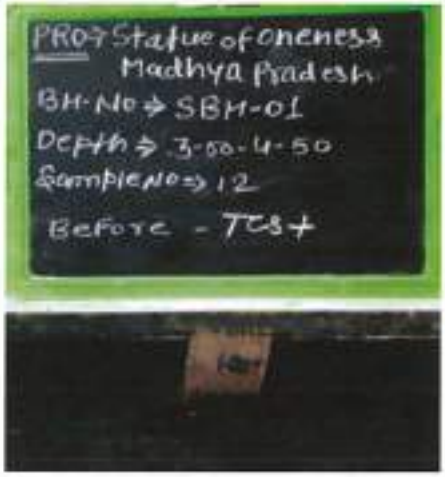

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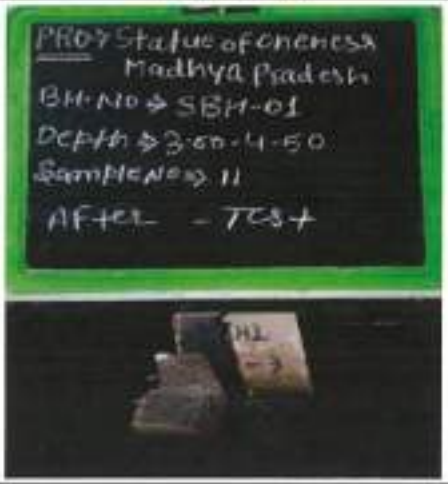

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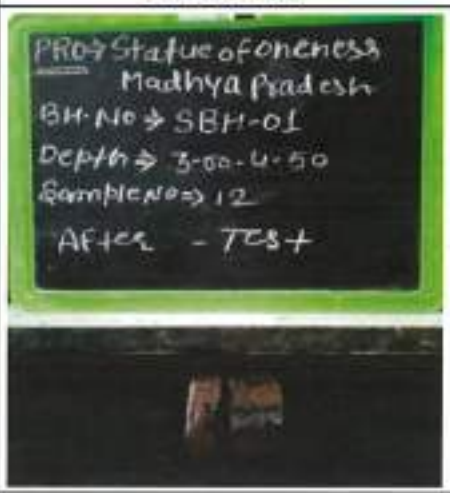

After Test

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

Before Test	Before Test	Before Test
After Test	After Test	After Test
Before Test	Before Test	Before Test

INDIAN GEOTECHNICAL SERVICES
New Delhi

LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

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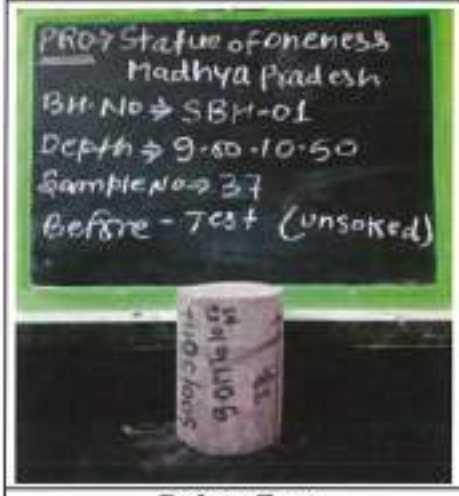

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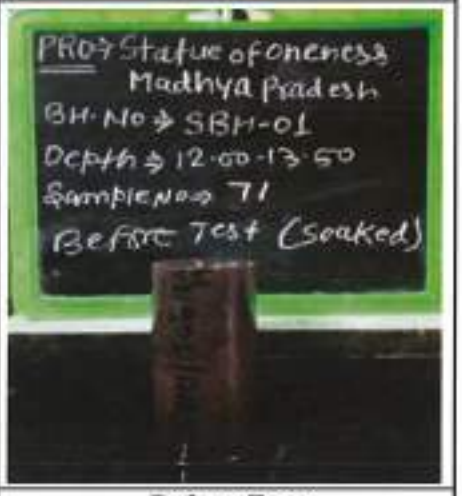

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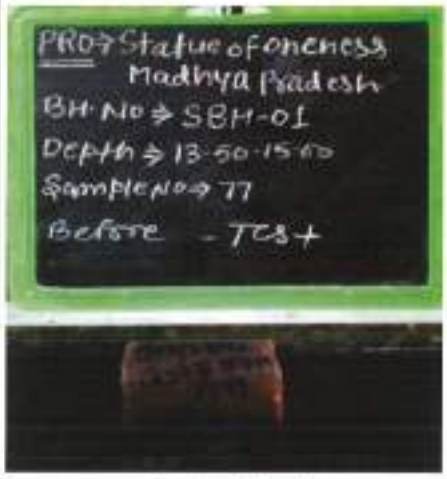
LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01



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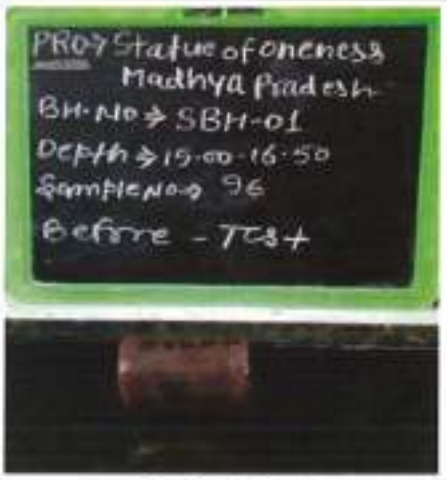

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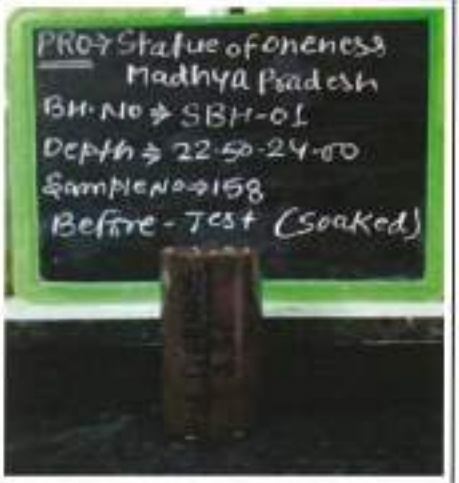
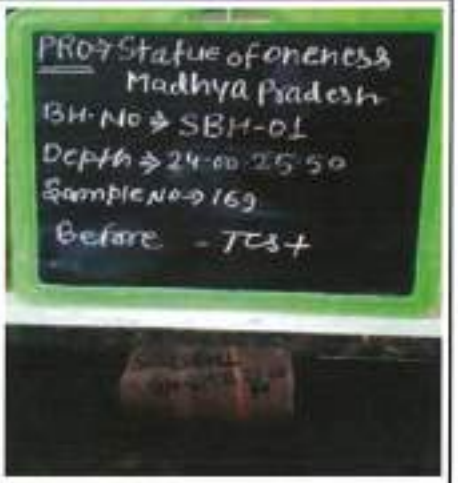
INDIAN GEOTECHNICAL SERVICES
New Delhi

LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

After Test	**After Test**	**After Test**
		
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	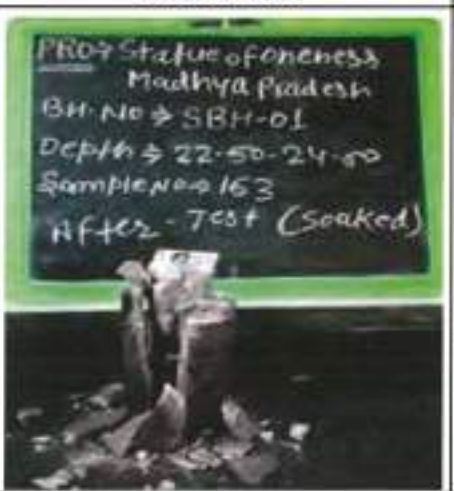	
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New Delhi

LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

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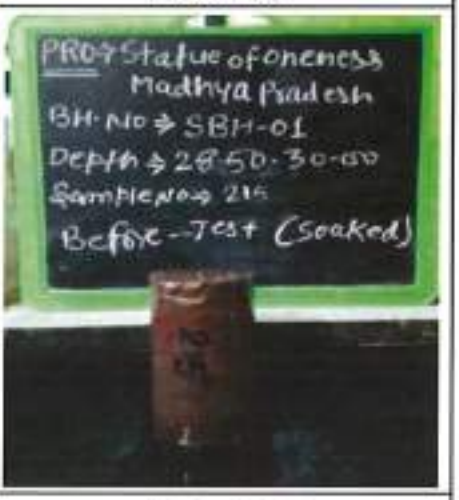

Before Test

INDIAN GEOTECHNICAL SERVICES
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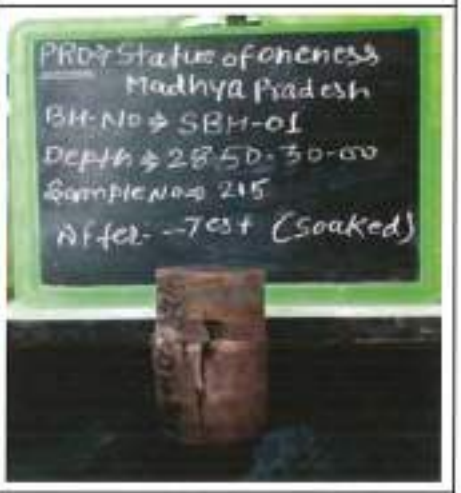
LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

After Test

After Test



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New Delhi

LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-01

After Test

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Before Test

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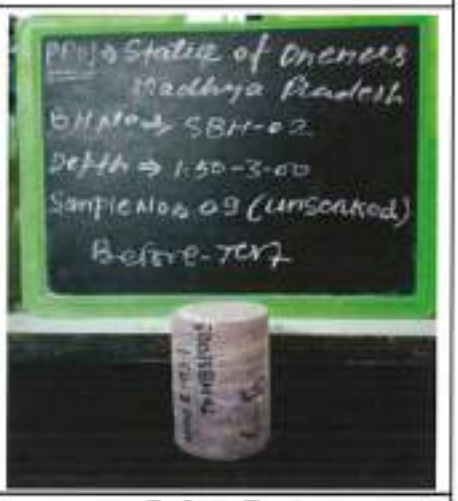
LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

Before Test

Before Test



Before Test

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

After Test	After Test	After Test
Before Test	Before Test	Before Test
After Test	After Test	After Test

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PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

Before Test	Before Test	Before Test
After Test	After Test	After Test
Before Test	Before Test	Before Test

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

After Test	After Test	After Test
Before Test	Before Test	Before Test
After Test	After Test	After Test

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

Before Test	Before Test	Before Test
After Test	After Test	After Test
Before Test	Before Test	Before Test

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LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

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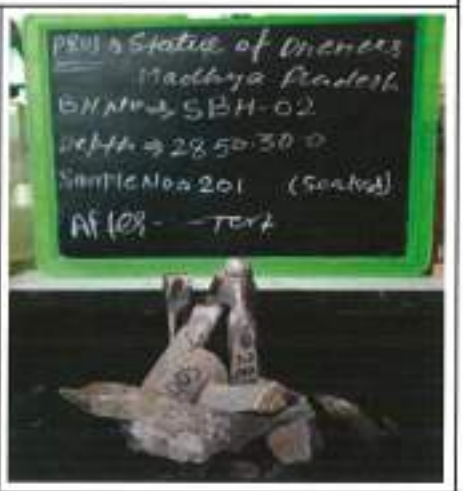
After Test



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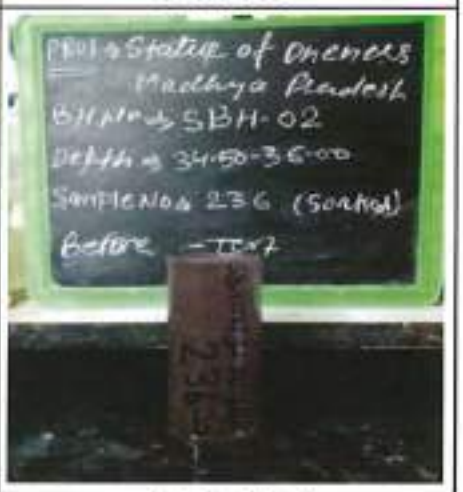

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New Delhi

LABORATORY TEST PHOTOGRAPHS

PROJECT : GEOTECHNICAL INVESTIGATION FOR "PROPOSED STATUE OF ONENESS" MADHYA PREADESH

Borehole No. SBH-02

Before Test

Before Test

Before Test

After Test

After Test

After Test

Before Test

After Test

Before Test / After Test

ANNEXURE - F

ROCK CORE PHOTOGRAPHS (SBH-01 & SBH-02)

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

Box No. 1 of 11

Box No. 2 of 11

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

Box No. 3 of 11

Box No. 4 of 11

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

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Box No. 6 of 11

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-1

Box No. 11 of 11

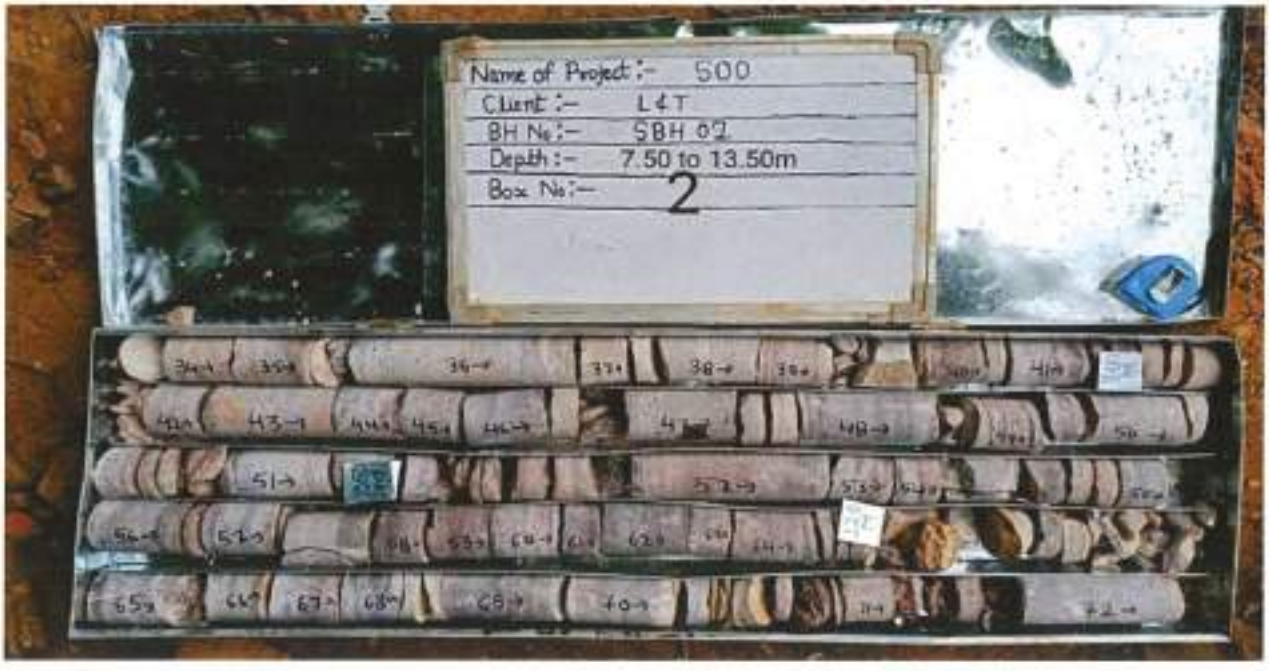
INDIAN GEOTECHNICAL SERVICES
New Delhi

CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-2

Box No. 1 of 10



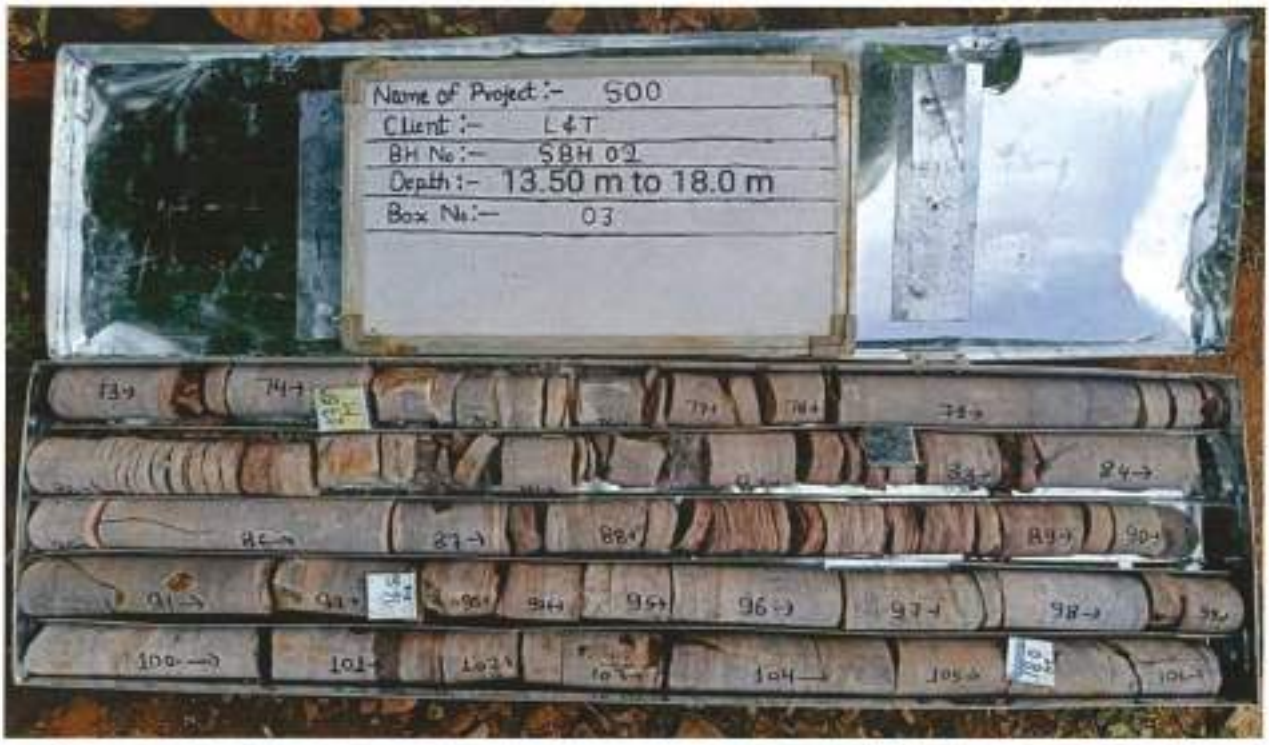
Box No. 2 of 10

INDIAN GEOTECHNICAL SERVICES
New Delhi

CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-2



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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-2

Box No. 5 of 10

INDIAN GEOTECHNICAL SERVICES
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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-2

Box No. 7 of 10

Box No. 8 of 10

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CORE BOX PHOTOGRAPHS

Project: Geotechnical Investigation for SOO

Borehole No. SBH-2

Box No. 9 of 10

Box No. 10 of 10

REPORT ON
MULTI CHANNEL ANALYSIS OF SURFACE WAVES (MASW) STUDY

PROPOSED STATUE OF ONENESS

STATE OF MADHYA PRADESH

SUBMITTED TO:

L&T Construction
Buildings & Factories

L&T Delhi Cluster - B&F IC

JULY 2022

SUBMITTED BY

INDIAN GEOTECHNICAL SERVICES
(AN ISO 9001 – 2008 CERTIFIED COMPANY)
C-91, GROUND FLOOR, SHIVALIK, MALVIYA NAGAR
NEW DELHI, INDIA
TEL/FAX.: +91-11- 45509700-706
TEL/FAX.: +91-11-26677711, 45509700-706

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REPORT ON
MULTI CHANNEL ANALYSIS OF SURFACE WAVES (MASW) STUDY
PROPOSED STATUE OF ONENESS
IN THE STATE OF MADHYA PRADESH

1.0 INTRODUCTION

Madhya Pradesh's culture and tourism department (Owner) has decided to build a multi-metal statue of Shankaracharya on Mandhata Parvat hill facing the river Narmada. The site is a river island in the Narmada about 4 km by 2 km in size. It is also a hill that is surrounded by waters of the Narmada on all sides. Which is located in the district of Khandwa, Madhya Pradesh.

Owner have awarded the work to "**M/s L & T Construction (Buildings and Factories group)** (Contractor / Our Client)".

The Client has engaged, M/s Indian Geotechnical Services to carryout "Detailed Geotechnical and Geophysical Investigation for proposed Statue of Oneness", Madhya Pradesh. Geophysical survey includes Multichannel Analysis of Surface Waves Study (MASW).

The MASW is planned to be carried out at proposed site. Based on the requirement, four no of 2D MASW profiles were planned by the Client. M/s Indian Geo-technical Services (IGS) carried out ***MASW***, the data acquisition was completed in presence client's representative.

The objective of this Investigation is to map overburden thickness, bedrock profile and any anomaly within in the bedrock.

The purpose and objective of the survey was to assess resistivity, velocity and associated thickness of:

- Overburden soil
- weathered rock
- depth of bedrock
- identify any possible anomalous zone in bedrock

The report summarizes the outcome of seismic study. The MASW data was of good to very good quality at most of the locations. Based on the interpretation three to four layer models have been established comprising thin layer of overburden soil cover on the top, followed by weathered, fractured and hard strata as bed rock. The strata are relatively compact strata followed by bedrock.

1.1 Scope of This Report

This report contains the following information;

- Scope of work
- 2D MASW survey – 04 Lines
- Summary and Conclusions

2.0 SCOPE OF WORK

Geophysical investigations involving multichannel analysis of surface waves and electrical resistivity was conducting to establish the subsurface stratification such as overburden soil, weathered/ fractured/ jointed and basement rock mass through subsurface seismic velocity and its characteristic along the seismic lines for assessment of the rock level/mass conditions for the construction of proposed statue and slope stability multichannel analysis of surface waves profiles are being conducted at around the reposed proposed location.

Based on the above field studies, various aspects such as the nature and the bedrock profile were assessed. The reporting includes representative schematic sections and its corresponding interpretations for the geological setting of the site. The coordinates of the multichannel analysis of surface waves profiles are given in the Table 1, Location Plan of MASW Profiles is shown in figure-1-2.

Table 1: Start and End Coordinates of MASW Profiles.

MASW Profile No.	MASW direction	Start Coordinates (m)			End Coordinates (m)		
		Easting	Northing	Elev	Easting	Northing	Elev
MASW-1	EAST	618572.193	2460955.756	254.314	618565.668	2460989.490	253.984
MASW-2	WEST	618533.601	2460952.138	255.175	618536.164	2460986.456	254.559
MASW-3	NORTH	618535.936	2460989.706	254.210	618569.478	2460992.110	254.214
MASW-4	SOUTH	618530.246	2460960.371	255.132	618564.584	2460957.976	254.761

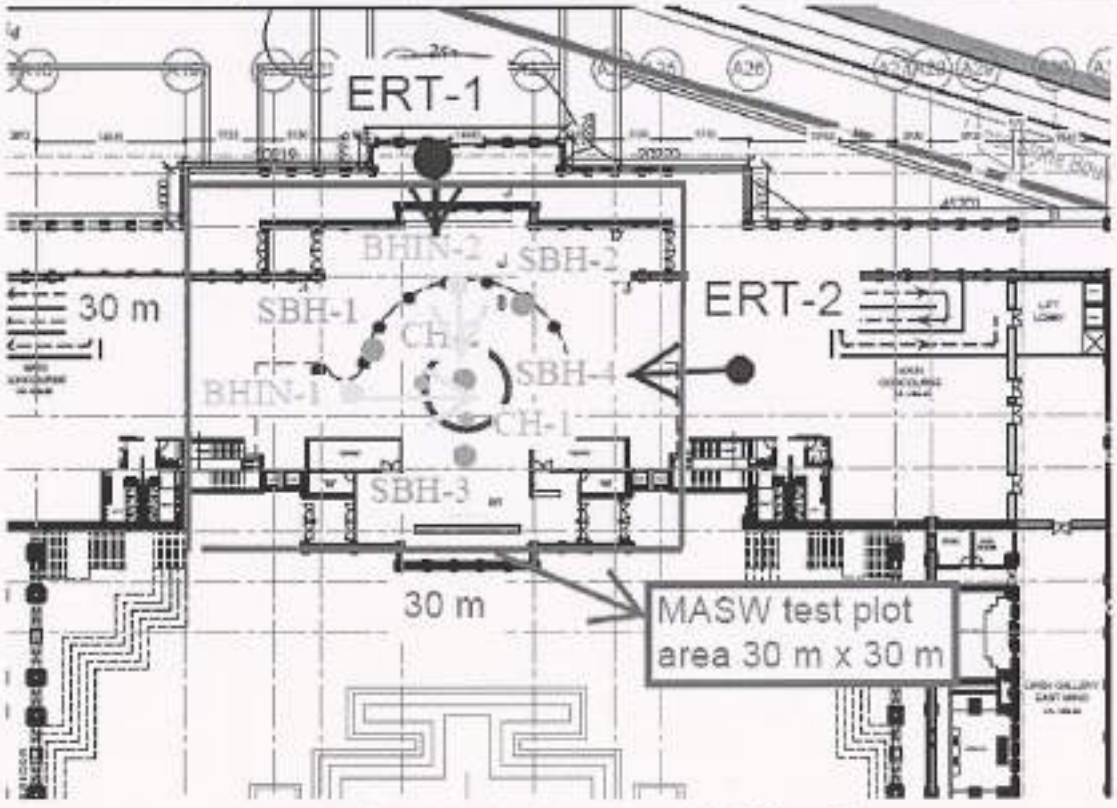


Figure-1: Plan showing location of MASW profiles

Figure-2: Plan showing MASW profiles on Google map

3.0 GEOLOGICAL SET UP OF THE AREA

The proposed Site is a river island in the Narmada about 4 km by 2 km in size. It is also a hill that is surrounded by waters of the Narmada on all sides.

Present study, area is located on igneous formation (basalts) in general, having less porosity. This layer is underlined The peninsular shield of India was considered to be seismically stable intra-plate region, far away from the Himalayan plate boundary (Khan, 2009). However, several isolated areas of the Peninsula are known to have experienced low to moderate level of seismicity in the recent past and the Central India Tectonic Zone (CITZ) is one of them. One of the largest earthquakes in the study area was the Satpura earthquake of 14th March 1938, with magnitude (Ms) 6.3, which occurred near Khandwa within the CITZ. The CITZ is a conspicuous feature in India and at present is under the compressional forces of the Himalayan orogeny (Kaila, 1986).It is a zone of fractures belonging to early Precambrian, Cretaceous and post Deccan trap period (Kaila et al., 1989). This zone is dissected by several E-W/ENE–WSW trending faults. The Son Narmada South fault (NSF) is one of them and is considered to be seismically active (Fig.1) by the granitic basement, which also has low porosity the study area is situated major approximately at latitude 22.25° N and 76.15° E it is ~1.5 km away to the reservoirs of India in S-E direction which is located approximately at latitude 22° 17' N and longitude 76° 28' E, and lying at a distance of~40 km from the Son-Narmada south fault in the CITZ. Since geological faults and formations play a major role in triggering the seismic activity.

Table 2 : Geological successions of Khandwa District

AGE	FORMATION	LITHOLOGY
Pleistocene to Recent	-	*Laterite /Black CottonSoils*
Cretaceous to Eocene	**Deccan Trap**	**Basaltic Flows with intertrappeans**
----------	**Un-conformity**	----------
Upper-Precambrian To lower Paleozoic	Vindhyan Super Group	Quartzite, Sand stone shale & Conglomerate
----------	**Un-conformity**	----------
Upper-Precambrian	Bijawar Group	Dolomite, Chert breccia, Quartzite & Conglomerate.
----------	**Un-conformity**	----------
Lower-Precambrian	Archean	Granite/Granite Gneisses

Reference : DISTRICT SURVEY REPORT OF KHANDWA DISTRICT AS PER NOTIFICATION NO. S.O. 141(E) NEW DELHI, THE 15TH JANUARY, 2016 OF MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

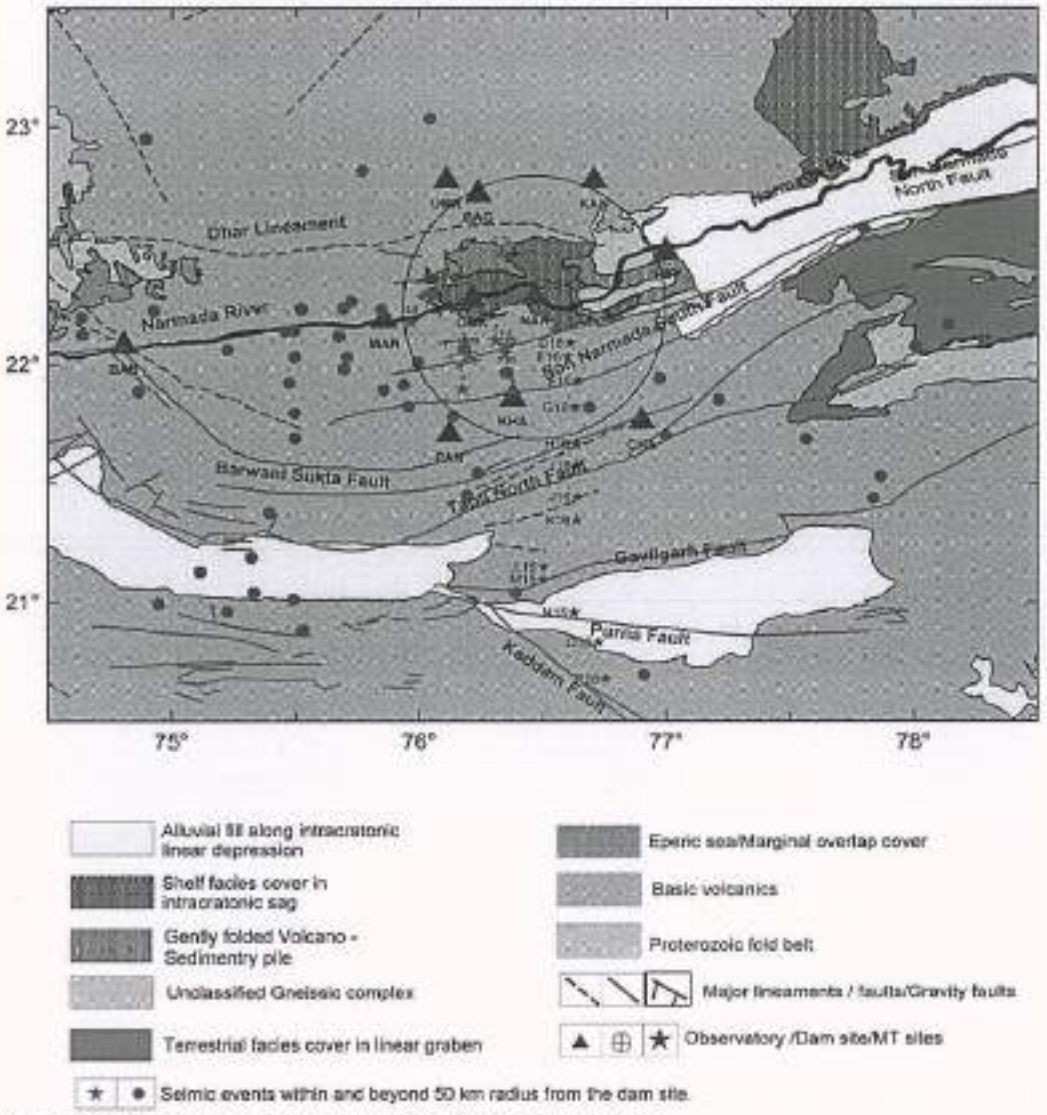


Figure 3. Detailed geological map of the study area
Showing major seismotectonic and geological features along with the epicenters of recorded seismic events in the area of Indira Sagar reservoir site, which is very close to our stady area Madhya Pradesh (GSI, 2000). Seismic events (stars) within the radius of 50km from the dam site are shown in the black circle.

Reference : Deciphering the seismicity pattern from MEQ study atindira Sagar reservoir area, Madhya Pradesh, India by G.Dhanunjaya Naidu*, Sachin Khupat and D.K.Awasthi

4.0 METHODOLOGY OF MULTICHANNEL ANALYSIS OF SURFACE WAVES (MASW) SURVEY

Study of Shear Wave Velocity profile and (Vs30) shall be carried out through Multi-Channel Analysis of Surface Waves (MASW) technique by using at least 24 channel digital engineering seismograph with 4.5 Hz geophones, including data acquisition, data processing and interpretation for assessment of dynamic elastic properties of rock mass and earthquake design parameter at various locations.

4.1 Basic Principle of (MASW) Survey

Multichannel Analysis of Surface Waves (MASW) is a non-destructive surface wave technique based fundamentally on the dispersion of Rayleigh wave, analysis of which helps in determination of the vertical distribution of the S-wave velocity underground The S-wave velocity is a function of the elastic properties of the subsurface medium and is directly related to the hardness and stiffness of the materials. The Rayleigh Wave dispersion characteristic is illustrated in Figure 7. Dispersion is the process by which, the mechanical properties of the subsurface layers with different frequencies/wavelength have different phase velocity. In a vertically homogeneous medium, as the mechanical property remains unchanged, the wavelengths vary with depth while the phase velocity remains constant. Whereas, in case of vertical heterogeneity, the wavelength varies depth-wise and the phase velocity is different for each subsurface stratum that has specific mechanical characteristics.

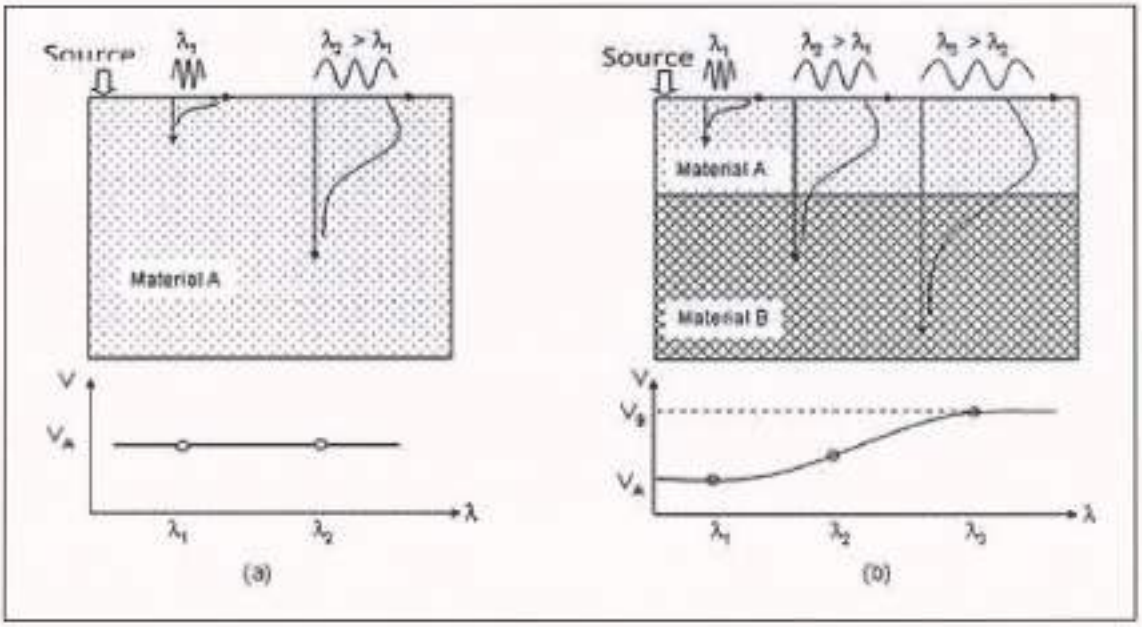


Figure-4: Dispersion of Rayleigh wave depicting relationship between phase velocity (V) & wavelength (λ) for (a) vertically homogeneous medium, and (b) vertically heterogeneous medium.

The MASW study procedure includes data acquisition as well as processing to evaluate Rayleigh wave dispersion characteristics and finally inversion of the dispersion curve to determine 1-D & 2-D distribution of S-wave velocity up to 30m depth.

The field layout for data acquisition comprises a mechanical source (hammer) for generating the seismic wave. A linear array of 24 receivers (4.5 Hz vertical geophones) is deployed in a horizontal 46m and 96m ground spread and connected to a multichannel

seismograph recorder. In data acquisition the two parameters of importance are the source offset and the receiver spacing: The source offset is set according to the depth of probing, while receiver spacing is decided on the basis of desired resolution.

The data processing involves transformation of raw data from time to frequency domain by Fourier analysis. The frequency spectrum consists of body waves, fundamental mode & higher modes of Rayleigh wave and reflected/scattered waves. The "energy accumulation pattern recognition technique" is employed to extract the fundamental mode Rayleigh wave for generating the dispersion curve which represents relationship between Rayleigh wave, phase velocity and frequency.

Finally, the extracted dispersion curve is used as a reference to back calculate the S-wave velocity variations with depth through inversion process. The procedure is an iterative process involving matching of theoretically developed dispersion curve of specific subsurface layer model with the field dispersion curve wherein a priori information about the site is used.

4.3 Generation of 1-D and 2-D S-Wave Velocity Images

As per the desired application, the results of MASW study are presented either in the form of 1-D or 2-D image for visualizing the detailed status of the subsurface and evaluating the site characteristics. The procedure for generating 2-D S-wave velocity image involves collection of data in a roll-along manner with fixed source-receiver configuration. Processing & inversion is being done in an automated manner. Basically, the 2-D image includes 1-D observations combined through roll along survey process and is portrayed in Figure 8.

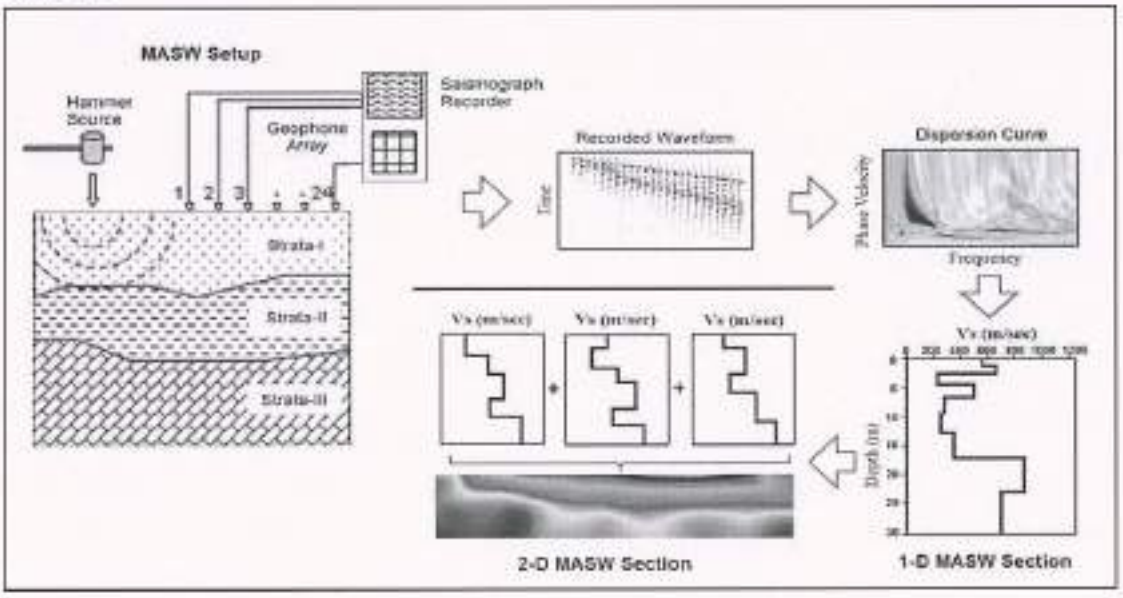


Figure-5: Depiction of procedure for generating 1-D and 2-D MASW Profile

Because of the merits of MASW technique, its application and advantages, it is gaining popularity as an efficient complimentary aid in reliably defining the subsurface condition. However, in case of steep topography and soft ground condition, its application becomes limited. As in the case of other geophysical techniques, a priori information is helpful in improving MASW interpretation.

4.4 Analysis of MASW Survey

MASW data was of fair quality. Analysis of the MASW data was carried out by SeisImager SW software. Seismic sections thus obtained were interpreted in terms of geological cross sections along each seismic line.

Based on MASW survey number of subsurface layers will be inferred.

The seismic site characterization for calculating seismic hazard is usually carried out based on the near-surface shear wave velocity values. The average shear wave velocity for the depth d of soil is referred to as Vs^H. The average shear wave velocity up to a depth of H (V_s^H) is computed as: $V_s^H = \sum di / \sum(\frac{di}{vi})$ (1)

Where, $\sum di$ is the cumulative depth in meter. For 30-m depth, average shear wave velocity is calculated from: $V_s^{30} = \frac{30}{\sum_{i=1}^{i=N}(\frac{di}{vi})}$ (2)

Where d_i and v_i denote the thickness (in meters) and shear wave velocity in m/s (at a shear strain level of 1025 or less) of the ith formation or layer, respectively, in a total of N layers, existing in the top 30 m. Calculated average shear wave velocity (V_s^{30}) at different locations along the proposed alignment are represented on the middle of MASW spread

5.0 INTERPRETATION OF MULTICHANNEL ANALYSIS OF SURFACE WAVES (MASW) SURVEY

5.1 Interpretation of MASW Results

2D MASW data was acquired at four locations with profile length varies from 46m to 96m at different locations within the monastery and outside also refer location map at fig-1. The data obtained are in SEG2 format of good to very good quality. Analysis of the MASW data was carried out through Surface Wave analysis, then by Wave equation and finally in Geoplot for graphical representation of analyzed data.

Data analysis starts with input seismic field files usually in SEG-2 format, The entire steps can be divided into pre- and main- process steps as illustrated by a generalized flowchart in figure-6.

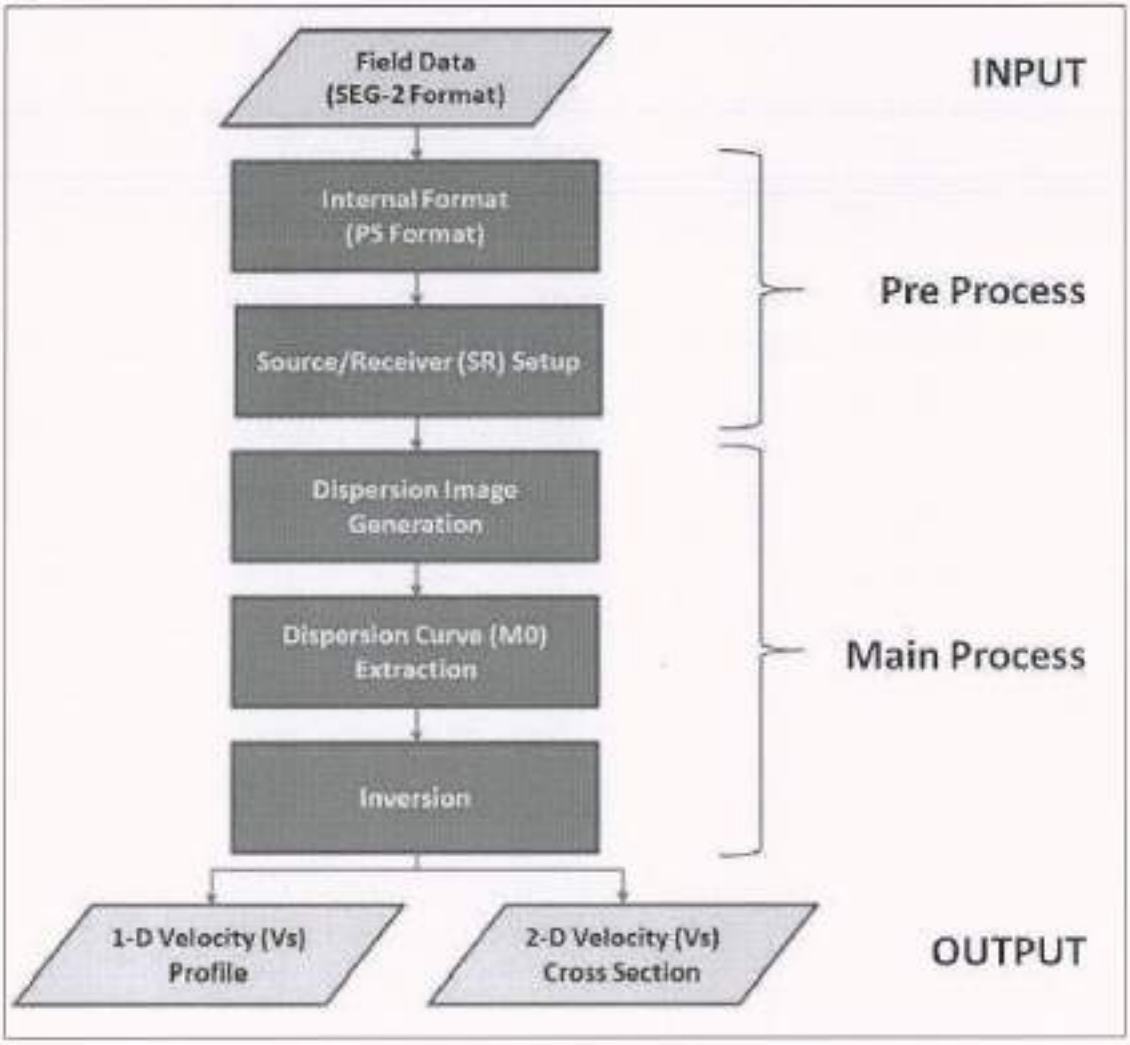


Figure-6: MASW process flow chart

5.2 Pre-Process Step

This step that is required depending on the specific analysis software is being used, and also on the acquisition parameters being taken during data acquisition

- **Internal Format:** The input data set in SEG-2 is converted into a proprietary software designated format as the very first step of the processing. This may take place internally with the software or requires a separate preparation of the converted data set.
- **Source/Receiver (SR) Setup:** All field files (records) have to possess with correct information about acquisition geometry such as surface coordinates of source and receivers. Although this information is encoded by acquisition software during data acquisition in the field, however, it is usually re-encoded through a data processing step provided in the analysis software.

5.3 Main-Process Step

Once the input seismic data is set with proper field geometry information then data is ready for theoretical analysis. Main processing steps of surface waves are being taken up with following analysis steps.

- **Dispersion Analysis :** Using 2-D wave field transformation method i.e. phase-shift method, tau-pi transformation, f-k, etc. for Generation of Dispersion Images from field record. F-k filtering is being used for eliminating the aliasing surface-wave energy and maintains the low frequency information of the reflected waves, and attenuating the residual weak energy of ground roll. The main application for F-k filtering is to eliminate coherent noise in seismic data as exemplified.
- **Dispersion Analysis :** From dispersion image the next step is Extraction of Dispersion Curve from each of the dispersion image generated in the previous step. This curve is called a "Theoretical measured curve." (M0). In multichannel approach does not attempt to calculate individual phase velocity first, but constructs an image space where dispersion trends are identified from the pattern of energy accumulation in this space. Then, necessary dispersion curves are extracted by following the image trends.
- **Inversion of Dispersion Curve:** By inverting the dispersion curves obtained through 2D MASW data, a 1-D shear-wave velocity (Vs) model (i.e. Vs variation with depth) whose theoretical dispersion curve (M0) best matches the measured M0 curve.
- **Generation of 2D velocity model:** The final output is a 1-D velocity (Vs) profile for each field record. If input data set contained field record(s) obtained by using a stationary receiver array, then there will be only one 1-D Vs profile obtained as output. On the other hand, for multiple field records obtained at successively different locations along a survey line were used as an input data set, then multiple 1-D velocity (Vs) profiles are generated at the end. In the present study, 2-D interpolation method used to generate a 2-D velocity (Vs) cross section as output.

5.3 Interpretation

Based on 2D MASW study, three layers subsurface model with variation in Shear wave velocity (Vs) has been inferred both vertically and laterally. The range of inferred shear wave velocity indicating at MASW-1, MASW-2, MASW-3 and MASW-4 locations varies from 290m/sec to 386m/sec inferred as Thin layer of unconsolidated soil followed by highly to completely weathered basalt as top layer; thickness varies from 1.7m to 5.4m from surface. Followed by relatively compact strata comprise of weathered / fractured basalt inferred with shear wave velocity of the order of 386m/sec to 570m/sec and thickness varies from 3.9m to 13.0m. This is overlain by slightly weathered and jointed basalt

interpreted with velocity of the order of 500m/sec to 614m/sec. depth of this layer extend up to 32.2m. For detail interpretation refer Table -4.

From 2D Shear wave velocity and depth model, **Vs^{30}**, as the average seismic shear-wave velocity from the surface to a depth of 30 meters has been calculated (refer Table-5); Harmonic average value of **Vs^{30}** is calculated at MASW -1 is 484m/sec, MASW -2 is 462m/sec, MASW-3 is 484m/sec and at MASW-4 is 388m/sec respectively. Based on the Vs^{30} values, site can be classified as Class C.

This parameter can be used to characterize local site response for a wide range of applications ***ranging from simplified earthquake resistant design procedures in building codes to regional and global seismic hazard mapping***. Correlations with other local site characteristics **Vs^{30}** have proven to be a robust parameter for characterizing local site response for many applications.

Vs^{30} is used in the NEHRP (National Earthquake Hazards Reduction Program) site classification standard and the 1997 Uniform Building Code to separate sites into classes for earthquake engineering design. The 2000 International Building Code (IBC) permits a similar approach for site classification, the average shear wave velocity up to 30m depth. NEHRP site classes in terms of Vs30 are as follows:

Table 3: subsurface description with respect to Shear Wave velocity (v_s^{30})

Site class	Generalized subsurface description	Vs^{30} in m/sec
Class A	Hard bed rock	>1500
Class B	Rock	760 to ≤ 1500
Class C	Very dense soil & soft rock	360 to ≤ 760
Class D	Stiff or Hard soil (sand, clay, and gravel)	180 to ≤ 360
Class E	Soft soil	≤ 180 Require site specific response.

The interpretation of the MASW processed data is presented in the form of Shear Wave Velocity (Vs) section along each line. Figure-7 to 10 is showing the seismic sections along the MASW lines and the corresponding interpretation are given in Table-4. Shear Wave velocity, layer thickness and Vs30analysis from MASW study is presented in Table 5.

Table 4: Shear Wave velocity (Vs), and interpreted lithology

MASW Profile No	Location	Layer No	Shear Velocity Vs (m/sec)		Chainage (m)		Depth from the surface (m)		Interpreted Lithology
			From	To	From	To	From	To	
MASW-1	East Line	1	290	386	0.0	36.0	0.00	5.40	Thin soil cover followed by highly to completely weathered BASALT
		2	386	524	0.0	36.0	5.40	6.00	Moderately weathered / fractured basalt
		3	524	559	0.0	36.0	6.00	28.0	Slightly weathered / highly fractured BASALT
MASW-2	West Line	1	310	386	0.0	35.0	0.00	3.90	Thin soil cover followed by highly to completely weathered BASALT
		2	386	529	0.0	35.0	3.90	7.00	Moderately weathered / fractured basalt
		3	529	570	0.0	35.0	7.00	13.00	Slightly weathered / highly fractured BASALT
		4	445	512	0.0	35.0	13.00	31.00	Moderately weathered / highly jointed and fractured basalt
		5	520	579	0.0	35.0	31.00	32.20	Slightly weathered / fractured BASALT
MASW-3	North Line	1	363	407	0.0	33.0	0.00	4.10	Highly to completely weathered BASALT
		2	407	500	0.0	33.0	4.10	7.00	Moderately weathered / fractured basalt
		3	501	563	0.0	33.0	7.00	11.00	Moderately weathered / fractured basalt
		4	480	510	0.0	33.0	11.00	24.00	Moderately weathered / highly fractured BASALT
		5	526	563	0.0	33.0	24.00	27.40	Slightly weathered / fractured BASALT
MASW-4	South Line	1	209	377	0.0	33.0	0.00	4.60	Thin soil cover followed by highly to completely weathered BASALT
		2	387	463	0.0	33.0	4.60	28.00	Moderately weathered / highly fractured BASALT

Table 5: Shear Wave velocity *(Vs)*, layer thickness and Vs^{30} analysis from MASW study

MASW Profile No	Layer No:	Depth of layer (m)		Layer Thickness (Di in m	Measured Shear Wave velocity Vs (m/s)		Di/Vs		Mean Di / Vs	Harmonic Average Vs30 (m/sec)
		To	From		To	From	To	From		
MASW-1 (East Line)	1	0.00	5.40	5.40	290	386	0.0186207	0.013990	0.01631	484
	2	5.40	6.00	0.60	386	524	0.0015544	0.001145	0.00135	
	3	6.00	30.00	24.00	524	559	0.0458015	0.042934	0.04437	
MASW-2 (West Line)	1	0.00	3.90	3.90	310	386	0.0125806	0.010104	0.01134	462
	2	3.90	7.00	3.10	386	529	0.0080311	0.005860	0.00695	
	3	7.00	13.00	6.00	529	570	0.0113422	0.010526	0.01093	
	4	13.00	30.00	17.00	445	512	0.0382022	0.033203	0.0357	
MASW-3 (North Line)	1	0.00	4.10	4.10	363	407	0.0112948	0.010074	0.01068	484
	2	4.10	7.00	2.90	407	500	0.0071253	0.005800	0.00646	
	3	7.00	11.00	4.00	501	563	0.0079840	0.007105	0.00754	
	4	11.00	24.00	13.00	480	510	0.0270833	0.025490	0.02629	
	5	24.00	30.00	6.00	526	563	0.0114068	0.010657	0.01103	
MASW-4 (South Line)	1	0.00	4.60	4.60	209	377	0.0220096	0.012202	0.01711	388
	2	4.60	30.00	25.40	387	463	0.0656331	0.054860	0.06025	

MASW Processed Sections

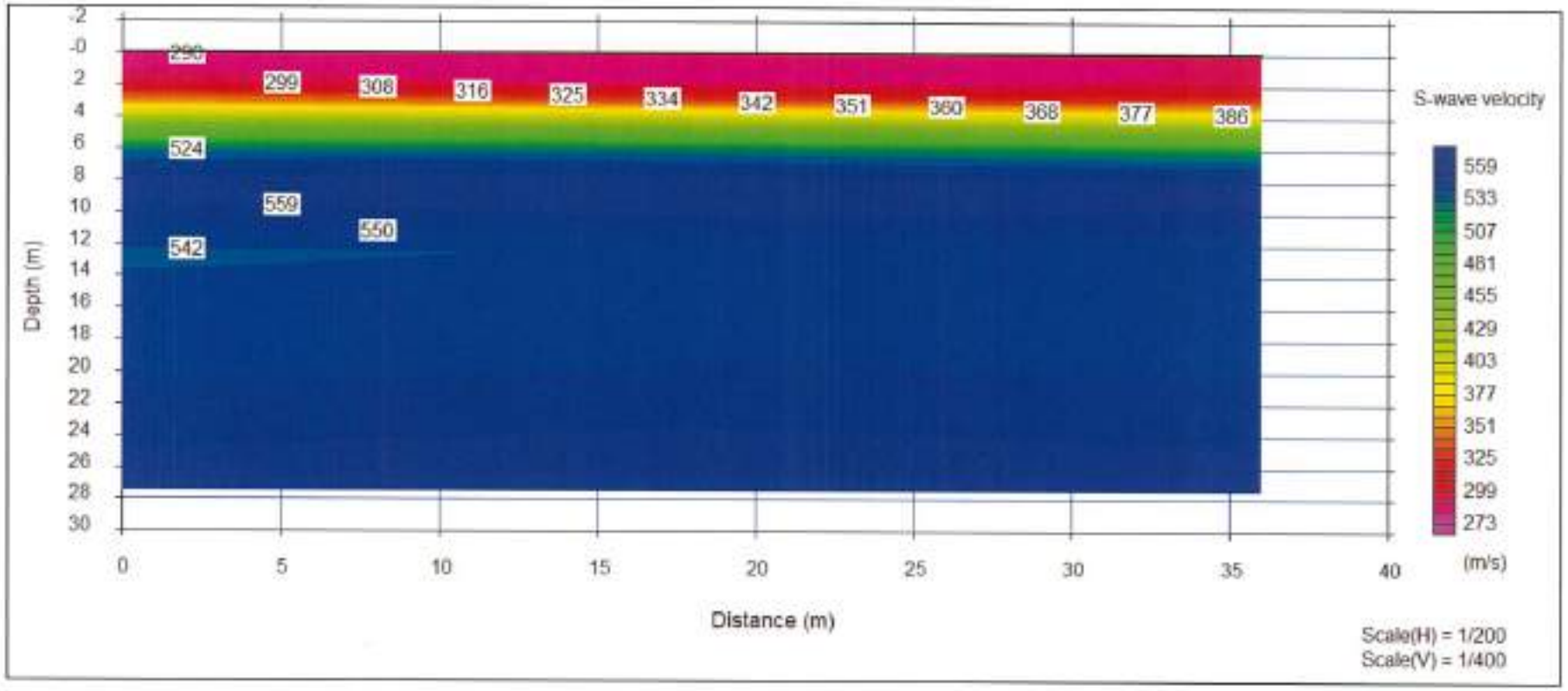


Figure 7 : Shear Wave velocity Section – EAST LINE (MASW-1)

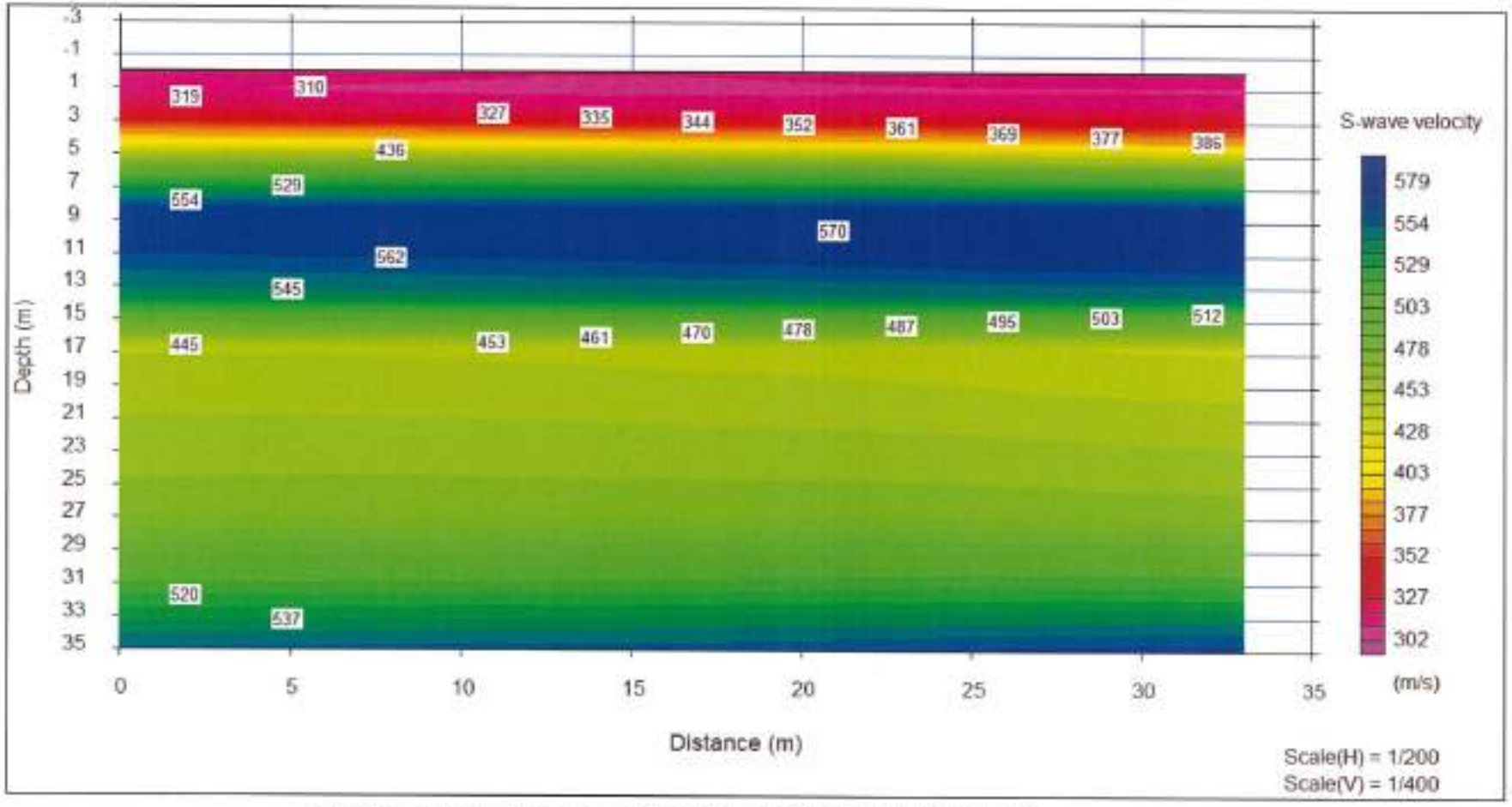


Figure 8: Shear Wave velocity Section – WEST LINE (MASW-2)

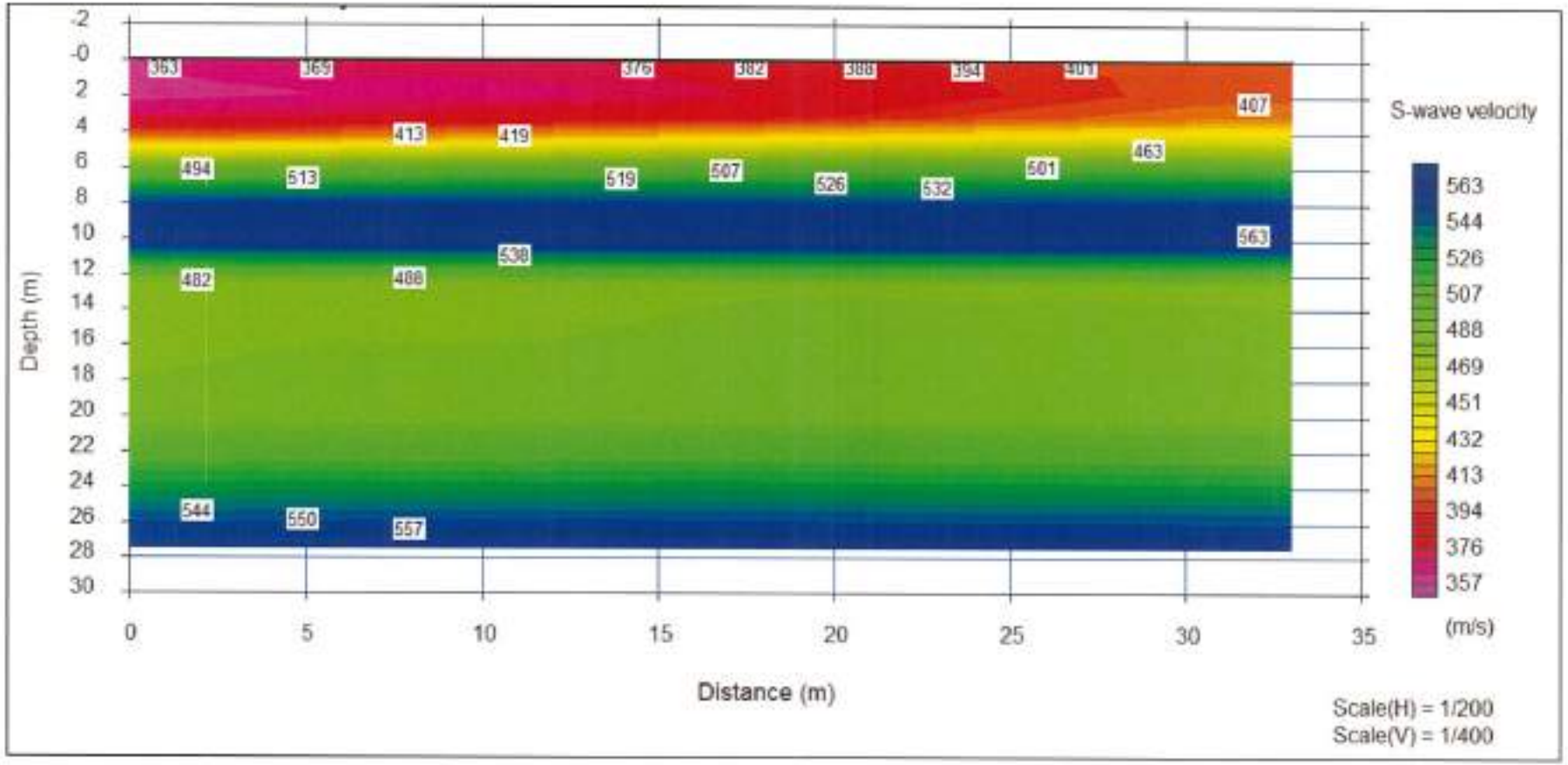


Figure 9: Shear Wave velocity Section – NORTH LINE (MASW-3)

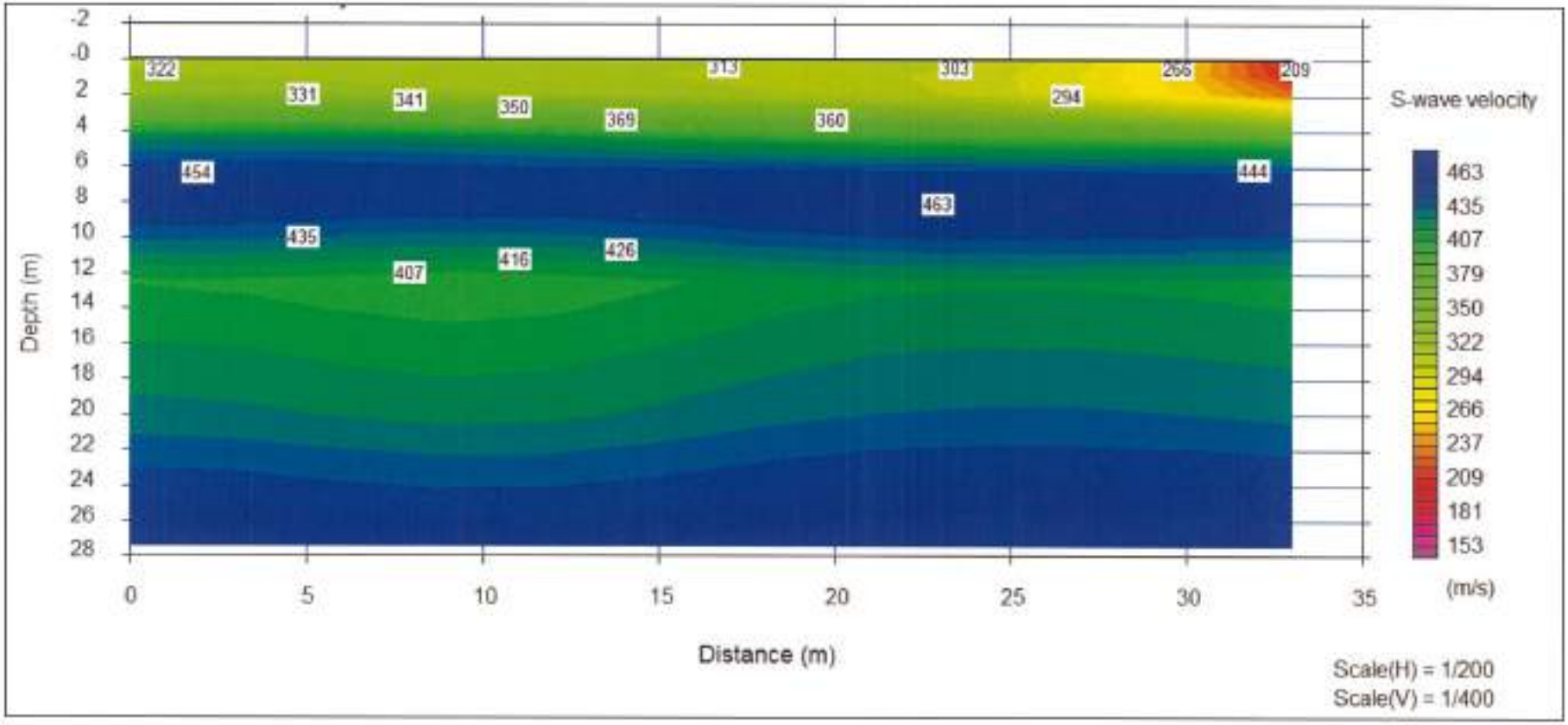


Figure 10: Shear Wave velocity Section – SOUTH LINE (MASW-4)

6.0 LIMITATIONS OF SEISMIC REFRACTION METHOD

i. In the seismic sections various refracting layers are identified based on the change in seismic velocity of the strata. Surface relief should be properly surveyed at each source and receiver location and should be properly fed at the data processing stage for correct interpretation. The errors in surface relief used at the processing stage will cause multifold error in the subsurface position/depth. This is particularly important while surveying in a hilly terrain. 5.0meter geophone spacing used in data collection, it is very likely that layers lesser than 2m thickness might not be identified.

ii. In case of hidden zone or blind zone the depth of the subsurface interfaces would either be overestimated or underestimated. In such cases depth of subsurface interfaces would be corroborated with borehole data.

iii. The errors in subsurface relief at source and receiver locations might restrict the accuracy of the depths to various horizons within 10%, but with digital data recording and computerizes data processing combined with errors in surface relief within 0.1 meter would pegged down the accuracy within 5%.

iv. A common limitation of refraction method is the lack of sufficient contrast in velocity, high background noise level, and it requires continuous velocity increase in depth. Hidden layer, velocity inversion, anisotropy and low velocity contrast coupled with high background noise almost always give rise to ambiguous layer assignments and can lead to misinterpretation. The refraction method is most suitable when layer velocities increase with depth by a factor of approximately 1.5 between each layer. A lower limit of 1.3 could probably be tolerated in relatively noise free data.

7.0 SUMMARY AND CONCLUSIONS:

i. Geologically, the study area is broadly covered with a igneous formation (basalts). This layer is underlined the Peninsular shield of india sourended by Dacan traps and Vindyan supergroup. At project site in the Narmada river, all the rocks belong to Cretaceous to Eocene age are represented by basaltic Flows with intertrappeans. Regionally, a major fault Son of Narmada South fault (NSF) is a ENE-WSW treanding fault, and is locatd to wards S-E direction from the study area .The NSF is consider to be seismically active. Geologically, the strata comprises of homogeneous basalt with interatrappean flows prone to variable degree of weathering and undergone fracturation due to sevear tectonic activity in past.

ii. Whereas, Shear wave velocity at MASW-1, MASW-2, MASW-3 and MASW-4 locations varies from 290m/sec to 386m/sec inferred as Thin layer of unconsolidated soil followed by highly to completely weathered basalt as top layer; thickness varies from 1.7m to 5.4m from surface. Followed by relatively compact strata comprise of highly to completely weathered basalt inferred with shear wave velocity of the order of 386m/sec to 570m/sec and thickness varies from 3.9m to 13.0m. This is overlain by slightly weathered and jointed basalt interpreted with velocity of the order of 500m/sec to 614m/sec. depth of this layer extend up to 32.2m

iii. Based on MASW study, Harmonic average value of Vs30 is calculated at MASW -1 is 484m/sec, MASW -2 is 462m/sec, MASW-3 is 484m/sec and at MASW-4 is 388m/sec respectively. ***Based on the Vs30 values, site can be classified as Class C.***

iv. Interpreted Seismic data may be correlated with borehole data and laboratory test results. The scope of refinement in interpretation remains open after correlation with geological and other subsurface information.

v. It is therefore recommended that MASW study results and direct drilling information are to be used to interpret the lithology, nature of rock mass conditions with strength for design and evaluation of design parameters.

SUBRATA KUNAR
CHIEF GEO-PHYSICSIST / TEAM LEADER
(IGS GEOPHYSICAL DIVISION)

For INDIAN GEOTECHNICAL SERVICES

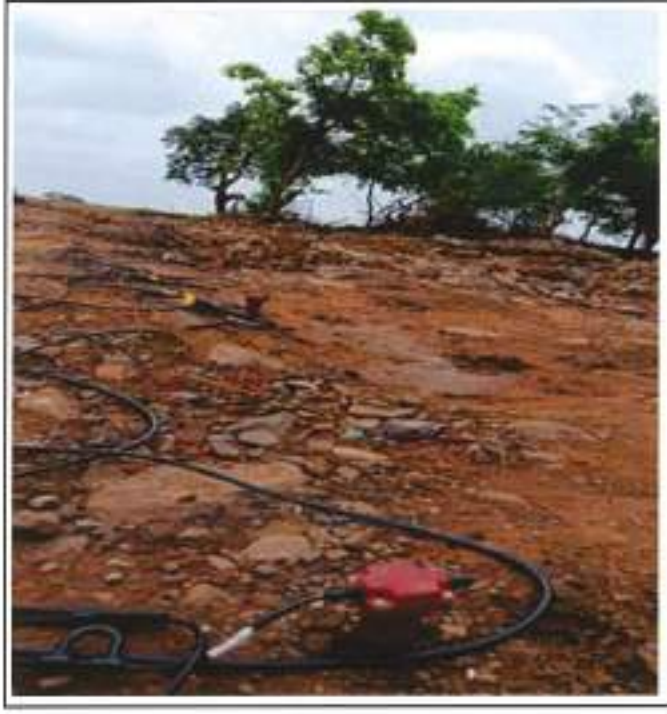
AJAY KUMAR GARG
Geotechnical Consultant / Partner

SITE Photographs

"Detailed Geotechnical and Geophysical Investigation for proposed Statue of Oneness", Madhya Pradesh. Geophysical survey includes Multichannel Analysis of Surface Waves Study (MASW).

Type of Geophysical Survey.	Multichannel Analysis of Surface Waves Study (MASW)

No of MASW Profiles : 04



East

West

North

South

REPORT ON
EARTH RESISTIVITY TEST
PROPOSED STATUE OF ONENESS
STATE OF MADHYA PRADESH

SUBMITTED TO:

L&T Construction
Buildings & Factories

L&T Delhi Cluster - B&F IC

JULY 2022

SUBMITTED BY

INDIAN GEOTECHNICAL SERVICES
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REPORT ON
EARTH RESISTIVITY TEST
PROPOSED STATUE OF ONENESS
STATE OF MADHYA PRADESH

1.0 INTRODUCTION

Madhya Pradesh's culture and tourism department (Owner) has decided to build a multi-metal statue of Shankaracharya on Mandhata Parvat hill facing the river Narmada. The site is a river island in the Narmada about 4 km by 2 km in size. It is also a hill that is surrounded by waters of the Narmada on all sides. Which is located in the district of Khandwa, Madhya Pradesh.

Owner have awarded the work to "**M/s L & T Construction (Buildings and Factories group)** (Contractor / Our Client)".

The Client has engaged, M/s Indian Geotechnical Services to carryout "Detailed Geotechnical and Geophysical Investigation for proposed Statue of Oneness", Madhya Pradesh. Geophysical survey includes Earth Resistivity Test.

The ERT is planned to be carried out at proposed site. Based on the requirement, test at 02 locations were planned by the Client. M/s Indian Geo-technical Services (IGS) carried out Earth Resistivity Tests, the data acquisition was completed in presence client's representative.

The aim of the resistivity survey was to obtain quantitative knowledge of the Resistivity of subsurface strata for designing suitable Earthing system.

2.0 LOCATION

The Resistivity survey was conducted at 2 ERT locations at ERT-1 and 2, are as shown in the map given in figure-1. ERT 1 & 2 conducted at locations having thin soil cover on top followed by highly fractured/ wreathed porphyritic basalt are subsurface resulting in relatively low resistivity values.

Table 1: Locations of ERT

ERT No.	Easting	Northing
ERT-1	618551.04	2460990.26
ERT-2	618562.54	2460973.14

Figure 1: Test Locations

3.0 ELECTRICAL EARTH RESISTIVITY SURVEY

3.1 Basic Principle of Resistivity Survey

In electrical resistivity method, a known amount of current (I) is sent into ground through a pair of electrodes (called current electrodes) and the potential (V) developed because of the resistance offered by subsurface due to passage of this current is measured across another pair of electrodes (called potential electrodes) planted into the ground. The ratio between the potential measured and the corresponding current sent into the ground yields resistance "R" of the ground to a depth depending upon spacing between two current electrodes. Through the multiplication of this value "R" by a geometric factor "K" a parameter called apparent resistivity "ρ_a " is computed. Both the parameters of apparent resistivity "ρ_a" and resistance "R" contain the information on the geo-electric characteristics of the subsurface. The conventional resistivity measurement requires four electrode arrangement, two of them for sending current into the ground and other two for measuring the resulting potential. In practice, there exist several configurations, bus most commonly used are Wenner and Schlumberger configurations. For this investigation, Wenner's configuration was used.

In Wenner's configuration all four electrodes are kept in a line symmetrically over a center point 'O', current is sent through outer electrodes (C1 and C2) which are kept in a line symmetrically over a point 'O' and Potential is measured across inner electrodes (V1 and V2) which are also kept symmetrically on the same line. It is the simplest and the most symmetrical arrangement. It is designed to measure the potential difference (ΔV) between potential electrodes V1 & V2 while the current I is sent between two current electrodes C1 & C2. For this arrangement, spacing between adjacent electrodes designated as "a", the formula for calculating apparent resistivity for a Wenner's measurement is $\rho_a = 2paR$. For deeper penetration the electrode spacing 'a' is increased to meet desired depth of investigation keeping the center of the arrangement 'o' fixed.

3.2 Vertical Electrical Sounding

Resistivity sounding is process by which the depth investigation is made. In this method, the center of configuration is kept fixed and the measurements are made by successively increasing the electrode spacing. The apparent resistivity values are obtained with increasing values of electrode separations, which are used to estimate the thickness and resistivities of subsurface formations. In Wenner configuration for increasing the depth of investigation the electrode spacing 'a' is increased by moving all the four electrodes. Apparent resistivity for each electrode separation is calculated by multiplying the resistance "R" and configuration factor 'K'. (=2pa).

The resistivity measurements are normally made by injecting current into the ground through two current electrodes (C1 and C2 in Figure 2), and measuring the resulting voltage difference at two potential electrodes (V1 and V2). From the current (I) and voltage (V) values, an apparent resistivity (pa) value is calculated.

$$\rho_a = k\,V / I$$

Where k is the geometric factor which depends on the arrangement of the four electrodes. The common arrays used in resistivity surveys together with their geometric factors.

Resistivity meters normally give a resistance value, R = V/I, so in practice the apparent resistivity value is calculated by

$$\rho_a = k\,R$$

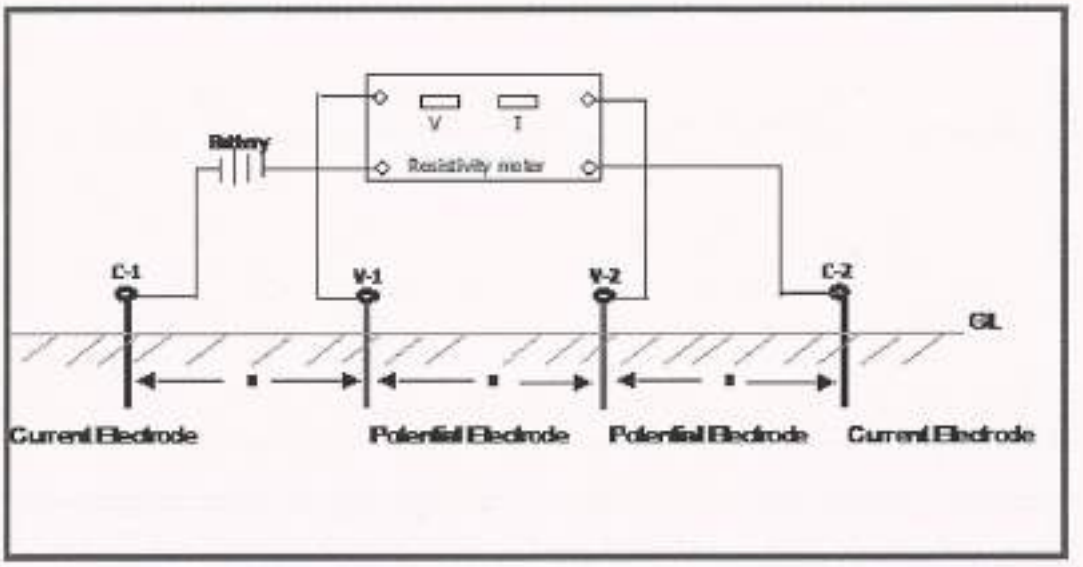

Figure 2: Illustration of a Typical Wenner's Electrode Arrangement

The calculated resistivity value is not the true resistivity of the subsurface, but an "apparent" value, which is the resistivity of a homogeneous ground, which will give the same resistance value for the same electrode arrangement. The relationship between the "apparent" resistivity and the "true" resistivity is a complex relationship.

Resistivity values have a much larger range compared to other physical quantities mapped by other geophysical methods. The resistivity of rocks and soils in a survey area can vary by several orders of magnitude.

In comparison, density values used by gravity surveys usually change by less than a factor of 2, and seismic velocities usually do not change by more than a factor of 10. This makes the resistivity and other electrical or electromagnetic based methods very versatile geophysical techniques.

3.3 Field Methodology and Test Values

WDA-1 resistivity meter was used for data collection, which is connected to four electrodes. This is light weight and automatic processor based unit. The equipment is capable of running self-potential checks and cancellation. In addition to that this unit shows real time VES curve to check the accuracy and consistency of recorded data in the filed.

In the field, apparent resistivity values were plotted on log-log paper allowing the field geophysicist to assess the quality of data being collected and to decide maximum electrode spacing to investigate up to desired depth.

Raw field data is given in Table-3 and Table-4 along with their apparent resistivity curves shown below;

3.3.1 ERT-1:

This location was surveyed by using Wenner array having electrode spacing varying from 1.0m to 10.0m due to limited space available. Based on the measured resistivity data it is observed that resistivity of the subsurface strata increases and then decreases. Such low resistivity values in rock formation may be due to highly fractured and saturated nature of rock formations. Maximum measured apparent resistivity is of the order of 47.23929 (Ω-m) corresponding top layer. The measured apparent resistivity is given in table 3 and the corresponding resistivity curve is shown in the graph shown below.

Table 2: Field Data of ERT-1

Sl. No.	Elec. Spacing "a" (m)	ρ (Ω-m)
1	1	22.10
2	2	38.91
3	3	47.24
4	4	34.57
5	5	19.49
6	6	29.04
7	8	17.85
8	10	45.26

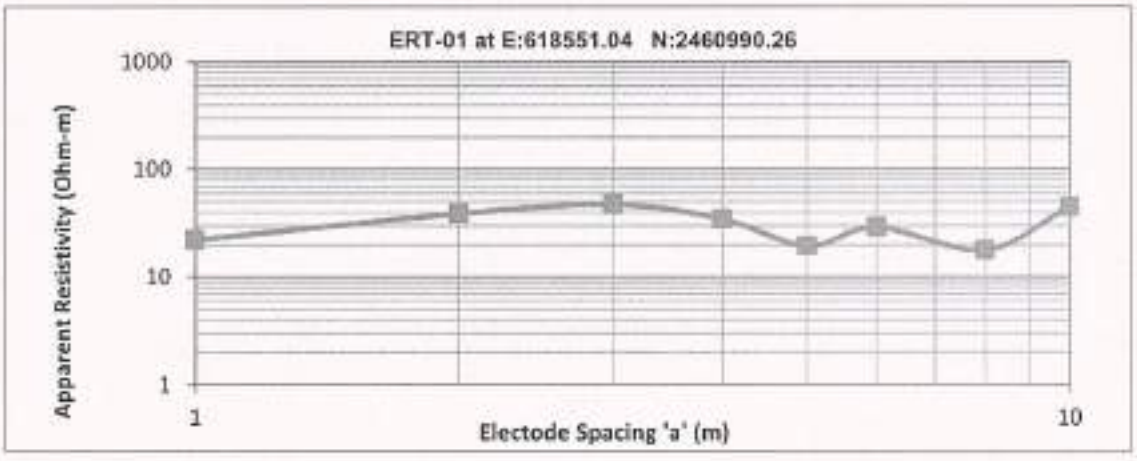

Figure 3: Apparent Resistivity versus Electrode Spacing Graph (ERT-1)

3.3.2 ERT-2:

This location was surveyed by using Wenner array having electrode spacing varying from 1.0m to 10.0m due to limited space available. Based on the measured resistivity data it is observed that resistivity of the subsurface strata increases with respect to depth. Such low resistivity values in rock formation may be due to highly fractured and saturated nature of rock formations. Maximum measured apparent resistivity is of the order of 94.03856 (Ω-m) on the top. The measured apparent resistivity is given in table 4 and the corresponding resistivity curve is shown in the graph shown below.

Table 3: Field Data of ERT-2

Sl. No.	Elec. Spacing "a" (m)	ρ (Ω-m)
1	1	20.90
2	2	38.47
3	3	50.26
4	4	82.10
5	5	81.40
6	6	85.62
7	8	94.04
8	10	84.86

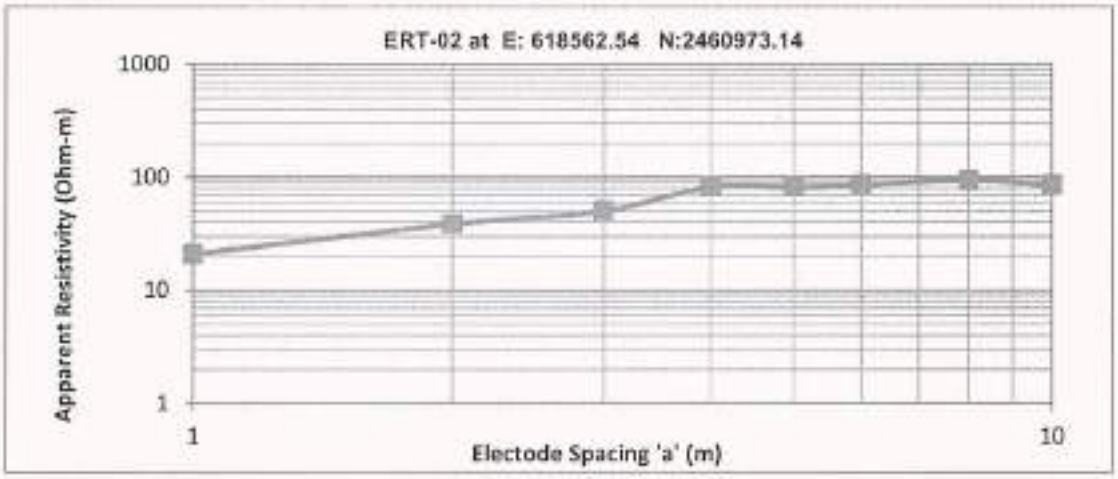

Figure 4: Apparent Resistivity versus Electrode Spacing Graph (ERT-2)

4.0 RESULTS & CONCLUSIONS

Geophysical investigations using resistivity sounding method has provided detail information about the resistivity distribution of the subsurface strata. Based on the apparent resistivity data observed that the resistivity of subsurface generally increases with depth. As the electrode spacing increases corresponding measured apparent resistivity values either generally increases with depth or remains almost stationary. Measured resistivity values corresponding to each ERT are shown below:

Table 4: Summary of Resistivity Values

Approximate Depth (m)	Resistivity in Ohm-m (ρ_a)	
	ERT-1	ERT-2
1	22.10	20.90
2	38.91	38.47
3	47.24	50.26
4	34.57	82.10
5	19.49	81.40
6	29.04	85.62
8	17.85	94.04
10	22.10	84.86

Such low resistivity values in rock formation may be due to highly fractured and saturated nature of rock mass.

Sl. No.	Location Name	Measured App. Resistivity (Ohm-m)	
		Minimum	Maximum
1	ERT-1	17.85	47.24
2	ERT-2	20.90	94.04

Sr. Geophysicist

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CHIEF GEO-PHYSICSIST / TEAM LEADER
(IGS GEOPHYSICAL DIVISION)

INDIAN GEOTECHNICAL SERVICES

AJAY KUMAR GARG
Geotechnical Consultant / Partner

ANNEXURE-17

संचालनालय पुरातत्व, अभिलेखागार एवं संग्रहालय

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वेबसाईट : www.archaeology.mp.gov.in ई–मेल mparchaeology@gmail.com
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क्र. 1031/संर./2022 भोपाल, दिनांक 18.7.22

प्रति,

सहायक संचालक (संस्कृति)
सह प्रभारी अधिकारी
आचार्य शंकर सांस्कृतिक एकता न्यास
श्यामला हिल्स, भोपाल

विषय :– आचार्य शंकर की प्रतिमा स्थापना एवं संग्रहालय स्थापना की अनुमति।

संदर्भ :– आपका पत्र कमांक 1638/ट्रस्ट/2022 दिनांक 15.07.2022.

—00—

उपरोक्त विषयान्तर्गत संदर्भित पत्र में आपके प्रस्ताव पर विचारोपरांत राज्य संरक्षित स्मारक गौरी सोमनाथ मंदिर ओंकारेश्वर जिला खण्डवा के लिये घोषित संरक्षित क्षेत्र से परे 100 मी. के प्रतिषिद्ध क्षेत्र को छोड़कर इसके आगे 200 मीटर विनियोजित क्षेत्र में निम्नांकित शर्तों के अध्याधीन आचार्य शंकर की प्रतिमा एवं संग्रहालय स्थापना की अनुमति प्रदान की जाती है :–

1. मध्यप्रदेश प्राचीन स्मारक एवं पुरातत्वीय स्थल तथा अवशेष अधिनियम 1964, 1970 एवं नियम 1975 में निहित सभी प्रावधानों का निष्ठापूर्वक पालन करना।
2. आचार्य शंकर की प्रतिमा स्थापना एवं संग्रहालय स्थापना के दौरान संरक्षित स्मारक के मूल स्वरूप को कोई नुकसान न हो।
3. उक्त किये जा रहे कार्यों से राज्य संरक्षित स्मारक के परिदृश्य वाधित न हो।
4. आचार्य शंकर सांस्कृतिक एकता न्यास द्वारा कराये जा रहे कार्यों के दौरान यदि कोई पुरातत्वीय अवशेष, प्रतिमा या पुरावशेष प्राप्त होते हैं तो उन्हें सुरक्षित रखा जावे।

(शिल्पा गुप्ता)
आयुक्त
पुरातत्व, अभिलेखागार एवं संग्रहालय
म.प्र.,भोपाल

पृ.क्र. 1032/संर./2022 भोपाल, दिनांक 18.7.22

प्रतिलिपि :–

1. प्रमुख सचिव, म.प्र. शासन, संस्कृति विभाग की ओर सूचनार्थ।
2. कलेक्टर, जिला–खण्डवा की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु।
3. उपसंचालक, पुरातत्व, अभिलेखागार एवं संग्रहालय, पश्चिमी क्षेत्र राजवाड़ा इन्दौर की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु।
4. संग्रहाध्यक्ष, केन्द्रीय पुरातत्व संग्रहालय इन्दौर की ओर सूचनार्थ एवं आवश्यक कार्यवाही हेतु।

पुरातत्ववेत्ता
पुरातत्व, अभिलेखागार एवं संग्रहालय
म.प्र.,भोपाल

ot on OnePlus

ANNEXURE-18

भारत हितरक्षा अभियान

78, वासुदेव नगर कलेक्टर कार्यालय के पास, इंदौर

मो.9425910939 ई-मेल bharathitraksha@gmail.

दिनांक 25 जन: 2023
ओंकारेश्वर

प्रति,

नेशनल ग्रीन ट्रिब्यूनल

दिल्ली /भोपाल

ओंकार पर्वत से संबंधित तथ्य इस प्रकार हैं,

1.नदी के अंदर बने प्रकृतिक ओमकारेश्वर पर्वत (जो नदी का ही हिस्सा है) को काटने का अधिकार सरकार को किसने दिया?

2. पूरी परियोजना से ओंकार पर्वत का प्राकृतिक स्वरूप ही बदल रहा है।

3.मूर्ति एवं संग्रहालय हेतु दस हजार वर्ग मीटर क्षेत्रफल की औसत 32 फीट गहरी खुदाई से निकला मलबा जो पर्वत के ढलान पर ही डाला गया है। इससे लगभग 50000 वर्ग मीटर क्षेत्र का प्राकृतिक हरा भरा जंगल कई पीढ़ियों के लिए मृत हो गया है। इस क्षति के लिए कौन जिम्मेदार है ?

4.पर्वत पर प्रस्तावित मूर्ति तक जाने हेतु 20 मीटर चौड़ा एवं 1200 मीटर लंबा मार्ग पर्वत को काटकर बनाया गया है। उस कारण से पर्वत की 24000 वर्ग मीटर की खुदाई की गई है तथा इसके मलबे से 1.2 लाख वर्ग मीटर जंगल, वन क्षेत्र मृत हो गया है।

परियोजना के कारण अभी तक 50,000 तथा 1.2 लाख कुल मिलाकर 1.7 लाख वर्ग मीटर भूमि निर्जीव हो गई है। हम जानते हैं कि भूमि पर उपजाऊ मिट्टी की 1 इंच परत बनने में हजार वर्ष लगते हैं।

5.परियोजना पूरी होने के बाद पर्यटकों के लिए वाहन पार्किंग हेतु 7.1 हेक्टेयर वन क्षेत्र भी समाप्त होगा, जिसमें शासन ने मात्र 350 वृक्ष होना बताया है तथा केवल 43 पेड़ों का कटना प्रस्तावित है। वास्तव में वहां एनटीपीसी खरगोन के सीएसआर फंड से वन विकास निगम द्वारा 9000 वृक्ष लगाए गए हैं तथा वर्तमान में वहां घना जंगल है।

इस प्रस्तावित पार्किंग क्षेत्र के वृक्षों की गिनती कर पंचनामा बनाने के लिए भारत हितरक्षा अभियान के कार्यकर्ता दिनांक,,,, को उक्त स्थल पर पहुंचे थे ,जिन्हें प्रशासन ने

भारत हितरक्षा अभियान

78, वासुदेव नगर कलेक्टर कार्यालय के पास, इंदौर

मो.9425910939 ई-मेल bharathitraksha@gmail.

रोक दिया था। उसी समय तहसीलदार और थाना प्रभारी से इन 9000 वृक्षों की सुरक्षा का अभिवचन लिया था ।उसकी प्रति संलग्न है।

6.पर्वत पर होने वाली तोड़फोड़ तथा निर्माण से वर्षा का जल जो धीमे-धीमे चारों ओर समान रूप से असंख्य धाराओं में के रूप में नदी में मिलता रहा है, भविष्य में वर्षा जल कुछ जगहों पर बड़ी मात्रा में एकत्र होकर बड़ी धाराओं के रूप में नर्मदा नदी में मिलेगा , जिससे निम्नांकित हानियां होगी,,

* नर्मदा नदी का प्राकृतिक बहाव को भटकाएगा।

* यह भटकाव भविष्य में पर्वत एवं घाटों को क्या और कितना नुकसान पहुंचाएगा कल्पना से परे है

* वर्षा का जो बूंद-बूंद जल पर्वत की जमीन में रिसकर प्राकृतिक जल भरण करता था अब 1.7 लाख वर्ग मीटर क्षेत्र में जल भरण नहीं होने से, पर्वत की भूमि में जल की कमी होने से क्षेत्र की हरियाली पर दुष्प्रभाव पड़ेगा।

अतः निवेदन है कि

नदी के अंदर स्थित इस परियोजना स्थल कि अभी सिर्फ खुदाई ही हुई है जो समय के साथ प्राकृतिक रूप से संभल सकती है लेकिन पक्का निर्माण होने के बाद तथा पर्यटकों की भारी आवाजाही से पूरे नदी एवं पर्वत क्षेत्र के प्राकृतिक स्वरूप को जो स्थाई हानि होगी, उसकी भरपाई असंभव है। अतः पूरी परियोजना को अन्य किसी निरापद स्थान पर स्थानांतरित करना ही सर्वोत्तम समाधान है।

संलग्न---

1.इस पर्वत के संरक्षण के संबंध में मध्यप्रदेश शासन का 2005 का नोटिफिकेशन क्रमांक 1 एफ6 -1 / 2005/सं/30 भोपाल दिनांक 20/09/ 2005 संलग्न है।

2.ओंकार पर्वत पर से सभी प्रकार के अतिक्रमण हटाने के लिए अतिक्रमण हटाने के लिए मध्य प्रदेश उच्च न्यायालय का आदेश रिट पिटिशन क्रमांक 957/2014.

भारत हितरक्षा अभियान

78, वासुदेव नगर कलेक्टर कार्यालय के पास, इंदौर

मो.9425910939 ई-मेल bharathitraksha@gmail.

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3. मध्य प्रदेश शासन द्वारा अमरकंटक केमिकल पर्वत के संरक्षण के लिए किये गये निर्णय के समाचार की पेपर कटिंग। 3A - 3B.

4. भारत रक्षा अभियान दौरा दिया गया ज्ञापन 2 जुलाई 2022 वृक्षों की गिनती से संबंधित ज्ञापन।

5. देश के प्रसिद्ध पर्यावरणविद् श्री ओ पी जोशी का अभिमत की प्रति।

6. विशेषज्ञों की अध्ययन रिपोर्ट Seismic hazard estimation at Omkareshwar hydroelectric project site.

7. ओंकार पर्वत के तथ्यों से संबंधित विशैषज्ञों के बयान एवं फोटोग्राफ्स पेनड्राइव संलग्न।
पेन ड्रा.नं. है → SDCZ50-016G BL221126778W

भवदीय

1. अभय जैन नई बस्ती कुलकर्णी नगर, इन्दौर 9981641219 [signature]
2. डॉ. सुभाष बारोड 388 ईई योजना क्र. 94 इन्दौर 9425081803 [signature]
स्वप्निल जोशी 3, न्यू आशीष नगर, इन्दौर 9425910939 [signature]
जितेन्द्र भा. दवे 6, कल्पना लोक, खजराना मार्ग इन्दौर 9425869488 [signature]
किशोर कोडवानी 14, सर्वोदय नगर इन्दौर 98274 40080 [signature]

संलग्न - 1

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मध्यप्रदेश कृति विभाग

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:- अधिसूचना -:

क्रमांक एफ 6-1/2005/सं./30 भोपाल, दिनांक 20/9/05

चूंकि नीचे दी गई अनुसूची में विनिर्दिष्ट किये गये प्राचीन स्मारक को राज्य शासन संरक्षित स्मारक के रूप में घोषित करने राज्य सरकार के आशय के संबंध में आपत्तियां आमंत्रित करते हुए मध्यप्रदेश एन्शीयन्ट मान्युमेन्टस एण्ड आर्क्योलाजीकल साइट्स एण्ड रिमेन्स एक्ट 1964 (क्रमांक 12 सन 1964) की धारा 3(1) एवं धारा 16 के अधीन अधिसूचना मध्यप्रदेश राजपत्र में दिनांक 19.2.91 को प्रकाशित की गई थी और चूंकि उस निमित्त कोई आपत्ति प्राप्त नहीं हुई है।

अतएव मध्यप्रदेश एन्शियेन्ट मान्युमेन्टस एण्ड आर्क्योलाजिकल साइट्स एण्ड रिमेन्स एक्ट 1964 (क्रमांक 12 सन 1964) की धारा 3 की उपधारा (1) एवं धारा 16 धारा प्रदत्त शक्तियों को प्रयोग में लाते हुए राज्य सरकार एतद् द्वारा उक्त प्राचीन स्मारक को राज्य संरक्षित स्मारक के रूप में घोषित करता है।

अनुसूची

राज्य	जिला	तहसील	स्थानीय क्षेत्र	स्मारक का नाम	राजस्व क्षेत्र जो संरक्षण में सम्मिलित होना है	क्षेत्रफल	स्वामित्व	धार्मिक पूजा के अधीन है अथवा नहीं
म.प्र.	पूर्व निमाड़, खण्डवा		मान्धाता	1- गौरी सोमनाथ मंदिर	खसरा नं. 87	50.43 / 20.409	म.प्र. शासन	-0-
				2- सिद्धेश्वर मंदिर	-"-	-"-	-"-	----
				3- पार्वती मंदिर (कालीमाता मंदिर)	खसरा नं. 9	21.56 / 8.725	-"-	----

मध्यप्रदेश के राज्यपाल के नाम से
तथा आदेशानुसार
(रेनू तिवारी)
उप सचिव
म.प्र. शासन, संस्कृति विभाग
क्रमशः... 2...

Archaeologist

21 SEP 2005

सत्यप्रतिलिपि

उप संचालक,
पुरातत्व, [illegible] एवं
संग्रहालय, (...) इन्दौर
दूरभाष नं. 542846

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(9)

(15)

भाग I] उत्तरप्रदेश राजपत्र, दिनांक 28 दिसम्बर 1984

1. एतद्वारा यह सूचना दी जाती है कि राज्य सरकार को यह प्रतीत होता है कि नीचे दी गई अनुसूची में विनिर्दिष्ट स्थानों में अवस्थित स्मारक पुरातत्वीय महत्व के हैं और उनके संरक्षण के लिए उन्हें राष्ट्रीय महत्व घोषित किया जाना चाहिए।

2. अतएव प्राचीनता एवं पुरातत्वीय स्मारक तथा पुरातात्विक स्थल एवं विशेष उपबंध अधिनियम, 1958 (1958 का 24) की धारा 4 की उपधारा (1) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए उक्त अधिनियम के प्रयोजनों के लिए उन्हें राष्ट्रीय महत्व के घोषित करने के अपने आशय की सूचना देता है।

3. किसी भी ऐसी आपत्ति पर, जो इस तारीख से जिस को उक्त अधिनियम की धारा 4 की उपधारा (1) के अधीन इस सूचना के "राजपत्र में प्रकाशित होने के विषय में की जाए और सक्षम अधिकारी द्वारा विचार किया जाएगा :—

अनुसूची

राज्य	जिला	तहसील	स्थान	स्मारक का नाम	राजस्व अभिलेख में यथा दिये गये प्लाट के अधीन अन्तर्विष्ट क्षेत्रफल	संरक्षण	स्थानीय सीमाएं
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
उत्तरप्रदेश	बांदा	अतर्रा	अतर्रा	आदीश्वर जिन मंदिर	खसरा सं. 1008	0.24 हेक्टेयर	पुरातत्व विभाग
						0.097 हे.	

1. एतद्वारा यह सूचना दी जाती है कि राज्य सरकार को यह प्रतीत होता है कि नीचे दी गई अनुसूची में विनिर्दिष्ट किये गये स्थानों में अवस्थित स्मारक, पुरातत्व स्थल तथा अवशेष को निक्षेप किये जाने, संरक्षित किये जाने, संधारित किये जाने, घिरा हुआ बनाये जाने, विनियमित किये जाने या उनका अनुरक्षण होने देने के संबंध में संक्षिप्त कथन आवश्यक है।

2. अतएव प्राचीनता एवं पुरातत्वीय स्मारक तथा पुरातात्विक स्थल एवं अवशेष अधिनियम, 1958 (1958 का 24) की धारा 4 की उपधारा (1) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, उक्त अधिनियम के प्रयोजनों के लिए उन्हें राष्ट्रीय महत्व के घोषित करने के अपने आशय की सूचना देता है।

3. किसी भी ऐसी आपत्ति पर, जो इस तारीख से जिस को उक्त अधिनियम की धारा 4 की उपधारा (1) के अधीन इस सूचना के राजपत्र में प्रकाशित होने के विषय में की जाए और सक्षम अधिकारी द्वारा विचार किया जाएगा :—

अनुसूची

राज्य	जिला	तहसील	स्थान	स्मारक का नाम	राजस्व अभिलेख में यथा दिये गये प्लाट के अधीन अन्तर्विष्ट क्षेत्रफल	संरक्षण	स्थानीय सीमाएं
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
उत्तरप्रदेश	पूर्व निमाड़ खंडवा	खंडवा	मुक्तागिरि	1. मोटी सोनागिर मंदिर	प्लॉट सं. 8	00.43 एकड़ 29,403 हेक्टेयर	एकसमान
				2. सिद्धवर मंदिर			
				3. पावली मंदिर (चन्द्रप्रभु का मंदिर)		21,858एकड़ 8.735हेक्टेयर	

True Copy

20 टाईप कापी - बी-3

गौरी सोमनाथ मंदिर विदेश्वर मंदिर, पार्वती मंदिर खण्डवा

मध्यप्रदेश राजपत्र दि. 28 दिस. 1984

एफ 6-8-84 ए तीस - चूंकि राज्य शासन की यह राय है कि नीचे दी गई अनुसूची मे विर्निर्दिष्ट किये गये प्राचीन स्मारक पुरावतीय स्थल तथा अवशेष को विष्ट किये जाने क्षतिग्रस्त किये जाने, परिवर्तित किये जाने, विलोपित किये जाने, हटाये जाने, तितर बितर किये जाने या समन अपय होने देने से संरक्षित करना आवश्यक है।

2- अतएव म0प्र0 एमवेन्ट मान्युटेर एण्ड कायमोलामिकल साइटस एण्ड रिमेना एक्ट 1994 (12 सन 1964) की धारा 3 की उपधारा (1) द्वारा प्रदत्त शक्तियो को प्रयोग मे जाते हुये राज्य शासन एतद द्वारा उक्त प्राचीन स्मारको को राज्य संरक्षित स्मारको के रूप मे घोषित करने के अपने आशय की सूचना देता है।

3- किसी भी ऐसी आपत्ति या सुझाव पर जो इस संबंध मे उक्त प्राचीन स्मारको तथा पुरातत्व स्थलो और उपयोगे के हित रखने वाले किसी व्यक्ति को इस सूचना के मध्यप्रदेश राजपत्र मे प्रकाशित होने के दिनांक से दो माह की न समाप्त होने के पूर्व प्रदत्त हो राज्य शासन द्वारा विचार किया जायेगा।

अनुसूची

राज्य	जिला	तहसील	स्थल	स्मारक का नाम	राज्य जिले संरक्षण के अधीन सम्मिलित करना है।	क्षेत्रफल	स्वामित्व	अधिसूचना के अधीनी के
1	2	3	4	5	6	7	8	9
म0 प्र0	झाबुआ	अलीराजपुर	मलवाई	प्राचीन शिव मंदिर	सर्वे न. 200	0.24 गुना 0.097 हे.	पुरातत्व विभाग	

T.C

क्र0 क 6,8,8,4, स-तीस- चूंकि राज्य शासन की यह राय है कि नीचे दी गई अनुसूची में विनिर्दिष्ट किये गये प्राचीन इमारत पुरातत्व वंचल तथा अवरोध को डिस्टर्ब किये जाने, क्षतिग्रस्त किये जाने परिवेदित किये जाने विरूपित किये जाने हटाने जाने फिसर वितर किये जाने या उनका आरक्षण होने देने से संरक्षित करना आवश्यक है ।

2- अतएवं मध्यप्रदेश एग्मिरेन्ट माग्यूमेण्ड्स एक्ट अंतर्गत आराजियात साइटस एण्ड रिमेग एक्ट 1964 12 जून 1964 की धारा 3 की उपधारा 1 द्वारा प्रदत्त शक्तियों को प्रयोग में लाते हुए, राज्य शासन एतद् द्वारा उक्त प्राचीन इमारतों को राज्य संरक्षित स्मारक के एवं में पीठ करने के आने आशय की सूचना देता है ।

3- किसी भी ऐसी आपत्ति या सुझाव पर जो इस संबंध में उक्त प्राचीन स्मारकों तथा पुरातत्व स्थलों और अवशेषों में हित रखने वाले किसी व्यक्ति से इस सूचना से मध्यप्रदेश राजपत्र में प्रकाशित होने के दिनांक से दो माह की कालावधि समाप्त होने के पूर्व प्राप्त है । राज्य शासन द्वारा विचार किया जावेगा ।

अनुसूची

राज्य	जिला	तहसील	स्थल	स्मानक कानाम	राजस्व क्षत्र क्रमांक जिसे संरक्षण के अधीन सम्मिलि करना है ।	स्वामित्व	धार्मि पूजा प्राचीन
मध्यप्रदेश	पूर्वनिमाड खंडवा	खडवा	मान्यता	गौरीसोमनाथ मंदिर	ख0नं07	50.45 एकड	
				2- विश्वेश्वर मंदिर		30 400 हे0	म0प्र0 शा
				पार्वती मंदिर	ख0नं09	21.56 एकड	
				कालीमाता मंदिर		0.725 हे0	

T.C.

HIGH COURT OF MADHYA PRADESH

ORDER SHEET

CASE No. ..... 201 .....

Vs. .....

DATE OF THE ORDER	ORDER Writ Petition No:957/2014

27.01.2014

Shri D.K.Tripathi, Advocate for the petitioner.

Shri Samdarshi Tiwari, Government Advocate for the respondents/State.

Heard counsel for the parties.

The issue raised in this PIL is regarding encroachment on the Government land. As it is indeed public property, we direct that the Collector to carry out demarcation of land, if necessary, and to initiate appropriate action in respect of all the encroachments and unauthorised occupations on the Government land in question. The Collector shall take steps as per law against all the unauthorised occupants and after due inquiry direct the concerned officials to remove the unauthorised structures and including to proceed against the occupants for recovery of compensation for unauthorised use and occupation of the land during the relevant period.

The removal of unauthorised structures, however, be done not later than 30.4.2014, by following due process and giving opportunity to all concerned.

Compliance report in this behalf be submitted to the Court within the same period. If the Collector fails to submit Action Taken Report within the specified time, matter be notified on Board on 2nd of May, 2014, under caption "Direction".

Subject to above, the petition stands disposed of.

Sd/-
(A.M.Khanwilkar)
Chief Justice

Sd/-
(Krishn Kumar Lahoti)
Judge

HS

True Copy

संलग्न पृ.सं- 3A

अमरकंटक में अब नहीं होंगे नए निर्माण कार्य : शिवराज

नर्मदा संरक्षण को लेकर मंथन, होटल, आश्रमों को भी नहीं मिलेगी जगह

• **मध्यप्रदेश ।** मुख्यमंत्री शिवराज सिंह चौहान ने कहा कि नर्मदा नदी मध्य प्रदेश की जीवन रेखा है। मध्य प्रदेश ही नहीं बल्कि गुजरात, महाराष्ट्र भी अपनी समृद्धि के लिए बहुत हद तक नर्मदा नदी पर निर्भर हैं। नर्मदा नदी हमारी आस्था एवं श्रद्धा का केंद्र है। लेकिन भौतिक रूप से अगर कोई मध्य प्रदेश को देखे तो सिंचाई का पानी, पीने का पानी, बिजली इत्यादि जो कुछ भी देती है हमें नर्मदा नदी ही देती है। नर्मदा जी है तो मध्य प्रदेश है।

मुख्यमंत्री ने कहा कि नर्मदा सेवा मिशन बनाकर कई काम सरकार ने किए हैं ताकि नर्मदा जी की धारा झर-झर कल-कल बहती रहे, निरंतर प्रवाह बना रहे तथा नर्मदा जी हमें जीवन देती रहे, इसके लिए आगे भी कई काम किए जाएंगे।

मुख्यमंत्री ने कहा कि जिस प्रकार भारत देश में गंगा जी का महत्व है, उसी प्रकार पूरे मध्य प्रदेश में नर्मदा जी का महत्व है। मुख्यमंत्री ने कहा कि अमरकंटक कोई साधारण जगह नहीं है, अमरकंटक कई ऋषि-मुनियों तथा तपस्वियों की भूमि है। मुख्यमंत्री ने कहा कि नर्मदा नदी के संरक्षण एवं संवर्धन के लिए नर्मदा सेवा यात्रा प्रारंभ की जाएगी। नर्मदा सेवा यात्रा के दौरान जो योजना बनाई थी, उस समय फलों की खेती, पौधारोपण का बड़े स्तर पर अभियान शुरू किया था। पौधारोपण अभियान में 16 विभागों को जोड़ा जाएगा तथा इसके क्रियान्वयन में समाज की अहम् भूमिका रहेगी।

मुख्यमंत्री ने कहा कि नर्मदा नदी को संरक्षित एवं संवर्धित करने के लिए रोडमैप तैयार किया जाएगा। 1 मई को नर्मदा सेवा अभियान से जुड़े लोग एकत्रित होकर जन जागरण अभियान का शुभारंभ करेंगे। तथा 5 जून को पर्यावरण दिवस के दिन संकल्प लेंगे कि किस-किस स्थान पर कहां-कहां, कौन-कौन से पौध लगाए जाएंगे तथा ऐसे पौधे लगाए जाएंगे जो यहां के इकोसिस्टम के अनुरूप हैं।

मुख्यमंत्री ने कहा कि अमरकंटक में अब कोई भी नया निर्माण नहीं किया जाएगा। कोई नया आश्रम या संस्था नहीं बनेगी। अमरकंटक में पर्यटकों की सुविधा के लिए कोई स्थान चाहिए तो पर्वत के नीचे नया निर्माण कार्य कराया जाएगा। जैसे होटल, रेस्टॉरेंट आदि। मुख्यमंत्री ने कहा कि हरियाली अमावस्या पर्व पर अमरकंट क्षेत्र में बड़े स्तर पर पौधरोपण अभियान चलाया जाएगा।

संलग्न 3 B

3-B.

नर्मदा संरक्षण को लेकर मंथन : होटल, आश्रमों को भी नहीं मिलेगी जगह

अमरकंटक में अब नहीं होंगे नए निर्माण कार्य : शिवराज

25/04/2022

25

2022

पत्रिका न्यूज नेटवर्क

अनूपपुर. नर्मदा नदी मध्यप्रदेश की जीवन रेखा है। गुजरात, महाराष्ट्र एवं राजस्थान भी अपनी समृद्धि के लिए बहुत हद तक नर्मदा नदी पर निर्भर हैं। नर्मदा नदी हमारी आस्था एवं श्रद्धा का केंद्र है, लेकिन भौतिक रूप से अगर कोई मध्यप्रदेश को देखें तो सिंचाई का पानी, पीने का पानी, बिजली जो कुछ भी देती है हमें नर्मदा नदी ही देती है। नर्मदा है तो मध्यप्रदेश है। नर्मदा सेवा मिशन बनाकर मध्य सरकार ने नर्मदा द्वारा कार्य करते रहें, जिससे पुराड़ मान रहे तथा हमें जीवन देती रहे, इसके लिए कई काम किए गए हैं। आगे भी कई काम किए जाएंगे।

मुख्यमंत्री शिवराज सिंह चौहान की अध्यक्षता में रविवार को देवास से केंद्रीय पर्यावरण तथा जलवायु परिवर्तन मंत्री भूपेन्द्र यादव, जलशक्ति राज्यमंत्री प्रहलाद सिंह पटेल, वन मंत्री विजय शाह, जनजातीय कार्य विभाग मंत्री मीना सिंह मांडावे, खाद्य मंत्री बिसाहूलाल सिंह मौजूद थे। कलेक्टर अनुपपुर सोनिया मीणा ने कार्यों की विस्तृत जानकारी दी।

अमरकंटक में नर्मदा पुनर्संरक्षण कार्यक्रम के लिए किए जा रहे कार्यों की समीक्षा की गई। सीएम ने कहा कि जिस प्रकार देश में गंगा का नाम है, उसी तरह मध्यप्रदेश में नर्मदा का नाम है। प्रधानमंत्री का जिस प्रकार गंगा मिशन एक मिशन है, उसी प्रकार मध्यप्रदेश में नर्मदा नदी के संरक्षण को भी मिशन बनाना होगा।

सीएम ने अधिकारियों को निर्देशित किया कि नर्मदा के संरक्षण एवं संवर्धन के लिए पर्यटन सेवा यात्रा प्रारंभ की जाएगी। अमरकंटक में अब कोई भी नया निर्माण कार्य नहीं किया जाएगा। नए आश्रम एवं संस्था नहीं बनेंगी। पर्यटकों की सुविधा के लिए कोई स्थान चाहिए तो नर्मदा के नीचे नया निर्माण कार्य हो, जैसे कि रेस्टोरेंट होटल बनाया जाए।

नर्मदा को संरक्षित करने बनेगा रोडमैप

मुख्यमंत्री ने कहा कि नर्मदा नदी को संरक्षित एवं संवर्धित करने के लिए रोडमैप तैयार किया जाएगा। एक माह की नर्मदा सेवा अभियान से जुड़ी लोग जल सहायता अभियान में सहयोग करेंगे। पांच जून को पर्यावरण दिवस पर संकल्प लिए जिला-जिला स्थान पर [illegible] जाएंगे। पौधे लगाने के बाद पौधे लगाए जाने वाले स्थान के ईकोसिस्टम के अनुकूल हैं। केन्द्रीय मंत्री भूपेन्द्र यादव ने कहा कि नर्मदा नदी सम्पदा के साथ-साथ अन्य राज्यों [illegible] आध्यात्मिक [illegible] पौधरोपण की जानकारी दी।

आरक्षण का लाभ नहीं देने की मांग को लेकर रैली

41 डिग्री पारे में जुटे 20 हजार लोग

धार @ पत्रिका. धार के डीलिस्टिंग को लेकर महारैली का आयोजन किया गया। 41 डिग्री की भीषण गर्मी में आदिवासी अंचल के भाई-बहनों ने अपने अधिकार और सम्मानजनक परिवर्तन लोग लालच देकर या अन्य प्रलोभन से कराते हैं। ऐसे लोग जो ईसाई या मुस्लिम धर्म अपना लेते हैं फिर भी अनुसूचित जनजाति वर्ग के आरक्षण का लाभ लेते हैं। ऐसे लोगों

अक्षय तृतीय पर इस बार नहीं होगा सामूहिक विवाह

पत्रिका न्यूज नेटवर्क

शिवपुरी. इस बार अक्षय तृतीय पर तीन मई को सरकारी सामूहिक विवाह नहीं होगा। आगे की तिथि प्रशासन तय करेगा। सीएम कन्यादान योजना की नई गाइडलाइन से इसके संकेत मिले हैं। अब सामूहिक विवाह आयोजन से 15 दिन पहले विवाह पोर्टल खोलना होगा।

इस निर्णय के हिसाब से देखा जाए तो अक्षय तृतीया के लिए केवल आठ दिन ही रह गए हैं। नई गाइडलाइन के अनुसार सामूहिक विवाह

कार्यालय कार्यपालन यंत्री, लोक निर्माण विभाग

1	2	3	4
2	2022_[illegible]_[illegible]	[illegible]	19.00
3	2022_[illegible]_[illegible]	[illegible]	19.00
4	2022_[illegible]_[illegible]	[illegible]	19.90
		योग	57.9

संलग्न - 4

दिनांक
24 जुलाई 2022

प्रति थाना प्रभारी, थाना मांधाता

1. स्टॅच्यू ऑफ ~~[illegible]~~ वनवेस, ओंकारेश्वर, की परियोजना की D.P.R मे प्रस्तावित पार्किंग स्थल पर, जो कि 7.1 हेक्टेयर का है, कुल 350 पेड होना बताया गया है एवम् 43 पेड काटने का प्रस्ताव है। जबकी हम इसी स्थान पर बैठकर यह अनुमान कर रहे हैं कि इसी क्षेत्र मे कम से कम 3000 हजार पेड होंगे।

2. D.P.R. मे गलत जानकारी देने वालों पर उचित कानूनी कार्यवाही करें।

विरोध :- दिनांक 8 जुलाई 2022 को हितरक्षा अभियान के कार्यकर्ता ~~[illegible]~~ पार्किंग स्थल के किनारे के 12 मीटर के पेडों की गणना कर के गये थे। उसमे 550 पेड गिने गये थे। जिसका व्हीडीयो भी उपलब्ध है।

कृपया भविष्य मे पेड न कटें यह सुनिश्चित करें। पेड काटने वाले पर कठोर कार्यवाही करें।

प्राप्त
24-7-22

मनीष काले मुकाबले 94254.36216
[illegible] 9617387090
मिहुल गरेल 9098727197
सुरेश 4144 - 9630206364
डॉ. मुकाबले बारोड 9425081803
सक्षम जैन 8103040747

संलग्न 5

साइंस कॉलेज
ा रोड,
ोर, (म.प्र) - 452001

निवास - 54, मधुबन कालोनी
केसर बाग रोड, इन्दौर- 452009
फोन : 0731-2478672
मो : 9926047209

ओंकार पर्वत पर शंकराचार्य पारियोजना के पर्यावरण पर सम्भावित प्रभाव

ओंकार पर्वत पर इस परियोजना के तहत किये जाने वाले विभिन्न कार्यों (प्रतिमा स्थापना, संग्रहालय, पार्किंग क्षेत्र एवं सड़क निर्माण आदि) हेतु पहाड़, खोदने एवं पेड़ो के काटे जाने से पर्यावरण पर प्रतिकूल सम्भावित प्रभाव इस प्रकार होंगे।

01. इस क्षेत्र की जैवविविधता (पेड़ पक्षी, कीट पतंगे एवं अन्य छोटे बड़े जीव) में कमी आयेगी।

02 पेड़ एवं पहाड़ का सम्बंध सबसे गहरा होता है अतः पेड़ो की कटाई से पहाड़ कमजोर होगा एवं भूस्खलन की घटनाएं बढ़ेगी।

03 प्रस्तावित निर्माण कार्य एवं मानवीय गतिविधियों बढ़ने से तापमान में वृद्धि होगी एवं लम्बे समय में मौसम में बदलाव भी।

04 ज्यादा लोगों के आवागमन से वायु प्रदूषण बढ़ेगा एवं कूड़े कचरे की समस्या भी फैलेगी जो नर्मदा के जल को भी प्रदूषित कर सकती है।

05 निर्माण कार्य से पैदा मलबे का यदि उचित निपटान नहीं किया जाता है तो तेज वर्षा में इसके नीचे बहकर आने से कोई मानवीय त्रासदी पैदा कर नर्मदा के जल स्तर एवं बहाव को भी प्रभावित कर सकता है

06 इस पहाड़ के दोनो ओर नदी का बहाव है जो कमजोर भूमि में भूमि कटाव बढ़ायेगा।

04. जलवायु परिवर्तन के प्रभाव से म.प्र. अब अछूता नहीं है। यहां के शहरों में प्रदूषण बढ़ रहा है, गर्मी के मौसम में ज्यादा गर्मी हो रही है, वर्षा का पेटर्न बदल गया है, साथ ही बिजलीका बढ़ रही है एवं आकाशीय बिजली गिरने के खतरे भी बढ़े हैं। इस परिवेश में शंकराचार्य परिसीमन हेतु पहाड़ एवं पेड़ों की कटाई विनाशकारी साबित होगी।

पृथ्वी ने हर जगह (पहाड़, नदी, झील, तालाब, समुद्र एवं रेगिस्तान) वहां की परिस्थिति के अनुसार मिट्टी, पेड़ पौधे, पशु पक्षी एवं अन्य जीवों की एक सामूहिक एवं संतुलित व्यवस्था विकसित की है। इकोलॉजी में इस व्यवस्था को पारिस्थितंत्र (इकोसिस्टम) कहा जाता है। इस व्यवस्था की कोई भी एक कड़ी या भाग कम या समाप्त होने से पूरे तंत्र पर इसका दुष्प्रभाव होता है एवं असंतुलन की स्थिति पैदा हो जाती है।

डा. ओ.पी. जोशी
29/07/2022

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Seismic Hazard Estimation at Omkareshwar Hydroelectric Project Dam Site

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[3]Professor & Head, Department of Civil Engineering, Jabalpur Engineering College, Jabalpur (M.P.), India.
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Abstract: *Omkareshwar Hydroelectric Project is constructed across the river Narmada in the downstream of famous Narmada Sagar multipurpose project in the state of Madhya Pradesh (India). In this study seismic hazard has been estimated at Omkareshwar Dam site. Effects of all the faults, which can produce earthquake equal to or more than 3.5 Magnitude and those within a radius of 300 Km from the centre of the Concrete Gravity Dam have been considered. The history of earthquakes indicated that a total 52 earthquakes, of magnitude 3.5 or more have been occurred in last 172 years. The maximum magnitude reported within the region of consideration is 6.2 in a1938 in Satpura range. The probabilistic Seismic Hazard analysis has been used. Probabilistic Rsults are presented in the form of peak ground acceleration and seismic hazard curves.*

Keywords: *Seismic Hazard, Peak ground acceleration, Ground motion, Omkareshwar Dam, PSHA*

I. Introduction

Large food grain requirements and shortage of electrical energy, forced India to go for different multipurpose schemes for water reservoirs so that sufficient water may be available for irrigation purpose and surplus water may be used for electrical energy generation. A large number of major dams (multipurpose) were constructed in the past also constructing new dams. At that time, consideration for seismic activity was not that sensitive for designing and construction of these dams In the present study the Omkareshwar Multipurpose Project (22°14'30"N, 76°09'45"E) popularly known as Omkareshwar Dam, site is considered for analysis. This dam is situated in the state of Madhya Pradesh (India) was constructed recently, completed electric generation component in year 2007, irrigation component is to be constructed in future. Occurrence of various earthquakes in recent past in the intra-plate region of peninsular India has clearly warned about the safety aspects of structures in the region. Omkareshwar Dam has been recently Constructed across the River Narmada, near Omkareshwar Town which is famous for one of the famous Dwadash Jyotirlinga temple called Omkareshwar temple. Omkareshwar Dam site is situated in Central Indian Tectonic Zone and come under seismic zone III (BIS-1893-2002, Part I). It is surrounded by number of faults, Son Narmada South Fault, Barwani-Sukta Fault, Son Narmada Fault, Govilgarh Fault, Tapti North Fault, Purna Fault, Kaddam Fault, Son Narmada North Fault are some of them and many unnamed faults. Omkareshwar Dam is situated within the range of famous 1938 Satpura (epicenter, 21.13°N, 75.75°E) Earthquake of Magnitude 6.2. The Dam site is located in Peninsular India (PI), which has experienced the devastating Koyna (1967, *Mw* = 6.3), Killari (1993, *Mw* = 6.1), Jabalpur (1997, Mw=6.0) and Bhuj (2001, *Mw* = 7.7) earthquakes. The hazard in this part of India is considered to be less severe than in the Himalayan plate boundary region. However, intra-plate earthquakes are rarer than plate boundary events but usually tend to be more harmful.

It is well established fact that past historical data plays very important role for any seismic hazard study. Age of earth is approximately 800 billion years. Seismic activities were there since very long period. As compared to this the available data for seismic activity is very small. Still earthquake engineers are trying to estimate the seismic hazard with these small number of recorded ground motion data. Ground motion introduces uncertainties into the nature of future and the dynamic forces to be considered in the design of dam structures. The response of any civil engineering structure depends primarily on the local ground motion at the foundation level. Accurate knowledge of such motion, due to all possible sources in the influence zone is the most sought information in engineering practice. The existing Indian code IS-1893 does not provide quantified seismic hazard, but lumps large parts of the India into unstructured regions of equal hazard of doubtful accuracy. There are other reasons also as to why probabilistic seismic hazard analysis (PSHA) should be adopted in India. The uncertain seismic scenario can be tailored to match the expected life of the structure. This way a normal building with a shorter life period of about 100 years may be designed for a shorter return period spectrum, whereas dam structure which has a longer social life could be designed for a longer return period scenario. In this work probabilistic seismic hazard has been estimated for Omkareshwar dam.

Omkareshwar dam is 949 meter long and 54 meter high (above deepest foundation level) concrete gravity dam across the river Narmada. A central Ogee type spillway 570 m. long with crest level 179.6 m. has been provided to pass the probable maximum flood of 882315 cumecs by 23 numbers of radial gates of size 20m.X 18 m. A surface power house (202 m. X 23 m. X 53 m.) is constructed within the body of Dam on the right bank of Narmada consisting of 8 units of 65 MW capacity with conventional Francis type turbines.

Figure 1: Cross Sections of Omkareshwar Dam from DPR

II. Seismicity of the Region

Considered dam i.e. Omkareshwar Project (22°14'30"N, 76°09'45"E) is situated in Son Narmada Lineament Zone, which is ENE-WSW trending Lineament belongs to Central Indian tectonic zone(CITZ) extends roughly between 20°N -24°N latitude and 77°E -83°E longitudes (Consists of Son Narmada North Fault, Son Narmada South Fault, Govilgarh Fault, Tapti North Fault, Barwani Sukta Fault, Purna Fault, Kaddam Fault etc. and number of Unnamed Faults.) which is a part of Peninsular India. The major prominent rifts are the Narmada Son Lineament and the Tapti Lineament together called SONATA (Son-Narmada-Tapti Lineament) zone separating the northern and the southern blocks of the shield.

The most significant earthquakes has been Satpura-valley earthquake of 14 March, 1938, which had a magnitude of 6.2. This earthquake was located in Madhya Pradesh's Barwani District (21.13°N, 75.75°E) and was felt at many of Madhya Bharat and Jabalpur Earthquake of magnitude 6.0 on 22 may 1997 (23.07°N,80.02°E), both were a deep-seated events.

According to Jain et.al. (1995 CRUMSONATA) the western part of Son Narmada Tapti lineament (SONATA) zone, starting from Surat to east of Jabalpur, is covered mostly by Deccan basalt lava. The thickness of the lava pile varies in different parts. A huge thickness of 1450 m of basalts is preserved in the Western Ghats and in Satpura area while the Deccan basalts are very thin along the eastern margin of the main exposure. In Amarkantak (Origin of Narmada River), lava pile is about 150 m. thick. A series of N-S traverses were taken using deep seismic sounding (DSS) across the lineament zone to study the nature of Deccan volcanics, disposition pattern of the flows in the various physiographic segments, their corelation if any, it shows that Near Jabalpur, Narmada river the Lameta- Deeccan basalt is exposed at elevation of 410 m. msl while south wards lowest exposed flow occurs below 385 m msl. This indicates reverse faulting at the Lameta contact.

The Deccan Basalts in the Narmada valleys and the Gondwana sediments in the area cut by numerous dykes trending NW-SE, ENE-WSW to NE-SW. The ENE-WSW trending dykes continuous further to the east of Seoni district (Dyke is a sheet of Rock that formed in a fracture in a pre existing rock body) North of the Narmada valley, dyke are found only up to the foothills of the Malwa Plateau and its scrap. Here also it is in the area south of the Narmada river course that dykes are very predominant. The river bed is highly fractured and the fractures carry dykes in the vicinity of the Narmada river ENE-WSW trend is more prevalent.

According to Pimpricar S.D. (2008), the increase in the seismicity level during the recent years in the central Indian shield, this keeping in view that the lithospheric environment beneath this zone may be wet, thus accounting for higher rates of magmatic activity. Evidences indicate that CITZ has a major zone of differential crustal movement since Neo-Archaeun time. As per SEISAT (2000) a series seven number of very small faults on the western side (Just down stream side) of the Omkareshwar Dam.

There is lack of information on seismicity of PI, in so far as its application in engineering is concerned. For example, till some years back there was no region-specific attenuation relationship for PI that engineers could use

as being rational enough, for future earthquake events, then Iyengar and Raghukant (2004) given a attenuation relationship for PI and Jaiswal (2008) computed seismic Hazard parameters of PI. It may not be out of place to note here in 2002, the Code IS-1893 has eliminated the erstwhile low hazard region of PI (zone I) and revised it to a higher hazard status as zone-II. The scientific basis for this revision, if any, remains obscure.

III. Fault Map

Identifications of different faults and their characteristics, around any site, are first and major step for any seismic hazard estimation. In the present study, Omkareshwar Dam has been selected as the target, a control region of radius 300 km around the Dam (22°14'30"N, 76°09'45"E) considered for further investigation. The fault map of this circular region prepared from the Seismo-tectonic Atlas of India (2000). Some researchers i.e. Raghukanth (2006) have taken 300 Km. Radius around the site and some researchers Sitharam (2012) mentioned the range 300 km to 400 km radius centered from site. hence, 300 km. radius has been considered for this study. It is well established fact that earthquakes occurring at epicentral distances greater than 400 km do not generally cause structural damage. Hence the faults lying within this radius from the site have been considered in estimating hazard. A total of Eighteen faults, influence seismic hazard at Omkareshwar Dam, can be identified from the above map. Details of considered faults are given in Table I.

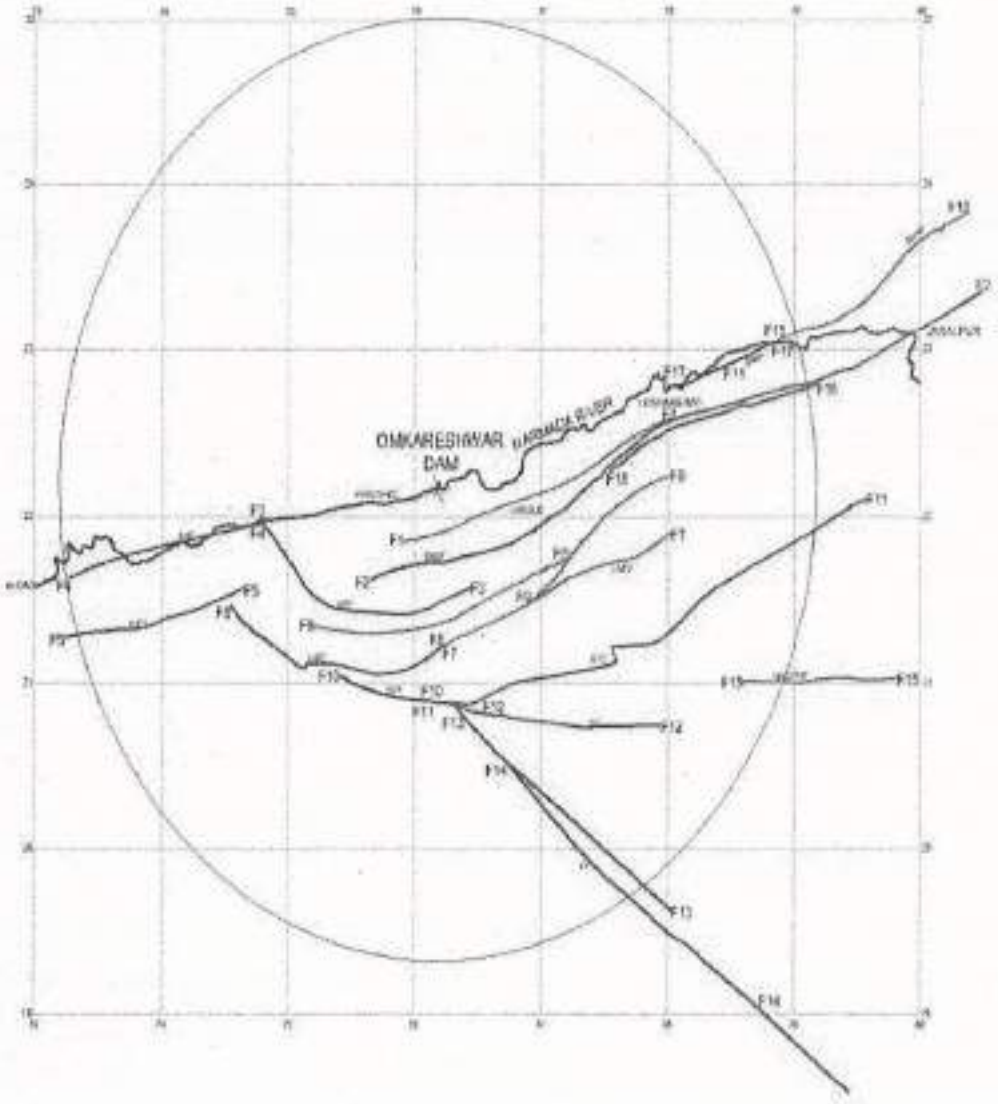

Figure 2: Fault map for SHA prepared from Seismotectonic Atlas of India for Omkareshwar Dam

Table 1: Details of Faults Considered

Fault No.	Name of Fault	M_{max} Associated	Mu	Length of Fault in Km	Shortage epicentral distance in Km	Average Weightage Factor
F1	-	4.0	4.5	188.6	23.9	0.0492
F2	SNSF	6.5	7.0	531.6	46.3	0.1112
F3	BSF	5.7	6.2	174.0	66.8	0.0507
F4	SNF	5.5	6.0	178.1	146.0	0.0538
F5	TNF-1	4.0	5.5	146.4	172..6	0.0434
F6	TNF-2	4.0	4.5	165.5	78.2	0.0460
F7	TNF-3	4.8	5.3	261.4	98.2	0.0705
F8	-	4.0	4.5	138.8	79.4	0.0422
F9	-	4.5	5.0	139.4	100.7	0.0447
F10	GGF(SubS)	6.2	6.7	72.5	133.2	0.0457
F11	GGF	6.2	4.5	318.0	133.2	0.0799
F12	Purna F	4.0	4.5	112.0	139.4	0.0464
F13	-	4.0	6.7	170.6	142.7	0.0531
F14	Kaddum F	4.0	4.5	352.0	186.3	0.0478
F15	Nagpur	5.6	6.1	118.0	282.2	0.0487
F16	-	5.2	5.7	185.3	133.8	0.0557
F17	SNNF(sub)	4.0	4.5	85.8	206.6	0.0349
F18	SNNF	4.7	5.2	352.1	292.5	0.0760

IV. Past Earthquake Records

Establishment of magnitude–frequency recurrence relation of individual fault is next step for seismic Hazard estimation. fault recurrence estimate has been developed from regional recurrence relationship. Hence a catalogue of past earthquakes in the 300 km radial region has been developed. There have been several efforts made in the past to create an earthquake catalogue for India. A list of earthquakes of magnitude 3.5 and above is prepared using catalogue of Oldham, Raghukant (2004), Pimparikar (2009), CGS, USGS, IMD, GSI. Total 52 events from 172 years(1846-2016) are chosen for seismic hazard analysis, whenever the magnitude of an event was not available in the previous reports, the approximate empirical relation [$m = (2/3)\ I_0 + 1$] has been used to estimate it from the reported maximum MMI number. To avoid confusion associated with different magnitude scales, all magnitudes have been converted to moment magnitude Mw.

Some of the major earthquakes reported within 300 km radius of Omkareshwar Project are :, 31st March 1852 (22.1°N,77.5°E) of Magnitude 6, 31st December 1858 (21°N,75°E) of Magnitude 5.5, 18th November 1863 (21.8°N,75.3°E) of magnitude 5.7 Near Barwani Sukta fault, 14th March 1938 (21.13°N,75.75°E) of magnitude 6.2 and 25th August 1957 (22°N,80°E) of magnitude 5.6 Near Govil Garh fault and series of very small magnitude earthquakes in Khandwa District.

V. Regional Recurrence

In this work regional seismic activity has been characterized by the Gutenberg–Richter frequency–magnitude recurrence relationship $\log_{10} N = a - bM$, where N stands for the number of earthquakes greater than or equal to a particular magnitude *M*. Parameters (*a*, *b*) characterize the seismicity of the region. The simplest way to obtain (*a*, *b*) is through least square regression as shown in Figure 3.

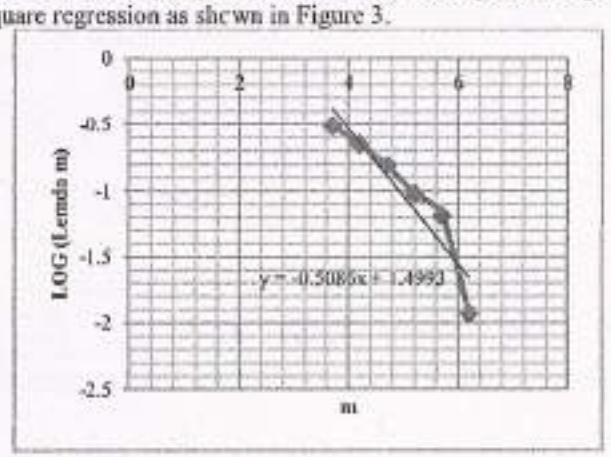

Figure 3: Gutenberg Richter relationship

In the present study, the 172 (1846-2016) years sample of earthquake data around Omkareshwar Dam site was evaluated and obtained values of a is 1.499 and b value is 0.508 for the region around Omkareshwar Dam.

VI. Deaggregation

The fault level recurrence is required for differentiating the nearby sources or far off sources from the Omkareshwar Dam site. Fault level recurrence is rarely known due to meager amount of recorded earthquakes, because only recent data is available, old data are of lower magnitude earthquake are not available. The recurrence relation computed above for the 300 km radius region around Omkareshwar Dam is for whole region and is specific to any particular fault. Hence this problem can be tackled using the principle of conservation of seismic activity. According to this the region measured in terms of number of earthquakes per year with $m \geq m_0$, should be equal to the sum of such earthquakes occurring on individual faults. Considering that longer fault can produce more number of small events of magnitude m_0 than a shorter fault. Hence, $Ni(m_0)$ may be taken as being proportional to the length of the fault, leading to a simple weight factor $p_i = L_i/\sum L_i$, where L_i is length of individual i th fault in Kms. It is now well established fact that future activity will continue, at least in the short run, similar to past activity. Hence, seismic activity of a fault should be related to the number of past events associated with it in the catalogue. Hence, one can arrive at another weight factor q_i as the ratio of the past events associated with fault i to the total number of events in the region. Here, the average of pi and qi is taken as the final weight to get $N_i(m_0) = 0.5(p_i + q_i)N(m_0)$. (1)

The above weight factors are included in Table 1. Since the control region is in a seismically homogenous region, it would be appropriate to use the regional b-value for individual faults also. This give

$$Ni(m) = Ni(m_0)\, \nu \left[\frac{e^{-\beta(m-m_0)} - e^{-\beta(m_u-m_0)}}{1-e^{-\beta(m_u-m_0)}}\right] \quad (2)$$

where m_u is the maximum potential magnitude of the i th fault and $\beta = 2.303b$ and $\nu = e^{\alpha-\beta m_0}$. The above arguments provide a basis for decomposing the regional hazard into fault-level recurrence relations.

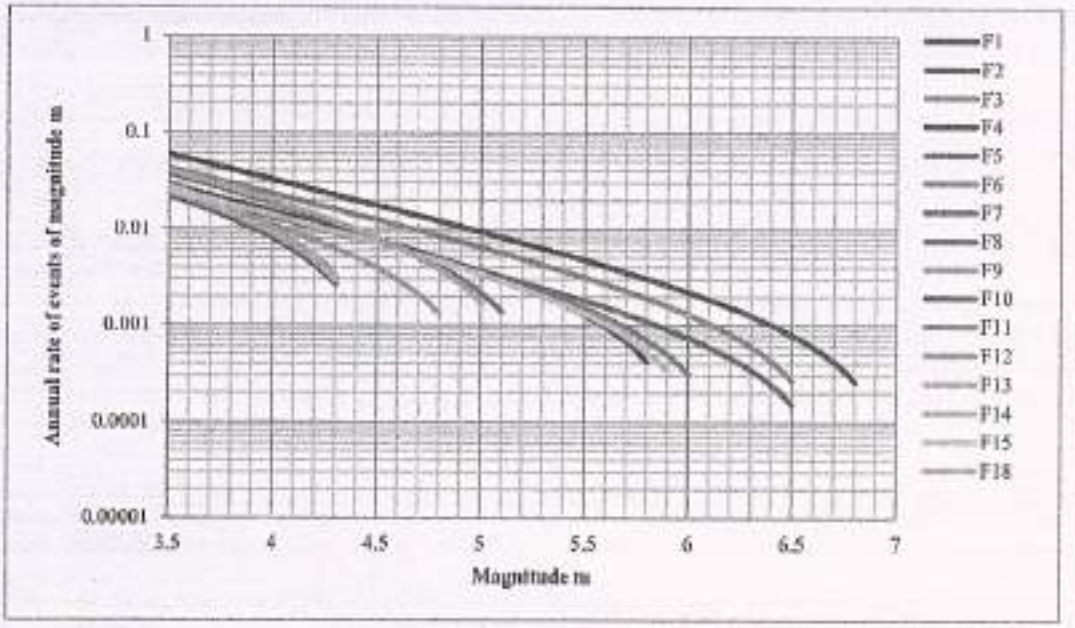

Figure 4: Fault level recurrence relation

VII. Attenuation of Strong Ground Motion

In engineering applications, the peak ground acceleration (PGA or zero period acceleration) and the response spectrum are needed at the site. These quantities depend primarily on the magnitude of the event and the distance of the site to the source. Thus, attenuation of spectral acceleration as a function of magnitude and hypocentral distance is a key element in further seismic hazard analysis. Attenuation relationship developed by Iyenger and Raghukanth (2004) considered for the analysis and PGA has been calculated. The form of the attenuation equation proposed for bedrock (br) condition is :

$$\ln(y_{br}) = C1 + C2(m-6) + C3(m-6)^2 - C4\, r - \ln r + ln\, \varepsilon_{br} \quad (3)$$

In this equation, y_{br} stands for the spectral acceleration (S_a/g); m and r refers to moment magnitude and hypocentral distance respectively. The coefficients of the above equation taken from Raghukanth & Iyengar

(2006) The average of the error term $\ln(\varepsilon_{ie})$ is zero, but the standard deviation is of importance in probabilistic hazard analysis. This relation is valid for bedrock sites with a shear wave velocity ore than 1.5 km/s. The coefficients for zero period were used for the calculation which are C1=1.6858, C2=0.9241, C3=-0.0760, C4=0.0057 and standard deviation of ε_{ie}=0.4648. The normal cumulative distribution function has a value which is most efficiently expressed in terms of the standard normal variables (z), which can be computed for any random variables using transformation as given below (Kramer, 1996):

$$z = \frac{\ln PHA - \ln PHA}{\sigma \ln PHA} \quad (4)$$

Where, PHA is the various targeted peak acceleration levels, which will be exceeded. ln PHA(bar) the value is calculated using attenuation relationship equation and ln PHA is the uncertainty in the attenuation relation expressed by the standard deviation.

VIII. Probabilistic Seismic Hazard Analysis

Probabilistic seismic hazard analysis (PSHA) estimates the probability of exceedance of spectral acceleration S_a at a site due to all possible future earthquakes. In reality, the seismic hazard at a site is influenced by all the earthquakes with different magnitudes and different distances. PSHA considers the contribution of all earthquakes in that region. PSHA also considers the uncertainties associated with time of occurrences of earthquakes and its location. The usefulness of PSHA in quantifying safety of man-made structures has been discussed extensively in the literature. PSHA has become a standard tool for estimating design basis ground motion. It also provides a framework where these uncertainties can be combined rationally to provide more complete picture of seismic hazard (Kramer 1996). Following Raghukanth & Iyengar (2006), assuming that the number of earthquakes occurring on a fault follows a stationary Poisson process, the probability that the control variable Y exceeds level y^*, in a time window of T years is given by :

$$P(Y > y^* \text{ in } T \text{ years}) = 1 - \exp(-\mu_{y^*} T) \quad (5)$$

The rate of exceedance, μ_{y^*} is computed from the expression :

$$\mu_{y^*} = \sum_{j=1}^{Nm} \sum_{k=1}^{Nr} vi\, P(Y > y^* | mj, rk)\, P[M=mj]\, P[R=rk] \quad (6)$$

Here P[M=m] and P[R=r] are the probability density functions of the magnitude and hypocentral distance respectively. $P(Y > y^*|m, r)$ is the conditional probability of exceedance of the ground motion parameter Y. The reciprocal of the annual probability of exceedance gives the return period for the corresponding ground motion value.

IX. Seismic Hazard Curves

Seismic hazard curves can be obtained by computing the mean annual rate of exceedance μ_{y^*}, for different specified ground motion values y^*. These curves are obtained individually for all the Sixteen capable faults around Dam site and considering the individual effect of all Sixteen faults and combined them to estimate the aggregate hazard at the site. The seismic hazaed curve for PGA at bed rock (foundation level of Dam) obtained by above procedure is shown in Figure 5 for Omkareshwar Dam Site. It is observed that seismic hazard at Omkareshwar dam is mainly influenced by Fault F2-Son Narmada South Fault, F3- Barwani-Sukta Fault, F4-Son Narmad Fault, F10 and F11- Govilgarh Fault

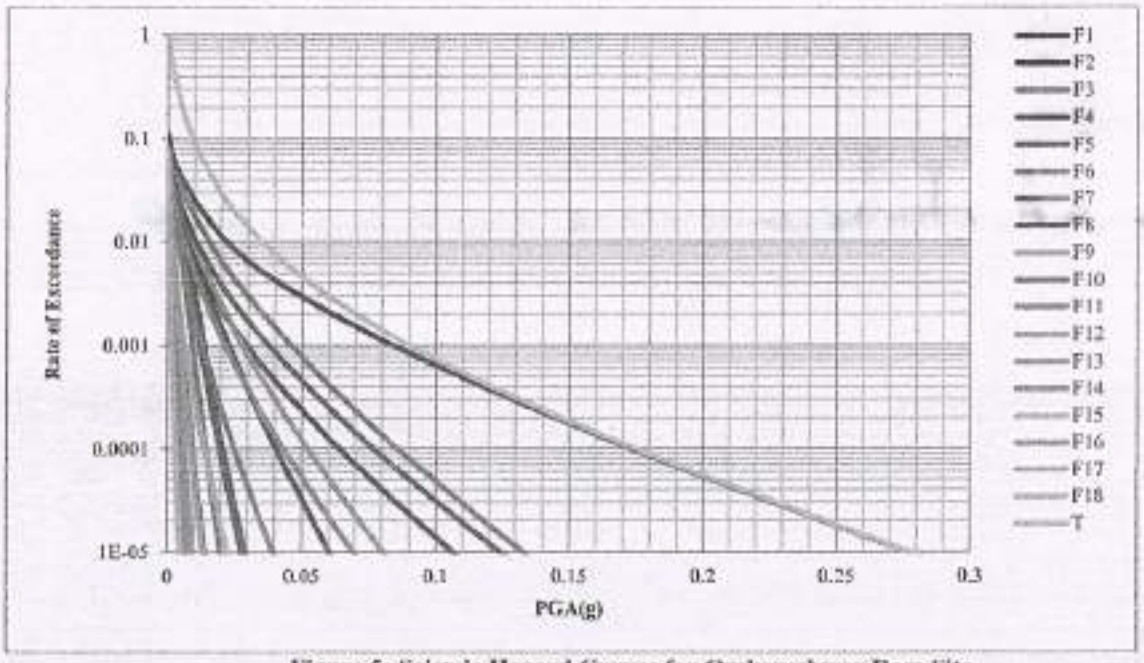

Figure 5: Seismic Hazard Curves for Omkareshwar Dam Site

X. Conclusions

The present article investigates seismic hazard of Omkareshwar Dam near Mandhata village of Khandwa District of Madhya Pradesh in India using state-of-the-art probabilistic analysis. Eighteen faults and Nine Lineaments Identified from Seismotectonic atlas of India and its environ, 2000 and considered. All the Eighteen Faults that can induce ground motion at Dam site have been identified from the seismo-tectonic map of the region and from old and recorded events of earthquake. Since slip rates of individual faults are not available, the recurrence relation of these faults has been estimated from the regional recurrence relation. The attenuation relations developed previously specifically for PI are used for computing spectral acceleration hazard curves. Probability that an acceleration of 0.1g would be exceeded in 50 years may be p[YT>y*] = 4.0% . The PGA that has a 10 % Probability of exceedance in 50 year (For return period of 475 years) is 0.09g and the PGA that has a 2 % Probability of exceedance in 50 year (For return period of 2475 years) is 0.19g which is within limits of IS 1893 (part I) : 2002 coefficients for zone III.

The maximum regional magnitude for Omkareshwar Dam is also estimated Mmax =7. With the help of these data we can Check the stability of Dam considering seismic activity in area.

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