

**Preparation of Master Plan & Preliminary Design  
for Roads and Services/ Utilities for**

# **Dighi Port Industrial Area**

**under Delhi Mumbai Industrial Corridor (DMIC)**

**Volume 2A Road Annexures**

**September 2024**



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 03)**

*Prepared by*



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## Geotechnical Investigation Report (Bridge No. 03)

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## Geotechnical Investigation Report (Bridge No. 03)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

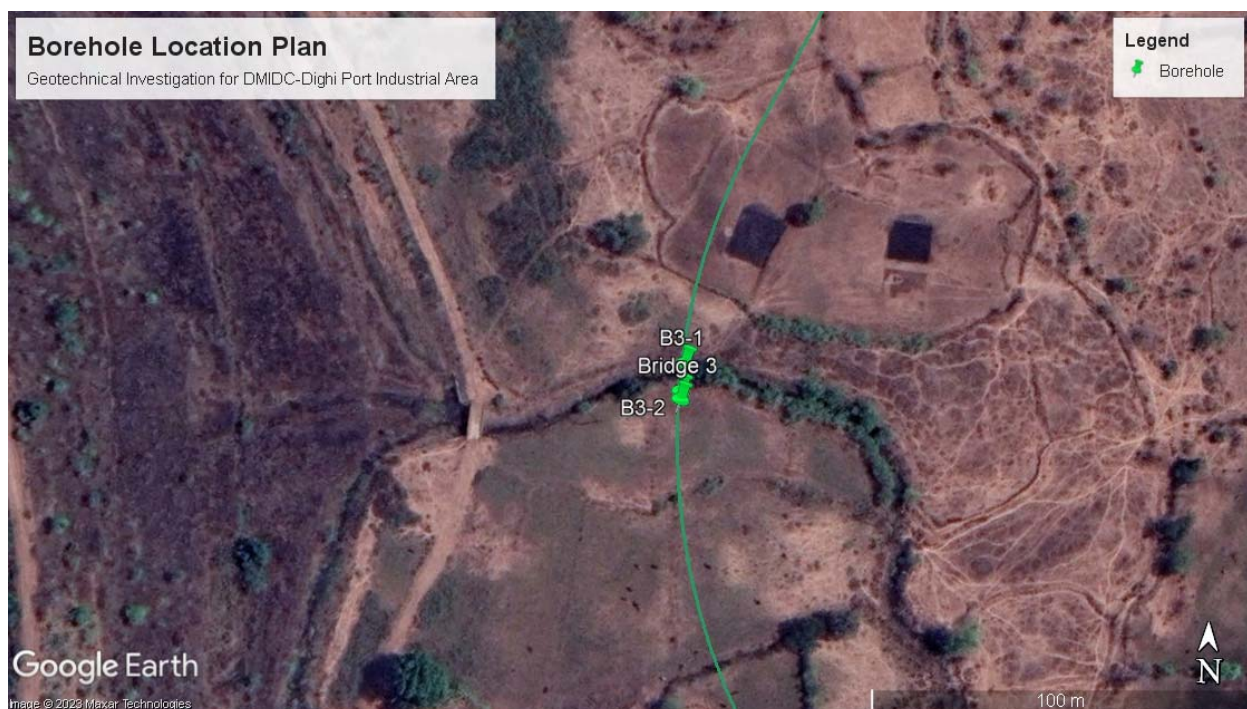


## 2.1 Exploration Scope

Two boreholes (B3-1, B3-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B3-1         | 2033721  | 317925  | 7.20m |
| B3-2         | 2033736  | 317928  | 8.10m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 0.50m to 2.10m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 0.50m to 2.10m below ground surface. Core Recoveries varied between 68% and 71%, while Rock Quality Designation (RQD) ranged between 23% and 49%. Compressive strength of rock core sample ranges from 540kg/cm<sup>2</sup> to 640kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 2.20m to 3.00m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 2.20m to 3.00m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 80% and 99%, while Rock Quality Designation (RQD) ranged between 47% and 97%. Compressive strength of rock core sample ranges from 510kg/cm<sup>2</sup> to 840kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 7.20m to 8.10m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 0.30m to 0.60m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 0.50m to 2.10m below ground surface. In this layer compressive strength of rock core samples ranged between 540kg/cm<sup>2</sup> to 640kg/cm<sup>2</sup>.

As per minimum compressive strength 510kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B3-1             | 0.50m | 2.20m     |
| B3-2             | 2.10m | 3.00m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**



## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -0.50m to -2.10m |
| Layer II, Moderately weathered rock |                  |
|                                     | -2.20m to -3.00m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 5100 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 5100 = 510 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |  |                                       |                              |                                 |         |         |                                     |   |   |  |  |  |                             |
|---|--------|--|---------------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--|--|--|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |  |                                       |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd.             |  |  |  |                             |
| Type of Boring  |        | Calyx with Bent. with casing                             |                                       |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 3                  |   |   |  |  |  |                             |
| Dia of Hole (mm):   |        | 100.00   |                                       |                              | 75.00                           |         |         | Bore Hole No.: B3-1                 |   |   |  |  |  |                             |
| Depth (M):  |        | 0.00-1.00  |                                       |                              | 1.00-7.20                       |         |         | Co-ordinates : N=2033721, E=317925  |   |   |  |  |  |                             |
| Commenced on : 14 April 2023  |        |  |                                       | Completed on : 15 April 2023 |                                 |         |         | Ground Bed RL: 81.00M               |   |   |  |  |  |                             |
| Water Struc :   |        |  |                                       | Ground Water : 0.30 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |  |  |  |                             |
| From (M)  | To (M) | Sample Depth (M)   | Description of Strata                 | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.   | Sl. No. of core recovery                 | Core Rcvry (%)                               | R.Q.D.                                       | Remarks                     |
|   |        |  |                                       |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |  |  |  |                             |
| 0.00  | 0.50   | 0.00 - 0.50  | BROWNISH MURUM, COBBLES, PEBBLES      |                              |                                 |         |         |                                     |   | DS-1  |  |  |  |                             |
| 0.50  | 2.20   | 0.50 - 1.20<br>1.20 - 2.20                               | REDDISH HYDROTHERMAL WEATHERED BASALT |                              |                                 |         |         |                                     |   | 1 TO 3<br><br>4 TO 6                                    | 0.50<br><br>0.68                         | 71.00<br><br>68.00                           | 49.00<br><br>23.00                           |                             |
| 2.20  | 7.20   | 2.20 - 3.50<br>3.50 - 5.00<br>5.00 - 6.10<br>6.10 - 7.20 | GRAY JOINTED BASALT                   |                              |                                 |         |         |                                     |   | 7 TO 16<br><br>17 TO 21<br><br>22 TO 27<br><br>28 TO 34 | 1.12<br><br>1.20<br><br>0.95<br><br>1.01 | 86.00<br><br>80.00<br><br>86.00<br><br>92.00 | 54.00<br><br>72.00<br><br>62.00<br><br>47.00 | Inclined and verticle veins |
|   |        |  |                                       |                              | Bore Hole Terminated at : 7.20  |         |         |                                     |   |   |  |  |  |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |  |                                       |                              |                                 |         |         |                                     |   |   |  |  |  |                             |
| No. of disturbed Sample : 1   |        |  |                                       |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                                    |  |  |  |                             |
|   |        |  |                                       |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                                 |  |  |  |                             |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                       |                              |                                 |         |         |                                     |    |   |                          |                |        |         |
|---|--------|------------------------------|---------------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|----|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                       |                              |                                 |         |         |                                     |    | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |        | Calyx with Bent. with casing |                                       |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 3                  |    |   |                          |                |        |         |
| Dia of Hole (mm):   |        | 100.00                       |                                       |                              | 75.00                           |         |         | Bore Hole No.: B3-2                 |    |   |                          |                |        |         |
| Depth (M):  |        | 0.00-2.50                    |                                       |                              | 2.50-8.10                       |         |         | Co-ordinates : N=2033736, E=317928  |    |   |                          |                |        |         |
| Commenced on : 14 April 2023  |        |                              |                                       | Completed on : 15 April 2023 |                                 |         |         | Ground Bed RL: 81.50M.              |    |   |                          |                |        |         |
| Water Struc :   |        |                              |                                       | Ground Water : 0.60 Meter    |                                 |         |         | Location of Bore Hole : As per plan |    |   |                          |                |        |         |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                 | Symbol                       | SPT Record                      |         |         |                                     |    | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |        |                              |                                       |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N  |   |                          |                |        |         |
| 0.00  |        | 0.00 - 1.50                  | BROWNISH MURUM, COBBLES, PEBBLES      |                              |                                 |         |         |                                     |    | DS-1  |                          |                |        |         |
|   |        | 1.50 - 2.10                  |                                       |                              | 6                               | 10      | 16      | 30                                  | 26 | SPT-1                                       |                          |                |        |         |
| 2.10  | 2.10   | 2.10 - 3.00                  | REDDISH HYDROTHERMAL WEATHERED BASALT |                              |                                 |         |         |                                     |    | 1 TO 5                                      | 0.61                     | 68.00          | 41.00  |         |
| 3.00  | 3.00   | 3.00 - 4.50                  | REDDISH HYDROTHERMAL ALTERED BASALT   |                              |                                 |         |         |                                     |    | 6 TO 10                                     | 1.36                     | 91.00          | 80.00  |         |
|   |        | 4.50 - 6.00                  |                                       |                              |                                 |         |         |                                     |    | 11 TO 15                                    | 1.20                     | 81.00          | 50.00  |         |
|   |        | 6.00 - 7.20                  |                                       |                              |                                 |         |         |                                     |    | 16 TO 19                                    | 1.19                     | 99.00          | 97.00  |         |
|   |        | 7.20 - 8.10                  |                                       |                              |                                 |         |         |                                     |    | 20 TO 22                                    | 0.85                     | 94.00          | 92.00  |         |
|   | 8.10   |                              |                                       |                              | Bore Hole Terminated at : 8.10  |         |         |                                     |    |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                       |                              |                                 |         |         |                                     |    |   |                          |                |        |         |
| No. of disturbed Sample : 1   |        |                              |                                       |                              | No. of U.D.S. : 0               |         |         |                                     |    | No. of Vane Test : 0                        |                          |                |        |         |
|   |        |                              |                                       |                              | No. of S.P.T. : 1               |         |         |                                     |    | No. of Water Sample : 0                     |                          |                |        |         |





TC-5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev No - 03                         | Dtd 30/08/2022       |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0032323/02225****ULR No. :TC528223000007549F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | Bridge B3-1  |       |   | Bridge B3-2  |      |       |    |   |      |       |   |   |
|--|---|------------------------------------|--------------|-------|---|--------------|------|-------|----|---|------|-------|---|---|
| Sample No. :   |   | --                                 | DS-1         |       |   | DS-1         |      |       |    |   |      |       |   |   |
| Depth, m :   |   | --                                 | 0.00 to 0.50 |       |   | 0.00 to 1.50 |      |       |    |   |      |       |   |   |
| Description :  |   | --                                 | Sandy Clay   |       |   | Sandy Clay   |      |       |    |   |      |       |   |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 51           |       |   | 75           |      |       |    |   |      |       |   |   |
|  | Plastic Limit                           |                                    | 13           |       |   | 33           |      |       |    |   |      |       |   |   |
|  | Plasticity Index                        |                                    | 38           |       |   | 42           |      |       |    |   |      |       |   |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                     | --           |       |   | --           |      |       |    |   |      |       |   |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 33           |       |   | 31           |      |       |    |   |      |       |   |   |
|  | Sand                                    |                                    | 84           |       |   | 64           |      |       |    |   |      |       |   |   |
|  | Gravel                                  |                                    | 10           |       |   | 32           |      |       |    |   |      |       |   |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Bulk                                    |                                    | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Density,T/m <sup>3</sup>                |                                    | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Water Content, %                        | IS 2720 Part-13                    |              |       |   |              |      |       |    |   |      |       |   |   |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    | --           |       |   | --           |      |       |    |   |      |       |   |   |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                    | --           |       |   | --           |      |       |    |   |      |       |   |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10         | 10-20 | - | -            | 5-10 | 10-20 | -  | - | 5-10 | 10-20 | - | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                    | -            | -     | - | -            | -    | -     | -  | - | -    | -     | - |   |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | -            | -     | - | -            | -    | -     | -  | - | -    | -     | - |   |
|  |   |                                    |              |       |   |              |      |       |    |   |      |       |   |   |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| Specific gravity   |   | IS 2720 Part-3                     | 2.71         |       |   | 2.68         |      |       | -- |   |      | --    |   |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
|  | Optimum Moist-Cont., %                  | Heavy Compaction IS 2720 Part-8    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
|  | Unsoaked %                              |                                    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| **Coefficient of Curvature (Cc)                            |   |                                    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    | --           |       |   | --           |      |       | -- |   |      | --    |   |   |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

  
**Checked By**
  
**Vikram B. Parmar**  
**Nodal Quality Manager**  
**Authorised Signatory**

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN032323

\*\*\*\*\* End of Report \*\*\*\*\*

*"Intelligence with Integrity"*

ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

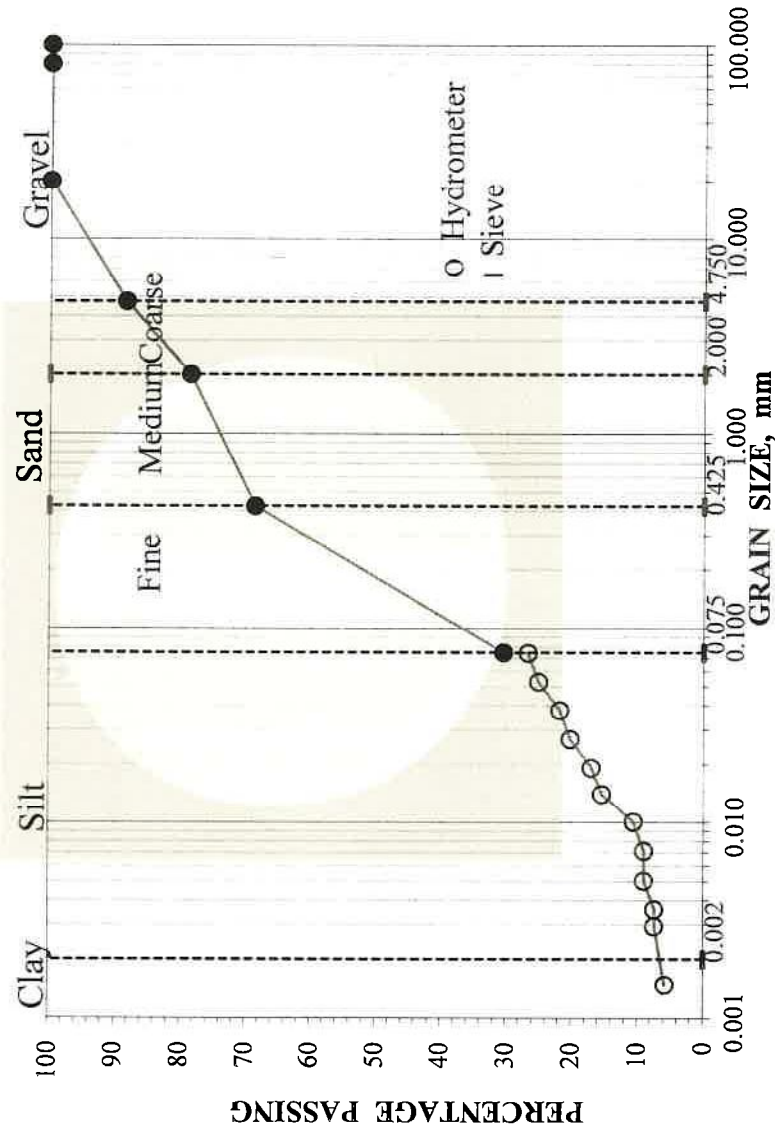


TC-5282

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER**

**CUSTOMER** M/s. P. N. Shidhore Civil Engineers (India) Private Limited.  
**LOCATION** Soil, Water and Rock samples for lab. testing for the work of  
 Geotechnical Investigation for DMIDC-Dighi Port Industrial Area,  
 Indapur  
**METHOD** B.H.No. Bridge B3-1

**Description** Sandy Clay **Sample #** DS-1 **Depth, m** 0.00 to 0.50

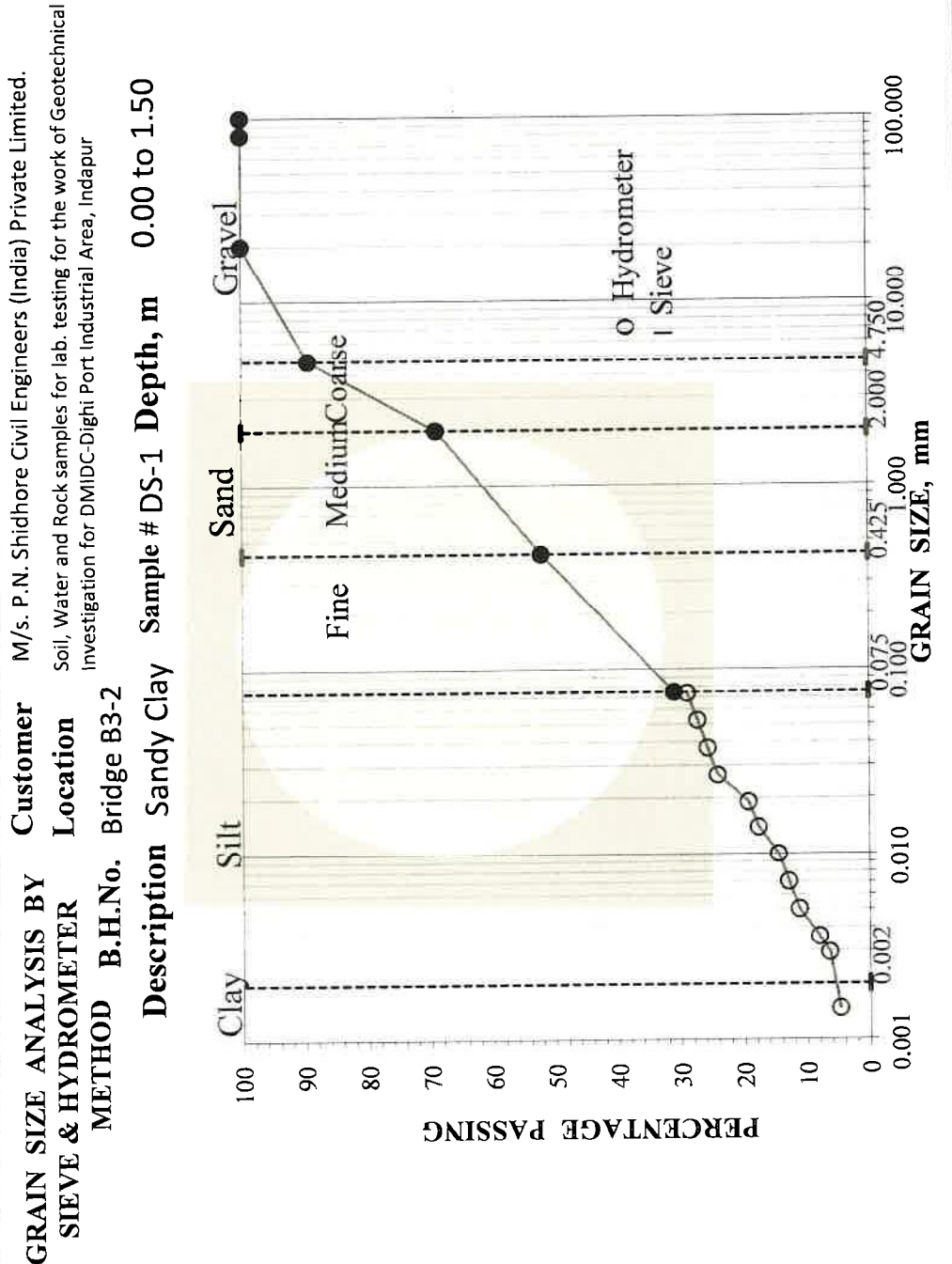


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TC-5282



2

• Hologram authenticates report • Hologram authenticates report • Hologram authenticates report • Hologram authenticates report



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TC-5282

**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE**R&D/LAB/SAN/2023-24/SAN0032323/02234  
ULR No. : TC528223000007558F  
17/05/2023

## 1. Name &amp; Address of Customer

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22 Dtd. 21.04.2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

## i) Description

Rock

## ii) Quantity

04 Nos.

## iii) Date of receipt

21/04/2023

## iii) Condition

Acceptable

## 6. Test method followed

As Mentioned Below.

## 7. Date of Testing From

23/04/2023 to 28/04/2023

**TEST REPORT**

| SR No.               | ID Mark                         | Depth | Dia   | Area            | Length | Dry Density                | Load   | Compressive strength      | Compressive strength corrected for L/D- N/mm <sup>2</sup> | SP. Gravity               | Porosity %                | Water Absorption % | Hardness by Moh's scale  |
|----------------------|---------------------------------|-------|-------|-----------------|--------|----------------------------|--------|---------------------------|---|---------------------------|---------------------------|--------------------|--------------------------|
|                      |                                 | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>          | N      | N/mm <sup>2</sup>         |   |                           |                           |                    |                          |
| Test Method Followed |                                 |       |       |                 |        | (IS:13030): 1991 (RA 2021) |        | (IS:9143): 1979 (RA 2021) |   | (IS 1122): 1974 (RA 2017) | (IS:13030):1991 (RA 2021) |                    | IS 13630 (Part 13): 2019 |
| 1                    | BH. No. B3-1<br>( Piece No. 5 ) | 1.50  | 54.20 | 2306.05         | 108.20 | --                         | 147800 | 64                        | 64  | --                        | 0.012                     | 0.47               | --                       |
| 2                    | BH. No. B3-1<br>( Piece No. 9 ) | 2.40  | 54.52 | 2333.36         | 110.64 | --                         | 195400 | 84                        | 84  | --                        | 0.012                     | 0.43               | --                       |
| 3                    | BH. No. B3-2<br>( Piece No. 5 ) | 2.50  | 54.30 | 2314.56         | 113.10 | --                         | 125400 | 54                        | 55  | --                        | 0.011                     | 0.45               | --                       |
| 4                    | BH. No. B3-5<br>( Piece No. 6 ) | 3.50  | 54.70 | 2348.79         | 111.70 | --                         | 120900 | 51                        | 52  | --                        | 0.011                     | 0.51               | --                       |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365-1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- Data provided by Customer

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0032323

  
**Vikram B. Parmar**  
 Nodal Quality Manager  
 Authorised Signatory
**\*\*\*\*\*End of Report\*\*\*\*\***

• Hologram authenticates report • Hologram authenticates report • Hologram authenticates report • Hologram authenticates report

## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

**TEST REPORT NO. & DATE** : **R&D/LAB/SAN/2023-24/SAN0032323/01541**  
**ULR No. : TC528223000006865F**  
**02/05/2023**

- Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
- Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
- Customer's Reference : PNS/Structwel/22 Dtd. 21.04.2023
- Location of performance of test : At Laboratory
- Sample :
  - Description : **Construction Water**
  - Quantity : 01 No.
  - Date of receipt : 21/04/2023
  - Condition : Acceptable
- Test method followed : Mentioned Below
- Date of Testing : 26/04/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : Bridge No. B3-1

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.30</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>13</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>12</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019), (EDTA method)            | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

#### NOTE :

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**

Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0032323

**Vikram B. Parmar**  
**Nodal Quality Manager**  
 Authorised Signatory

\*\*\*\*\* End of Report \*\*\*\*\*





# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 07)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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Kalyan – 421301, Maharashtra  
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## Geotechnical Investigation Report (Bridge No. 07)

### Table of Contents

| Section  | Page No. |
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| 1.0 Introduction                               | 3        |
| 2.0 Exploration Procedure                      | 3        |
| 2.1 Exploration Scope                          | 4        |
| 2.2 Subsurface Conditions                      | 4        |
| 2.3 Groundwater Levels                         | 5        |
| 3.0 Foundation Recommendations                 | 6        |
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## Geotechnical Investigation Report (Bridge No. 07)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

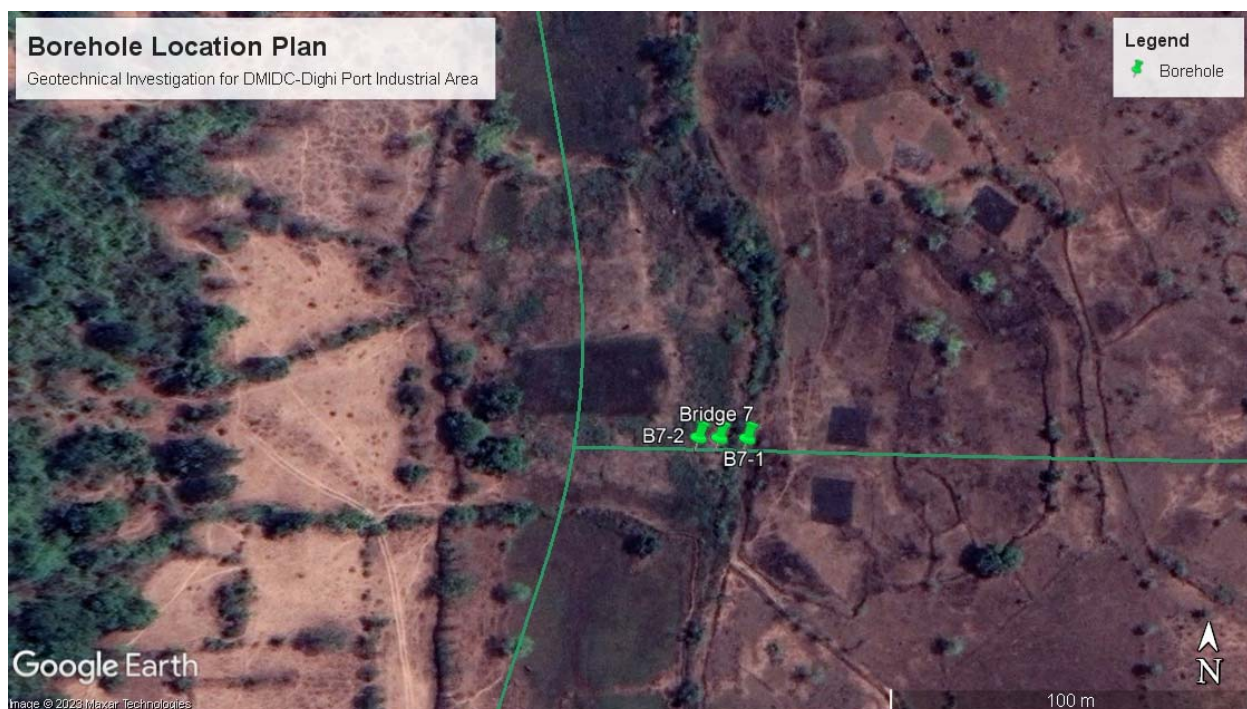
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B7-1, B7-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B7-1         | 2032908  | 318152  | 8.00m |
| B7-2         | 2032909  | 318136  | 9.00m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. Based on Standard Penetration Tests (SPT) conducted in this

layer encountered refusals. The lower boundary of this layer was encountered at depths of 1.60m to 3.00m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 1.60m to 3.00m below ground surface. Core Recoveries varied between 63% and 70%, while Rock Quality Designation (RQD) ranged between 23% and 65%. Compressive strength of rock core sample ranges from 930kg/cm<sup>2</sup> to 1390kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.00m to 4.00m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.00m to 4.00m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 82% and 95%, while Rock Quality Designation (RQD) ranged between 26% and 84%. Compressive strength of rock core sample ranges from 800kg/cm<sup>2</sup> to 1160kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 8.00m to 9.00m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 0.00m to 1.30m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.



### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 1.60m to 3.00m below ground surface. In this layer compressive strength of rock core samples ranged between 930kg/cm<sup>2</sup> to 1390kg/cm<sup>2</sup>.

As per minimum compressive strength 800kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B7-1             | 1.60m | 3.00m     |
| B7-2             | 3.00m | 4.00m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -1.60m to -3.00m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.00m to -4.00m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 8000 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 8000 = 800 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev. No - 03                        | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02222****ULR No. :TC528223000007546F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                   |   | IS CODE FOLLOWED                   | Bridge B7-1     |       |    |    | Bridge B7-2  |       |    |    | --   |       |    |    | --   |       |    |    |
|---|---|------------------------------------|-----------------|-------|----|----|--------------|-------|----|----|------|-------|----|----|------|-------|----|----|
| Sample No. :  |   | --                                 | DS-1            |       |    |    | DS-1         |       |    |    | --   |       |    |    | --   |       |    |    |
| Depth, m :  |   | --                                 | 0.00 to 0.60m   |       |    |    | 0.00 to 1.0m |       |    |    | --   |       |    |    | --   |       |    |    |
| Description :   |   | --                                 | Silty Sand      |       |    |    | Silty Sand   |       |    |    | --   |       |    |    | --   |       |    |    |
| Atterberg Limits  | Liquid Limit                            | IS 2720-Part 5                     | 56              |       |    |    | 51           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Plastic Limit                           |                                    | 27              |       |    |    | 31           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Plasticity Index                        |                                    | 29              |       |    |    | 20           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | ShrinkageLim.                           | IS 2720-Part 6                     | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| % Grain size by Sieve & Hydrometer                            | Clay + Silt                             | IS 2720-Part 4                     | 22              |       |    |    | 15           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Sand                                    |                                    | 58              |       |    |    | 73           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Gravel                                  |                                    | 21              |       |    |    | 11           |       |    |    | --   |       |    |    | --   |       |    |    |
| Shear Strength :<br>Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Angle                                   | Direct Shear Test (DUU, DCU & DCD) | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Bulk Density,T/m <sup>3</sup>           |                                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Water Content,%                         |                                    | IS 2720 Part-13 | --    |    |    |              | --    |    |    |      | --    |    |    |      | --    |    |    |
| Unconfined compression test                                   | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Shear Strength (kg/cm <sup>2</sup> )    |                                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Consolidation Test  | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10            | 10-20 | -- | -- | 5-10         | 10-20 | -- | -- | 5-10 | 10-20 | -- | -- | 5-10 | 10-20 | -- | -- |
|   | Mv, m <sup>2</sup> /Tx10 <sup>-1</sup>  |                                    | --              | --    | -- | -- | --           | --    | -- | -- | --   | --    | -- | -- | --   | --    | -- |    |
|   | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | --              | --    | -- | -- | --           | --    | -- | -- | --   | --    | -- | -- | --   | --    | -- |    |
|   |   |                                    | --              | --    | -- | -- | --           | --    | -- | -- | --   | --    | -- | -- | --   | --    | -- |    |
| Natural Moisture Content %                                    |   | IS 2720 Part-1                     | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Specific gravity  |   | IS 2720 Part-3                     | 2.65            |       |    |    | 2.67         |       |    |    | --   |       |    |    | --   |       |    |    |
| Compaction  | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Heavy Compaction  | Optimum Moist-Cont.,%                   | Heavy Compaction IS 2720 Part-8    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| California Bearing Ratio                                      | Soaked %                                | IS 2720 Part-16                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|   | Unsoaked %                              |                                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| **Coefficient of Uniformity (Cu)                              |   | IS 1498                            | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| **Coefficient of Curvature (Cc)                               |   |                                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Free Swell Index (%)  |   | IS 2720 Part-40                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Swelling Pressure (kg/cm <sup>2</sup> )                       |   | IS 2720 Part-41                    | --              |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN022023

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**End of Report**

\*\*\*\*\*

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|---|--------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                  |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                            |
| Type of Boring  |        | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 7                  |   |   |                          |                |        |                            |
| Dia of Hole (mm):   |        | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B7-1                 |   |   |                          |                |        |                            |
| Depth (M):  |        | 0.00-1.00                    |                                  |                              | 1.00-8.00                       |         |         | Co-ordinates : N=2032908, E=318152  |   |   |                          |                |        |                            |
| Commenced on : 11 April 2023  |        |                              |                                  | Completed on : 12 April 2023 |                                 |         |         | Ground Bed RL: 75.50M               |   |   |                          |                |        |                            |
| Water Struc :   |        |                              |                                  | Ground Water : 1.30 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                            |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                    |
|   |        |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                            |
| 0.00  |        | 0.00 - 0.60                  | BROWNISH MURUM, PEBBLES, COBBLES |                              |                                 |         |         |                                     |   | DS-1  |                          |                |        |                            |
|   |        | 0.60 - 1.60                  |                                  |                              |                                 |         |         |                                     |   | 1 TO 7                                      | 0.61                     | 61.00          | 13.00  |                            |
|   | 1.60   |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
| 1.60  |        | 1.60 - 3.00                  | GRAY MODERETALY WEATHERED ROCK   |                              |                                 |         |         |                                     |   | 8 TO 13                                     | 0.88                     | 63.00          | 23.00  |                            |
|   |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   | 3.00   |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
| 3.00  |        | 3.00 - 4.50                  | GRAY JOINTED BASALT              |                              |                                 |         |         |                                     |   | 14 TO 20                                    | 1.43                     | 95.00          | 84.00  | Inlined and verticle veins |
|   |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   |        | 4.50 - 5.90                  |                                  |                              |                                 |         |         |                                     |   | 21 TO 22                                    | 1.15                     | 82.00          | 56.00  |                            |
|   |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   |        | 5.90 - 7.20                  |                                  |                              |                                 |         |         |                                     |   | 23 TO 24                                    | 1.10                     | 85.00          | 78.00  |                            |
|   |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   |        | 7.20 - 8.00                  |                                  |                              |                                 |         |         |                                     |   | 25 TO 29                                    | 0.72                     | 90.00          | 40.00  |                            |
|   |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   | 8.00   |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   |        |                              |                                  |                              | Bore Hole Terminated at : 8.00  |         |         |                                     |   |   |                          |                |        |                            |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
| No. of disturbed Sample : 1   |        |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                            |
|   |        |                              |                                  |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                            |



# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

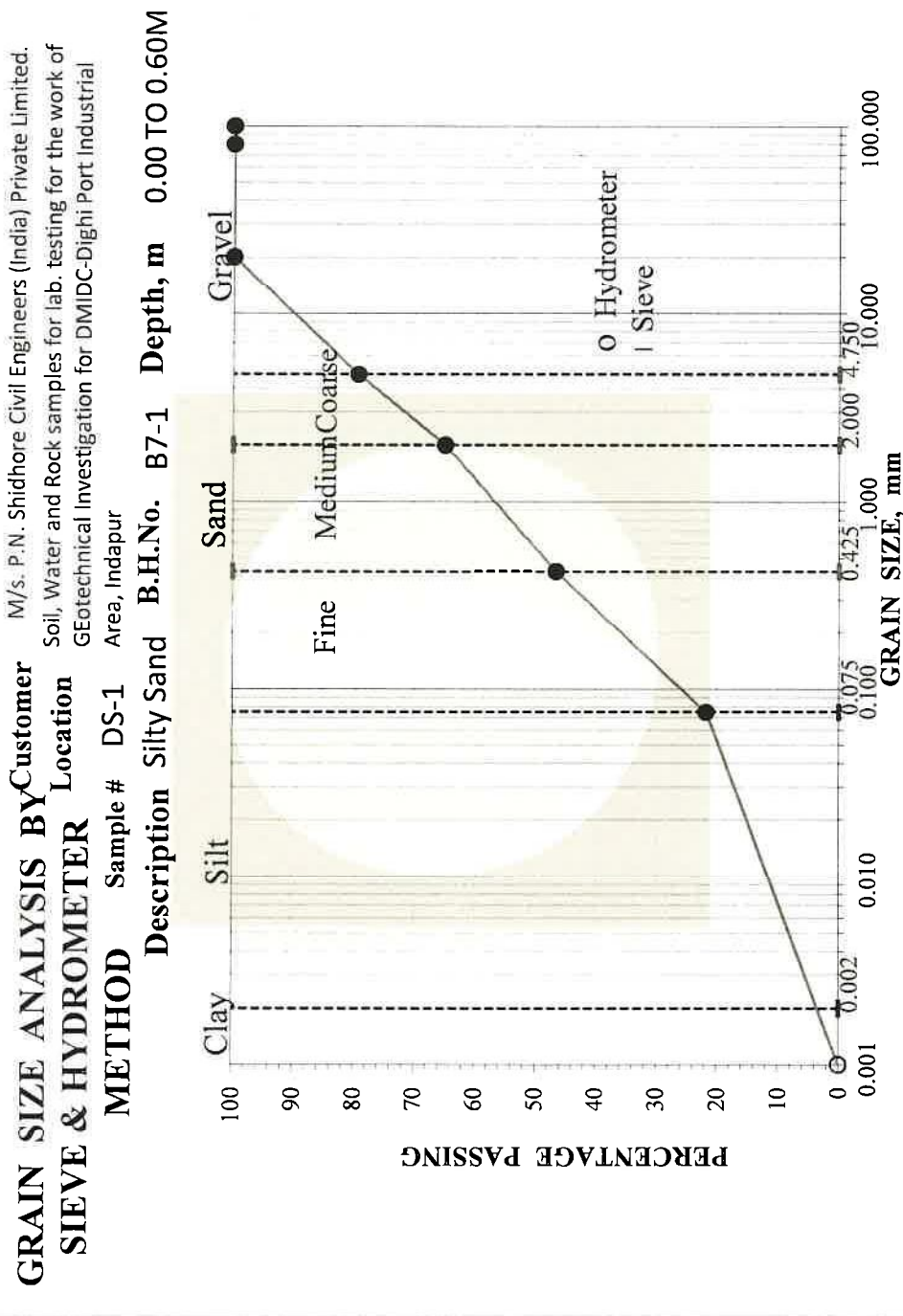
| BORE LOG  |        |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
|---|--------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|----|---|--------------------------|----------------|--------|-----------------------|--|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                  |                              |                                 |         |         |                                     |    | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                       |  |
| Type of Boring  |        | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 7                  |    |   |                          |                |        |                       |  |
| Dia of Hole (mm):   |        | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B7-2                 |    |   |                          |                |        |                       |  |
| Depth (M):  |        | 0.00-1.70                    |                                  |                              | 1.70-9.00                       |         |         | Co-ordinates : N=2032909, E=318136  |    |   |                          |                |        |                       |  |
| Commenced on : 11 April 2023  |        |                              |                                  | Completed on : 12 April 2023 |                                 |         |         | Ground Bed RL: 76.00M               |    |   |                          |                |        |                       |  |
| Water Struc :   |        |                              |                                  | Ground Water : 0.00 Meter    |                                 |         |         | Location of Bore Hole : As per plan |    |   |                          |                |        |                       |  |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |    | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks               |  |
|   |        |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N  |   |                          |                |        |                       |  |
| 0.00  |        | 0.00 - 1.00                  | BROWNISH MURUM, PEBBLES, COBBLES |                              |                                 |         |         |                                     |    | DS-1  |                          |                |        |                       |  |
|   |        | 1.00 - 1.50                  |                                  |                              |                                 |         |         |                                     |    |   | 1 TO 5                   | 0.20           | 40.00  | 0.00                  |  |
|   |        | 1.50 - 1.70                  |                                  |                              | 13                              | 51      | 0       | 0                                   | 51 | SPT-1                                       |                          |                |        |                       |  |
|   |        | 1.70 - 3.00                  |                                  |                              |                                 |         |         |                                     |    | 6 TO 12                                     | 0.80                     | 62.00          | 28.00  |                       |  |
|   | 3.00   |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
| 3.00  |        | 3.00 - 4.00                  | GRAY MODERETALY WEATHERED ROCK   |                              |                                 |         |         |                                     |    | 13 TO 15                                    | 0.70                     | 70.00          | 65.00  |                       |  |
|   | 4.00   |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
| 4.00  |        | 4.00 - 5.50                  | GRAY BASALT                      |                              |                                 |         |         |                                     |    | 16 TO 24                                    | 1.31                     | 87.00          | 63.00  | Vertical vein present |  |
|   |        | 5.50 - 7.00                  |                                  |                              |                                 |         |         |                                     |    | 25 TO 29                                    | 1.24                     | 83.00          | 65.00  |                       |  |
|   |        | 7.00 - 8.00                  |                                  |                              |                                 |         |         |                                     |    | 30 TO 37                                    | 0.92                     | 92.00          | 26.00  |                       |  |
|   |        | 8.00 - 9.00                  |                                  |                              |                                 |         |         |                                     |    | 38 TO 42                                    | 0.89                     | 89.00          | 62.00  |                       |  |
|   | 9.00   |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
| Bore Hole Terminated at : 9.00  |        |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                  |                              |                                 |         |         |                                     |    |   |                          |                |        |                       |  |
| No. of disturbed Sample : 1   |        |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |    | No. of Vane Test : 0                        |                          |                |        |                       |  |
| No. of S.P.T. : 1   |        |                              |                                  |                              |                                 |         |         |                                     |    | No. of Water Sample : 0                     |                          |                |        |                       |  |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

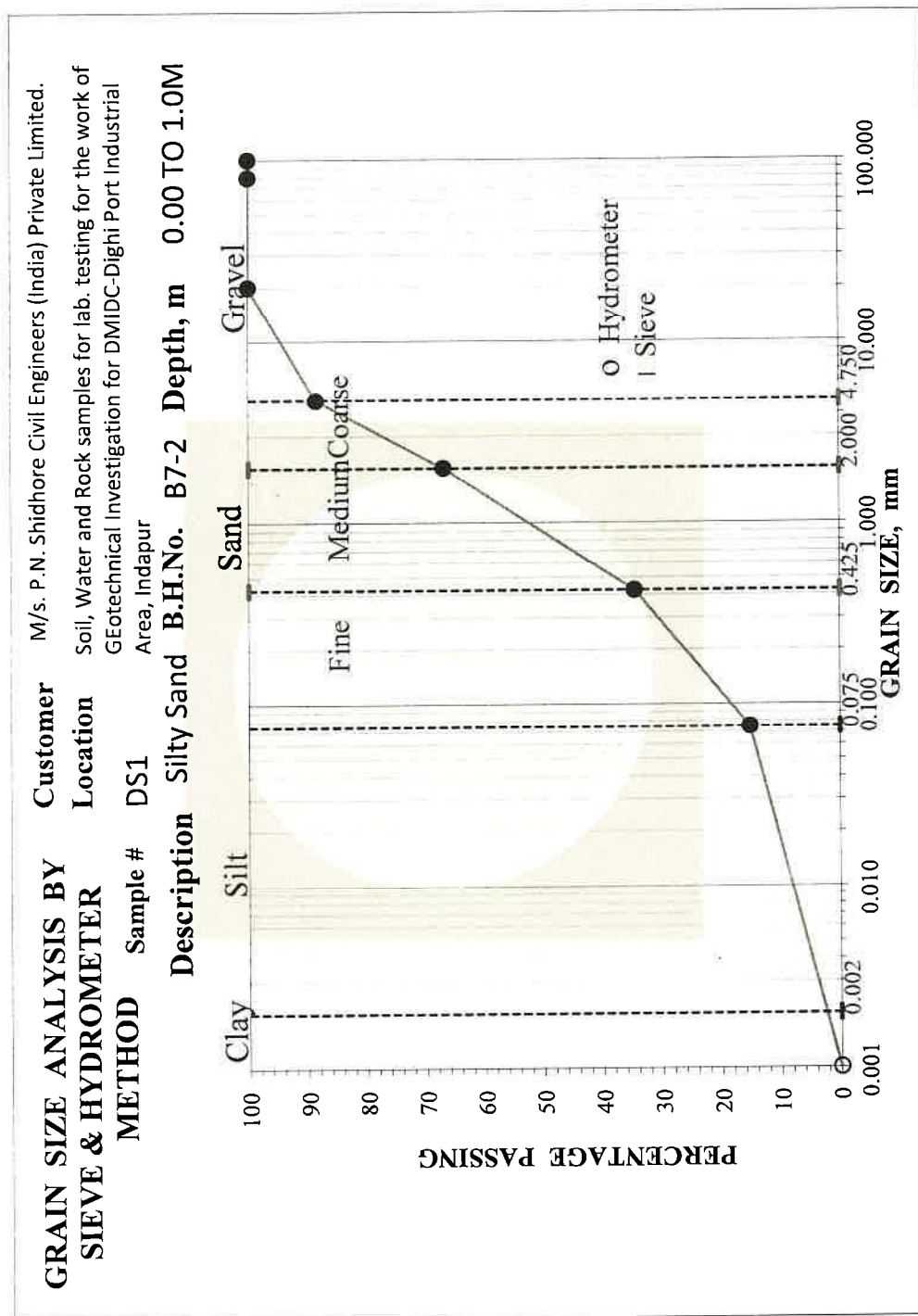


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ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282



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## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

### TEST REPORT NO. & DATE

R&D/LAB/SAN/2023-24/SAN0022023/01847

ULR No. : TC528223000007171F

09/05/2023

### 1. Name & Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

### 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

### 3. Customer's Reference

PNS/Structwel/22, Dtd. 15/04/2023

### 4. Location of performance of test

At Laboratory

### 5. Sample

#### i) Description

Construction Water

#### ii) Quantity

01 No.

#### iii) Date of receipt

15/04/2023

#### iv) Condition

Acceptable

### 6. Test method followed

Mentioned Below

### 7. Date of Testing

05/05/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

## CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : Bridge No. B-7-1

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 6.73    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 15      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 12      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

### NOTE :

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**

Check ed by

**Vikram B. Parmar**  
**Nodal Quality Manager**  
Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*



## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/01848****ULR No. : TC528223000007172F****09/05/2023****1. Name & Address of Customer**

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

**2. Project / Site**

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

**3. Customer's Reference**

PNS/Structwel/22, Dtd. 15/04/2023

**4. Location of performance of test**

At Laboratory

**5. Sample****i) Description**

Construction Water

**ii) Quantity**

01 No.

**iii) Date of receipt**

15/04/2023

**iv) Condition**

Acceptable

**6. Test method followed**

Mentioned Below

**7. Date of Testing**

05/05/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER****\* ID Mark. : Bridge No. B-7-2**

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.48</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>12</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>13</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**

Check ed by

**Vikram B. Parmar**  
**Nodal Quality Manager**  
Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 08)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)



## Geotechnical Investigation Report (Bridge No. 08)

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| 2.2 Subsurface Conditions                      | 4        |
| 2.3 Groundwater Levels                         | 5        |
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## Geotechnical Investigation Report (Bridge No. 08)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

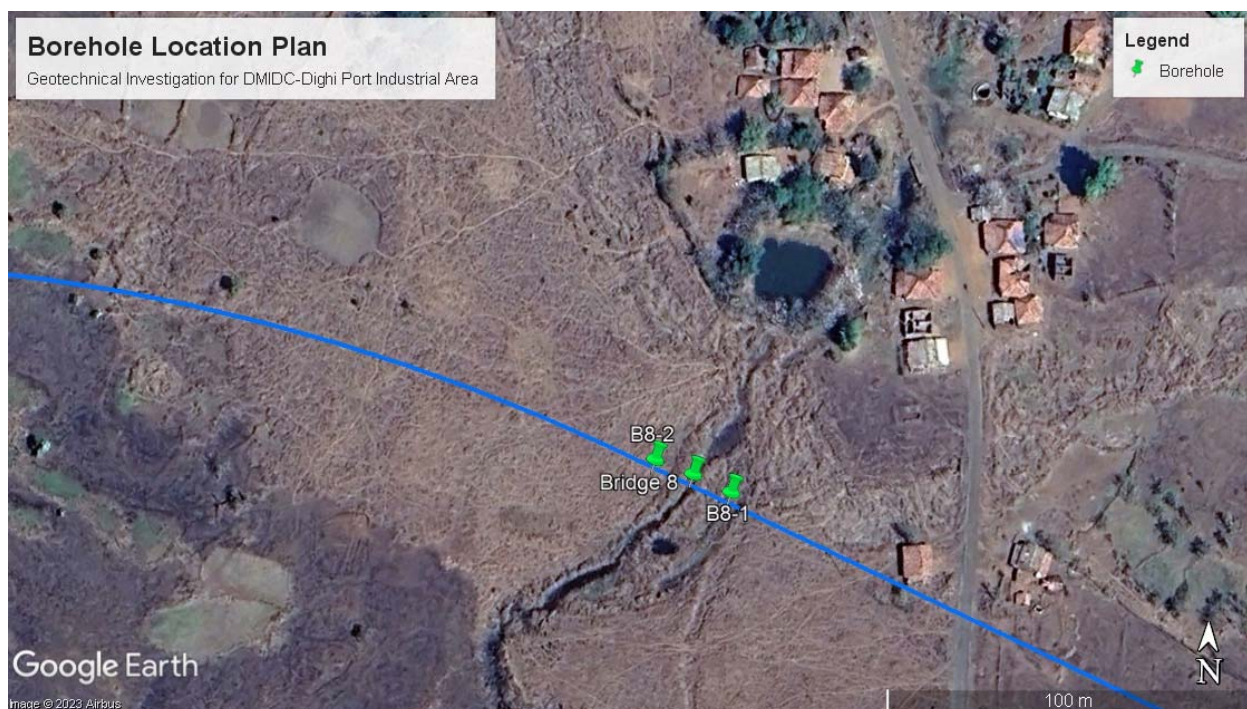
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B8-1, B8-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B8-1         | 2023987  | 319034  | 9.50m |
| B8-2         | 2033008  | 319004  | 9.45m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 3.00m to 3.50m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 3.00m to 3.50m below ground surface. Core Recoveries varied between 31% and 47%, while Rock Quality Designation (RQD) ranged between 0% and 16%. Compressive strength of rock core sample ranges from 990kg/cm<sup>2</sup> to 1270kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 4.25m to 4.50m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 4.25m to 4.50m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 86% and 100%, while Rock Quality Designation (RQD) ranged between 25% and 93%. Compressive strength of rock core sample ranges from 720kg/cm<sup>2</sup> to 850kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.45m to 9.50m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depth 4.0m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 3.00m to 3.50m below ground surface. In this layer compressive strength of rock core samples ranged between 990kg/cm<sup>2</sup> to 1270kg/cm<sup>2</sup>.

As per minimum compressive strength 720kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B8-1             | 3.50m | 4.50m     |
| B8-2             | 3.00m | 4.25m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -3.00m to -3.50m |
| Layer II, Moderately weathered rock |                  |
|                                     | -4.25m to -4.50m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 7200 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 7200 = 720 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.





## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |             |                              |   |                                 |                                |                                     |   |                         |          |                 |                          |                |        |                             |      |       |       |
|---|-------------|------------------------------|---|---------------------------------|--------------------------------|-------------------------------------|---|-------------------------|----------|-----------------|--------------------------|----------------|--------|-----------------------------|------|-------|-------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |             |                              |   |                                 |                                |                                     | Client :EGIS Consulting Engineers Pvt. Ltd. |                         |          |                 |                          |                |        |                             |      |       |       |
| Type of Boring  |             | Calyx with Bent. with casing |   | Calyx with Bent. without casing |                                | Job No. : BRIDGE 8                  |   |                         |          |                 |                          |                |        |                             |      |       |       |
| Dia of Hole (mm):   |             | 100.00                       |   | 75.00                           |                                | Bore Hole No.: B8-1                 |   |                         |          |                 |                          |                |        |                             |      |       |       |
| Depth (M):  |             | 0.00-3.00                    |   | 3.00-9.50                       |                                | Co-ordinates : N=2023987, E=319034  |   |                         |          |                 |                          |                |        |                             |      |       |       |
| Commenced on : 03 April 2023  |             |                              | Completed on : 05 April 2023            |                                 |                                | Ground Bed RL: 83.20M               |   |                         |          |                 |                          |                |        |                             |      |       |       |
| Water Struc :   |             |                              | Ground Water : 4.00M. Seasonal.         |                                 |                                | Location of Bore Hole : As per plan |   |                         |          |                 |                          |                |        |                             |      |       |       |
| From (M)  | To (M)      | Sample Depth (M)             | Description of Strata                   | Symbol                          | SPT Record                     |                                     |   |                         |          | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |      |       |       |
|   |             |                              |   |                                 | 0-150                          | 150-300                             | 300-450                                     | 450-600                 | N        |                 |                          |                |        |                             |      |       |       |
| 0.00  |             | 0.00 - 1.50                  | BROWNISH MURUM, PEBBLES, COBBLES        |                                 |                                |                                     |   |                         |          | DS-1            |                          |                |        |                             |      |       |       |
|   |             | 1.50 - 2.00                  |   |                                 |                                |                                     |   |                         |          | 1 TO 3          |                          |                |        |                             | 0.08 | 5.00  | 0.00  |
|   |             | 2.00 - 2.50                  |   |                                 |                                |                                     |   |                         |          | 4 TO 8          |                          |                |        |                             | 0.20 | 40.00 | 0.00  |
|   |             | 2.50 - 3.50                  |   |                                 |                                |                                     |   |                         |          | 9 TO 13         |                          |                |        |                             | 0.48 | 48.00 | 20.00 |
| 3.50  |             | 3.50 - 4.50                  | BROWNISH GREY MODERATELY WEATHERED ROCK |                                 |                                |                                     |   |                         | 14 TO 19 | 0.47            | 47.00                    | 0.00           |        |                             |      |       |       |
| 4.50  |             | 4.50 - 6.00                  | GREY BASALT                             |                                 |                                |                                     |   |                         |          | 20 TO 23        | 1.50                     | 100.00         | 93.00  | Inclined and vertical veins |      |       |       |
|   | 6.00 - 7.50 | 24 TO 30                     |   |                                 |                                |                                     |   |                         |          | 1.48            | 98.00                    | 84.00          |        |                             |      |       |       |
|   | 7.50 - 8.50 | 31 TO 42                     |   |                                 |                                |                                     |   |                         |          | 0.99            | 99.00                    | 25.00          |        |                             |      |       |       |
|   | 8.50 - 9.50 | 43 TO 51                     |   |                                 |                                |                                     |   |                         |          | 0.97            | 97.00                    | 60.00          |        |                             |      |       |       |
|   | 9.50        |                              |   |                                 | Bore Hole Terminated at : 9.50 |                                     |   |                         |          |                 |                          |                |        |                             |      |       |       |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |             |                              |   |                                 |                                |                                     |   |                         |          |                 |                          |                |        |                             |      |       |       |
| No. of disturbed Sample : 1   |             |                              |   | No. of U.D.S. : 0               |                                |                                     |   | No. of Vane Test : 0    |          |                 |                          |                |        |                             |      |       |       |
|   |             |                              |   | No. of S.P.T. : 0               |                                |                                     |   | No. of Water Sample : 0 |          |                 |                          |                |        |                             |      |       |       |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
|---|--------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                             |
| Type of Boring  |        | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 8                  |   |   |                          |                |        |                             |
| Dia of Hole (mm):   |        | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B8-2                 |   |   |                          |                |        |                             |
| Depth (M):  |        | 0.00-3.00                    |   |                                 | 3.00-9.45                       |         |         | Co-ordinates : N=2033008, E=319004  |   |   |                          |                |        |                             |
| Commenced on : 03 April 2023  |        |                              |   | Completed on : 05 April 2023    |                                 |         |         | Ground Bed RL: 82.97M               |   |   |                          |                |        |                             |
| Water Struc :   |        |                              |   | Ground Water : 4.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                             |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                   | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |
|   |        |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                             |
| 0.00  |        | 0.00 - 1.40                  | BROWNISH MURUM, PEBBLES, COBBLES        |                                 |                                 |         |         |                                     |   | 1 TO 3                                      | 0.30                     | 21.00          | 12.00  |                             |
|   |        | 1.40 - 2.00                  |   |                                 |                                 |         |         |                                     |   | 4 TO 7                                      | 0.20                     | 33.00          | 0.00   |                             |
|   |        | 2.00 - 3.00                  |   |                                 |                                 |         |         |                                     |   | 8 TO 11                                     | 0.30                     | 30.00          | 12.00  |                             |
| 3.00  |        | 3.00                         |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| 3.00  |        | 3.00 - 4.25                  | BROWNISH GREY MODERATELY WEATHERED ROCK |                                 |                                 |         |         |                                     |   | 12 TO 15                                    | 0.50                     | 31.00          | 16.00  |                             |
| 4.25  |        | 4.25                         |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| 4.25  |        | 4.25 - 5.75                  | GREY BASALT                             |                                 |                                 |         |         |                                     |   | 16 TO 22                                    | 1.50                     | 100.00         | 93.00  | Vertical and inclined veins |
|   |        | 5.75 - 7.25                  |   |                                 |                                 |         |         |                                     |   | 23 TO 28                                    | 1.30                     | 86.00          | 84.00  |                             |
|   |        | 7.25 - 8.75                  |   |                                 |                                 |         |         |                                     |   | 29 TO 35                                    | 1.30                     | 86.00          | 73.00  |                             |
|   |        | 8.75 - 9.45                  |   |                                 |                                 |         |         |                                     |   | 36 TO 38                                    | 0.67                     | 95.00          | 36.00  |                             |
| 9.45  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| Bore Hole Terminated at : 9.45  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| No. of disturbed Sample : 0   |        |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                             |
| No. of S.P.T. : 0   |        |                              |   |                                 | No. of Water Sample : 0         |         |         |                                     |   |   |                          |                |        |                             |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|                                    |                      |
|------------------------------------|----------------------|
| STRUCTWEL/Level/IV/PHY/TR/Soil/061 |                      |
| Rev No - 03                        | Dtd. 30/08/2022      |
| Discipline: Mechanical             | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02224****ULR No. : TC528223000007548F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | Bridge B8-1             |       |   |   | Bridge B8-2   |       |   |   |      |       |   |   |      |       |   |   |
|--|---|------------------------------------|-------------------------|-------|---|---|---------------|-------|---|---|------|-------|---|---|------|-------|---|---|
| Sample No. :   |   | --                                 | DS-1                    |       |   |   | DS-1          |       |   |   |      |       |   |   |      |       |   |   |
| Depth, m :   |   | --                                 | 0.00 to 0.50m           |       |   |   | 0.00 to 0.55m |       |   |   |      |       |   |   |      |       |   |   |
| Description :  |   | --                                 | Silty Sand with gravels |       |   |   | Sandy Gravels |       |   |   |      |       |   |   |      |       |   |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 27                      |       |   |   | 57            |       |   |   |      |       |   |   |      |       |   |   |
|  | Plastic Limit                           |                                    | NP                      |       |   |   | 30            |       |   |   |      |       |   |   |      |       |   |   |
|  | Plasticity Index                        |                                    |                         |       |   |   | 27            |       |   |   |      |       |   |   |      |       |   |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                     |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 7                       |       |   |   | 36.12         |       |   |   |      |       |   |   |      |       |   |   |
|  | Sand                                    |                                    | 61                      |       |   |   | 38            |       |   |   |      |       |   |   |      |       |   |   |
|  | Gravel                                  |                                    | 32                      |       |   |   | 14            |       |   |   |      |       |   |   |      |       |   |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Bulk Density,T/m <sup>3</sup>           |                                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Water Content, %                        | IS 2720 Part-13                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10                    | 10-20 | - | - | 5-10          | 10-20 | - | - | 5-10 | 10-20 | - | - | 5-10 | 10-20 | - | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                    | -                       | -     | - | - | -             | -     | - | - | -    | -     | - | - | -    | -     | - |   |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | -                       | -     | - | - | -             | -     | - | - | -    | -     | - | - | -    | -     | - |   |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Specific gravity   |   | IS 2720 Part-3                     | 2.62                    |       |   |   | 2.75          |       |   |   |      |       |   |   |      |       |   |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Heavy Compaction   | Optimum Moist-Cont., %                  | Heavy Compaction IS 2720 Part-8    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
|  | Unsoaked %                              |                                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| **Coefficient of Curvature (Cc)                            |   |                                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    |                         |       |   |   |               |       |   |   |      |       |   |   |      |       |   |   |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN022023

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**End of Report**

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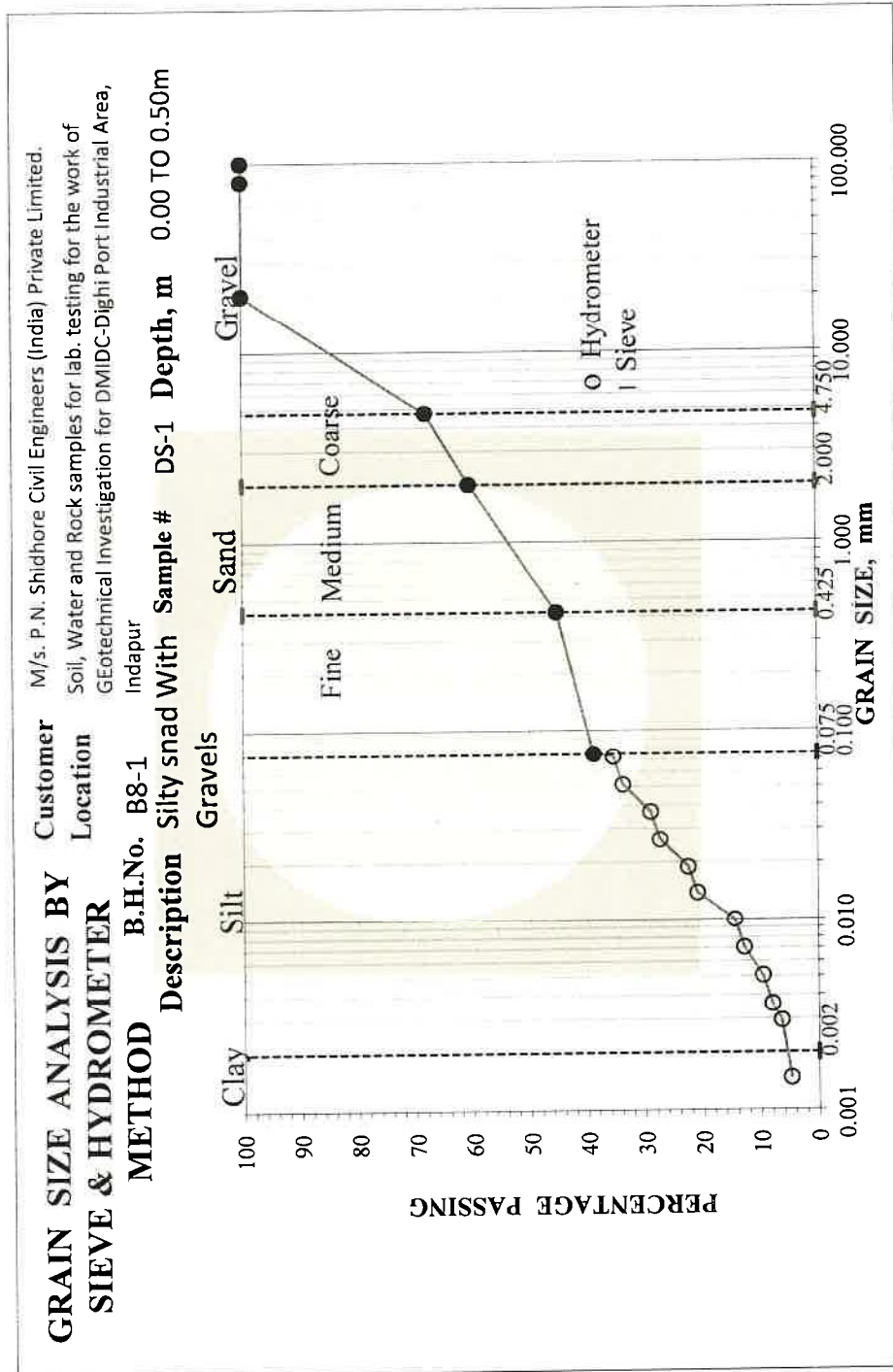
Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

*"Intelligence with Integrity"*

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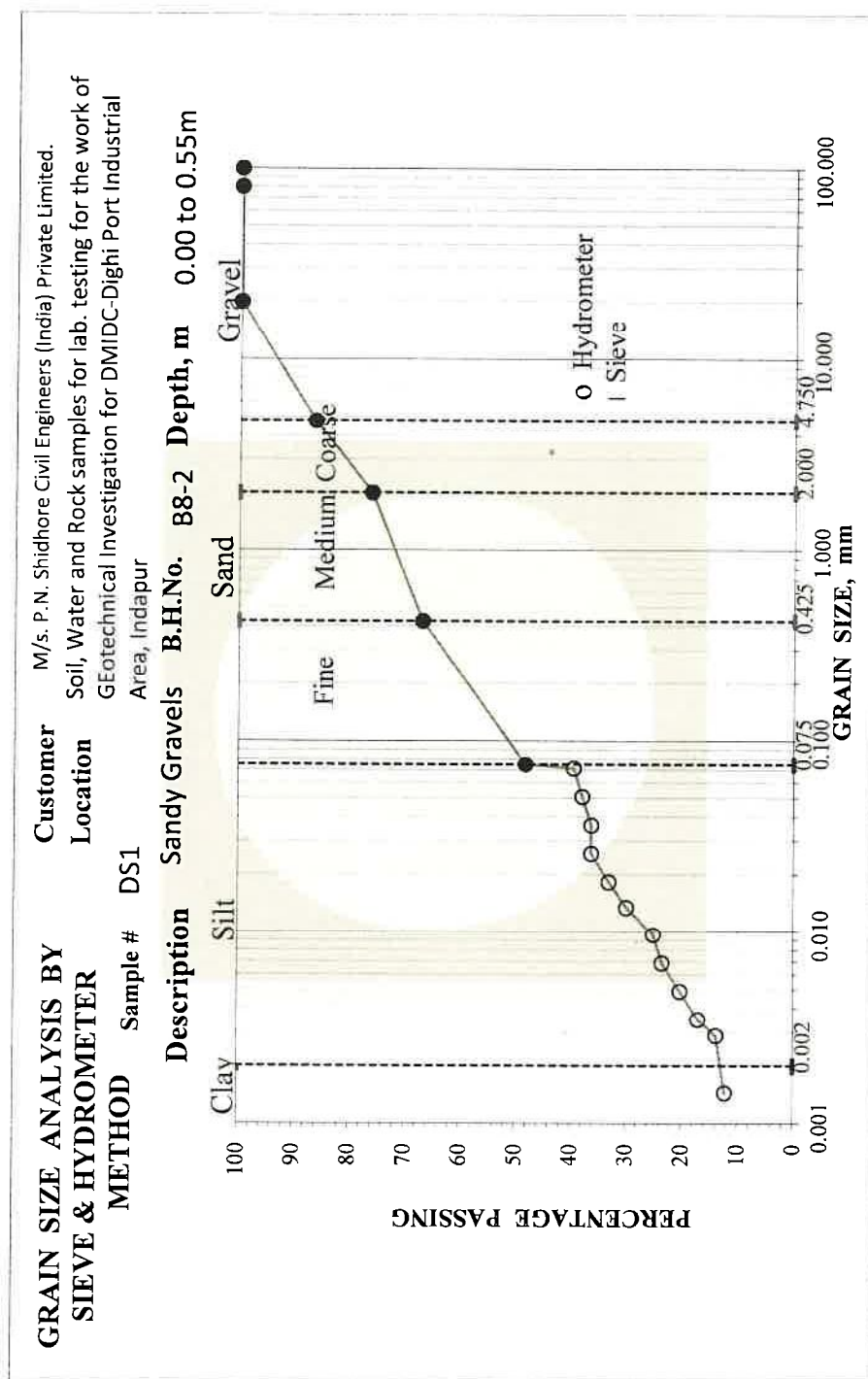
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*"Intelligence with Integrity"***ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282****TEST REPORT**

TC-5282

|                                       |                       |  |
|---------------------------------------|-----------------------|--|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |  |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |  |
| Discipline: Mechanical                | Group: Soil and Rock  |  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02232**  
**ULR No. : TC528223000007556F****17/05/2023**

## 1. Name &amp; Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22, Dtd. 15/04/2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

i) Description

**Rock**

ii) Quantity

04 Nos.

iii) Date of receipt

15/04/2023

iii) Condition

Acceptable

## 6. Test method followed, if any

As Mentioned Below.

## 7. Date of Testing From

18/04/2023 to 25/04/2023

**TEST REPORT**

| SR. No.              | ID Mark                          | Depth | Dia.  | Area            | Length | Dry Density                | Load   | Compressive strength      | Compressive strength corrected | SP Gravity                | Porosity                  | Water Absorption | Hardness                 |
|----------------------|----------------------------------|-------|-------|-----------------|--------|----------------------------|--------|---------------------------|--------------------------------|---------------------------|---------------------------|------------------|--------------------------|
|                      |                                  | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>          | N      | N / mm <sup>2</sup>       | for L/D- N / mm <sup>2</sup>   |                           | %                         | %                | by Moh's scale           |
| Test Method Followed |                                  |       |       |                 |        | (IS:13030): 1991 (RA 2021) |        | (IS:9143): 1979 (RA 2021) |                                | (IS 1122): 1974 (RA 2017) | (IS:13030):1991 (RA 2021) |                  | IS 13630 (Part 13): 2019 |
| 1                    | BH. No. B8-1<br>( Piece No. 11 ) | 2.60  | 55.10 | 2383.27         | 112.06 | --                         | 301500 | 127                       | 127                            | --                        | 0.013                     | 0.45             | --                       |
| 2                    | BH. No. B8-1<br>( Piece No. 21 ) | 5.30  | 54.82 | 2359.11         | 110.74 | --                         | 201400 | 85                        | 86                             | --                        | 0.010                     | 0.33             | --                       |
| 3                    | BH. No. B8-2<br>( Piece No. 14 ) | 4.20  | 54.18 | 2304.35         | 109.36 | --                         | 227400 | 99                        | 99                             | --                        | 0.015                     | 0.51             | --                       |
| 4                    | BH. No. B8-2<br>( Piece No. 18 ) | 4.75  | 54.52 | 2333.36         | 112.10 | --                         | 168000 | 72                        | 72                             | --                        | 0.016                     | 0.54             | --                       |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- \* --Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.

Checked By

Vikram B. Parmar  
Nodal Quality Manager  
Authorized Signatory

SST/N/LAB/Tech Report/2022-23/Test Report/Nabl/Phy/Rock/SAN0022023

\*\*\*\*\*End of Report\*\*\*\*\*

## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/TV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

### TEST REPORT NO. & DATE

R&D/LAB/SAN/2023-24/SAN0016023/00817  
ULR No. : TC528223000006141F  
17/04/2023

1. Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
2. Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
3. Customer's Reference : PNS/Structwel/22 Dtd. 25.03.2023
4. Location of performance of test : At Laboratory
5. Sample :
  - i) Description : Construction Water
  - ii) Quantity : 01 No.
  - iii) Date of receipt : 08/04/2023
  - iv) Condition : Acceptable
6. Test method followed : Mentioned Below
7. Date of Testing : 14/04/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : BH.No. Bridge No. 8-1

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.23    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 12      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 12      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

#### NOTE :

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

Swati Sonawane  
Manager - Chemical  
Checked by

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0016023

\*\*\*\*\* End of Report \*\*\*\*\*



# GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA

## Geotechnical Investigation Report (Bridge No. 10)

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

Prabhakar Apt, B Wing,  
3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)



## Geotechnical Investigation Report (Bridge No. 10)

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## Geotechnical Investigation Report (Bridge No. 10)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

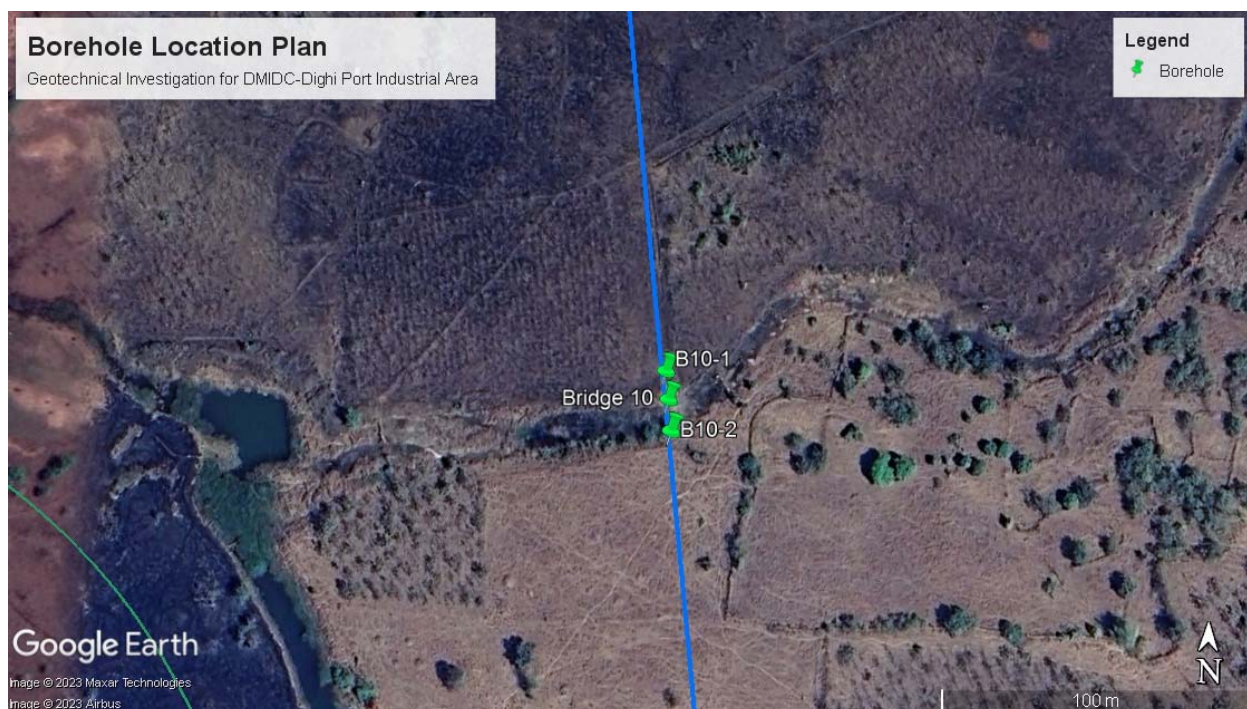
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B10-1, B10-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B10-1        | 2032568  | 318532  | 8.60m |
| B10-2        | 2032543  | 318530  | 9.70m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil



Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 3.00m to 3.25m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 3.00m to 3.25m below ground surface. Core Recoveries varied between 60% and 65%, while Rock Quality Designation (RQD) ranged between 54% and 58%. Compressive strength of rock core sample ranges from 640kg/cm<sup>2</sup> to 830kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.50m to 4.25m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.50m to 4.25m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 85% and 91%, while Rock Quality Designation (RQD) ranged between 28% and 82%. Compressive strength of rock core sample ranges from 610kg/cm<sup>2</sup> to 880kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.45m to 9.50m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 2.10m to 3.50m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.



### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 3.00m to 3.25m below ground surface. In this layer compressive strength of rock core samples ranged between 640kg/cm<sup>2</sup> to 830kg/cm<sup>2</sup>.

As per minimum compressive strength 610kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.25m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B10-1            | 3.00m | 3.50m     |
| B10-2            | 3.25m | 4.25m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -3.00m to -3.25m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.50m to -4.25m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 6100 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 6100 = 610 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

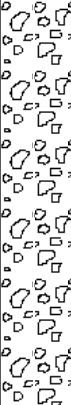


| BORE LOG  |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
|---|--------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                  |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |        | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 10                 |   |   |                          |                |        |         |
| Dia of Hole (mm):   |        | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B10-1                |   |   |                          |                |        |         |
| Depth (M):  |        | 0.00-1.00                    |                                  |                              | 1.00-8.60                       |         |         | Co-ordinates : N=2032568, E=318532  |   |   |                          |                |        |         |
| Commenced on : 07 April 2023  |        |                              |                                  | Completed on : 09 April 2023 |                                 |         |         | Ground Bed RL: 74.55M               |   |   |                          |                |        |         |
| Water Struc :   |        |                              |                                  | Ground Water : 2.10 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |         |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |        |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |         |
| 0.00  |        | 0.00 - 1.50                  | BROWNISH MURUM, PEBBLES, COBBLES |                              |                                 |         |         |                                     |   | 1 TO 10                                     | 0.93                     | 62.00          | 0.00   |         |
|   |        | 1.50 - 3.00                  |                                  |                              |                                 |         |         |                                     |   | 11 TO 19                                    | 1.07                     | 71.00          | 17.00  |         |
|   |        | 3.00                         |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
| 3.00  | 3.50   | 3.00 - 3.50                  | GRAY MODERETALY WEATHERED BASALT |                              |                                 |         |         |                                     |   | 20 TO 21                                    | 0.30                     | 60.00          | 58.00  |         |
| 3.50  |        | 3.50 - 5.00                  | GRAY JOINTED AMYGDLOIDAL BASALT  |                              |                                 |         |         |                                     |   | 22 TO 26                                    | 1.33                     | 89.00          | 82.00  |         |
|   |        | 5.00 - 6.50                  |                                  |                              |                                 |         |         |                                     |   | 27 TO 35                                    | 1.36                     | 91.00          | 29.00  |         |
|   |        | 6.50 - 8.00                  |                                  |                              |                                 |         |         |                                     |   | 36 TO 41                                    | 1.27                     | 85.00          | 73.00  |         |
|   |        | 8.00 - 8.60                  |                                  |                              |                                 |         |         |                                     |   | 42 TO 45                                    | 0.51                     | 85.00          | 28.00  |         |
|   | 8.60   |                              |                                  |                              | Bore Hole Terminated at : 8.60  |         |         |                                     |   |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
| No. of disturbed Sample : 0   |        |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |
| No. of S.P.T. : 0   |        |                              |                                  |                              | No. of Water Sample : 0         |         |         |                                     |   |   |                          |                |        |         |



# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |             |                              |                                  |   |                                 |         |         |                                     |   |   |                          |                |        |                             |      |
|---|-------------|------------------------------|----------------------------------|---|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-----------------------------|------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |             |                              |                                  |   |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                             |      |
| Type of Boring  |             | Calyx with Bent. with casing |                                  |   | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 10                 |   |   |                          |                |        |                             |      |
| Dia of Hole (mm):   |             | 100.00                       |                                  |   | 75.00                           |         |         | Bore Hole No.: B10-2                |   |   |                          |                |        |                             |      |
| Depth (M):  |             | 0.00-1.50                    |                                  |   | 1.50-9.70                       |         |         | Co-ordinates : N=2032543, E=318530  |   |   |                          |                |        |                             |      |
| Commenced on : 07 April 2023  |             |                              |                                  | Completed on : 09 April 2023  |                                 |         |         | Ground Bed RL: 74.71M               |   |   |                          |                |        |                             |      |
| Water Struc :   |             |                              |                                  | Ground Water : 3.50 Meter   |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                             |      |
| From (M)  | To (M)      | Sample Depth (M)             | Description of Strata            | Symbol  | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |      |
|   |             |                              |                                  |   | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                             |      |
| 0.00  |             | 0.00 - 0.25                  | BROWNISH MURUM, COBBLES, PEBBLES |   |                                 |         |         |                                     |   | DS-1  | 0.80                     | 53.00          | 0.00   |                             |      |
|   |             | 0.25 - 1.75                  |                                  |   |                                 |         |         |                                     |   | 1 TO 10                                     |                          |                |        |                             |      |
|   |             | 1.75 - 3.25                  |                                  |   |                                 |         |         |                                     |   | 11 TO 24                                    |                          |                |        |                             | 1.05 |
| 3.25  | 3.25        | 3.25 - 4.25                  | GRAY MODERETALY WEATHERED ROCK   |  |                                 |         |         |                                     |   | 25 TO 29                                    | 0.65                     | 65.00          | 54.00  |                             |      |
| 4.25  | 4.25        | 4.25 - 5.70                  | GRAY JOINTED BASALT              |  |                                 |         |         |                                     |   | 30 TO 35                                    | 1.28                     | 88.00          | 56.00  | Inclined and verticle veins |      |
|   | 5.70 - 7.20 |                              | 36 TO 44                         | 1.29  |                                 |         |         |                                     |   | 86.00                                       | 43.00                    |                |        |                             |      |
|   | 7.20 - 8.70 |                              | 45 TO 52                         | 1.33  |                                 |         |         |                                     |   | 89.00                                       | 52.00                    |                |        |                             |      |
|   | 8.70 - 9.70 |                              | 53 TO 58                         | 0.91  |                                 |         |         |                                     |   | 91.00                                       | 66.00                    |                |        |                             |      |
|   | 9.70        |                              |                                  |   | Bore Hole Terminated at : 9.70  |         |         |                                     |   |   |                          |                |        |                             |      |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |             |                              |                                  |   |                                 |         |         |                                     |   |   |                          |                |        |                             |      |
| No. of disturbed Sample : 1   |             |                              |                                  |   | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                             |      |
|   |             |                              |                                  |   | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                             |      |



TC-5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev. No. - 03                       | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02221****ULR No. :TC528223000007545F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                       | IS CODE FOLLOWED                   | Bridge B10-1         | Bridge B10-2         |              |              |
|---|------------------------------------|----------------------|----------------------|--------------|--------------|
| <b>Sample No. :</b>   | --                                 | <b>DS-1</b>          | <b>DS-1</b>          | --           | --           |
| <b>Depth, m :</b>   | --                                 | <b>0.00 to 0.35m</b> | <b>0.00 to 0.25m</b> | --           | --           |
| <b>Description :</b>  | --                                 | <b>Silty Sand</b>    | <b>Silty Sand</b>    | --           | --           |
| <b>Atterberg Limits</b>   |                                    |                      |                      |              |              |
| Liquid Limit  |                                    | 36                   | 54                   | --           | --           |
| Plastic Limit   | IS 2720-Part 5                     | 18                   | 32                   | --           | --           |
| Plasticity Index  |                                    | 18                   | 22                   | --           | --           |
| Shrinkage Lim.  | IS 2720-Part 6                     | --                   | --                   | --           | --           |
| <b>% Grain size by Sieve &amp; Hydrometer</b>                     |                                    |                      |                      |              |              |
| Clay + Silt   |                                    | 17                   | 31+4                 | --           | --           |
| Sand  | IS 2720-Part 4                     | 63                   | 54                   | --           | --           |
| Gravel  |                                    | 20                   | 10                   | --           | --           |
| <b>Shear Strength : Triaxial / Unconfined compression, Direct</b> |                                    |                      |                      |              |              |
| Test Code   | Triaxial Test (TUU)                | --                   | --                   | --           | --           |
| Cohesion, kg/cm <sup>2</sup>                                      | IS 2720 Part-11                    | --                   | --                   | --           | --           |
| Angle   | Direct Shear Test (DUU, DCU & DCD) | --                   | --                   | --           | --           |
| Bulk  |                                    | --                   | --                   | --           | --           |
| Density, T/m <sup>3</sup>   |                                    | --                   | --                   | --           | --           |
| Water Content, %  | IS 2720 Part-13                    | --                   | --                   | --           | --           |
| <b>Unconfined compression test</b>                                |                                    |                      |                      |              |              |
| qu (kg/cm <sup>2</sup> )  |                                    | --                   | --                   | --           | --           |
| Shear Strength (kg/cm <sup>2</sup> )                              | IS 2720 Part-10                    | --                   | --                   | --           | --           |
| <b>Consolidation Test</b>   |                                    |                      |                      |              |              |
| Pressure Range, T/m <sup>2</sup>                                  | IS 2720 Part-15                    | 5-10   10-20         | 5-10   10-20         | 5-10   10-20 | 5-10   10-20 |
| Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>                            |                                    | --                   | --                   | --           | --           |
| Cv, m <sup>2</sup> /yr x10 <sup>-2</sup>                          |                                    | --                   | --                   | --           | --           |
| <b>Natural Moisture Content %</b>                                 | IS 2720 Part-1                     | --                   | --                   | --           | --           |
| <b>Specific gravity</b>   | IS 2720 Part-3                     | 2.76                 | 2.74                 | --           | --           |
| <b>Compaction</b>   |                                    |                      |                      |              |              |
| Max dry density, g/cm <sup>3</sup>                                | Light Compaction IS 2720 Part-7    | --                   | --                   | --           | --           |
| <b>Heavy Compaction</b>   |                                    |                      |                      |              |              |
| Optimum Moist-Cont., %  | Heavy Compaction IS 2720 Part-8    | --                   | --                   | --           | --           |
| <b>California Bearing Ratio</b>                                   |                                    |                      |                      |              |              |
| Soaked %  | IS 2720 Part-16                    | --                   | --                   | --           | --           |
| Unsoaked %  |                                    | --                   | --                   | --           | --           |
| <b>**Coefficient of Uniformity (Cu)</b>                           |                                    | --                   | --                   | --           | --           |
| <b>**Coefficient of Curvature (Cc)</b>                            | IS 1498                            | --                   | --                   | --           | --           |
| <b>Free Swell Index (%)</b>                                       | IS 2720 Part-40                    | --                   | --                   | --           | --           |
| <b>Swelling Pressure (kg/cm<sup>2</sup>)</b>                      | IS 2720 Part-41                    | --                   | --                   | --           | --           |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN032323

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**End of Report**

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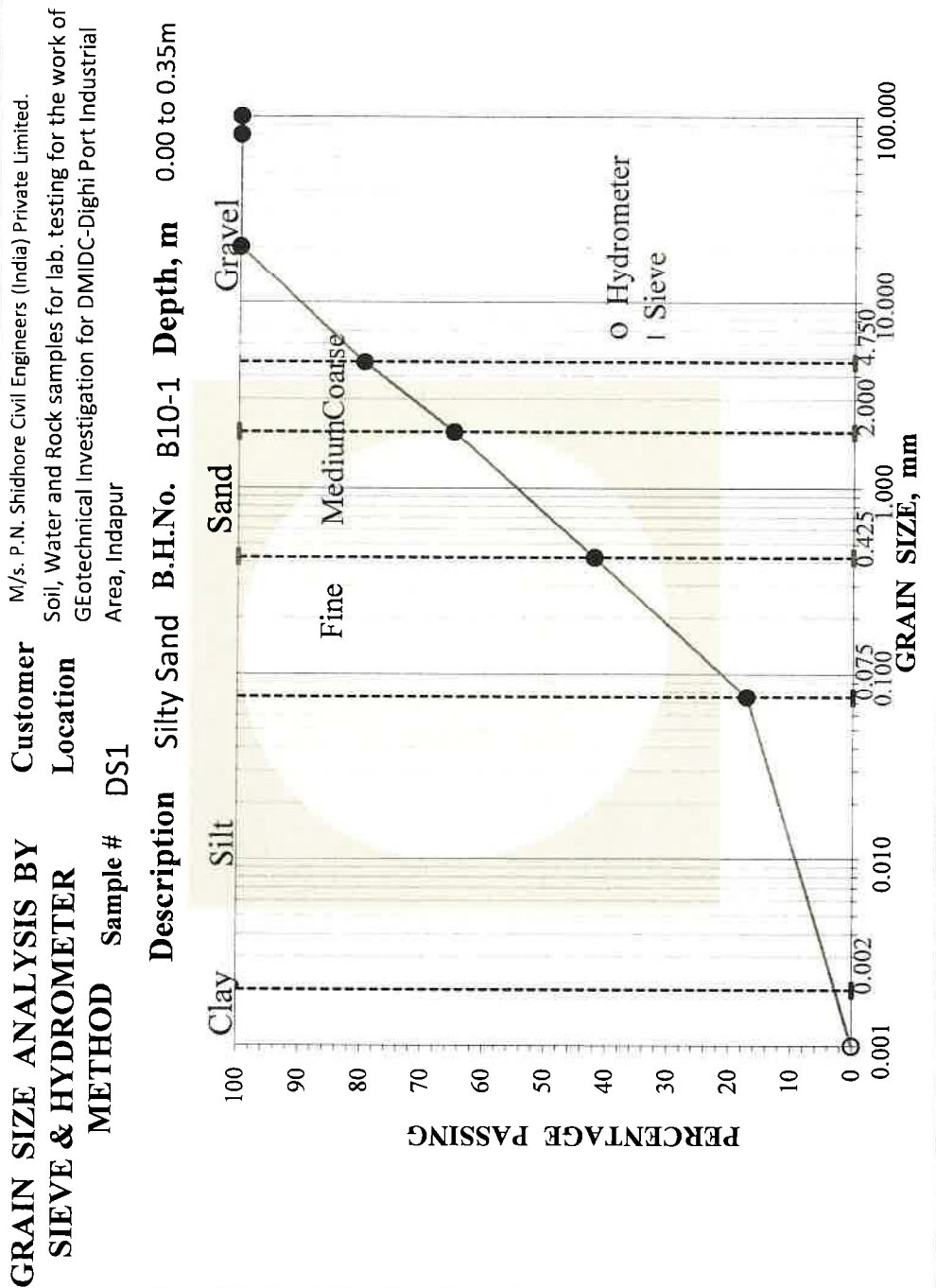
Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

*"Intelligence with Integrity"*

ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282



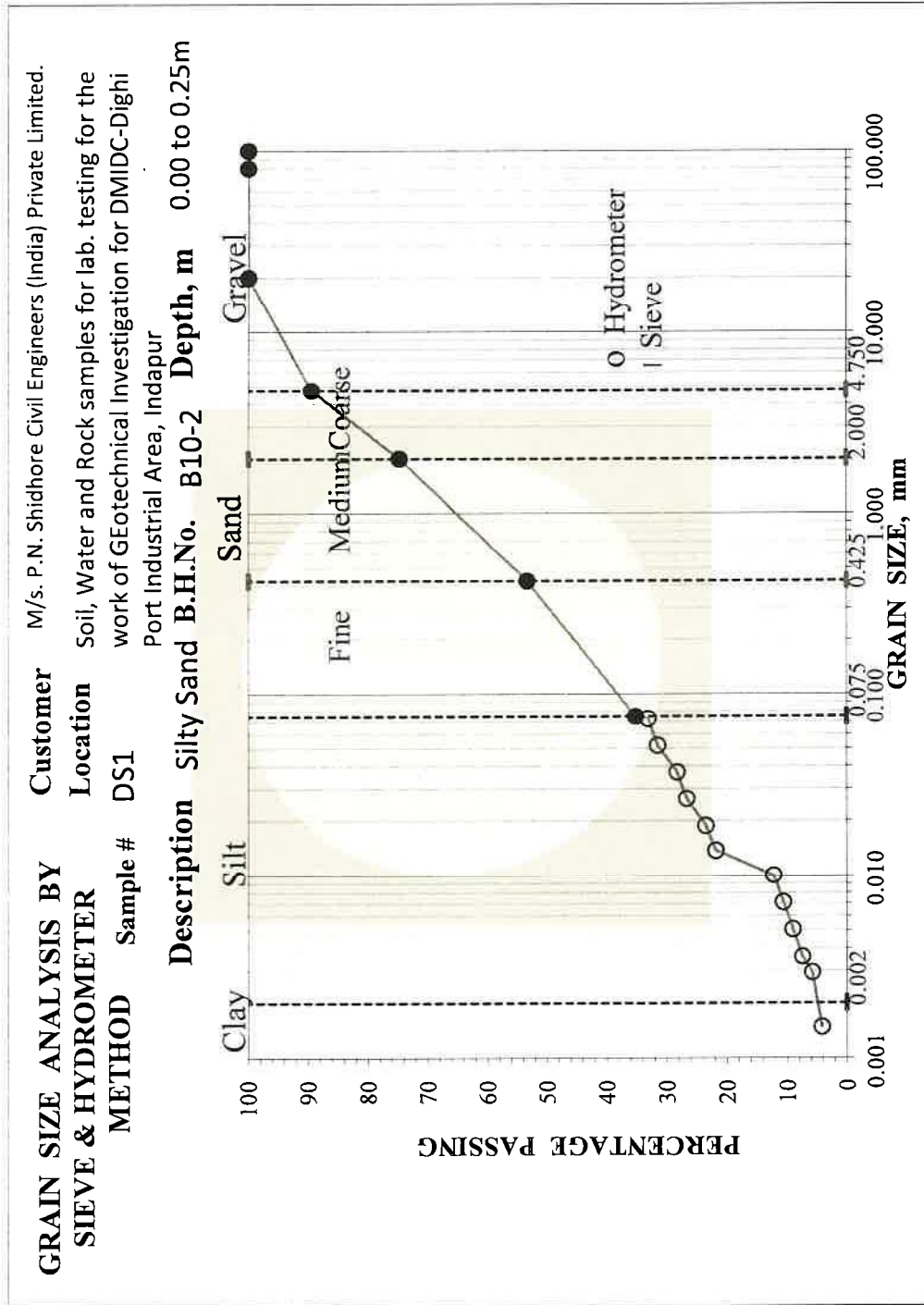
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**TEST REPORT**

TC-5282

|                                       |                       |  |
|---------------------------------------|-----------------------|--|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |  |
| Rev. No 05                            | Rev. Date: 30/08/2022 |  |
| Discipline: Mechanical                | Group: Soil and Rock  |  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2023-24/SAN0022023/02230

ULR No. : TC528223000007554F

17/05/2023

## 1. Name &amp; Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22, Dtd. 15/04/2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

## i) Description

Rock

## ii) Quantity

04 Nos.

## iii) Date of receipt

15/04/2023

## iii) Condition

Acceptable

## 6. Test method followed, if any

As Mentioned Below.

## 7. Date of Testing From

18/04/2023 to 25/04/2023

**TEST REPORT**

| SR. No.              | ID. Mark                          | Depth<br>mtr. | Dia.<br>mm. | Area<br>mm <sup>2</sup> | Length<br>mm. | Dry Density<br>kg/m <sup>3</sup> | Load<br>N | Compressive strength<br>N / mm <sup>2</sup> | Compressive strength corrected<br>for L/D- N/mm <sup>2</sup> | SP Gravity                      | Porosity<br>%                | Water Absorption<br>% | Hardness by Moh's scale        |
|----------------------|-----------------------------------|---------------|-------------|-------------------------|---------------|----------------------------------|-----------|---|--|---------------------------------|------------------------------|-----------------------|--------------------------------|
| Test Method Followed |                                   |               |             |                         |               | (IS:13030):<br>1991<br>(RA 2021) |           | (IS:9143):<br>1979<br>(RA 2021)             |  | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) |                       | IS 13630<br>(Part 13):<br>2019 |
| 1                    | BH. No. B10-1<br>( Piece No. 20 ) | 3.10          | 54.44       | 2326.52                 | 12.08         | --                               | 193400    | 83  | 67   | --                              | 0.189                        | 0.68                  | --                             |
| 2                    | BH. No. B10-1<br>( Piece No. 22 ) | 3.75          | 54.76       | 2353.95                 | 112.16        | --                               | 144400    | 61  | 62   | --                              | 0.016                        | 0.57                  | --                             |
| 3                    | BH. No. B10-2<br>( Piece No. 27 ) | 3.25          | 54.42       | 2324.81                 | 110.86        | --                               | 147900    | 64  | 64   | --                              | 0.012                        | 0.40                  | --                             |
| 4                    | BH. No. B10-2<br>( Piece No. 32 ) | 4.50          | 54.38       | 2321.39                 | 109.92        | --                               | 203200    | 88  | 88   | --                              | 0.012                        | 0.40                  | --                             |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength<br>(N/mm <sup>2</sup> ) |
|---------|----------------------|--|
| 1       | Exceptionally Strong | > 250                                  |
| 2       | Very Strong          | 100-250                                |
| 3       | Strong               | 50-100                                 |
| 4       | Average              | 25-50                                  |
| 5       | Weak                 | 10-25                                  |
| 6       | Very Weak            | 2-10                                   |
| 7       | Extremely Weak       | < 2                                    |

**NOTE :**

- \* --Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.

Checked By

SST/N/LAB/Tech Report/2022-23/Test Report/Nabl/Phy/Rock/SAN0022023

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

\*\*\*\*\*End of Report\*\*\*\*\*

## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/01849****ULR No. : TC528223000007173F****09/05/2023****1. Name & Address of Customer**

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

**2. Project / Site**

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

**3. Customer's Reference**

PNS/Structwel/22, Dtd. 15/04/2023

**4. Location of performance of test**

At Laboratory

**5. Sample****i) Description**

Construction Water

**ii) Quantity**

01 No.

**iii) Date of receipt**

15/04/2023

**iv) Condition**

Acceptable

**6. Test method followed**

Mentioned Below

**7. Date of Testing**

05/05/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER****\* ID Mark. : Bridge No. B-10-1**

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.72</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>24</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>15</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**

Check ed by

**Vikram B. Parmar**  
**Nodal Quality Manager**  
Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*

## TEST REPORT

|   |                 |             |
|---|-----------------|-------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 | PAGE 1 OF 1 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |             |
| Discipline: Chemical                                | Group: Water    |             |

**TEST REPORT NO. & DATE** : R&D/LAB/SAN/2023-24/SAN0022023/01850

**ULR No. : TC528223000007174F**

**09/05/2023**

1. Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
2. Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
3. Customer's Reference : PNS/Structwel/22, Dtd. 15/04/2023
4. Location of performance of test : At Laboratory
5. Sample :
  - i) Description : **Construction Water**
  - ii) Quantity : 01 No.
  - iii) Date of receipt : 15/04/2023
  - iv) Condition : Acceptable
6. Test method followed : Mentioned Below
7. Date of Testing : 05/05/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

**\* ID Mark. : Bridge No. B-10-2**

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.00</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>13</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>12</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
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- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**  
Check ed by

**Vikram B. Parmar**  
**Nodal Quality Manager**  
Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*





# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 11)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

Prabhakar Apt, B Wing,  
3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)



## **Geotechnical Investigation Report (Bridge No. 11)**

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## Geotechnical Investigation Report (Bridge No. 11)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

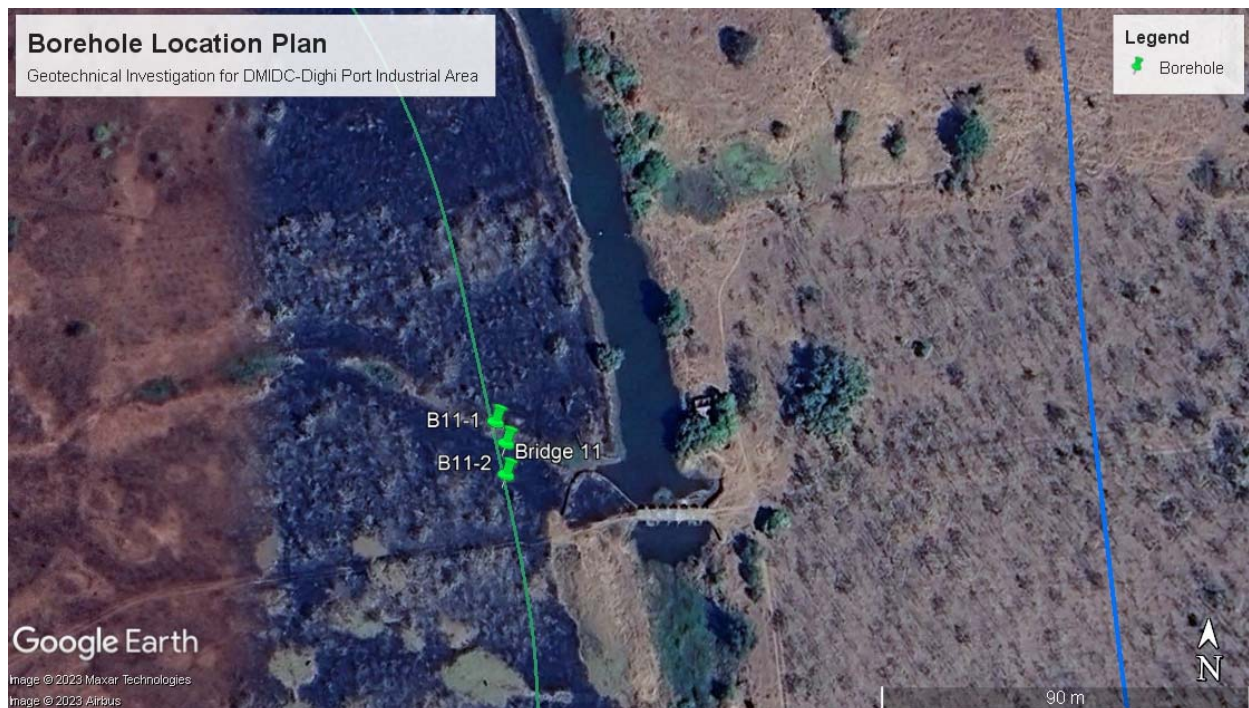
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B11-1, B11-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B11-1        | 2032357  | 318392  | 9.50m |
| B11-2        | 2032337  | 318390  | 8.80m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 3.00m to 3.25m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depth of 3.00m below ground surface. Core Recoveries varied between 70% and 73%, while Rock Quality Designation (RQD) ranged between 50% and 58%. Compressive strength of rock core sample ranges from 380kg/cm<sup>2</sup> to 1230kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.80m to 4.50m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.80m to 4.50m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 86% and 100%, while Rock Quality Designation (RQD) ranged between 42% and 95%. Compressive strength of rock core sample ranges from 740kg/cm<sup>2</sup> to 920kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 8.80m to 9.50m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 1.80m to 2.00m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depth of 3.00m below ground surface. In this layer compressive strength of rock core samples ranged between 380kg/cm<sup>2</sup> to 1230kg/cm<sup>2</sup>.

As per minimum compressive strength 380kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B11-1            | 3.00m | 4.50m     |
| B11-2            | 3.00m | 3.80m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**



## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -3.00m           |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.80m to -4.50m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 3800 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 3800 = 380 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |       |
|---|--------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|-------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                  |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |       |
| Type of Boring  |        | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 11                 |   |   |                          |                |        |         |       |
| Dia of Hole (mm):   |        | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B11-1                |   |   |                          |                |        |         |       |
| Depth (M):  |        | 0.00-1.00                    |                                  |                              | 1.00-9.50                       |         |         | Co-ordinates : N=2032357, E=318392  |   |   |                          |                |        |         |       |
| Commenced on : 13 April 2023  |        |                              |                                  | Completed on : 14 April 2023 |                                 |         |         | Ground Bed RL: 73.61M               |   |   |                          |                |        |         |       |
| Water Struc :   |        |                              |                                  | Ground Water : 2.00 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |         |       |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |       |
|   |        |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |         |       |
| 0.00  | 3.00   | 0.00 - 1.00                  | BROWNISH MURUM, COBBLES, PEBBLES |                              |                                 |         |         |                                     |   | DS-1  |                          |                |        |         |       |
|   |        | 1.00 - 1.50                  |                                  |                              |                                 |         |         |                                     |   |   | 1 TO 5                   | 0.30           | 60.00  |         | 0.00  |
|   |        | 1.50 - 3.00                  |                                  |                              |                                 |         |         |                                     |   |   | 6 TO 16                  | 0.95           | 63.00  |         | 20.00 |
| 3.00  | 4.50   | 3.00 - 4.50                  | GRAY MODERETALY WEATHERED BASALT |                              |                                 |         |         |                                     |   | 17 TO 24                                    | 1.06                     | 70.00          | 58.00  |         |       |
| 4.50  |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |       |
| 4.50  | 9.50   | 4.50 - 6.00                  | GRAY BASALT                      |                              |                                 |         |         |                                     |   | 25 TO 29                                    | 1.46                     | 97.00          | 95.00  |         |       |
|   |        | 6.00 - 7.50                  |                                  |                              |                                 |         |         |                                     |   |   | 30 TO 35                 | 1.36           | 90.00  |         | 84.00 |
|   |        | 7.50 - 9.00                  |                                  |                              |                                 |         |         |                                     |   |   | 36 TO 41                 | 1.40           | 93.00  |         | 83.00 |
|   |        | 9.00 - 9.50                  |                                  |                              |                                 |         |         |                                     |   |   | 42                       | 0.50           | 100.00 |         | 90.00 |
|   |        |                              |                                  |                              | Bore Hole Terminated at : 9.50  |         |         |                                     |   |   |                          |                |        |         |       |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |       |
| No. of disturbed Sample : 1   |        |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |       |
|   |        |                              |                                  |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |         |       |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |          |                              |                                  |                              |                                 |         |         |                                     |          |   |                          |                |        |         |
|---|----------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|----------|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |          |                              |                                  |                              |                                 |         |         |                                     |          | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |          | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 11                 |          |   |                          |                |        |         |
| Dia of Hole (mm):   |          | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B11-2                |          |   |                          |                |        |         |
| Depth (M):  |          | 0.00-1.50                    |                                  |                              | 1.50-8.80                       |         |         | Co-ordinates : N=2032337, E=318390  |          |   |                          |                |        |         |
| Commenced on : 10 April 2023  |          |                              |                                  | Completed on : 12 April 2023 |                                 |         |         | Ground Bed RL: 73.40M               |          |   |                          |                |        |         |
| Water Struc :   |          |                              |                                  | Ground Water : 1.80 Meter    |                                 |         |         | Location of Bore Hole : As per plan |          |   |                          |                |        |         |
| From (M)  | To (M)   | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |          | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |          |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N        |   |                          |                |        |         |
| 0.00  |          | 0.00 - 1.00                  | BROWNISH MURUM, COBBLES, PEBBLES |                              |                                 |         |         |                                     |          | 1 TO 2                                      | 0.10                     | 10.00          | 0.00   |         |
|   |          | 3 TO 13                      |                                  |                              |                                 |         |         |                                     |          | 0.43  | 43.00                    | 0.00           |        |         |
|   |          | 14 TO 20                     |                                  |                              |                                 |         |         |                                     |          | 0.68  | 68.00                    | 10.00          |        |         |
| 3.00  | 3.00     | 3.00 - 3.80                  | GRAY MODERETALY WEATHERED BASALT |                              |                                 |         |         |                                     | 21 TO 25 | 0.59  | 73.00                    | 50.00          |        |         |
| 3.80  | 3.80     | 3.80 - 5.30                  | GRAY BASALT                      |                              |                                 |         |         |                                     |          | 26 TO 32                                    | 1.45                     | 97.00          | 86.00  |         |
| 5.30 - 6.80   | 33 TO 45 | 1.38                         |                                  |                              |                                 |         |         |                                     |          | 92.00                                       | 43.00                    |                |        |         |
| 6.80 - 7.80   | 46 TO 52 | 0.90                         |                                  |                              |                                 |         |         |                                     |          | 90.00                                       | 42.00                    |                |        |         |
| 8.80  | 8.80     | 7.80 - 8.80                  |                                  |                              |                                 |         |         |                                     | 53 TO 57 | 0.86  | 86.00                    | 63.00          |        |         |
|   |          |                              |                                  |                              | Bore Hole Terminated at : 8.80  |         |         |                                     |          |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |          |                              |                                  |                              |                                 |         |         |                                     |          |   |                          |                |        |         |
| No. of disturbed Sample : 0   |          |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |          | No. of Vane Test : 0                        |                          |                |        |         |
|   |          |                              |                                  |                              | No. of S.P.T. : 0               |         |         |                                     |          | No. of Water Sample : 0                     |                          |                |        |         |



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TC-5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev No - 03                         | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02223****ULR No. :TC528223000007547F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                | IS CODE FOLLOWED                   | Bridge B11-1   | Bridge B11-2   |                |                |
|--|------------------------------------|----------------|----------------|----------------|----------------|
| Sample No. :   | --                                 | DS-1           | DS-1           | --             | --             |
| Depth, m :   | --                                 | 0.00 to 0.60m  | 0.00 to 0.55m  | --             | --             |
| Description :  | --                                 | Silty Sand     | Sandy Gravels  | --             | --             |
| Atterberg Limits   |                                    |                |                |                |                |
| Liquid Limit   |                                    | 46             | 56             | --             | --             |
| Plastic Limit  | IS 2720-Part 5                     | 37             | 38             | --             | --             |
| Plasticity Index   |                                    | 9              | 18             | --             | --             |
| Shrinkage Lim.   | IS 2720-Part 6                     | --             | --             | --             | --             |
| % Grain size by Sieve & Hydrometer                         |                                    |                |                |                |                |
| Clay + Silt  |                                    | 29+4           | 35+3           | --             | --             |
| Sand   | IS 2720-Part 4                     | 46             | 22             | --             | --             |
| Gravel   |                                    | 21             | 40             | --             | --             |
| Shear Strength : Triaxial / Unconfined compression, Direct |                                    |                |                |                |                |
| Test Code  | Triaxial Test (TUU)                | --             | --             | --             | --             |
| Cohesion, kg/cm <sup>2</sup>                               | IS 2720 Part-11                    | --             | --             | --             | --             |
| Angle  | Direct Shear Test (DUU, DCU & DCD) | --             | --             | --             | --             |
| Bulk Density, T/m <sup>3</sup>                             |                                    | --             | --             | --             | --             |
| Water Content, %   | IS 2720 Part-13                    | --             | --             | --             | --             |
| Unconfined compression test                                |                                    |                |                |                |                |
| qu (kg/cm <sup>2</sup> )                                   |                                    | --             | --             | --             | --             |
| Shear Strength (kg/cm <sup>2</sup> )                       | IS 2720 Part-10                    | --             | --             | --             | --             |
| Consolidation Test   |                                    |                |                |                |                |
| Pressure Range, T/m <sup>2</sup>                           | IS 2720 Part-15                    | 5-10 10-20 - - | 5-10 10-20 - - | 5-10 10-20 - - | 5-10 10-20 - - |
| Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>                     |                                    | --             | --             | --             | --             |
| Cv, m <sup>2</sup> /yr x10 <sup>-2</sup>                   |                                    | --             | --             | --             | --             |
| Natural Moisture Content %                                 | IS 2720 Part-1                     | --             | --             | --             | --             |
| Specific gravity   | IS 2720 Part-3                     | 2.77           | 2.65           | --             | --             |
| Compaction   |                                    |                |                |                |                |
| Max dry density, g/cm <sup>3</sup>                         | Light Compaction IS 2720 Part-7    | --             | --             | --             | --             |
| Heavy Compaction   |                                    |                |                |                |                |
| Optimum Moist-Cont., %                                     | Heavy Compaction IS 2720 Part-8    | --             | --             | --             | --             |
| California Bearing Ratio                                   |                                    |                |                |                |                |
| Soaked %   | IS 2720 Part-16                    | --             | --             | --             | --             |
| Unsoaked %   |                                    | --             | --             | --             | --             |
| **Coefficient of Uniformity (Cu)                           |                                    | --             | --             | --             | --             |
| **Coefficient of Curvature (Cc)                            | IS 1498                            | --             | --             | --             | --             |
| Free Swell Index (%)                                       | IS 2720 Part-40                    | --             | --             | --             | --             |
| Swelling Pressure (kg/cm <sup>2</sup> )                    | IS 2720 Part-41                    | --             | --             | --             | --             |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN022023

\*\*\*\*\*

**End of Report**

\*\*\*\*\*



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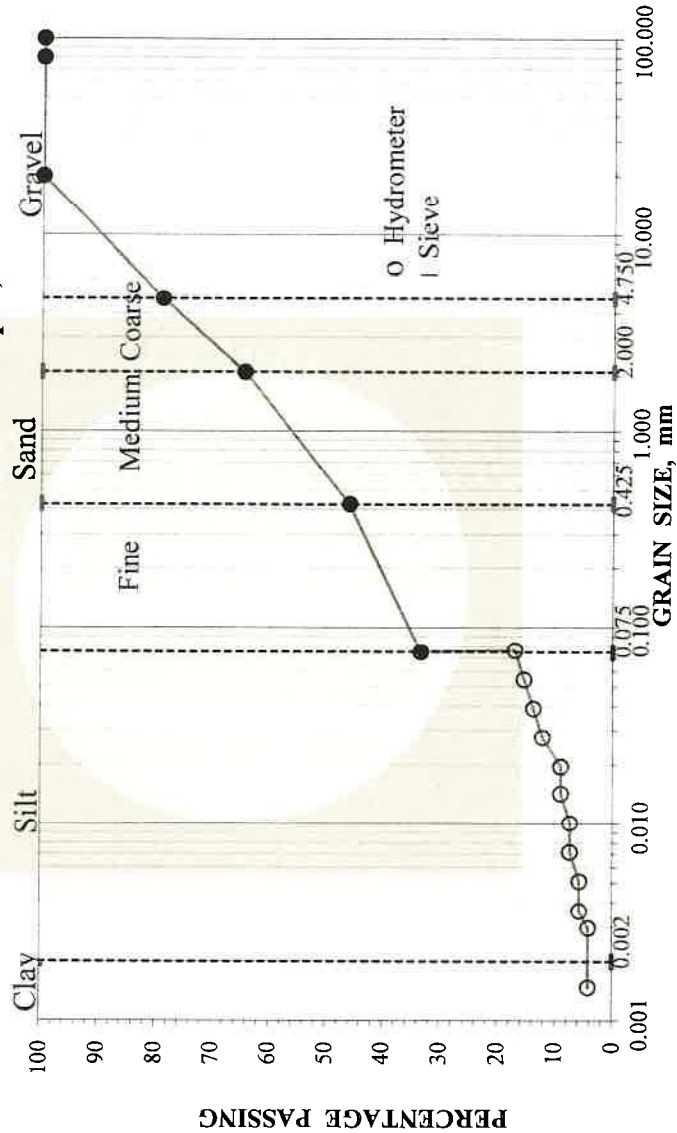


TC-5282

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER  
METHOD**

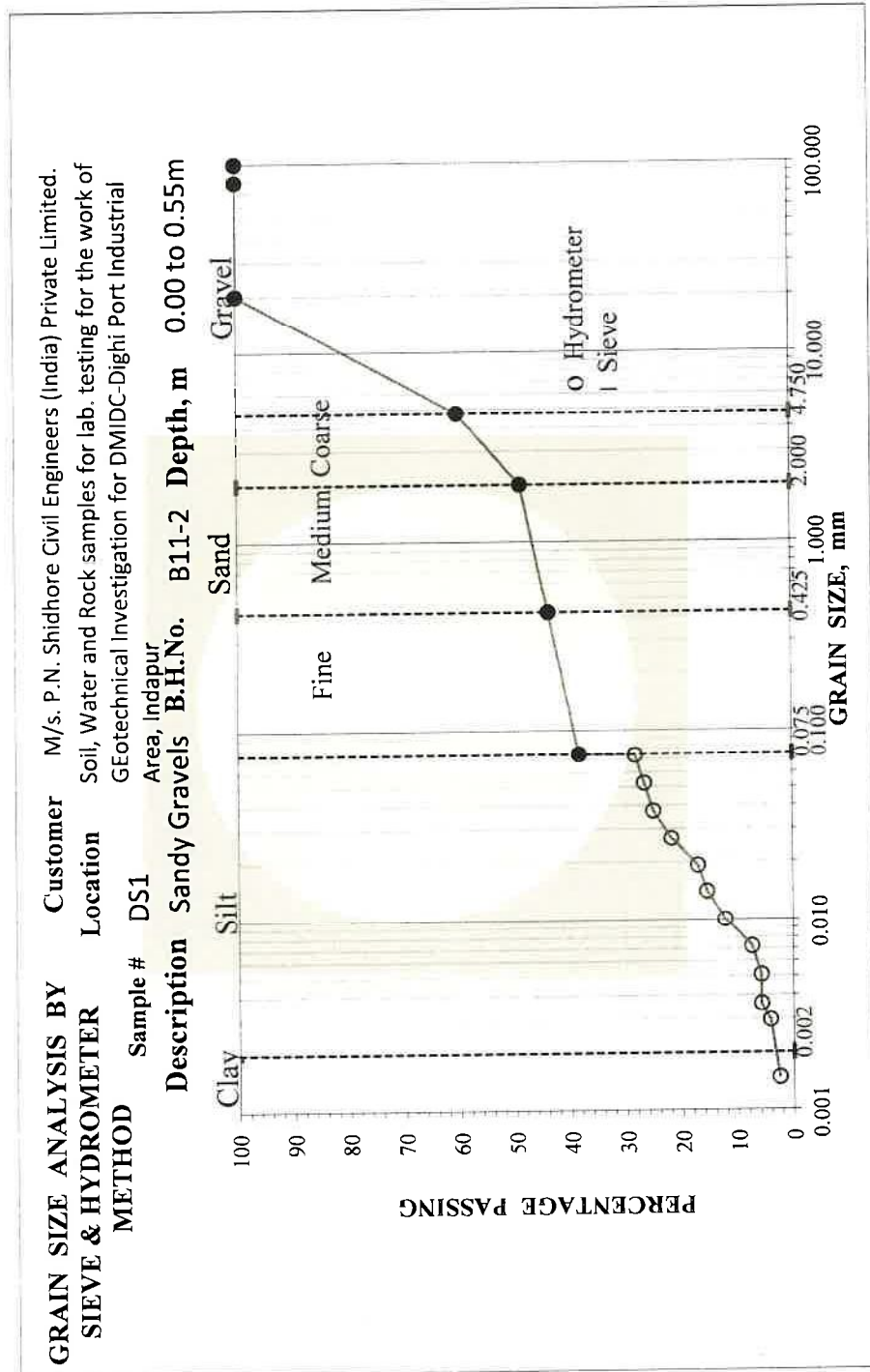
**Customer** M/s. P. N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMIDC-Dighi Port Industrial Area,  
Indapur  
**Sample #** DS1

**Description** Silty Sand **B.H.No.** B11-1 **Depth, m** 0.00 to 0.60m



• Hologram authenticates report • Hologram authenticates report • Hologram authenticates report • Hologram authenticates report





2

*"Intelligence with Integrity"***ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282****TEST REPORT**

TC-5282

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0022023/02231****ULR No. : TC528223000007555F****17/05/2023**

## 1. Name &amp; Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22, Dtd. 15/04/2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

## i) Description

**Rock**

## ii) Quantity

04 Nos.

## iii) Date of receipt

15/04/2023

## iii) Condition

Acceptable

## 6. Test method followed, if any

As Mentioned Below.

## 7. Date of Testing From

18/04/2023 to 25/04/2023

**TEST REPORT**

| SR No                | ID Mark                           | Depth | Dia.  | Area            | Length | Dry Density                | Load   | Compressive strength      | Compressive strength corrected | SP Gravity                | Porosity                  | Water Absorption | Hardness by Moh's scale  |
|----------------------|-----------------------------------|-------|-------|-----------------|--------|----------------------------|--------|---------------------------|--------------------------------|---------------------------|---------------------------|------------------|--------------------------|
|                      |                                   | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>          | N      | N / mm <sup>2</sup>       | for L/D- N/mm <sup>2</sup>     |                           | %                         | %                |                          |
| Test Method Followed |                                   |       |       |                 |        | (IS:13030): 1991 (RA 2021) |        | (IS:9143): 1979 (RA 2021) |                                | (IS 1122): 1974 (RA 2017) | (IS:13030):1991 (RA 2021) |                  | IS 13630 (Part 13): 2019 |
| 1                    | BH. No. B11-1<br>( Piece No. 18 ) | 3.20  | 54.72 | 2350.51         | 111.84 | --                         | 288000 | 123                       | 123                            | --                        | 0.014                     | 0.49             | --                       |
| 2                    | BH. No. B11-1<br>( Piece No. 25 ) | 4.50  | 55.00 | 2374.63         | 111.24 | --                         | 175000 | 74                        | 74                             | --                        | 0.014                     | 0.46             | --                       |
| 3                    | BH. No. B11-2<br>( Piece No. 24 ) | 3.50  | 54.80 | 2357.39         | 109.80 | --                         | 90500  | 38                        | 38                             | --                        | 0.012                     | 0.58             | --                       |
| 4                    | BH. No. B11-2<br>( Piece No. 26 ) | 3.80  | 54.50 | 2331.65         | 110.06 | --                         | 213500 | 92                        | 92                             | --                        | 0.016                     | 0.53             | --                       |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|--------|----------------------|-------------------------------------|
| 1      | Exceptionally Strong | > 250                               |
| 2      | Very Strong          | 100-250                             |
| 3      | Strong               | 50-100                              |
| 4      | Average              | 25-50                               |
| 5      | Weak                 | 10-25                               |
| 6      | Very Weak            | 2-10                                |
| 7      | Extremely Weak       | < 2                                 |

**NOTE :**

- \* --Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.

Checked By

SST/N/LAB/Tech Report/2022-23/Test Report/Nabl/Phy/Rock/SAN0022023

Vikram B. Parmar  
Nodal Quality Manager

Authorized Signatory

\*\*\*\*\*End of Report\*\*\*\*\*

## TEST REPORT

|   |                 |             |
|---|-----------------|-------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 | PAGE 1 OF 1 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |             |
| Discipline: Chemical                                | Group: Water    |             |

**TEST REPORT NO. & DATE** : R&D/LAB/SAN/2023-24/SAN0022023/01851  
**ULR No. : TC528223000007175F**

- 09/05/2023**
- Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
  - Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
  - Customer's Reference : PNS/Structwel/22, Dtd. 15/04/2023
  - Location of performance of test : At Laboratory
  - Sample :
    - Description : **Construction Water**
    - Quantity : 01 No.
    - Date of receipt : 15/04/2023
    - Condition : Acceptable
  - Test method followed : Mentioned Below
  - Date of Testing : 05/05/2023

**STRUCTWEL**  
**Provisional Report**  
*For information only*

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

**\* ID Mark. : Bridge No. B-11-1**

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.49</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>18</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>17</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

#### NOTE :

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- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**  
 Check ed by

**Vikram B. Parmar**  
**Nodal Quality Manager**  
 Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*

## TEST REPORT

|   |                 |             |
|---|-----------------|-------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 | PAGE 1 OF 1 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |             |
| Discipline: Chemical                                | Group: Water    |             |

TEST REPORT NO. & DATE : R&D/LAB/SAN/2023-24/SAN0022023/01852

ULR No. : TC528223000007176F

09/05/2023

1. Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
2. Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
3. Customer's Reference : PNS/Structwel/22, Dtd. 15/04/2023
4. Location of performance of test : At Laboratory
5. Sample :
  - i) Description : Construction Water
  - ii) Quantity : 01 No.
  - iii) Date of receipt : 15/04/2023
  - iv) Condition : Acceptable
6. Test method followed : Mentioned Below
7. Date of Testing : 05/05/2023

**STRUCTWEL**  
Provisional Report  
For information only

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : Bridge No. B-11-2

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.52    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 19      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 18      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic ) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

#### NOTE :

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- This test report is valid at the time of and under the conditions specified herein.
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- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
Manager - Chemical  
Check ed by

**Vikram B. Parmar**  
Nodal Quality Manager  
Aur horised Signat ory

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0022023

\*\*\*\*\* End of Report \*\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 12)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

Prabhakar Apt, B Wing,  
3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)



## Geotechnical Investigation Report (Bridge No. 12)

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|--|----------|
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| 2.0 Exploration Procedure                      | 3        |
| 2.1 Exploration Scope                          | 4        |
| 2.2 Subsurface Conditions                      | 4        |
| 2.3 Groundwater Levels                         | 5        |
| 3.0 Foundation Recommendations                 | 6        |
| 3.1 Foundation Protection                      | 7        |
| Appendix I - Calculations for Bearing Capacity | 8        |
| Appendix II - Borelogs and Lab Test Reports    | 11       |

## Geotechnical Investigation Report (Bridge No. 12)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .



## 2.1 Exploration Scope

Two boreholes (B12-1, B12-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B12-1        | 2031966  | 318304  | 9.25m |
| B12-2        | 2031963  | 318288  | 9.00m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depth of 3.00m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depth of 3.00m below ground surface. Core Recoveries varied between 15% and 66%, while Rock Quality Designation (RQD) ranged between 0% and 38%. Compressive strength of rock core sample ranges from 600kg/cm<sup>2</sup> to 840kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 4.00m to 4.25m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 4.00m to 4.25m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 88% and 100%, while Rock Quality Designation (RQD) ranged between 60% and 98%. Compressive strength of rock core sample ranges from 570kg/cm<sup>2</sup> to 880kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.00m to 9.25m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 0.50m to 1.00m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depth of 3.00m below ground surface. In this layer compressive strength of rock core samples ranged between 600kg/cm<sup>2</sup> to 840kg/cm<sup>2</sup>.

As per minimum compressive strength 570kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B12-1            | 3.00m | 4.25m     |
| B12-2            | 3.00m | 4.00m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -3.00m           |
| Layer II, Moderately weathered rock |                  |
|                                     | -4.00m to -4.25m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 5700 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 5700 = 570 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.





## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                     |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
|---|--------|------------------------------|-------------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                     |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |        | Calyx with Bent. with casing |                                     |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 12                 |   |   |                          |                |        |         |
| Dia of Hole (mm):   |        | 100.00                       |                                     |                              | 75.00                           |         |         | Bore Hole No.: B12-1                |   |   |                          |                |        |         |
| Depth (M):  |        | 0.00-1.20                    |                                     |                              | 1.20-9.25                       |         |         | Co-ordinates : N=2031966, E=318304  |   |   |                          |                |        |         |
| Commenced on : 16 April 2023  |        |                              |                                     | Completed on : 18 April 2023 |                                 |         |         | Ground Bed RL: 71.50M               |   |   |                          |                |        |         |
| Water Struc :   |        |                              |                                     | Ground Water : 0.50 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |         |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata               | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |        |                              |                                     |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |         |
| 0.00  |        | 0.00 - 0.40                  | BROWNISH MURUM, COBBLES, PEBBLE     |                              |                                 |         |         |                                     |   | DS-1  | 0.28                     | 25.00          | 0.00   |         |
|   |        | 0.40 - 1.50                  |                                     |                              |                                 |         |         |                                     |   | 1 TO 6                                      |                          |                |        |         |
|   |        | 1.50 - 3.00                  |                                     |                              |                                 |         |         |                                     |   | 7 TO 13                                     |                          |                |        |         |
|   |        | 3.00                         |                                     |                              |                                 |         |         |                                     |   | 14 TO 16                                    |                          |                |        |         |
| 3.00  | 4.25   | 3.00 - 4.25                  | BROWNISH GRAY HIGHLY WEATHERED ROCK |                              |                                 |         |         |                                     |   | 0.20  | 15.00                    | 0.00           |        |         |
| 4.25  |        | 4.25 - 5.35                  | GRAY BASALT                         |                              |                                 |         |         |                                     |   | 17 TO 24                                    | 1.07                     | 95.00          | 61.00  |         |
|   |        | 5.35 - 6.35                  |                                     |                              |                                 |         |         |                                     |   | 25  | 1.00                     | 100.00         | 98.00  |         |
|   |        | 6.35 - 7.35                  |                                     |                              |                                 |         |         |                                     |   | 26 TO 30                                    | 0.90                     | 90.00          | 60.00  |         |
|   |        | 7.35 - 8.35                  |                                     |                              |                                 |         |         |                                     |   | 31 TO 32                                    | 0.89                     | 89.00          | 80.00  |         |
|   |        | 8.35 - 9.25                  |                                     |                              |                                 |         |         |                                     |   | 33 TO 35                                    | 0.80                     | 88.00          | 66.00  |         |
| 9.25  |        |                              |                                     |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
| Bore Hole Terminated at : 9.25  |        |                              |                                     |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                     |                              |                                 |         |         |                                     |   |   |                          |                |        |         |
| No. of disturbed Sample : 1   |        |                              |                                     |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |
|   |        |                              |                                     |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |         |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |             |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |      |       |      |
|---|-------------|------------------------------|----------------------------------|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|------|-------|------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |             |                              |                                  |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |      |       |      |
| Type of Boring  |             | Calyx with Bent. with casing |                                  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 12                 |   |   |                          |                |        |         |      |       |      |
| Dia of Hole (mm):   |             | 100.00                       |                                  |                              | 75.00                           |         |         | Bore Hole No.: B12-2                |   |   |                          |                |        |         |      |       |      |
| Depth (M):  |             | 0.00-2.00                    |                                  |                              | 2.00-9.00                       |         |         | Co-ordinates : N=2031963, E=318288  |   |   |                          |                |        |         |      |       |      |
| Commenced on : 16 April 2023  |             |                              |                                  | Completed on : 17 April 2023 |                                 |         |         | Ground Bed RL: 71.30M.              |   |   |                          |                |        |         |      |       |      |
| Water Struc :   |             |                              |                                  | Ground Water : 1.00 Meter    |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |         |      |       |      |
| From (M)  | To (M)      | Sample Depth (M)             | Description of Strata            | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |      |       |      |
|   |             |                              |                                  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |         |      |       |      |
| 0.00  |             | 0.00 - 0.50                  | BROWNISH MURUM, COBBLES, PEBBLES |                              |                                 |         |         |                                     |   | DS-1  |                          |                |        |         |      |       |      |
|   |             | 0.50 - 2.00                  |                                  |                              |                                 |         |         |                                     |   | 1 TO 2                                      |                          |                |        |         | 0.15 | 10.00 | 0.00 |
|   |             | 2.00 - 3.00                  |                                  |                              |                                 |         |         |                                     |   | 3 TO 8                                      |                          |                |        |         | 0.50 | 50.00 | 0.00 |
| 3.00  | 3.00        | 3.00 - 4.00                  | GRAY MODERETALY WEATHERED BASALT |                              |                                 |         |         |                                     |   | 9 TO 14                                     | 0.66                     | 66.00          | 38.00  |         |      |       |      |
| 4.00  | 4.00        | 4.00 - 5.50                  | GRAY BASALT                      |                              |                                 |         |         |                                     |   | 15 TO 23                                    | 1.43                     | 95.00          | 80.00  |         |      |       |      |
|   | 5.50 - 7.00 | 24 TO 28                     |                                  |                              |                                 |         |         |                                     |   | 1.38  | 92.00                    | 69.00          |        |         |      |       |      |
|   | 7.00 - 8.00 | 29 TO 33                     |                                  |                              |                                 |         |         |                                     |   | 0.90  | 90.00                    | 64.00          |        |         |      |       |      |
|   | 8.00 - 9.00 | 34 TO 38                     |                                  |                              |                                 |         |         |                                     |   | 1.00  | 100.00                   | 95.00          |        |         |      |       |      |
|   | 9.00        |                              |                                  |                              | Bore Hole Terminated at : 9.00  |         |         |                                     |   |   |                          |                |        |         |      |       |      |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |             |                              |                                  |                              |                                 |         |         |                                     |   |   |                          |                |        |         |      |       |      |
| No. of disturbed Sample : 1   |             |                              |                                  |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |      |       |      |
|   |             |                              |                                  |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |         |      |       |      |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev No - 03                         | Dtd 30/08/2022       |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0032323/02226****ULR No. : TC528223000007550F****17/05/2023****1. Name & Address of Client**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | Bridge B12-1      |       |    |    | Bridge B12-2 |       |    |    | --   |       |    |    | --   |       |    |    |
|--|---|------------------------------------|-------------------|-------|----|----|--------------|-------|----|----|------|-------|----|----|------|-------|----|----|
| Sample No. :   |   | --                                 | DS-1              |       |    |    | DS-1         |       |    |    | --   |       |    |    | --   |       |    |    |
| Depth, m :   |   | --                                 | 0.00 to 0.40      |       |    |    | 0.00 to 0.50 |       |    |    | --   |       |    |    | --   |       |    |    |
| Description :  |   | --                                 | Silty Gravel Sand |       |    |    | Sand Clay    |       |    |    | --   |       |    |    | --   |       |    |    |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 57                |       |    |    | 46           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Plastic Limit                           |                                    | 38                |       |    |    | 57           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Plasticity Index                        |                                    | 19                |       |    |    | 9            |       |    |    | --   |       |    |    | --   |       |    |    |
|  | ShrinkageLim.                           | IS 2720-Part 6                     | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 34                |       |    |    | 33           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Sand                                    |                                    | 68                |       |    |    | 72           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Gravel                                  |                                    | 27                |       |    |    | 26           |       |    |    | --   |       |    |    | --   |       |    |    |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Bulk Density, T/m <sup>3</sup>          |                                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Water Content,%                         |                                    | IS 2720 Part-13   | --    |    |    |              | --    |    |    |      | --    |    |    |      | --    |    |    |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10              | 10-20 | -- | -- | 5-10         | 10-20 | -- | -- | 5-10 | 10-20 | -- | -- | 5-10 | 10-20 | -- | -- |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                    | --                | --    | -- | -- | --           | --    | -- | -- | --   | --    | -- | -- | --   | --    | -- |    |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | --                | --    | -- | -- | --           | --    | -- | -- | --   | --    | -- | -- | --   | --    | -- |    |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Specific gravity   |   | IS 2720 Part-3                     | 2.66              |       |    |    | 2.60         |       |    |    | --   |       |    |    | --   |       |    |    |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Heavy Compaction   | Optimum Moist-Cont. %                   | Heavy Compaction IS 2720 Part-8    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
|  | Unsoaked %                              |                                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| **Coefficient of Curvature (Cc)                            |   |                                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    | --                |       |    |    | --           |       |    |    | --   |       |    |    | --   |       |    |    |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

Vikram B. Parmar  
Nodal Quality Manager  
Authorized Signatory

SST/N/LAB/Tech Report/2022-23/turbhe/test report/NABL/Phy/Soil/SAN032323

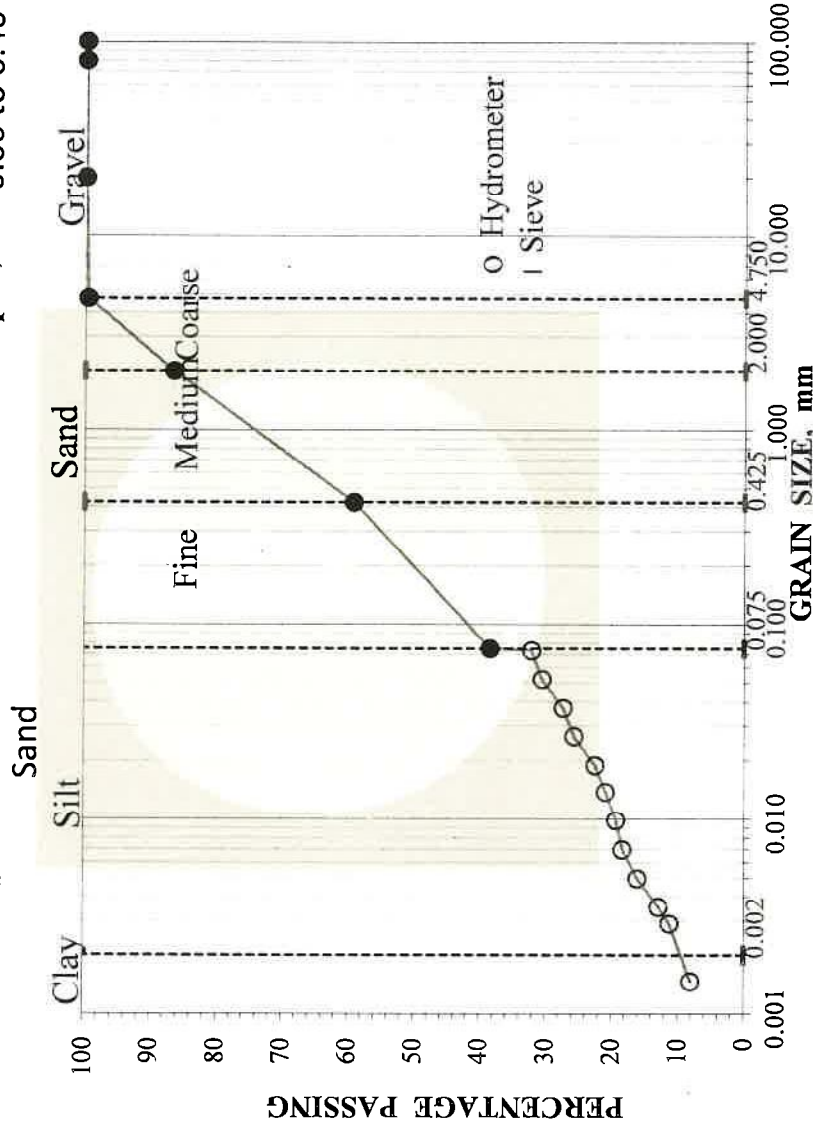
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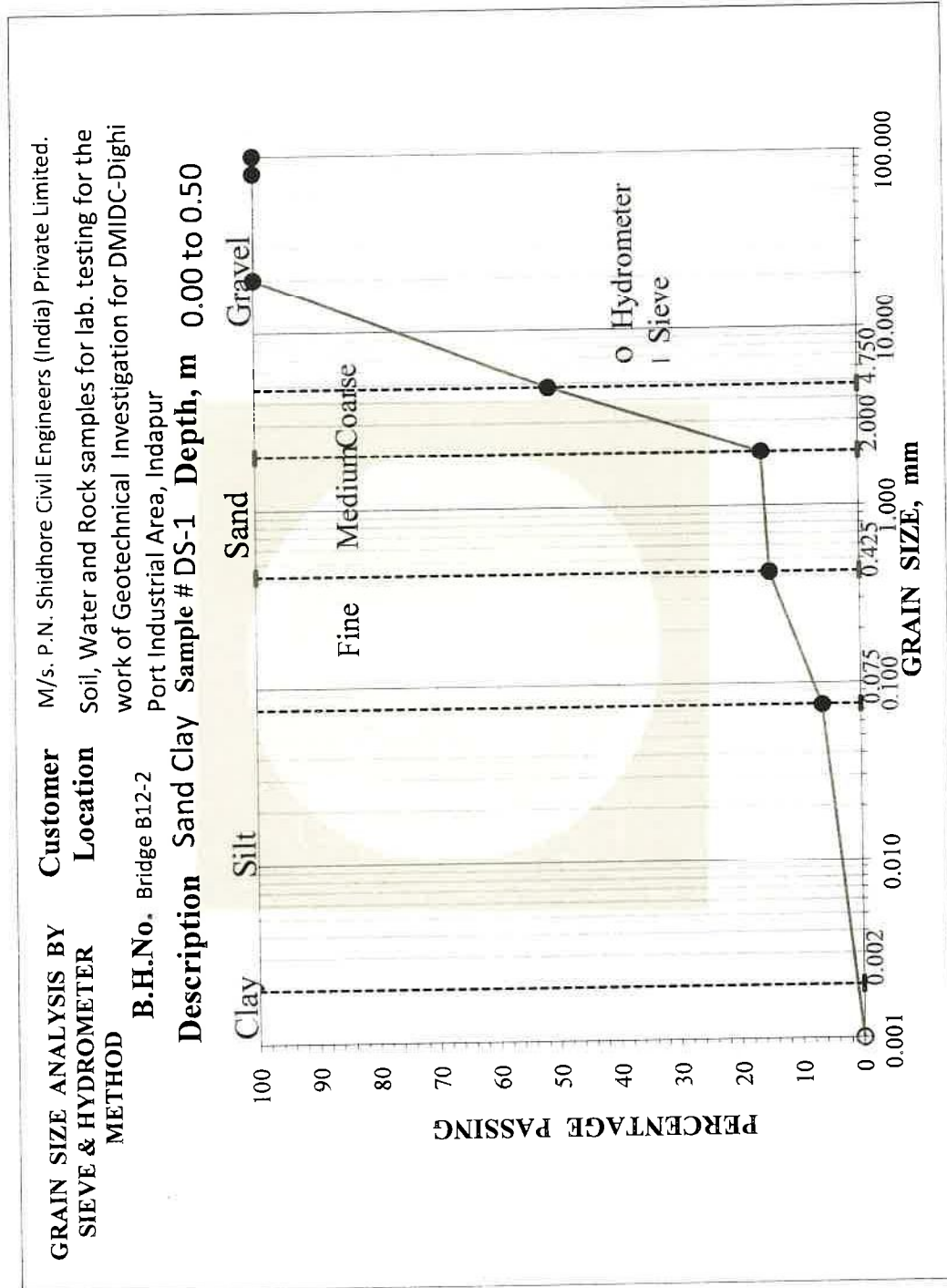
**End of Report**

\*\*\*\*\*



**GRAIN SIZE ANALYSIS BY** Customer M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**SIEVE & HYDROMETER** Location Soil, Water and Rock samples for lab. testing for the work  
**METHOD** B.H.No. Bridge B12-1 of Geotechnical Investigation for DMIDC-Dighi Port  
 Industrial Area, Indapur  
**Description** Silty Gravel Sample # DS-1 Depth, m 0.00 to 0.40





*P*



*"Intelligence with Integrity"***ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282****TEST REPORT**

|                                       |                      |
|---------------------------------------|----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                      |
| Rev No 05                             | Rev Date 30/08/2022  |
| Discipline: Mechanical                | Group: Soil and Rock |

PAGE 1 OF 1

**TEST REPORT NO. & DATE**R&D/LAB/SAN/2023-24/SAN0032323/02233  
ULR No. : TC528223000007557F  
17/05/2023**1. Name & Address of Customer**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur**3. Customer's Reference**

PNS/Structwel/22 Dtd. 21.04.2023

**4. Location of test Performance**

At Laboratory

**5. Sample****i) Description**

Rock

**ii) Quantity**

04 Nos.

**iii) Date of receipt**

21/04/2023

**iii) Condition**

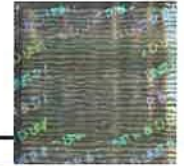
Acceptable

**6. Test method followed**

As Mentioned Below.

**7. Date of Testing From**

23/04/2023 to 28/04/2023

**TEST REPORT**

| SR No.               | ID. Mark                        | Depth | Dia.  | Area            | Length | Dry Density                      | Load   | Compressive strength            | Compressive strength corrected | SP Gravity                      | Porosity                     | Water Absorption               | Hardness by Moh's scale |
|----------------------|---------------------------------|-------|-------|-----------------|--------|----------------------------------|--------|---------------------------------|--------------------------------|---------------------------------|------------------------------|--------------------------------|-------------------------|
|                      |                                 | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>                | N      | N / mm <sup>2</sup>             | for L/D- N /mm <sup>2</sup>    |                                 | %                            | %                              |                         |
| Test Method Followed |                                 |       |       |                 |        | (IS:13030):<br>1991<br>(RA 2021) |        | (IS:9143):<br>1979<br>(RA 2021) |                                | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) | IS 13630<br>(Part 13):<br>2019 |                         |
| 1                    | BH No B12-1<br>( Piece No. 17 ) | 4.25  | 54.20 | 2306.05         | 108.74 | --                               | 138470 | 60                              | 60                             | --                              | 0.014                        | 0.45                           | --                      |
| 2                    | BH No B12-1<br>( Piece No. 25 ) | 6.35  | 55.30 | 2400.60         | 112.09 | --                               | 210500 | 88                              | 88                             | --                              | 0.009                        | 0.32                           | --                      |
| 3                    | BH No B12-2<br>( Piece No. 10 ) | 3.10  | 54.72 | 2350.51         | 110.85 | --                               | 198470 | 84                              | 85                             | --                              | 0.012                        | 0.42                           | --                      |
| 4                    | BH No B12-2<br>( Piece No. 15 ) | 4.15  | 54.74 | 2352.23         | 100.40 | --                               | 134800 | 57                              | 56                             | --                              | 0.018                        | 0.54                           | --                      |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report
- Data provided by Customer

**Vikram B. Parmar**  
Nodal Quality Manager  
Authorised Signatory

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0032323

\*\*\*\*\*End of Report\*\*\*\*\*

Hologram authenticates report • Hologram authenticates report • Hologram authenticates report • Hologram authenticates report • Hologram authenticates report



## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

TEST REPORT NO. & DATE : R&D/LAB/SAN/2023-24/SAN0032323/01542  
ULR No. : TC528223000006866F  
02/05/2023

1. Name & Address of Customer : M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.
2. Project / Site : Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur
3. Customer's Reference : PNS/Structwel/22 Dtd. 21.04.2023
4. Location of performance of test : At Laboratory
5. Sample :  
i) Description : Construction Water  
ii) Quantity : 01 No.  
iii) Date of receipt : 21/04/2023  
iv) Condition : Acceptable
6. Test method followed : Mentioned Below
7. Date of Testing : 26/04/2023

**STRUCTWEL**  
Provisional Report  
For information only

### CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : Bridge No.B12-2

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 8.26    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 9       | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 13      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019), (EDTA method)            | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

#### NOTE :

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

Swati Sonawane  
Manager - Chemical

Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0032323

\*\*\*\*\* End of Report \*\*\*\*\*

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 17)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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## Geotechnical Investigation Report (Bridge No. 17)

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## Geotechnical Investigation Report (Bridge No. 17)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

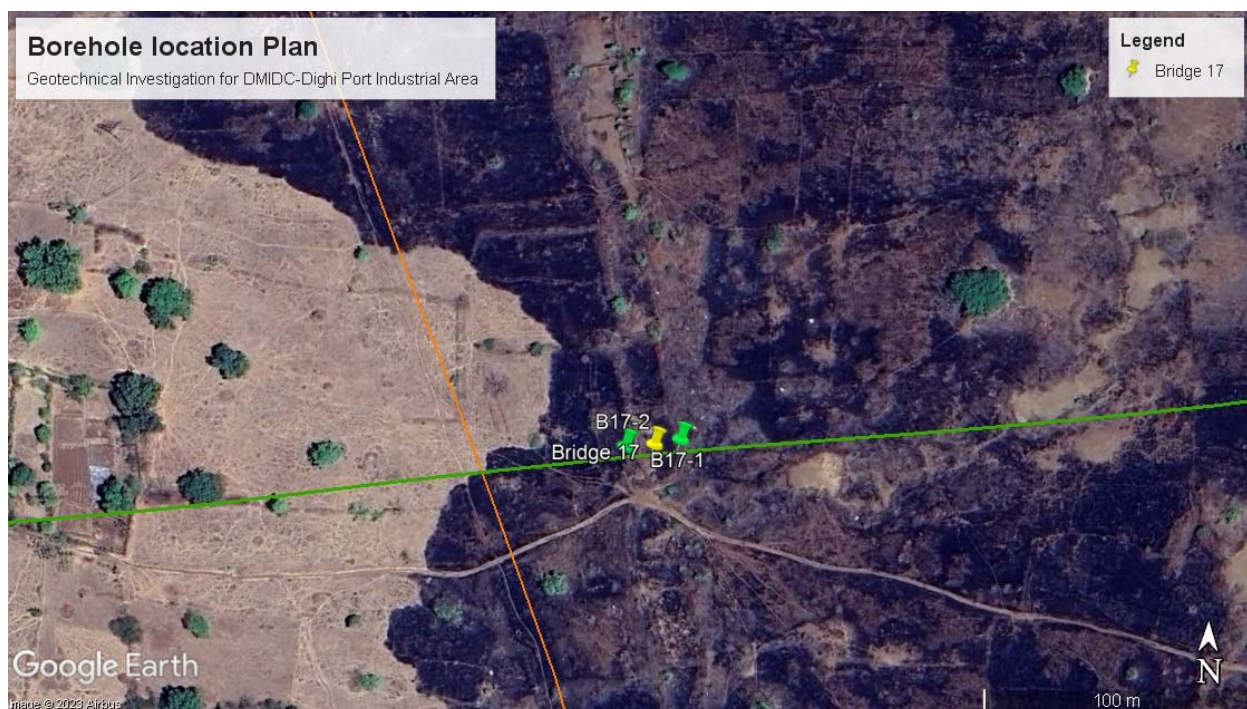
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B17-1, B17-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B17-1        | 2032194  | 319599  | 9.05m |
| B17-2        | 2032191  | 319572  | 9.60m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil which includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock.

**Silt Factor-** Representative disturbed samples were collected from the river bed for calculating the Silt Factor. The Silt Factor value for this location is 1.806 (as per IRC78:2014 & IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)).

Encountered soil/rock layers are described below;

#### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 3.00m to 3.60m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 3.00m to 3.60m below ground surface. Core Recoveries varied between 45% and 73%, while Rock Quality Designation (RQD) ranged between 0% and 22%. Compressive strength of rock core sample ranges from 117kg/cm<sup>2</sup> to 974kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 4.00m to 4.60m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 4.00m to 4.60m below ground surface in the boreholes. The bedrock was sound, inclined and vertical veins are observed. Core Recoveries varied between 80% and 95%, while Rock Quality Designation (RQD) ranged between 13% and 75%. Compressive strength of rock core sample ranges from 510kg/cm<sup>2</sup> to 840kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.05m to 9.60m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 2.10m to 6.00m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 3.00m to 3.60m below ground surface. In this layer compressive strength of rock core samples ranged between 117kg/cm<sup>2</sup> to 974kg/cm<sup>2</sup>.

As per minimum compressive strength 117kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B17-1            | 3.00m | 4.00m     |
| B17-2            | 3.60m | 4.60m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).



### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -3.00m to -3.60m |
| Layer II, Moderately weathered rock |                  |
|                                     | -4.00m to -4.60m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 1170 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 1170 = 117 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.
- 7) IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)
- 8) IRC78:2014 Standard Specifications and code of practice for Road Bridges



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
|---|--------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|--------------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                                |
| Type of Boring  |        | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 17                 |   |   |                          |                |        |                                |
| Dia of Hole (mm):   |        | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B17-1                |   |   |                          |                |        |                                |
| Depth (M):  |        | 0.00-2.00                    |   |                                 | 2.00-9.05                       |         |         | Co-ordinates : N=2032194, E=319599  |   |   |                          |                |        |                                |
| Commenced on : 10 May 2023  |        |                              |   | Completed on : 12 May 2023      |                                 |         |         | Ground Bed RL: 80.38M.              |   |   |                          |                |        |                                |
| Water Struc :   |        |                              |   | Ground Water : 2.10M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                                |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                     | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                        |
|   |        |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                                |
| 0.00  |        | 0.00 - 1.00                  | BROWNISH MURUM COBBLES, PEBBLES, BOULDERS |                                 |                                 |         |         |                                     |   | 1 TO 10                                     | 0.53                     | 53.00          | 0.00   |                                |
|   |        | 11 TO 21                     |   |                                 |                                 |         |         |                                     |   | 0.71  | 71.00                    | 0.00           |        |                                |
|   |        | 22 TO 30                     |   |                                 |                                 |         |         |                                     |   | 0.65  | 65.00                    | 0.00           |        |                                |
| 3.00  | 3.00   |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| 3.00  | 4.00   | 3.00 - 4.00                  | GREY MODERATELY WEATHERED ROCK            |                                 |                                 |         |         |                                     |   | 31 TO 35                                    | 0.73                     | 73.00          | 22.00  |                                |
| 4.00  | 4.00   |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| 4.00  |        | 4.00 - 5.30                  | GREY JOINTED BASALT                       |                                 |                                 |         |         |                                     |   | 36 TO 39                                    | 1.15                     | 88.00          | 58.00  | Inclined veins, vertical veins |
|   |        | 40 TO 49                     |   |                                 |                                 |         |         |                                     |   | 1.25  | 83.00                    | 54.00          |        |                                |
|   |        | 50 TO 57                     |   |                                 |                                 |         |         |                                     |   | 1.20  | 86.00                    | 63.00          |        |                                |
|   |        | 58 TO 61                     |   |                                 |                                 |         |         |                                     |   | 0.79  | 93.00                    | 46.00          |        |                                |
| 9.05  | 9.05   |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| Bore Hole Terminated at : 9.05  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| No. of disturbed Sample : 0   |        |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                                |
|   |        |                              |   |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                                |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
|---|-------------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|--------------------------------|------|-------|------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |             |                              |   |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                                |      |       |      |
| Type of Boring  |             | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 17                 |   |   |                          |                |        |                                |      |       |      |
| Dia of Hole (mm):   |             | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B17-2                |   |   |                          |                |        |                                |      |       |      |
| Depth (M):  |             | 0.00-3.00                    |   |                                 | 3.00-9.60                       |         |         | Co-ordinates : N=2032191, E=319572  |   |   |                          |                |        |                                |      |       |      |
| Commenced on : 10 May 2023  |             |                              |   | Completed on : 11 May 2023      |                                 |         |         | Ground Bed RL: 80.55M.              |   |   |                          |                |        |                                |      |       |      |
| Water Struc :   |             |                              |   | Ground Water : 6.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                                |      |       |      |
| From (M)  | To (M)      | Sample Depth (M)             | Description of Strata                     | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                        |      |       |      |
|   |             |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                                |      |       |      |
| 0.00  |             | 0.00 - 0.50                  | BROWNISH MURUM COBBLES, PEBBLES, BOULDERS |                                 |                                 |         |         |                                     |   | DS-1  |                          |                |        |                                |      |       |      |
|   |             | 0.50 - 1.20                  |   |                                 |                                 |         |         |                                     |   | 1 TO 3                                      |                          |                |        |                                | 0.20 | 28.00 | 0.00 |
|   |             | 1.20 - 2.70                  |   |                                 |                                 |         |         |                                     |   | 4 TO 17                                     |                          |                |        |                                | 1.00 | 60.00 | 0.00 |
|   |             | 2.70 - 3.60                  |   |                                 |                                 |         |         |                                     |   | 18 TO 24                                    |                          |                |        |                                | 0.57 | 63.00 | 0.00 |
| 3.60  |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
| 3.60  |             | 3.60 - 4.60                  | GREY MODERATELY WEATHERED ROCK            |                                 |                                 |         |         |                                     |   | 25 TO 29                                    | 0.45                     | 45.00          | 0.00   |                                |      |       |      |
| 4.60  |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
| 4.60  |             | 4.60 - 5.80                  | GREY BASALT                               |                                 |                                 |         |         |                                     |   | 30 TO 39                                    | 0.96                     | 80.00          | 13.00  | Inclined veins, Vertical veins |      |       |      |
|   | 5.80 - 7.10 | 40 TO 47                     |   |                                 |                                 |         |         |                                     |   | 1.20  | 92.00                    | 75.00          |        |                                |      |       |      |
|   | 7.10 - 8.30 | 48 TO 55                     |   |                                 |                                 |         |         |                                     |   | 1.15  | 95.00                    | 58.00          |        |                                |      |       |      |
|   | 8.30 - 9.60 | 56 TO 62                     |   |                                 |                                 |         |         |                                     |   | 1.15  | 88.00                    | 63.00          |        |                                |      |       |      |
| 9.60  |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
|   |             |                              |   |                                 | Bore Hole Terminated at : 9.60  |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |      |       |      |
| No. of disturbed Sample : 1   |             |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                                |      |       |      |
|   |             |                              |   |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                                |      |       |      |





## SOIL TEST DATA SHEET

|                     |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |
|---------------------|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|------------|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep-3/R0   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |
| Project :-          | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |
| Client:-            | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |
| Location:-          | Bridge No. 17   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | DATE: | 18.05.2023 |

| BH No. | Depth* (m) | Sample Type * | Density Test<br>(IS: 2720 - Part-8 : 1983) |                     | Moisture Content (%)<br>(IS: 2720 - Part-2 : 1973) | Soil Classification<br>(IS: 1498-1970) | Mechanical Analysis<br>(IS: 2720 - Part-4 : 1985) |        |        |        | Consistency Limits<br>(IS: 2720- Part-5 : 1985) |           |                                    | Shrinkage Limit<br>(IS: 2720- Part-6 : 1972) | Free Swell Index %<br>(IS:2720 - Part-40 : 1977 ) | Triaxial Test<br>(IS:2720 Part-11: 1993) |  |               | Vertical Consolidation<br>(IS:2720 Part-15 : 1965) |                       | Specific Gravity<br>(IS:2720 Part-03) | Remarks |
|--------|------------|---------------|--|---------------------|--|--|---|--------|--------|--------|---|-----------|------------------------------------|--|---|--|--|---------------|--|-----------------------|---------------------------------------|---------|
|        |            |               | Wet Density (gm/cc)                        | Dry Density (gm/cc) |  |  | Gravel %  | Sand % | Silt % | Clay % | Liquid %  | Plastic % | Plasticity Index, I <sub>p</sub> % |  |   | Type                                     | Cohesion C <sub>u</sub> kg/cm <sup>2</sup> | Degree $\phi$ | Comp. Index C <sub>c</sub> (Lab)                   | Initial Void Ratio, e |                                       |         |
| B 17-2 | 0.00-0.50  | DS-01         | ---  | ---                 | ---  | SC                                     | 9   | 50     | 21     | 20     | 43  | 24        | 19                                 | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.64                                  |         |
|        |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|        |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|        |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|        |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |

|                          |  |   |  |
|--------------------------|--|---|--|
| CHEM : Chemical Analysis | Tuu : Triaxial Test ( Unconsolidated Undrained ) | SP : Swelling Pressure or Swelling Potential Test | $\phi$ : Angle of Internal Friction            |
| COMP : Compaction Test   | Tcu : Triaxial Test ( Consolidated Undrained )   | SPT : Standard Penetration Test Sample            | Cu : Undrained Cohesion                        |
| DS : Direct Shear        | Tcd : Triaxial Test ( Consolidated Drained )     | UDS : Undisturbed Soil Sample                     | $\phi'$ : Effective Angle of Internal Friction |
| K : Permeability Test    | NP : Non Plastic                                 | VL : Laboratory Vane Shear Test                   | Cu' : Effective Cohesion                       |
| FSI : Free Swell Test    | SL : Shrinkage Limit Test                        | UC : Unconfined Compression Test                  | NPO : Not Possible                             |

S & R Geotechniques Pvt. Ltd.

JOB NO : PNS10206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



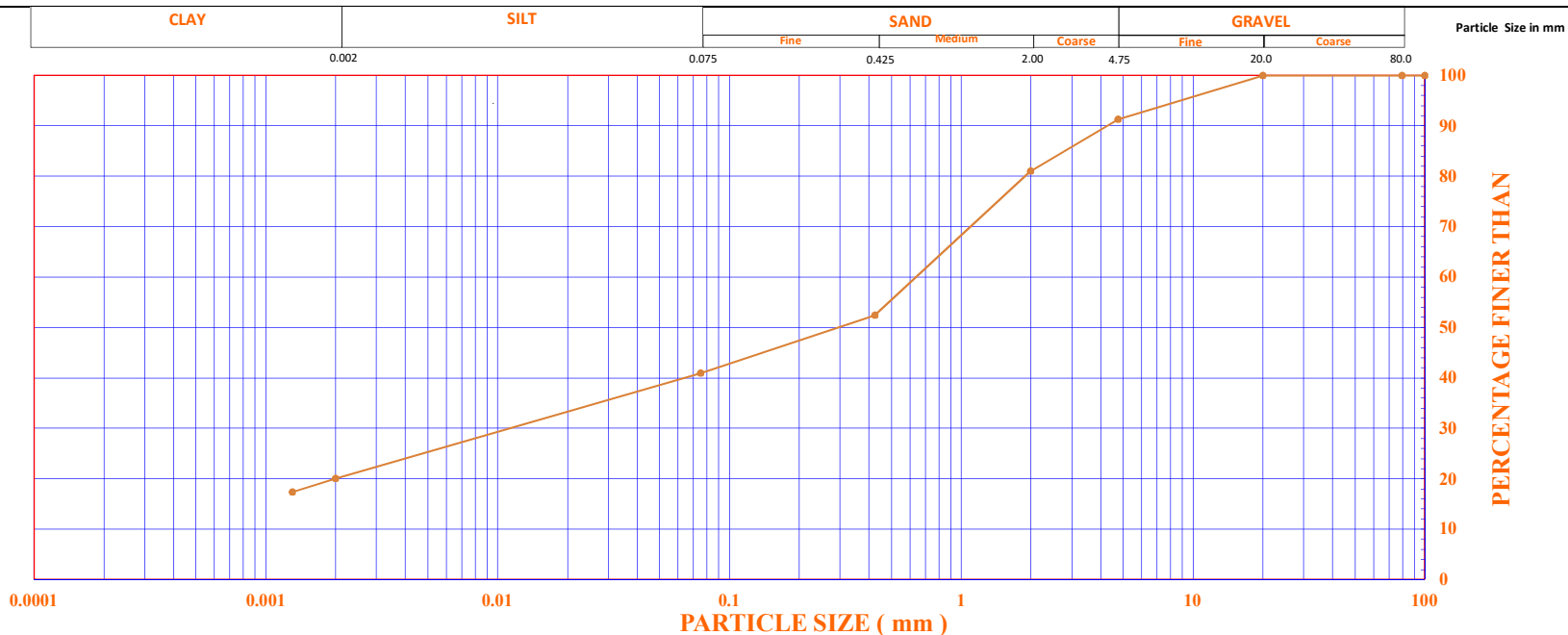
(Atul Chaudhari - Technical Manager)  
Authorized By

# GRAIN SIZE DISTRIBUTION CURVE (IS 2720: PART 4)

**Project :-** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Location:-** Bridge No. 17

S & R Geotechniques Pvt. Ltd.



JOB NO : PNS10206

| Symbol | BH No. | Depth* (m) | Classification (IS 1498) | Gravel | Sand | Silt | Clay | $\Phi_{10\%}$ | $\Phi_{30\%}$ | $\Phi_{60\%}$ | Coeff. of Uniformity, $C_u = D_{60} / D_{10}$ | Coeff. Of Curvature $C_c = D_{30}^2 / (D_{60} * D_{10})$ | Liquid Limit, $W_L$ | Plastic Limit, $W_P$ | Plasticity Index, $I_p$ | Remarks |
|--------|--------|------------|--------------------------|--------|------|------|------|---------------|---------------|---------------|---|--|---------------------|----------------------|-------------------------|---------|
|        |        |            |                          | %      | %    | %    | %    | mm            | mm            | mm            |   |  |                     |                      |                         |         |
| ●-●    | B 17-2 | 0.00-0.50  | SC                       | 9      | 50   | 21   | 20   | ---           | ---           | ---           | ---   | ---  | 43                  | 24                   | 19                      | DS-01   |
| ■-■    |        |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| ▲-▲    |        |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| *-*    |        |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| ◆-◆    |        |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |

*(Signature)*

(Pooja Patil - Report Engineer)  
Prepared By

*(Signature)*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



*(Signature)*

(Atul Chaudhari - Technical Manager)  
Authorised By

## TEST RESULTS OF ROCK CORES

|                           |   |   |               |
|---------------------------|---|---|---------------|
| <b>Report No. :-</b>      | SRGeo/Lab/PNS10206/Rep-3/R0   | <b>DATE :</b>                             | 18.05.2023.   |
| <b>Project :-</b>         | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |   |               |
| <b>Principal Client :</b> | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | <b>Direction of Loading:</b>              | Axial         |
| <b>Client :-</b>          | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          | <b>Enviromental condition at storage:</b> | (+ 2) 27.0 °C |
| <b>Location :-</b>        | Bridge No.17  | <b>Room Temperature:</b>                  | 27.0 °C       |

| Sr. No. | Bore Hole No.* | Core No.* | Depth*,<br>m | Diameter, | Height, | Thickness | H : D<br>(1:H/D) | Correction Factor | Condition of Test | Failure Load | Point Load Index<br>(IS 8764:1998) | Brazilian Test<br>(IS 10082:1981) | Porosity<br>(IS 13030:1991) | Water Absorption<br>(IS 13030:1991) | Dry Density<br>(IS 13030:1991) | Bulk Density<br>(IS 13030:1991) | Specific Gravity<br>(IS 1122: 1974) | Remarks |
|---------|----------------|-----------|--------------|-----------|---------|-----------|------------------|-------------------|-------------------|--------------|------------------------------------|-----------------------------------|-----------------------------|-------------------------------------|--------------------------------|---------------------------------|-------------------------------------|---------|
|         |                |           |              | cm        | cm      | cm        |                  |                   |                   | kN           | kg/cm <sup>2</sup>                 | kg/cm <sup>2</sup>                | %                           | %                                   | g/cm <sup>3</sup>              | g/cm <sup>3</sup>               |                                     |         |
| 1       | B 17-1         | 33        | 3.50         | 5.45      | 7.28    | -----     | 1.34             | 0.90              | Soaked            | 32.8         | 117.56                             | -                                 | 0.46                        | 0.17                                | ----                           | ----                            | ----                                |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |
|         |                |           |              |           |         |           |                  |                   |                   |              |                                    |                                   |                             |                                     |                                |                                 |                                     |         |

**S & R Geotechniques Pvt. Ltd.**

**JOB NO. :**

**RKM10119**



(Pooja Patil - Report Engineer)  
Prepared By



(Atul Bopche - Dy. Technical Manager)  
Reviewed By




(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

|                     |   |  |
|---------------------|---|--|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep-3/R0   | DATE : 18.05.2023  |
| Project :-          | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | Orientation of Loading axis with respect to anisotropy : Perpendicular |
| Client :-           | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          | Enviromental condition at storage: ( $\pm 2$ ) 27.0 °C                 |
| Location :-         | Bridge No.17  | Room Temperature: 27.0 °C  |
| Co-Ordinates :-     | ----  | Pace Rate (KN/Sec) : 1.5   |

| Sr. No. | Bore Hole No. | Core No. | Depth, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Uniaxial Compressive Strength (IS 9143:1979) | Modulus of Elasticity (IS 9221:1979) | Poisson's Ratio (IS 9221:1979) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|---------------|----------|----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|--|--------------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |               |          |          | cm        | cm      | cm        |               |                   |                   | kN           | kg/cm <sup>2</sup>                           | kg/cm <sup>2</sup>                   | ----                           | %                        | %                                | g/cm <sup>3</sup>           | g/cm <sup>3</sup>            |                                  |         |
| 1       | B 17-1        | 37       | 4.10     | 5.42      | 11.55   | -----     | 2.13          | 1.000             | Soaked            | 222.3        | 982.4  | -----                                | -----                          | 0.19                     | 0.06                             | -----                       | -----                        | -----                            |         |
| 2       | B 17-2        | 27       | 3.70     | 5.46      | 11.30   | -----     | 2.07          | 1.000             | Soaked            | 223.7        | 974.1  | -----                                | -----                          | 0.15                     | 0.05                             | -----                       | -----                        | -----                            |         |
| 3       | B 17-2        | 32       | 4.80     | 5.47      | 11.34   | -----     | 2.07          | 1.000             | Soaked            | 210.5        | 913.3  | -----                                | -----                          | 0.23                     | 0.08                             | -----                       | -----                        | -----                            |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |

**S & R Geotechniques Pvt. Ltd.**

JOB NO. : PNS10206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
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Authorised By



## S & R Geotechniques Pvt. Ltd.

Report No: SRGeo/Lab/PNS10206/Rep-3/R0

Date: 18.05.2023

### SILT FACTOR As per IRC:5-2015

**Project :** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Principal Client :** M/s. EGIS Consulting Engineers Pvt. Ltd.

**Client :** M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.

**Sample ID:** Bridge No. 17 (From River Bed).

**Coordinates:** ----

Table No. 01

| Sieve Designation | Sieve Opening | Weight of Soil | Percent Retained |
|-------------------|---------------|----------------|------------------|
|                   | (mm)          | Retained (gm)  |                  |
| 4.750 mm          | 4.750         | 10.51          | 10.51            |
| 2.000 mm          | 2.000         | 8.89           | 8.89             |
| 1.180 mm          | 1.180         | 8.99           | 8.99             |
| 0.600 mm          | 0.600         | 5.72           | 5.72             |
| 0.300 mm          | 0.300         | 3.87           | 3.87             |
| 0.150 mm          | 0.150         | 8.53           | 8.53             |
| 0.075 mm          | 0.075         | 3.55           | 3.55             |
| Pan               |               | 49.94          | 49.94            |
|                   | <b>Total</b>  | <b>100.00</b>  | <b>100.00</b>    |

Table No. 02

| Sieve No.         | Average Size (mm) | Percentage of Weight Retained | Column (2) x Column (3) |
|-------------------|-------------------|-------------------------------|-------------------------|
| <b>1</b>          | <b>2</b>          | <b>3</b>                      | <b>4</b>                |
| 4.750 mm          | 4.75              | 10.51                         | 49.92                   |
| 4.750 to 2.000 mm | 3.38              | 8.89                          | 30.00                   |
| 2.000 to 1.180 mm | 1.59              | 8.99                          | 14.29                   |
| 1.180 to 0.600 mm | 0.89              | 5.72                          | 5.09                    |
| 0.600 to 0.300 mm | 0.45              | 3.87                          | 1.74                    |
| 0.300 to 0.150 mm | 0.23              | 8.53                          | 1.92                    |
| 0.150 to 0.075 mm | 0.11              | 3.55                          | 0.40                    |
| 0.075 mm & below  | 0.04              | 49.94                         | 1.87                    |
|                   |                   | <b>Total</b>                  | <b>105.24</b>           |

Weighted mean diameter

$$d_m = 105.24/100$$

$$d_m = 1.0524$$

$$\text{Say } 1.05$$

Where,

$$\text{Silt Factor } k_{sf} = 1.76\sqrt{d_m}$$

$$K_{sf} = 1.806$$

$$\text{So, Silt Factor} = 1.806$$

**S & R Geotechniques Pvt. Ltd.**

**JOB NO.**

**PNS10206**

(Pooja Patil - Report Engineer)

Prepared By

(Atul Bopche - Dy. Technical Manager)

Reviewed By



(Atul Chaudhari - Technical Manager)

Authorised By

\*\*\*\*End of Report\*\*\*\*




## S & R Geotechniques Pvt. Ltd.

|                       |   |                 |
|-----------------------|---|-----------------|
| Report No. :          | SRGeo/Lab/PNS10206/Rep.-3/R0  | Date:17.05.2023 |
| Lab Reference No. :   | Lab/2023/May/Chem/L-03  | Page:2 of 2     |
| Name of the Project : | Geotechnical Investigation For DMIDC Dighi port Industrial Area, Indapur. |                 |
| Client Name:          | M/s. P.N.Shidhore Civil Engineers (I) Pvt.Ltd.                            |                 |


### Annexure -1 Summary of Laboratory Test Results of Water Chemical

| Sr. No. | BH No. | Type of Sample | Chemical Analysis of Water Samples     |   |   |  | Remarks |
|---------|--------|----------------|--|---|---|--|---------|
|         |        |                | pH Value<br>IS 3025 (Part 11):<br>1983 | Sulphate<br>(as $\text{SO}_4^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Sulphite<br>(as $\text{SO}_3^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Chloride<br>IS 3025 (Part 32):<br>1988 |         |
|         |        |                |  | mg/l  | mg/l  | mg/l                                   |         |
| 1       | B17-1  | Water Sample   | 7.53                                   | 7.41  | 6.17  | 9.00                                   |         |

  
Prepared By  
(Akshata Ghone- Chemist)

  
Checked By  
(Yogesh Navkar-Quality Manager)



  
Authorized By  
(J.S.Salunkhe-M.D. & Tech. Manager)

\*\*\*\*\*END OF REPORT\*\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 18)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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## **Geotechnical Investigation Report (Bridge No. 18)**

### **Table of Contents**

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## Geotechnical Investigation Report (Bridge No. 18)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

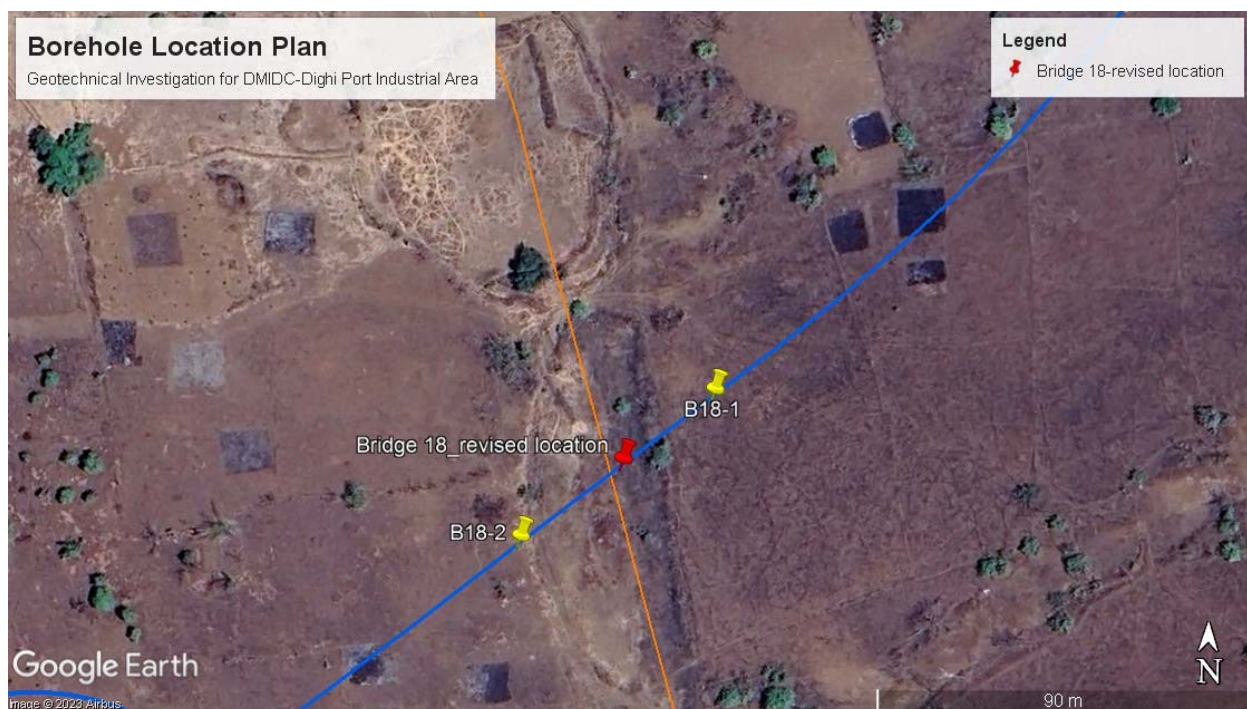
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B18-1, B18-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth  |
|--------------|----------|---------|--------|
| B18-1        | 2031618  | 319725  | 10.00m |
| B18-2        | 2031587  | 319679  | 8.85m  |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil which includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock.

**Silt Factor-** Representative disturbed samples were collected from the river bed for calculating the Silt Factor. The Silt Factor value for this location is 2.92 (as per IRC78:2014 & IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)).

Encountered soil/rock layers are described below;

#### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 2.85m to 4.00m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 2.85m to 4.00m below ground surface. Core Recoveries varied between 65% and 66%, while Rock Quality Designation (RQD) ranged between 24% and 45%. Compressive strength of rock core sample ranges from 1263 kg/cm<sup>2</sup> to 1604 kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.85m to 5.00m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.85m to 5.00m below ground surface in the boreholes. The bedrock was sound, inclined and vertical veins are observed. Core Recoveries varied between 80% and 98%, while Rock Quality Designation (RQD) ranged between 28% and 98%. Compressive strength of rock core sample ranges from 1221 kg/cm<sup>2</sup> to 1416 kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 8.85m to 10.00m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths of 6.00m to 6.30m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Moderately weathered rock (MWR) was encountered at depths of 2.85m to 4.00m below ground surface. In this layer compressive strength of rock core samples ranged between 1221 kg/cm<sup>2</sup> to 1416 kg/cm<sup>2</sup>.

As per minimum compressive strength 1221 kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| <b>Borehole Numbers</b> | <b>MWR</b> | <b>Hard Rock</b> |
|-------------------------|------------|------------------|
| B18-1                   | 4.00m      | 5.00m            |
| B18-2                   | 2.85m      | 3.85m            |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Based on chemical results, the site falls under Class V for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 400 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.40                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -2.85m to -4.00m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.85m to -5.00m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 12210 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 12210 = 1221 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**



## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.
- 7) IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)
- 8) IRC78:2014 Standard Specifications and code of practice for Road Bridges



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.




P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.






| BORE LOG  |        |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
|---|--------|------------------------------|---|---------------------------------|------------|-------------------------------------|---|-------------------------|---|-----------------|--------------------------|----------------|--------|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |                                 |            |                                     | Client :EGIS Consulting Engineers Pvt. Ltd. |                         |   |                 |                          |                |        |                             |
| Type of Boring  |        | Calyx with Bent. with casing |   | Calyx with Bent. without casing |            | Job No. : BRIDGE 18                 |   |                         |   |                 |                          |                |        |                             |
| Dia of Hole (mm):   |        | 100.00                       |   | 75.00                           |            | Bore Hole No.: B18-1                |   |                         |   |                 |                          |                |        |                             |
| Depth (M):  |        | 0.00-2.50                    |   | 2.50-10.00                      |            | Co-ordinates : N=2031618, E=319725  |   |                         |   |                 |                          |                |        |                             |
| Commenced on : 27 May 2023  |        |                              | Completed on : 28 May 2023                    |                                 |            | Ground Bed RL: 77.50M.              |   |                         |   |                 |                          |                |        |                             |
| Water Struc :   |        |                              | Ground Water : 6.30M. Seasonal.               |                                 |            | Location of Bore Hole : As per plan |   |                         |   |                 |                          |                |        |                             |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                         | Symbol                          | SPT Record |                                     |   |                         |   | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |
|   |        |                              |   |                                 | 0-150      | 150-300                             | 300-450                                     | 450-600                 | N |                 |                          |                |        |                             |
| 0.00  |        | 0.00 To 0.30                 | BROWNISH MURUM, PEBBLES, COBBLES AND BOULDERS |                                 |            |                                     |   |                         |   | DS-1            | 0.20                     | 16.00          | 0.00   |                             |
|   |        | 1 TO 4                       |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
|   |        |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
|   |        | 1.80 To 2.50                 |   |                                 |            |                                     |   |                         |   | 5 TO 8          | 0.25                     | 35.00          | 0.00   |                             |
|   |        | 2.50 To 4.00                 |   |                                 |            |                                     |   |                         |   | 9 TO 18         | 0.70                     | 46.00          | 10.00  |                             |
| 4.00  | 4.00   |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
| 4.00  |        | 4.00 To 5.00                 | BROWNISH GREY MODERATELY WEATHERED ROCK       |                                 |            |                                     |   |                         |   | 19 TO 25        | 0.66                     | 66.00          | 45.00  |                             |
| 5.00  | 5.00   |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
| 5.00  |        | 5.00 To 6.50                 | GREY BASALT                                   |                                 |            |                                     |   |                         |   | 26 TO 39        | 1.47                     | 98.00          | 28.00  | Inclined and vertical veins |
|   |        | 6.50 To 8.00                 |   |                                 |            |                                     |   |                         |   | 40 TO 49        | 1.28                     | 86.00          | 46.00  |                             |
|   |        | 8.00 To 9.00                 |   |                                 |            |                                     |   |                         |   | 50 TO 56        | 0.89                     | 89.00          | 44.00  |                             |
|   |        | 9.00 To 10.00                |   |                                 |            |                                     |   |                         |   | 57 TO 61        | 0.80                     | 80.00          | 60.00  |                             |
| 10.00   | 10.00  |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
| Bore Hole Terminated at : 10.00   |        |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |                                 |            |                                     |   |                         |   |                 |                          |                |        |                             |
| No. of disturbed Sample : 1   |        |                              |   | No. of U.D.S. : 0               |            |                                     |   | No. of Vane Test : 0    |   |                 |                          |                |        |                             |
|   |        |                              |   | No. of S.P.T. : 0               |            |                                     |   | No. of Water Sample : 0 |   |                 |                          |                |        |                             |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |              |                              |   |   |                                 |         |         |                                     |   |   |                          |                |        |                             |
|---|--------------|------------------------------|---|---|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |              |                              |   |   |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                             |
| Type of Boring  |              | Calyx with Bent. with casing |   |   | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 18                 |   |   |                          |                |        |                             |
| Dia of Hole (mm):   |              | 100.00                       |   |   | 75.00                           |         |         | Bore Hole No.: B18-2                |   |   |                          |                |        |                             |
| Depth (M):  |              | 0.00-3.00                    |   |   | 3.00-8.85                       |         |         | Co-ordinates : N=2031587, E=319679  |   |   |                          |                |        |                             |
| Commenced on : 26 May 2023  |              |                              |   | Completed on : 27 May 2023  |                                 |         |         | Ground Bed RL: 76.24M.              |   |   |                          |                |        |                             |
| Water Struc :   |              |                              |   | Ground Water : 6.00M. Seasonal.   |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                             |
| From (M)  | To (M)       | Sample Depth (M)             | Description of Strata                         | Symbol  | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |
|   |              |                              |   |   | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                             |
| 0.00  |              | 0.00 To 0.35                 | BROWNISH MURUM, COBBLES, PEBBLES AND BOULDERS |   |                                 |         |         |                                     |   | DS-1  | 0.20                     | 13.00          | 0.00   |                             |
|   |              | 1 TO 4                       |   |   |                                 |         |         |                                     |   |   |                          |                |        |                             |
|   |              | 5 TO 7                       |   |   |                                 |         |         |                                     |   |   |                          |                |        |                             |
| 2.85  |              | 1.85 To 2.85                 |   |   |                                 |         |         |                                     |   | 0.12  | 12.00                    | 0.00           |        |                             |
| 2.85  |              | 2.85 To 3.85                 | GREY MODERATELY WEATHERED ROCK                |  |                                 |         |         |                                     |   | 8 TO 15                                     | 0.65                     | 65.00          | 24.00  |                             |
| 3.85  |              | 3.85 To 5.35                 | GREY BASALT                                   |  |                                 |         |         |                                     |   | 16 TO 25                                    | 1.46                     | 97.00          | 64.00  | Inclined and vertical veins |
| 8.85  | 5.35 To 6.85 | 26 TO 36                     |   |   |                                 |         |         |                                     |   | 1.48  | 98.00                    | 80.00          |        |                             |
|   | 6.85 To 7.85 | 37 TO 39                     |   |   |                                 |         |         |                                     |   | 0.98  | 98.00                    | 96.00          |        |                             |
|   | 7.85 To 8.85 | 40 TO 44                     |   |   |                                 |         |         |                                     |   | 0.81  | 81.00                    | 69.00          |        |                             |
| Bore Hole Terminated at : 8.85  |              |                              |   |   |                                 |         |         |                                     |   |   |                          |                |        |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |              |                              |   |   |                                 |         |         |                                     |   |   |                          |                |        |                             |
| No. of disturbed Sample : 1   |              |                              |   |   | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                             |
| No. of S.P.T. : 0   |              |                              |   |   | No. of Water Sample : 0         |         |         |                                     |   |   |                          |                |        |                             |

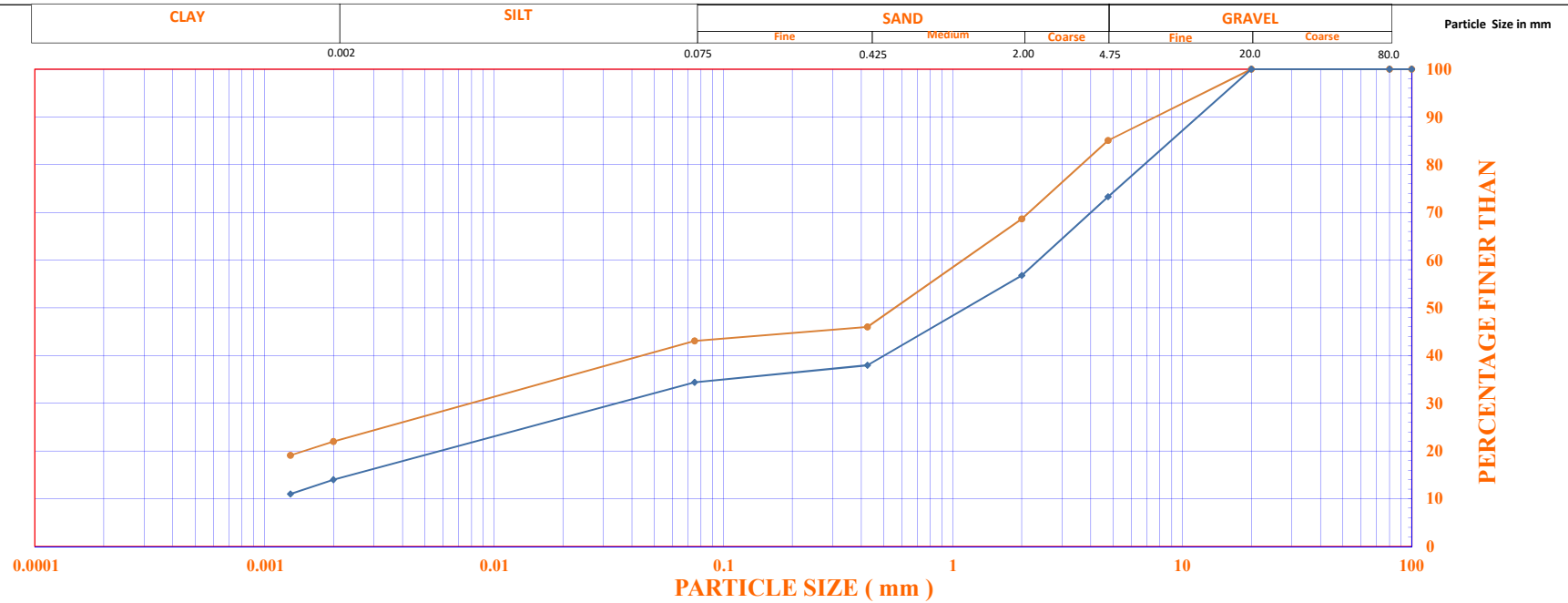
|    |            | SOIL TEST DATA SHEET  |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
|---|------------|---|--|---------------------|--|---|---|--------|--|--------|---|--|------------------------------------|--|---|--|--|---------------|--|-----------------------|---------------------------------------|---------|
| Report No. :-   |            | SRGeo/Lab/PNS10206/Rep-7/R0   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| Project :-  |            | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| Principal Client :-   |            | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| Client:-  |            | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| Location:-  |            | Bridge No. 18   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  | DATE:         |  | 05.06.2023            |                                       |         |
| BH No.  | Depth* (m) | Sample Type *   | Density Test<br>(IS: 2720 - Part-8 : 1983)       |                     | Moisture Content (%)<br>(IS: 2720 - Part-2 : 1973) | Soil Classification<br>(IS: 1498-1970)  | Mechanical Analysis<br>(IS: 2720 - Part-4 : 1985) |        |  |        | Consistency Limits<br>(IS: 2720- Part-5 : 1985) |  |                                    | Shrinkage Limit<br>(IS: 2720- Part-6 : 1972) | Free Swell Index %<br>(IS:2720 - Part-40 : 1977 ) | Triaxial Test<br>(IS:2720 Part-11: 1993) |  |               | Vertical Consolidation<br>(IS:2720 Part-15 : 1965) |                       | Specific Gravity<br>(IS:2720 Part-03) | Remarks |
|   |            |   | Wet Density (gm/cc)                              | Dry Density (gm/cc) |  |   | Gravel %  | Sand % | Silt %   | Clay % | Liquid %  | Plastic %  | Plasticity Index, I <sub>p</sub> % |  |   | Type                                     | Cohesion C <sub>u</sub> kg/cm <sup>2</sup> | Degree $\phi$ | Comp. Index C <sub>c</sub> (Lab)                   | Initial Void Ratio, e |                                       |         |
| B 18-01   | 0.00-0.30  | DS-01   | ---  | ---                 | ---  | SC  | 15  | 42     | 21   | 22     | 37  | 24   | 13                                 | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.64                                  |         |
| B 18-02   | 0.00-0.35  | DS-01   | ---  | ---                 | ---  | SC  | 27  | 39     | 20   | 14     | 31  | 23   | 8                                  | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.65                                  |         |
|   |            |   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
|   |            |   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
|   |            |   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| CHEM : Chemical Analysis  |            |   | Tuu : Triaxial Test ( Unconsolidated Undrained ) |                     |  | SP : Swelling Pressure or Swelling Potential Test   |   |        | $\phi$ : Angle of Internal Friction            |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| COMP : Compaction Test  |            |   | Tcu : Triaxial Test ( Consolidated Undrained )   |                     |  | SPT : Standard Penetration Test Sample  |   |        | Cu : Undrained Cohesion                        |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| DS : Direct Shear   |            |   | Tcd : Triaxial Test ( Consolidated Drained )     |                     |  | UDS : Undisturbed Soil Sample   |   |        | $\phi'$ : Effective Angle of Internal Friction |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| K : Permeability Test   |            |   | NP : Non Plastic                                 |                     |  | VL : Laboratory Vane Shear Test   |   |        | Cu' : Effective Cohesion                       |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| FSI : Free Swell Test   |            |   | SL : Shrinkage Limit Test                        |                     |  | UC : Unconfined Compression Test  |   |        | NPO : Not Possible                             |        |   |  |                                    |  |   |  |  |               |  |                       |                                       |         |
| S & R Geotechniques Pvt. Ltd.   |            |   |  |                     |  |   |   |        |  |        |   |  |                                    |  |   | JOB NO : PNSI0206                        |  |               |  |                       |                                       |         |
| <br>(Pooja Patil - Report Engineer)<br>Prepared By |            |   |  |                     |  | <br>(Atul Bopche - Dy. Technical Manager)<br>Reviewed By |   |        |  |        |   |  <br>(Atul Chaudhari - Technical Manager)<br>Authorized By |                                    |  |   |  |  |               |  |                       |                                       |         |

## GRAIN SIZE DISTRIBUTION CURVE (IS 2720: PART 4)

**Project :-** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Location:-** Bridge No. 18

S & R Geotechniques Pvt. Ltd.



JOB NO : PNSI0206

| Symbol | BH No.  | Depth* (m) | Classification<br>(IS 1498) | Gravel | Sand | Silt | Clay | $\Phi_{10\%}$ | $\Phi_{30\%}$ | $\Phi_{60\%}$ | Coeff. of<br>Uniformity,<br>$C_u = D_{60} / D_{10}$ | Coeff. Of<br>Curvature<br>$C_c = D_{30}^2 / (D_{60} * D_{10})$ | Liquid Limit, $W_L$ | Plastic Limit, $W_p$ | Plasticity Index, $I_p$ | Remarks |
|--------|---------|------------|-----------------------------|--------|------|------|------|---------------|---------------|---------------|---|--|---------------------|----------------------|-------------------------|---------|
|        |         |            |                             | %      | %    | %    | %    | mm            | mm            | mm            |   |  |                     |                      |                         |         |
| —●—    | B 18-01 | 0.00-0.30  | SC                          | 15     | 42   | 21   | 22   | ---           | ---           | ---           | ---   | ---  | 37                  | 24                   | 13                      | DS-01   |
| —■—    | B 18-02 | 0.00-0.35  | SC                          | 27     | 39   | 20   | 14   | ---           | ---           | ---           | ---   | ---  | 31                  | 23                   | 8                       | DS-01   |
| —▲—    |         |            |                             |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —*—    |         |            |                             |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —◆—    |         |            |                             |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |

*[Signature]*

(Pooja Patil - Report Engineer)  
Prepared By

*[Signature]*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



*[Signature]*

(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

|                     |   |  |               |
|---------------------|---|--|---------------|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep.-07/R0   | DATE :   | 05.06.2023    |
| Project :-          | Geotechnical Investigation For DMIDC Dighi Port Industrial Area, Indapur. |  |               |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | Orientation of Loading axis with respect to anisotropy : | Perpendicular |
| Client :-           | M/s. P.N.Shidore Civil Engineers Pvt.Ltd.                                 | Enviromental condition at storage:                       | (± 2) 27.0 °C |
| Location :-         | Bridge No. 18   | Room Temperature:  | 27.0 °C       |
| Co-Ordinates :-     | ----  | Pace Rate (KN/Sec) :                                     | 1.5           |

| Sr. No. | Bore Hole No. | Core No. | Depth, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Uniaxial Compressive Strength (IS 9143:1979) | Modulus of Elasticity (IS 9221:1979) | Poisson's Ratio (IS 9221:1979) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|---------------|----------|----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|--|--------------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |               |          |          | cm        | cm      | cm        |               |                   |                   | kN           | kg/cm <sup>2</sup>                           | kg/cm <sup>2</sup>                   | ----                           | %                        | %                                | g/cm <sup>3</sup>           | g/cm <sup>3</sup>            |                                  |         |
| 1       | B 18-1        | 20       | 4.10     | 5.42      | 11.46   | -----     | 2.11          | 1.000             | Soaked            | 363.0        | 1604.2                                       | -----                                | -----                          | 0.11                     | 0.04                             | -----                       | -----                        | -----                            |         |
| 2       | B 18-1        | 32       | 5.80     | 5.46      | 11.30   | -----     | 2.07          | 1.000             | Soaked            | 280.4        | 1221.0                                       | -----                                | -----                          | 0.15                     | 0.05                             | -----                       | -----                        | -----                            |         |
| 3       | B 18-2        | 14       | 3.40     | 5.46      | 10.50   | -----     | 1.92          | 0.991             | Soaked            | 292.8        | 1263.8                                       | -----                                | -----                          | 0.37                     | 0.13                             | -----                       | -----                        | -----                            |         |
| 4       | B 18-2        | 19       | 4.20     | 5.40      | 11.59   | -----     | 2.15          | 1.000             | Soaked            | 318.1        | 1416.2                                       | -----                                | -----                          | 0.41                     | 0.14                             | -----                       | -----                        | -----                            |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |

S & R Geotechniques Pvt. Ltd.

JOB NO. :

PNS10206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



(Atul Chaudhari - Technical Manager)  
Authorised By



## S & R Geotechniques Pvt. Ltd.

Report No: SRGeo/LAB/PNS10206/Rep-7/R0

Date: 05.06.2023

### SILT FACTOR As per IRC:5-2015

**Project :** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Principal Client :** M/s. EGIS Consulting Engineers Pvt. Ltd.

**Client :** M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.

**Sample ID:** Bridge No. 18 (From River Bed).

**Coordinates:** ----

Table No. 01

| Sieve Designation | Sieve Opening | Weight of Soil | Percent Retained |
|-------------------|---------------|----------------|------------------|
|                   | (mm)          | Retained (gm)  |                  |
| 4.750 mm          | 4.750         | 15.13          | 15.13            |
| 2.000 mm          | 2.000         | 43.97          | 43.97            |
| 1.180 mm          | 1.180         | 32.20          | 32.20            |
| 0.600 mm          | 0.600         | 4.49           | 4.49             |
| 0.300 mm          | 0.300         | 0.41           | 0.41             |
| 0.150 mm          | 0.150         | 0.25           | 0.25             |
| 0.075 mm          | 0.075         | 0.11           | 0.11             |
| Pan               |               | 3.44           | 3.44             |
|                   | <b>Total</b>  | <b>100.00</b>  | <b>100.00</b>    |

Table No. 02

| Sieve No.         | Average Size (mm) | Percentage of Weight Retained | Column (2) x Column (3) |
|-------------------|-------------------|-------------------------------|-------------------------|
| <b>1</b>          | <b>2</b>          | <b>3</b>                      | <b>4</b>                |
| 4.750 mm          | 4.75              | 15.10                         | 71.73                   |
| 4.750 to 2.000 mm | 3.38              | 43.97                         | 148.40                  |
| 2.000 to 1.180 mm | 1.59              | 32.20                         | 51.20                   |
| 1.180 to 0.600 mm | 0.89              | 4.49                          | 4.00                    |
| 0.600 to 0.300 mm | 0.45              | 0.41                          | 0.18                    |
| 0.300 to 0.150 mm | 0.23              | 0.25                          | 0.06                    |
| 0.150 to 0.075 mm | 0.11              | 0.11                          | 0.01                    |
| 0.075 mm & below  | 0.04              | 3.44                          | 0.13                    |
|                   |                   | <b>Total</b>                  | <b>275.700</b>          |

Weighted mean diameter

$$d_m = 2.75699975$$

Say **2.76**

Where,

$$\text{Silt Factor } k_{sf} = 1.76\sqrt{d_m}$$

$$K_{sf} = 2.92$$

So, Silt Factor = 2.92

**S & R Geotechniques Pvt. Ltd.**

**JOB NO.**

**PNS10206**

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



(Atul Chaudhari - Technical Manager)  
Authorised By

\*\*\* End of Report\*\*\*







## S & R Geotechniques Pvt. Ltd.

|                       |   |                 |
|-----------------------|---|-----------------|
| Report No. :          | SRGeo/Lab/PNS10206/Rep.-7/R0  | Date:05.06.2023 |
| Lab Reference No. :   | Lab/2023/June/Chem/L-09   | Page:2 of 2     |
| Name of the Project : | Geotechnical Investigation For DMIDC Dighi port Industrial Area, Indapur. |                 |
| Principal Client:     | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |                 |
| Client Name:          | M/s. P.N.Shidhore Civil Engineers (I) Pvt.Ltd.                            |                 |


### Annexure -1 Summary of Laboratory Test Results of Water Chemical

| Sr. No. | BH No. | Type of Sample | Chemical Analysis of Water Samples     |   |   |  | Remarks |
|---------|--------|----------------|--|---|---|--|---------|
|         |        |                | pH Value<br>IS 3025 (Part 11):<br>1983 | Sulphate<br>(as $\text{SO}_4^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Sulphite<br>(as $\text{SO}_3^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Chloride<br>IS 3025 (Part 32):<br>1988 |         |
|         |        |                |  | mg/l  | mg/l  | mg/l                                   |         |
| 1       | B18-2  | Water Sample   | 6.20                                   | 13.99   | 11.66   | 16.49                                  |         |
|         |        |                |  |   |   |  |         |
|         |        |                |  |   |   |  |         |
|         |        |                |  |   |   |  |         |

  
Prepared By  
(Akshata Ghone- Chemist)

  
Checked By  
(Yogesh Navkar-Quality Manager)



  
Authorized By  
(J.S.Salunkhe-M.D. & Tech. Manager)

\*\*\*\*END OF REPORT\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 20)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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## Geotechnical Investigation Report (Bridge No. 20)

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| 2.3 Groundwater Levels                         | 5        |
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## Geotechnical Investigation Report (Bridge No. 20)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

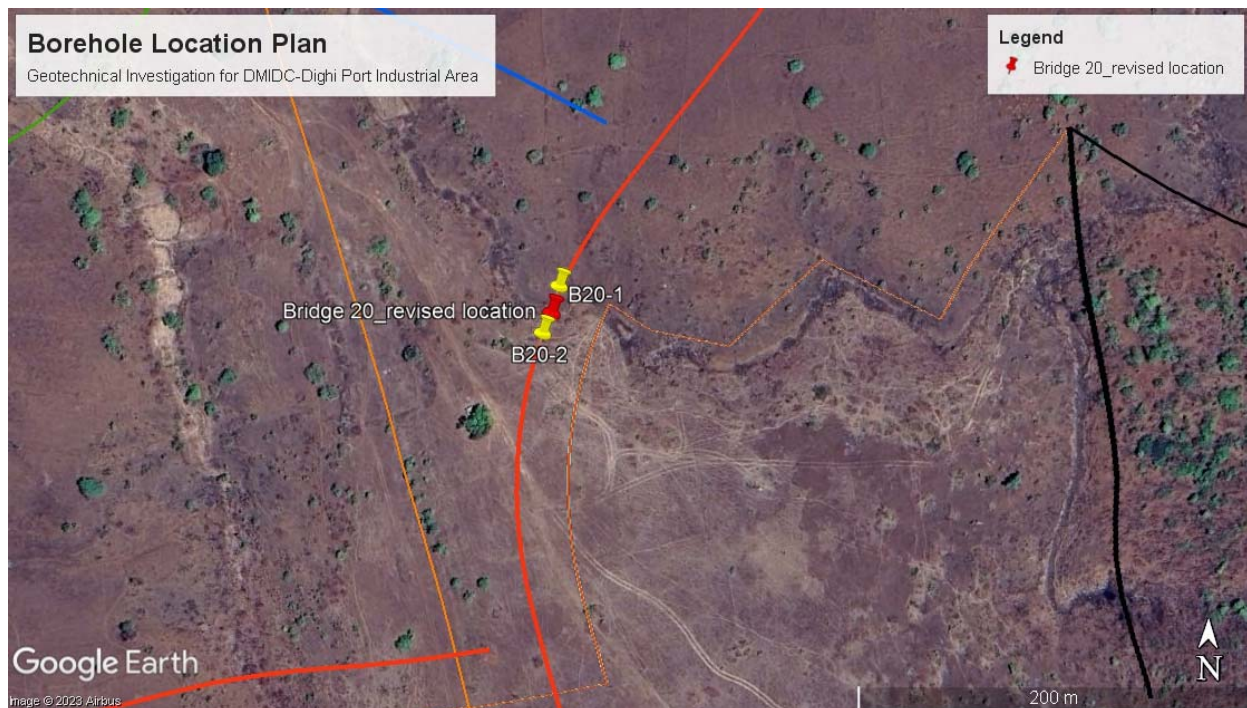
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B20-1, B20-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B20-1        | 2031245  | 319902  | 8.00m |
| B20-2        | 2031221  | 319899  | 9.00m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil which includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock.

**Silt Factor-** Representative disturbed samples were collected from the river bed for calculating the Silt Factor. The Silt Factor value for this location is 1.83 (as per IRC78:2014 & IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)).

Encountered soil/rock layers are described below;

#### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 1.80m to 3.00m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 1.80m to 3.00m below ground surface. Core Recoveries varied between 64% and 65%, while Rock Quality Designation (RQD) ranged between 26% and 47%. Compressive strength of rock core sample ranges from 1047kg/cm<sup>2</sup> to 1392kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.00m to 4.00m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.00m to 4.00m below ground surface in the boreholes. The bedrock was sound, inclined and vertical veins are observed. Core Recoveries varied between 80% and 97%, while Rock Quality Designation (RQD) ranged between 45% and 88%. Compressive strength of rock core sample ranges from 873kg/cm<sup>2</sup> to 1254kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.05m to 9.60m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depth 6.00m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Moderately weathered rock (MWR) was encountered at depths of 1.80m to 3.00m below ground surface. In this layer compressive strength of rock core samples ranged between 1047kg/cm<sup>2</sup> to 1392kg/cm<sup>2</sup>.

As per minimum compressive strength 873kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| <b>Borehole Numbers</b> | <b>MWR</b> | <b>Hard Rock</b> |
|-------------------------|------------|------------------|
| B20-1                   | 1.80m      | 3.00m            |
| B20-2                   | 3.00m      | 4.00m            |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Based on chemical results, the site falls under Class V for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 400 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.40                  |
| Minimum Cover to Reinforcement:             | 50mm                  |





## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -1.80m to -3.00m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.00m to -4.00m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 8730 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 8730 = 873 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.
- 7) IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)
- 8) IRC78:2014 Standard Specifications and code of practice for Road Bridges



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG   |        |                              |  |                                 |                                |                                    |   |                                     |   |                 |                          |                |        |                |
|--|--------|------------------------------|--|---------------------------------|--------------------------------|------------------------------------|---|-------------------------------------|---|-----------------|--------------------------|----------------|--------|----------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                     |        |                              |  |                                 |                                |                                    | Client :EGIS Consulting Engineers Pvt. Ltd. |                                     |   |                 |                          |                |        |                |
| Type of Boring   |        | Calyx with Bent. with casing |  | Calyx with Bent. without casing |                                | Job No. : BRIDGE 20                |   |                                     |   |                 |                          |                |        |                |
| Dia of Hole (mm):  |        | 100.00                       |  | 75.00                           |                                | Bore Hole No.: B20-1               |   |                                     |   |                 |                          |                |        |                |
| Depth (M):   |        | 0.00-2.50                    |  | 2.50-8.00                       |                                | Co-ordinates : N=2031245, E=319902 |   |                                     |   |                 |                          |                |        |                |
| Commenced on : 23 May 2023   |        |                              |  | Completed on : 24 May 2023      |                                |                                    |   | Ground Bed RL: 70.81M.              |   |                 |                          |                |        |                |
| Water Struc :  |        |                              |  | Ground Water : 6.00M. Seasonal. |                                |                                    |   | Location of Bore Hole : As per plan |   |                 |                          |                |        |                |
| From (M)   | To (M) | Sample Depth (M)             | Description of Strata                        | Symbol                          | SPT Record                     |                                    |   |                                     |   | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks        |
|  |        |                              |  |                                 | 0-150                          | 150-300                            | 300-450                                     | 450-600                             | N |                 |                          |                |        |                |
| 0.00   | 1.80   | 0.00 To 0.30                 | BROWNISH MURUM,COBBLES, PEBBLES AND BOULDERS |                                 |                                |                                    |   |                                     |   | DS-1            |                          |                |        |                |
|  |        | 0.30 To 1.80                 |  |                                 |                                |                                    |   |                                     |   | 1 TO 2          | 0.15                     | 10.00          | 0.00   |                |
|  |        |                              |  |                                 |                                |                                    |   |                                     |   |                 |                          |                |        |                |
| 1.80   | 3.00   | 1.80 To 3.00                 | BROWNISH GREY MODERATELY WEATHERED ROCK      |                                 |                                |                                    |   |                                     |   | 3 TO 8          | 0.77                     | 64.00          | 47.00  |                |
| 3.00   | 8.00   | 3.00 To 4.50                 | GREY BASALT                                  |                                 |                                |                                    |   |                                     |   | 9 TO 13         | 1.46                     | 97.00          | 88.00  | Inclined veins |
|  |        |                              |  |                                 |                                |                                    |   |                                     |   | 14 TO 15        | 0.80                     | 80.00          | 79.00  |                |
|  |        |                              |  |                                 |                                |                                    |   |                                     |   | 16 TO 17        | 0.81                     | 81.00          | 80.00  |                |
|  |        |                              |  |                                 |                                |                                    |   |                                     |   | 18 TO 19        | 1.25                     | 83.00          | 82.00  |                |
|  |        |                              |  |                                 |                                |                                    |   |                                     |   |                 |                          |                |        |                |
|  |        |                              |  |                                 | Bore Hole Terminated at : 8.00 |                                    |   |                                     |   |                 |                          |                |        |                |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standardr Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |  |                                 |                                |                                    |   |                                     |   |                 |                          |                |        |                |
| No. of disturbed Sample : 1  |        |                              |  | No. of U.D.S. : 0               |                                |                                    |   | No. of Vane Test : 0                |   |                 |                          |                |        |                |
|  |        |                              |  | No. of S.P.T. : 0               |                                |                                    |   | No. of Water Sample : 0             |   |                 |                          |                |        |                |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |              |                              |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
|---|--------------|------------------------------|--|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|--------------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |              |                              |  |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                                |
| Type of Boring  |              | Calyx with Bent. with casing |  |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 20                 |   |   |                          |                |        |                                |
| Dia of Hole (mm):   |              | 100.00                       |  |                                 | 75.00                           |         |         | Bore Hole No.: B20-2                |   |   |                          |                |        |                                |
| Depth (M):  |              | 0.00-3.00                    |  |                                 | 3.00-9.00                       |         |         | Co-ordinates : N=2031221, E=319899  |   |   |                          |                |        |                                |
| Commenced on : 21 May 2023  |              |                              |  | Completed on : 22 May 2023      |                                 |         |         | Ground Bed RL: 71.66M               |   |   |                          |                |        |                                |
| Water Struc :   |              |                              |  | Ground Water : 6.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                                |
| From (M)  | To (M)       | Sample Depth (M)             | Description of Strata                        | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                        |
|   |              |                              |  |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                                |
| 0.00  |              | 0.00 To 0.35                 | BROWNISH MURUM,COBBLES, PEBBLES AND BOULDERS |                                 |                                 |         |         |                                     |   | DS-1  | 0.40                     | 34.00          | 0.00   |                                |
|   |              | 0.35 To 1.50                 |  |                                 |                                 |         |         |                                     |   | 1 TO 5                                      |                          |                |        |                                |
|   |              | 1.50 To 3.00                 |  |                                 |                                 |         |         |                                     |   | 6 TO 11                                     |                          |                |        |                                |
| 3.00  |              | 3.00 To 4.00                 | BROWNISH GRAY MODERATELY WEATHERED ROCK      |                                 |                                 |         |         |                                     |   | 12 TO 17                                    | 0.65                     | 65.00          | 26.00  |                                |
| 4.00  |              | 4.00 To 5.50                 | GRAY BASALT                                  |                                 |                                 |         |         |                                     |   | 18 TO 24                                    | 1.33                     | 88.00          | 83.00  | Inclined veins, vertical veins |
| 9.00  | 5.50 To 7.00 | 25 TO 31                     |  |                                 |                                 |         |         |                                     |   | 1.40  | 90.00                    | 60.00          |        |                                |
|   | 7.00 To 8.00 | 32 TO 35                     |  |                                 |                                 |         |         |                                     |   | 0.87  | 87.00                    | 45.00          |        |                                |
|   | 8.00 To 9.00 | 36 TO 40                     |  |                                 |                                 |         |         |                                     |   | 0.94  | 94.00                    | 70.00          |        |                                |
|   |              |                              |  |                                 | Bore Hole Terminated at : 9.00  |         |         |                                     |   |   |                          |                |        |                                |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |              |                              |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                                |
| No. of disturbed Sample : 1   |              |                              |  |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                                |
|   |              |                              |  |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                                |



SOIL TEST DATA SHEET

|                     |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
|---------------------|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|------------|--|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep-5/R0   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Project :-          | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Client:-            | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Location:-          | Bridge No. 20   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | DATE: | 30.05.2023 |  |

| BH No.  | Depth* (m) | Sample Type * | Density Test<br>(IS: 2720 - Part-8 : 1983) |                     | Moisture Content (%)<br>(IS: 2720 - Part-2 : 1973) | Soil Classification<br>(IS: 1498-1970) | Mechanical Analysis<br>(IS: 2720 - Part-4 : 1985) |        |        |        | Consistency Limits<br>(IS: 2720- Part-5 : 1985) |           |                                    | Shrinkage Limit<br>(IS: 2720- Part-6 : 1972) | Free Swell Index %<br>(IS:2720 - Part-40 : 1977 ) | Triaxial Test<br>(IS:2720 Part-11: 1993) |  |               | Vertical Consolidation<br>(IS:2720 Part-15 : 1965) |                       | Specific Gravity<br>(IS:2720 Part-03) | Remarks |
|---------|------------|---------------|--|---------------------|--|--|---|--------|--------|--------|---|-----------|------------------------------------|--|---|--|--|---------------|--|-----------------------|---------------------------------------|---------|
|         |            |               | Wet Density (gm/cc)                        | Dry Density (gm/cc) |  |  | Gravel %  | Sand % | Silt % | Clay % | Liquid %  | Plastic % | Plasticity Index, I <sub>p</sub> % |  |   | Type                                     | Cohesion C <sub>u</sub> kg/cm <sup>2</sup> | Degree $\phi$ | Comp. Index C <sub>c</sub> (Lab)                   | Initial Void Ratio, e |                                       |         |
| B 20-01 | 0.00-0.30  | DS-01         | ---  | ---                 | ---  | GC                                     | 31  | 20     | 22     | 27     | 38  | 25        | 13                                 | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.64                                  |         |
| B 20-02 | 0.00-0.35  | DS-01         | ---  | ---                 | ---  | GC                                     | 32  | 18     | 25     | 25     | 36  | 24        | 12                                 | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.65                                  |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |

|                          |  |   |  |
|--------------------------|--|---|--|
| CHEM : Chemical Analysis | Tuu : Triaxial Test ( Unconsolidated Undrained ) | SP : Swelling Pressure or Swelling Potential Test | $\phi$ : Angle of Internal Friction            |
| COMP : Compaction Test   | Tcu : Triaxial Test ( Consolidated Undrained )   | SPT : Standard Penetration Test Sample            | Cu : Undrained Cohesion                        |
| DS : Direct Shear        | Tcd : Triaxial Test ( Consolidated Drained )     | UDS : Undisturbed Soil Sample                     | $\phi'$ : Effective Angle of Internal Friction |
| K : Permeability Test    | NP : Non Plastic                                 | VL : Laboratory Vane Shear Test                   | Cu' : Effective Cohesion                       |
| FSI : Free Swell Test    | SL : Shrikage Limit Test                         | UC : Unconfined Compression Test                  | NPO : Not Possible                             |

S & R Geotechniques Pvt. Ltd.

JOB NO : PNSI0206

*[Signature]*

(Pooja Patil - Report Engineer)  
Prepared By

*[Signature]*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



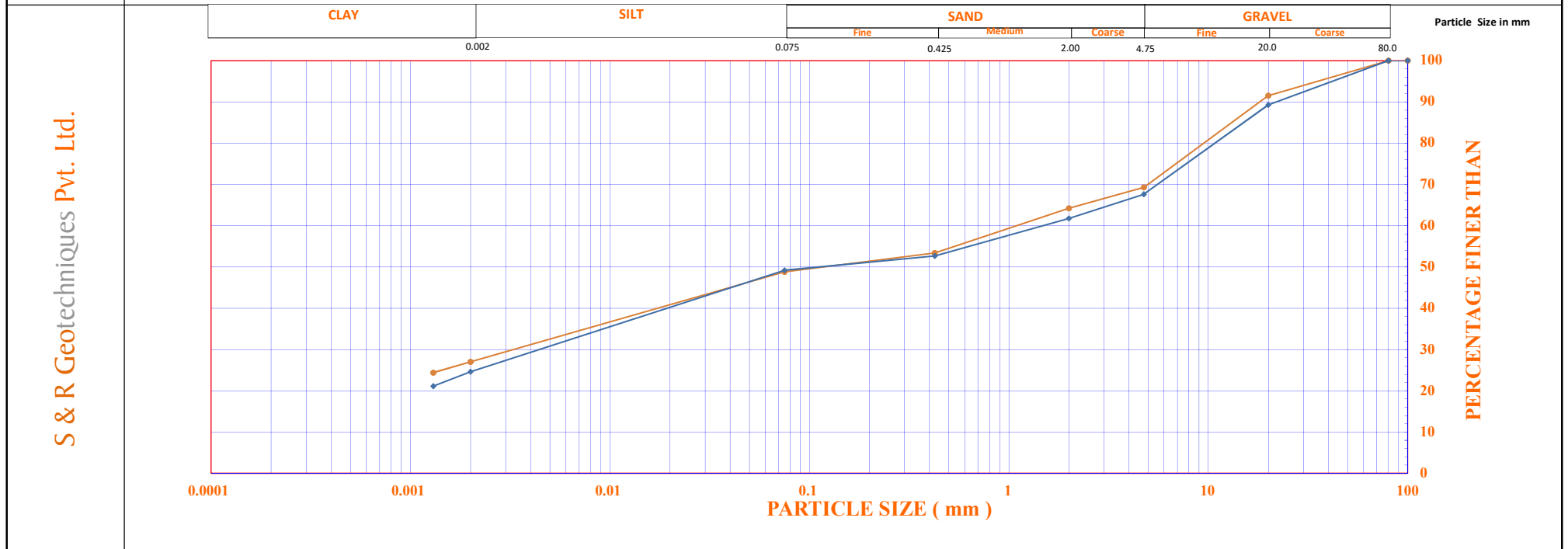
*[Signature]*

(Atul Chaudhari - Technical Manager)  
Authorized By

# GRAIN SIZE DISTRIBUTION CURVE (IS 2720: PART 4)

**Project :-** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Location:-** Bridge No. 20



**JOB NO : PNSI0206**

| Symbol | BH No.  | Depth* (m) | Classification ( IS 1498 ) | Gravel | Sand | Silt | Clay | $\Phi_{10\%}$ | $\Phi_{30\%}$ | $\Phi_{60\%}$ | Coeff. of Uniformity, $C_u = D_{60} / D_{10}$ | Coeff. Of Curvature $C_c = D_{30}^2 / (D_{60} * D_{10})$ | Liquid Limit, $W_L$ | Plastic Limit, $W_p$ | Plasticity Index, $I_p$ | Remarks |
|--------|---------|------------|----------------------------|--------|------|------|------|---------------|---------------|---------------|---|--|---------------------|----------------------|-------------------------|---------|
| —●—    | B 20-01 | 0.00-0.30  | GC                         | 31     | 20   | 22   | 27   | ---           | ---           | ---           | ---   | ---  | 38                  | 25                   | 13                      | DS-01   |
| —■—    | B 20-02 | 0.00-0.35  | GC                         | 32     | 18   | 25   | 25   | ---           | ---           | ---           | ---   | ---  | 36                  | 24                   | 12                      | DS-01   |
| —▲—    |         |            |                            |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —*—    |         |            |                            |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —◆—    |         |            |                            |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |

*[Signature]*

(Pooja Patil - Report Engineer)  
Prepared By

*[Signature]*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By






*[Signature]*

(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

| <b>Report No. :-</b>  |                | SRGeo/Lab/PNS10206/Rep.-5/RO   |              |           |         |           |                  |                   |                   |              |                                    | <b>DATE :</b>                             |                             | 30.05.2023                          |                                |                                 |                                     |                 |                    |
|---|----------------|--|--------------|-----------|---------|-----------|------------------|-------------------|-------------------|--------------|------------------------------------|---|-----------------------------|-------------------------------------|--------------------------------|---------------------------------|-------------------------------------|-----------------|--------------------|
| <b>Project :-</b>   |                | Geotechnical Investigation For DMIDC Dighi Port Industrial Area,Indapur. |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
| <b>Principal Client :-</b>  |                | M/s. EGIS Consulting Engineers Pvt. Ltd.                                 |              |           |         |           |                  |                   |                   |              |                                    | <b>Direction of Loading:</b>              |                             |                                     |                                | Axial                           |                                     |                 |                    |
| <b>Client :-</b>  |                | M/s. P.N Shidore Civil Engineer Pvt.Ltd                                  |              |           |         |           |                  |                   |                   |              |                                    | <b>Enviromental condition at storage:</b> |                             |                                     |                                | (±2) 27.0 °C                    |                                     |                 |                    |
| <b>Location :-</b>  |                | Bridge No. 20  |              |           |         |           |                  |                   |                   |              |                                    | <b>Room Temperature:</b>                  |                             |                                     |                                | 27.0 °C                         |                                     |                 |                    |
|   |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
| Sr. No.   | Bore Hole No.* | Core No.*  | Depth*,<br>m | Diameter, | Height, | Thickness | H : D<br>(1:H/D) | Correction Factor | Condition of Test | Failure Load | Point Load Index<br>(IS 8764:1998) | Brazilian Test<br>(IS 10082:1981)         | Porosity<br>(IS 13030:1991) | Water Absorption<br>(IS 13030:1991) | Dry Density<br>(IS 13030:1991) | Bulk Density<br>(IS 13030:1991) | Specific Gravity<br>(IS 1122: 1974) | Remarks         |                    |
|   |                |  |              | cm        | cm      | cm        |                  |                   |                   | kN           |                                    |   |                             |                                     |                                |                                 |                                     |                 | kg/cm <sup>2</sup> |
| 1   | B 20-1         | 5  | 2.10         | 5.48      | 8.31    | -----     | 1.52             | 0.93              | Soaked            | 17.8         | 63.28                              | --  | 0.50                        | 0.18                                | --                             | --                              | --                                  |                 |                    |
| 2   | B 20-2         | 15   | 3.50         | 5.48      | 7.61    | -----     | 1.39             | 0.91              | Soaked            | 13.4         | 47.63                              | --  | 0.91                        | 0.33                                | --                             | --                              | --                                  |                 |                    |
|   |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
|   |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
|   |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
|   |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |
| <b>S &amp; R Geotechniques Pvt. Ltd.</b>  |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                | <b>JOB NO. :</b>                |                                     | <b>PNSI0206</b> |                    |
| <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> <br/> (Pooja Patil - Report Engineer)<br/> Prepared By </div> <div style="text-align: center;"> <br/> (Atul Bopche - Dy. Technical Manager)<br/> Reviewed By </div> <div style="text-align: center;"> <br/> (Atul Chaudhari - Technical Manager)<br/> Authorised By </div> </div> |                |  |              |           |         |           |                  |                   |                   |              |                                    |   |                             |                                     |                                |                                 |                                     |                 |                    |

## TEST RESULTS OF ROCK CORES

|                            |   |   |               |
|----------------------------|---|---|---------------|
| <b>Report No. :-</b>       | SRGeo/Lab/PNS10206/Rep.-5/R0  | <b>DATE :</b>   | 30.05.2023    |
| <b>Project :-</b>          | Geotechnical Investigation For DMIDC Dighi Port Industrial Area, Indapur. |   |               |
| <b>Principal Client :-</b> | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | <b>Orientation of Loading axis with respect to anisotropy :</b> | Perpendicular |
| <b>Client :-</b>           | M/s. P.N.Shidore Civil Engineers Pvt.Ltd.                                 | <b>Environmental condition at storage:</b>                      | (±2) 27.0 °C  |
| <b>Location :-</b>         | Bridge No. 20   | <b>Room Temperature:</b>  | 27.0 °C       |
| <b>Co-Ordinates :-</b>     | ----  | <b>Pace Rate (KN/Sec) :</b>                                     | 1.5           |

| Sr. No. | Bore Hole No. | Core No. | Depth, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Uniaxial Compressive Strength (IS 9143:1979) | Modulus of Elasticity (IS 9221:1979) | Poisson's Ratio (IS 9221:1979) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|---------------|----------|----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|--|--------------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |               |          |          | cm        | cm      | cm        |               |                   |                   | kN           | kg/cm <sup>2</sup>                           | kg/cm <sup>2</sup>                   | ----                           | %                        | %                                | g/cm <sup>3</sup>           | g/cm <sup>3</sup>            |                                  |         |
| 1       | B 20-1        | 9        | 3.10     | 5.45      | 11.60   | ----      | 2.13          | 1.000             | Soaked            | 286.9        | 1253.9                                       | ----                                 | ----                           | 0.34                     | 0.12                             | ----                        | ----                         | ----                             |         |
| 2       | B 20-2        | 20       | 4.50     | 5.45      | 11.81   | ----      | 2.17          | 1.000             | Soaked            | 199.8        | 873.3  | ----                                 | ----                           | 0.29                     | 0.10                             | ----                        | ----                         | ----                             |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |

**S & R Geotechniques Pvt. Ltd.**

**JOB NO. :**

**PNSI0206**



(Pooja Patil - Report Engineer)  
Prepared By



(Atul Bopche - Dy. Technical Manager)  
Reviewed By




(Atul Chaudhari - Technical Manager)  
Authorised By



# S & R Geotechniques Pvt. Ltd.

Report No: SRGeo/LAB/PNS10206/Rep-5/R0

Date: 30.05.2023

## SILT FACTOR

As per IRC:5-2015

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

Principal Client : M/s. EGIS Consulting Engineers Pvt. Ltd.

Client : M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.

Sample ID: Bridge No. 20 (From River Bed).

Coordinates: ----

Table No. 01

| Sieve Designation | Sieve Opening | Weight of Soil | Percent Retained |
|-------------------|---------------|----------------|------------------|
|                   | (mm)          | Retained (gm)  |                  |
| 4.750 mm          | 4.750         | 4.54           | 4.54             |
| 2.000 mm          | 2.000         | 11.32          | 11.32            |
| 1.180 mm          | 1.180         | 16.19          | 16.19            |
| 0.600 mm          | 0.600         | 16.14          | 16.14            |
| 0.300 mm          | 0.300         | 12.65          | 12.65            |
| 0.150 mm          | 0.150         | 6.72           | 6.72             |
| 0.075 mm          | 0.075         | 1.38           | 1.38             |
| Pan               |               | 31.06          | 31.06            |
| Total             |               | 100.00         | 100.00           |

Table No. 02

| Sieve No.         | Average Size (mm) | Percentage of Weight Retained | Column (2) x Column (3) |
|-------------------|-------------------|-------------------------------|-------------------------|
| 1                 | 2                 | 3                             | 4                       |
| 4.750 mm          | 4.75              | 4.54                          | 21.57                   |
| 4.750 to 2.000 mm | 3.38              | 11.32                         | 38.21                   |
| 2.000 to 1.180 mm | 1.59              | 16.19                         | 25.74                   |
| 1.180 to 0.600 mm | 0.89              | 16.14                         | 14.36                   |
| 0.600 to 0.300 mm | 0.45              | 12.65                         | 5.69                    |
| 0.300 to 0.150 mm | 0.23              | 6.72                          | 1.51                    |
| 0.150 to 0.075 mm | 0.11              | 1.38                          | 0.16                    |
| 0.075 mm & below  | 0.04              | 31.06                         | 1.16                    |
| Total             |                   |                               | 108.401                 |

Weighted mean diameter

$$d_m = 1.084012$$

$$\text{Say } 1.08$$

Where,

$$\text{Silt Factor } k_{sf} = 1.76 \sqrt{d_m}$$

$$K_{sf} = 1.83$$

$$\text{So, Silt Factor} = 1.83$$

S & R Geotechniques Pvt. Ltd.

JOB NO.

PNS10206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Chopra - Dy. Technical Manager)  
Reviewed By



(Atul Chaudhari - Technical Manager)  
Authorised By

\*\*\*\*End of Report\*\*\*\*




## S & R Geotechniques Pvt. Ltd.

|                       |   |                 |
|-----------------------|---|-----------------|
| Report No. :          | SRGeo/Lab/PNS10206/Rep.-5/R0  | Date:30.05.2023 |
| Lab Reference No. :   | Lab/2023/May/Chem/L-08  | Page:2 of 2     |
| Name of the Project : | Geotechnical Investigation For DMIDC Dighi port Industrial Area, Indapur. |                 |
| Principal Client:     | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |                 |
| Client Name:          | M/s. P.N.Shidhore Civil Engineers (I) Pvt.Ltd.                            |                 |

### Annexure -1 Summary of Laboratory Test Results of Water Chemical

| Sr. No. | BH No. | Type of Sample | Chemical Analysis of Water Samples     |   |   |  | Remarks |
|---------|--------|----------------|--|---|---|--|---------|
|         |        |                | pH Value<br>IS 3025 (Part 11):<br>1983 | Sulphate<br>(as $SO_4^{2-}$ )<br>IS 3025 (Part 24):1986 | Sulphite<br>(as $SO_3^{2-}$ )<br>IS 3025 (Part 24):1986 | Chloride<br>IS 3025 (Part 32):<br>1988 |         |
|         |        |                |  | mg/l  | mg/l  | mg/l                                   |         |
| 1       | B20-2  | Water Sample   | 7.38                                   | 24.69   | 20.58   | 39.99                                  |         |

  
Prepared By  
(Akshata Ghone- Chemist)

  
Checked By  
(Yogesh Navkar-Quality Manager)



  
Authorized By  
(J.S.Salunkhe-M.D. & Tech. Manager)

\*\*\*\*END OF REPORT\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 30)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
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## Geotechnical Investigation Report (Bridge No. 30)

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| 2.0 Exploration Procedure                      | 3        |
| 2.1 Exploration Scope                          | 4        |
| 2.2 Subsurface Conditions                      | 4        |
| 2.3 Groundwater Levels                         | 5        |
| 3.0 Foundation Recommendations                 | 6        |
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## Geotechnical Investigation Report (Bridge No. 30)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B30-1, B30-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth  |
|--------------|----------|---------|--------|
| B30-1        | 2035426  | 318810  | 10.00m |
| B30-2        | 2035400  | 318807  | 8.55m  |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil which includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock.

**Silt Factor-** Representative disturbed samples were collected from the river bed for calculating the Silt Factor. The Silt Factor value for this location is 2.49 (as per IRC78:2014 & IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)).



Encountered soil/rock layers are described below;

#### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 2.50m to 3.40m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 2.50m to 3.40m below ground surface. Core Recoveries varied between 55% and 68%, while Rock Quality Designation (RQD) ranged between 12% and 38%. Compressive strength of rock core sample ranges from 1008 kg/cm<sup>2</sup> to 1197 kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.50m to 4.90m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.50m to 4.90m below ground surface in the boreholes. The bedrock was sound, inclined and vertical veins are observed. Core Recoveries varied between 85% and 96%, while Rock Quality Designation (RQD) ranged between 45% and 90%. Compressive strength of rock core sample ranges from 1271 kg/cm<sup>2</sup> to 1282 kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 8.55m to 10.00m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths of 3.40m to 4.70m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Moderately weathered rock (MWR) was encountered at depths of 2.50m to 3.40m below ground surface. In this layer compressive strength of rock core samples ranged between 1008 kg/cm<sup>2</sup> to 1197 kg/cm<sup>2</sup>.

As per minimum compressive strength 1008 kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| <b>Borehole Numbers</b> | <b>MWR</b> | <b>Hard Rock</b> |
|-------------------------|------------|------------------|
| B30-1                   | 3.40m      | 4.90m            |
| B30-2                   | 2.50m      | 3.50m            |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Based on chemical results, the site falls under Class V for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 400 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.40                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -2.50m to -3.40m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.50m to -4.90m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 10080 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 10080 = 1008 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.
- 7) IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)
- 8) IRC78:2014 Standard Specifications and code of practice for Road Bridges



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |          |                              |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
|---|----------|------------------------------|--|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |          |                              |  |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                             |
| Type of Boring  |          | Calyx with Bent. with casing |  |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 30                 |   |   |                          |                |        |                             |
| Dia of Hole (mm):   |          | 100.00                       |  |                                 | 75.00                           |         |         | Bore Hole No.: B30-1                |   |   |                          |                |        |                             |
| Depth (M):  |          | 0.00-1.50                    |  |                                 | 1.50-10.00                      |         |         | Co-ordinates : N=2035426, E=318810  |   |   |                          |                |        |                             |
| Commenced on : 24 May 2023  |          |                              |  | Completed on : 26 May 2023      |                                 |         |         | Ground Bed RL: 91.50M.              |   |   |                          |                |        |                             |
| Water Struc :   |          |                              |  | Ground Water : 3.40M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                             |
| From (M)  | To (M)   | Sample Depth (M)             | Description of Strata                  | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |
|   |          |                              |  |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                             |
| 0.00  |          | 0.00 To 0.40                 | BROWNISH COBBLES, PEBBLES AND BOULDERS |                                 |                                 |         |         |                                     |   | DS-1  | 0.82                     | 55.00          | 0.00   |                             |
|   |          | 1 TO 13                      |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
|   |          | 14 TO 20                     |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| 3.40  | 3.40     | 3.40 To 4.90                 | GREY MODERATELY WEATHERED ROCK         |                                 |                                 |         |         |                                     |   | 21 TO 27                                    | 1.02                     | 68.00          | 38.00  |                             |
| 4.90  |          | 4.90 To 6.20                 | GREY AMYGDOLOIDAL BASALT               |                                 |                                 |         |         |                                     |   | 28 TO 32                                    | 1.13                     | 86.00          | 65.00  | Inclined and vertical veins |
| 6.20 To 7.70  | 33 TO 35 | 1.27                         |  |                                 |                                 |         |         |                                     |   | 85.00                                       | 80.00                    |                |        |                             |
| 7.70 To 9.20  | 36 TO 40 | 1.40                         |  |                                 |                                 |         |         |                                     |   | 93.00                                       | 90.00                    |                |        |                             |
| 9.20 To 10.00   | 41 TO 43 | 0.70                         |  |                                 |                                 |         |         |                                     |   | 88.00                                       | 78.00                    |                |        |                             |
|   | 10.00    |                              |  |                                 | Bore Hole Terminated at : 10.00 |         |         |                                     |   |   |                          |                |        |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |          |                              |  |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| No. of disturbed Sample : 1   |          |                              |  |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                             |
|   |          |                              |  |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                             |

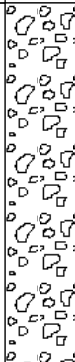









# Report Sheet

**Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.**

**P. N. Shidhore**  
**Civil Engineers (I) Pvt. Ltd.**  
**Kalyan(W).0251-2206495.**

# BORE LOG

| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |              |                  |   |   |   |         |                                    |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |                             |       |
|---|--------------|------------------|---|---|---|---------|------------------------------------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|-----------------------------|-------|
| Type of Boring  |              |                  | Calyx with Bent. with casing                |   | Calyx with Bent. without casing   |         | Job No. : BRIDGE 30                |                                     |   |   |                          |                |        |         |                             |       |
| Dia of Hole (mm):   |              |                  | 100.00                                      |   | 75.00   |         | Bore Hole No.: B30-2               |                                     |   |   |                          |                |        |         |                             |       |
| Depth (M):  |              |                  | 0.00-1.50                                   |   | 1.50-8.55   |         | Co-ordinates : N=2035400, E=318807 |                                     |   |   |                          |                |        |         |                             |       |
| Commenced on : 24 May 2023  |              |                  |   | Completed on : 26 May 2023  |   |         |                                    | Ground Bed RL: 91.00M.              |   |   |                          |                |        |         |                             |       |
| Water Struc :   |              |                  |   | Ground Water : 4.70M. Seasonal.   |   |         |                                    | Location of Bore Hole : As per plan |   |   |                          |                |        |         |                             |       |
| From (M)  | To (M)       | Sample Depth (M) | Description of Strata                       | Symbol  | SPT Record  |         |                                    |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |                             |       |
|   |              |                  |   |   | 0-150   | 150-300 | 300-450                            | 450-600                             | N |   |                          |                |        |         |                             |       |
| 0.00  | 2.50         | 0.00 To 1.50     | BROWNISH GREY PEBBLES, COBBLES AND BOULDERS |   |   |         |                                    |                                     |   | 1 TO 14                                     | 0.63                     | 42.00          | 0.00   |         |                             |       |
|   |              | 1.50 To 2.50     |   |   |   |         |                                    |                                     |   |   |                          | 15 TO 21       | 0.56   |         | 56.00                       | 15.00 |
| 2.50  | 3.50         | 2.50 To 3.50     | GREY MODERATELY WEATHERED BASALT            |  |   |         |                                    |                                     |   | 22 TO 28                                    | 0.55                     | 55.00          | 12.00  |         |                             |       |
| 3.50  |              | 8.55             | 3.50 To 4.90                                | GREY JOINTED BASALT   |  |         |                                    |                                     |   |   | 29 TO 35                 | 1.22           | 87.00  | 59.00   | Vertical and inclined veins |       |
|   | 4.90 To 6.10 |                  |   |   |   |         |                                    |                                     |   |   |                          | 36 TO 41       | 1.11   | 92.00   |                             | 55.00 |
|   | 6.10 To 7.40 |                  |   |   |   |         |                                    |                                     |   |   |                          | 42 TO 50       | 1.20   | 92.00   |                             | 45.00 |
|   | 7.40 To 8.55 |                  |   |   |   |         |                                    |                                     |   |   |                          | 51 TO 55       | 1.11   | 96.00   |                             | 68.00 |
|   |              |                  |   |   | Bore Hole Terminated at : 8.55  |         |                                    |                                     |   |   |                          |                |        |         |                             |       |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |              |                  |   |   |   |         |                                    |                                     |   |   |                          |                |        |         |                             |       |
| No. of disturbed Sample : 0   |              |                  |   |   | No. of U.D.S. : 0   |         |                                    |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |                             |       |
| No. of S.P.T. : 0   |              |                  |   |   | No. of Water Sample : 0   |         |                                    |                                     |   |   |                          |                |        |         |                             |       |

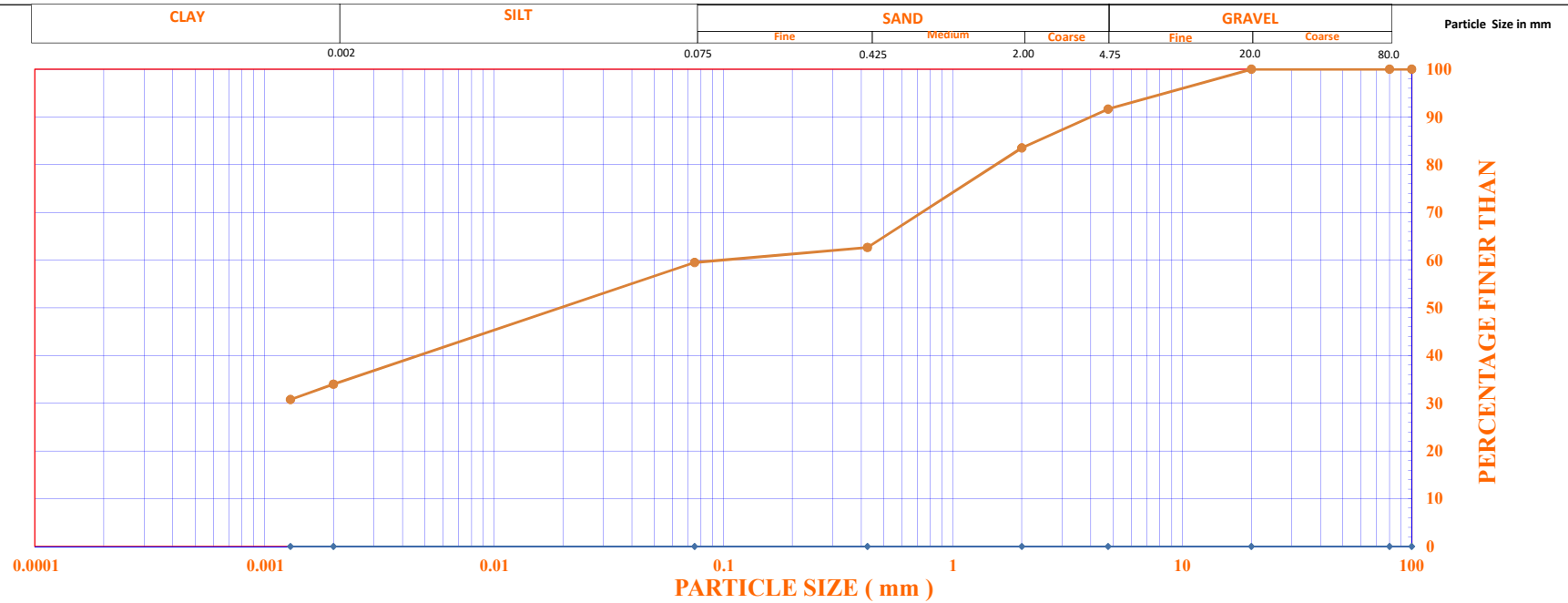
|    |            | SOIL TEST DATA SHEET  |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
|---|------------|---|--|---------------------|--|---|---|--------|--------|--------|---|---|------------------------------------|--|---|--|--|--|--|-----------------------|---------------------------------------|------------|--|
| Report No. :-   |            | SRGeo/Lab/PNS10206/Rep-08/R0  |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| Project :-  |            | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| Principal Client :-   |            | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| Client:-  |            | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| Location:-  |            | Bridge No. 30   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  | DATE:                 |                                       | 05.06.2023 |  |
| BH No.  | Depth* (m) | Sample Type *   | Density Test<br>(IS: 2720 - Part-8 : 1983)       |                     | Moisture Content (%)<br>(IS: 2720 - Part-2 : 1973) | Soil Classification<br>(IS: 1498-1970)  | Mechanical Analysis<br>(IS: 2720 - Part-4 : 1985) |        |        |        | Consistency Limits<br>(IS: 2720- Part-5 : 1985) |   |                                    | Shrinkage Limit<br>(IS: 2720- Part-6 : 1972) | Free Swell Index %<br>(IS:2720 - Part-40 : 1977 ) | Triaxial Test<br>(IS:2720 Part-11: 1993) |  |  | Vertical Consolidation<br>(IS:2720 Part-15 : 1965) |                       | Specific Gravity<br>(IS:2720 Part-03) | Remarks    |  |
|   |            |   | Wet Density (gm/cc)                              | Dry Density (gm/cc) |  |   | Gravel %  | Sand % | Silt % | Clay % | Liquid %  | Plastic %   | Plasticity Index, I <sub>p</sub> % |  |   | Type                                     | Cohesion C <sub>u</sub> kg/cm <sup>2</sup> | Degree $\phi$  | Comp. Index C <sub>c</sub> (Lab)                   | Initial Void Ratio, e |                                       |            |  |
| B 30-01   | 0.00-0.40  | DS-01   | ---  | ---                 | ---  | CI  | 8   | 32     | 26     | 34     | 45  | 24  | 21                                 | 22   | ---   | ---                                      | ---  | ---  | ---  | ---                   | 2.62                                  |            |  |
|   |            |   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
|   |            |   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
|   |            |   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
|   |            |   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| CHEM : Chemical Analysis  |            |   | Tuu : Triaxial Test ( Unconsolidated Undrained ) |                     |  |   | SP : Swelling Pressure or Swelling Potential Test |        |        |        | $\phi$ : Angle of Internal Friction             |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| COMP : Compaction Test  |            |   | Tcu : Triaxial Test ( Consolidated Undrained )   |                     |  |   | SPT : Standard Penetration Test Sample            |        |        |        | Cu : Undrained Cohesion                         |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| DS : Direct Shear   |            |   | Tcd : Triaxial Test ( Consolidated Drained )     |                     |  |   | UDS : Undisturbed Soil Sample                     |        |        |        | $\phi'$ : Effective Angle of Internal Friction  |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| K : Permeability Test   |            |   | NP : Non Plastic                                 |                     |  |   | VL : Laboratory Vane Shear Test                   |        |        |        | Cu' : Effective Cohesion                        |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| FSI : Free Swell Test   |            |   | SL : Shrinkage Limit Test                        |                     |  |   | UC : Unconfined Compression Test                  |        |        |        | NPO : Not Possible                              |   |                                    |  |   |  |  |  |  |                       |                                       |            |  |
| S & R Geotechniques Pvt. Ltd.   |            |   |  |                     |  |   |   |        |        |        |   |   |                                    |  |   |  |  | JOB NO : PNSI0206  |  |                       |                                       |            |  |
| <br>(Pooja Patil - Report Engineer)<br>Prepared By |            |   |  |                     |  | <br>(Atul Bopche - Dy. Technical Manager)<br>Reviewed By |   |        |        |        |   |  |                                    |  |   |  |  | <br>(Atul Chaudhari - Technical Manager)<br>Authorized By |  |                       |                                       |            |  |

# GRAIN SIZE DISTRIBUTION CURVE (IS 2720: PART 4)

**Project :-** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Location:-** Bridge No. 30

S & R Geotechniques Pvt. Ltd.



JOB NO : PNSI0206

| Symbol | BH No.  | Depth* (m) | Classification (IS 1498) | Gravel | Sand | Silt | Clay | $\Phi_{10\%}$ | $\Phi_{30\%}$ | $\Phi_{60\%}$ | Coeff. of Uniformity, $C_u = D_{60} / D_{10}$ | Coeff. Of Curvature $C_c = D_{30}^2 / (D_{60} * D_{10})$ | Liquid Limit, $W_L$ | Plastic Limit, $W_p$ | Plasticity Index, $I_p$ | Remarks |
|--------|---------|------------|--------------------------|--------|------|------|------|---------------|---------------|---------------|---|--|---------------------|----------------------|-------------------------|---------|
|        |         |            |                          | %      | %    | %    | %    | mm            | mm            | mm            |   |  |                     |                      |                         |         |
| —●—    | B 30-01 | 0.00-0.40  | CI                       | 8      | 32   | 26   | 34   | ---           | ---           | ---           | ---   | ---  | 45                  | 24                   | 21                      | DS-01   |
| —■—    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —▲—    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —*—    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| —◆—    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |

*Pooja Patil*

(Pooja Patil - Report Engineer)  
Prepared By

*Atul Bopche*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



*Atul Chaudhari*

(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

|                     |   |  |               |
|---------------------|---|--|---------------|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep.-08/R0   | DATE :   | 05.06.2023    |
| Project :-          | Geotechnical Investigation For DMIDC Dighi Port Industrial Area, Indapur. |  |               |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | Orientation of Loading axis with respect to anisotropy : | Perpendicular |
| Client :-           | M/s. P.N.Shidore Civil Engineers Pvt.Ltd.                                 | Environmental condition at storage:                      | (± 2) 27.0 °C |
| Location :-         | Bridge No. 30   | Room Temperature:  | 27.0 °C       |
| Co-Ordinates :-     | ----  | Pace Rate (KN/Sec) :                                     | 1.5           |

| Sr. No. | Bore Hole No. | Core No. | Depth, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Uniaxial Compressive Strength (IS 9143:1979) | Modulus of Elasticity (IS 9221:1979) | Poisson's Ratio (IS 9221:1979) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|---------------|----------|----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|--|--------------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |               |          |          | cm        | cm      | cm        |               |                   |                   | kN           | kg/cm <sup>2</sup>                           | kg/cm <sup>2</sup>                   | ----                           | %                        | %                                | g/cm <sup>3</sup>           | g/cm <sup>3</sup>            |                                  |         |
| 1       | B 30-1        | 22       | 3.50     | 5.46      | 11.82   | -----     | 2.16          | 1.000             | Soaked            | 274.9        | 1197.1                                       | -----                                | -----                          | 0.25                     | 0.09                             | -----                       | -----                        | -----                            |         |
| 2       | B 30-1        | 28       | 5.00     | 5.46      | 11.89   | -----     | 2.18          | 1.000             | Soaked            | 294.4        | 1282.0                                       | -----                                | -----                          | 0.22                     | 0.07                             | -----                       | -----                        | -----                            |         |
| 3       | B 30-2        | 26       | 3.00     | 5.46      | 11.13   | -----     | 2.04          | 1.000             | Soaked            | 231.6        | 1008.5                                       | -----                                | -----                          | 0.27                     | 0.10                             | -----                       | -----                        | -----                            |         |
| 4       | B 30-2        | 29       | 3.70     | 5.46      | 11.57   | -----     | 2.12          | 1.000             | Soaked            | 292.0        | 1271.6                                       | -----                                | -----                          | 0.15                     | 0.05                             | -----                       | -----                        | -----                            |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |

S & R Geotechniques Pvt. Ltd.

JOB NO. :

PNS10206

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Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



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Authorised By



## S & R Geotechniques Pvt. Ltd.

Report No: SRGeo/LAB/PNS10206/Rep-08/R0

Date: 05.06.2023

### SILT FACTOR As per IRC:5-2015

**Project :** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Principal Client :** M/s. EGIS Consulting Engineers Pvt. Ltd.

**Client :** M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.

**Sample ID:** Bridge No. 30 (From River Bed).

**Coordinates:** ----

Table No. 01

| Sieve Designation | Sieve Opening | Weight of Soil | Percent Retained |
|-------------------|---------------|----------------|------------------|
|                   | (mm)          | Retained (gm)  |                  |
| 4.750 mm          | 4.750         | 23.68          | 23.68            |
| 2.000 mm          | 2.000         | 12.81          | 12.81            |
| 1.180 mm          | 1.180         | 18.08          | 18.08            |
| 0.600 mm          | 0.600         | 12.93          | 12.93            |
| 0.300 mm          | 0.300         | 5.50           | 5.50             |
| 0.150 mm          | 0.150         | 2.98           | 2.98             |
| 0.075 mm          | 0.075         | 0.75           | 0.75             |
| Pan               |               | 23.27          | 23.27            |
|                   | <b>Total</b>  | <b>100.00</b>  | <b>100.00</b>    |

Table No. 02

| Sieve No.         | Average Size (mm) | Percentage of Weight Retained | Column (2) x Column (3) |
|-------------------|-------------------|-------------------------------|-------------------------|
| <b>1</b>          | <b>2</b>          | <b>3</b>                      | <b>4</b>                |
| 4.750 mm          | 4.75              | 23.68                         | 112.48                  |
| 4.750 to 2.000 mm | 3.38              | 12.81                         | 43.23                   |
| 2.000 to 1.180 mm | 1.59              | 18.08                         | 28.75                   |
| 1.180 to 0.600 mm | 0.89              | 12.93                         | 11.51                   |
| 0.600 to 0.300 mm | 0.45              | 5.50                          | 2.48                    |
| 0.300 to 0.150 mm | 0.23              | 2.98                          | 0.67                    |
| 0.150 to 0.075 mm | 0.11              | 0.75                          | 0.08                    |
| 0.075 mm & below  | 0.04              | 23.27                         | 0.87                    |
|                   |                   | <b>Total</b>                  | <b>200.071</b>          |

Weighted mean diameter

$$d_m = 2.0007$$

$$\text{Say } 2.00$$

Where,

$$\text{Silt Factor } k_{sf} = 1.76 \sqrt{d_m}$$

$$K_{sf} = 2.49$$

$$\text{So, Silt Factor} = 2.49$$

**S & R Geotechniques Pvt. Ltd.**

**JOB NO.**

**PNS10206**

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\*\*\* End of Report\*\*\*




## S & R Geotechniques Pvt. Ltd.

|                       |   |                 |
|-----------------------|---|-----------------|
| Report No. :          | SRGeo/Lab/PNS10206/Rep.-8/R0  | Date:05.06.2023 |
| Lab Reference No. :   | Lab/2023/June/Chem/L-09   | Page:2 of 2     |
| Name of the Project : | Geotechnical Investigation For DMIDC Dighi port Industrial Area, Indapur. |                 |
| Principal Client:     | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |                 |
| Client Name:          | M/s. P.N.Shidhore Civil Engineers (I) Pvt.Ltd.                            |                 |


### Annexure -1 Summary of Laboratory Test Results of Water Chemical

| Sr. No. | BH No. | Type of Sample | Chemical Analysis of Water Samples     |   |   |  | Remarks |
|---------|--------|----------------|--|---|---|--|---------|
|         |        |                | pH Value<br>IS 3025 (Part 11):<br>1983 | Sulphate<br>(as $\text{SO}_4^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Sulphite<br>(as $\text{SO}_3^{2-}$ )<br>IS 3025 (Part<br>24):1986 | Chloride<br>IS 3025 (Part 32):<br>1988 |         |
|         |        |                |  | mg/l  | mg/l  | mg/l                                   |         |
| 1       | B30-1  | Water Sample   | 7.27                                   | 18.93   | 15.78   | 29.99                                  |         |
|         |        |                |  |   |   |  |         |
|         |        |                |  |   |   |  |         |
|         |        |                |  |   |   |  |         |

  
Prepared By  
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Checked By  
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Authorized By  
(J.S.Salunkhe-M.D. & Tech. Manager)

\*\*\*\*END OF REPORT\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 31)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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## Geotechnical Investigation Report (Bridge No. 31)

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## Geotechnical Investigation Report (Bridge No. 31)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

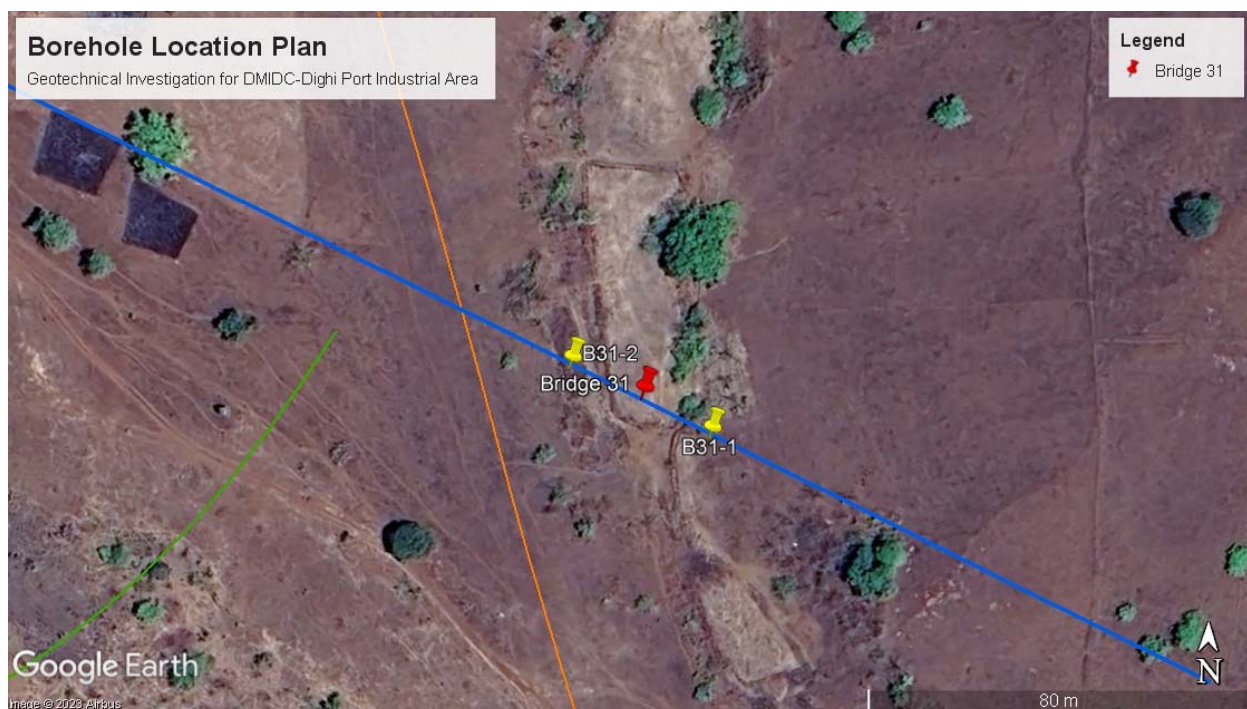
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B31-1, B31-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B31-1        | 2031386  | 319796  | 7.10m |
| B31-2        | 2031388  | 319816  | 9.50m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil which includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock.

**Silt Factor-** Representative disturbed samples were collected from the river bed for calculating the Silt Factor. The Silt Factor value for this location is 2.07 (as per IRC78:2014 & IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)).

Encountered soil/rock layers are described below;

#### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 1.00m to 3.00m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 1.00m to 3.00m below ground surface. Core Recoveries varied between 54% and 69%, while Rock Quality Designation (RQD) ranged between 14% and 43%. Compressive strength of rock core sample ranges from 1064kg/cm<sup>2</sup> to 2136kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 2.00m to 4.50m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 2.00m to 4.50m below ground surface in the boreholes. The bedrock was sound, inclined and vertical veins are observed. Core Recoveries varied between 83% and 95%, while Rock Quality Designation (RQD) ranged between 43% and 92%. Compressive strength of rock core sample ranges from 1065kg/cm<sup>2</sup> to 1164kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 7.10m to 9.50m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 2.10m to 3.10m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Moderately weathered rock (MWR) was encountered at depths of 1.00m to 3.00m below ground surface. In this layer compressive strength of rock core samples ranged between 1064kg/cm<sup>2</sup> to 2136kg/cm<sup>2</sup>.

As per minimum compressive strength 1064kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| <b>Borehole Numbers</b> | <b>MWR</b> | <b>Hard Rock</b> |
|-------------------------|------------|------------------|
| B31-1                   | 1.00m      | 2.00m            |
| B31-2                   | 3.00m      | 4.50m            |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Based on chemical results, the site falls under Class V for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 400 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.40                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -1.00m to -3.00m |
| Layer II, Moderately weathered rock |                  |
|                                     | -2.00m to -4.50m |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 10640 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 10640 = 1064 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.
- 7) IRC5:2015 Standard Specifications and code of practice for Road Bridges (clause 106.9.3.1)
- 8) IRC78:2014 Standard Specifications and code of practice for Road Bridges





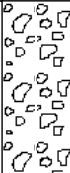


## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

**Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.**

**P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.**

## BORE LOG

| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |              |                  |  |   |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                  |
|---|--------------|------------------|--|---|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|------------------|
| Type of Boring  |              |                  | Calyx with Bent. with casing                 |   | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 31                 |   |   |                          |                |        |                  |
| Dia of Hole (mm):   |              |                  | 100.00                                       |   | 75.00                           |         |         | Bore Hole No.: B31-1                |   |   |                          |                |        |                  |
| Depth (M):  |              |                  | 0.00-1.50                                    |   | 1.50-7.10                       |         |         | Co-ordinates : N=2031386, E=319796  |   |   |                          |                |        |                  |
| Commenced on : 21 May 2023  |              |                  |  | Completed on : 22 May 2023  |                                 |         |         | Ground Bed RL: 73.00M.              |   |   |                          |                |        |                  |
| Water Struc :   |              |                  |  | Ground Water : 2.10M. Seasonal.   |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                  |
| From (M)  | To (M)       | Sample Depth (M) | Description of Strata                        | Symbol  | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks          |
|   |              |                  |  |   | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                  |
| 0.00  | 1.00         | 0.00 To 0.40     | BROWNISH MURUM, COBBLES,PEBBLES AND BOULDERS |    |                                 |         |         |                                     |   | DS-1  | 0.20                     | 33.00          | 0.00   |                  |
|   |              | 0.40 To 1.00     |  |   |                                 |         |         |                                     |   | 1 TO 3                                      |                          |                |        |                  |
| 1.00  | 2.00         | 1.00 To 2.00     | GREY MODERATELY WEATHERED ROCK               |   |                                 |         |         |                                     |   | 4 TO 7                                      | 0.54                     | 54.00          | 43.00  |                  |
|   |              |                  |  |   |                                 |         |         |                                     |   |   |                          |                |        |                  |
| 2.00  | 7.10         | 2.00 To 3.10     | GREY AMYGDOLOIDAL BASALT                     |  |                                 |         |         |                                     |   | 8 TO 11                                     | 0.98                     | 89.00          | 86.00  | White infillings |
|   |              |                  |  |   |                                 |         |         |                                     |   |   |                          |                |        |                  |
|   |              | 3.10 To 4.60     |  |   |                                 |         |         |                                     |   | 12 TO 17                                    | 1.28                     | 85.00          | 69.00  |                  |
|   |              | 4.60 To 5.20     |  |   |                                 |         |         |                                     |   | 18 TO 19                                    | 0.51                     | 85.00          | 78.00  |                  |
|   |              | 5.20 To 6.20     |  |   |                                 |         |         |                                     |   | 20  | 0.95                     | 95.00          | 92.00  |                  |
|   | 6.20 To 7.10 | 21 TO 23         | 0.83   | 92.00   | 90.00                           |         |         |                                     |   |   |                          |                |        |                  |
|   |              |                  |  |   | Bore Hole Terminated at : 7.10  |         |         |                                     |   |   |                          |                |        |                  |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |              |                  |  |   |                                 |         |         |                                     |   |   |                          |                |        |                  |
| No. of disturbed Sample : 1   |              |                  |  |   | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                  |
| No. of S.P.T. : 0   |              |                  |  |   | No. of Water Sample : 0         |         |         |                                     |   |   |                          |                |        |                  |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
|---|--------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                             |
| Type of Boring  |        | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 31                 |   |   |                          |                |        |                             |
| Dia of Hole (mm):   |        | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B31-2                |   |   |                          |                |        |                             |
| Depth (M):  |        | 0.00-3.00                    |   |                                 | 3.00-9.50                       |         |         | Co-ordinates : N=2031388, E=319816  |   |   |                          |                |        |                             |
| Commenced on : 21 May 2023  |        |                              |   | Completed on : 22 May 2023      |                                 |         |         | Ground Bed RL: 73.93M               |   |   |                          |                |        |                             |
| Water Struc :   |        |                              |   | Ground Water : 3.10M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                             |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                         | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                     |
|   |        |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                             |
| 0.00  | 3.00   | 0.00 To 0.20                 | BROWNISH MURUM, COBBLES, PEBBLES AND BOULDERS |                                 |                                 |         |         |                                     |   | DS-1 1 TO 7                                 | 0.34                     | 26.00          | 0.00   |                             |
|   |        | 0.20 To 1.50                 |   |                                 |                                 |         |         |                                     |   | 8 TO 13                                     | 0.28                     | 19.00          | 0.00   |                             |
| 3.00  | 4.50   | 3.00 To 4.50                 | GREY MODERATELY WEATHERED BASALT              |                                 |                                 |         |         |                                     |   | 14 TO 18                                    | 1.03                     | 69.00          | 14.00  | Vertical veins              |
|   |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| 4.50  | 9.50   | 4.50 To 5.50                 | GREY BASALT                                   |                                 |                                 |         |         |                                     |   | 19 TO 21                                    | 0.87                     | 87.00          | 43.00  | Inclined and vertical veins |
|   |        | 5.50 To 7.00                 |   |                                 |                                 |         |         |                                     |   | 22 TO 24                                    | 1.26                     | 84.00          | 53.00  |                             |
|   |        | 7.00 To 8.50                 |   |                                 |                                 |         |         |                                     |   | 25 TO 32                                    | 1.29                     | 86.00          | 69.00  |                             |
|   |        | 8.50 To 9.50                 |   |                                 |                                 |         |         |                                     |   | 33 TO 35                                    | 0.83                     | 83.00          | 76.00  |                             |
|   |        |                              |   |                                 | Bore Hole Terminated at : 9.50  |         |         |                                     |   |   |                          |                |        |                             |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                             |
| No. of disturbed Sample : 1   |        |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                             |
|   |        |                              |   |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                             |



# SOIL TEST DATA SHEET

|                     |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
|---------------------|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|------------|--|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep-6/R1   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Project :-          | Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Client:-            | M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |            |  |
| Location:-          | Bridge No. 31   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | DATE: | 30.05.2023 |  |

| BH No.  | Depth* (m) | Sample Type * | Density Test<br>(IS: 2720 - Part-8 : 1983) |                     | Moisture Content (%)<br>(IS: 2720 - Part-2 : 1973) | Soil Classification<br>(IS: 1498-1970) | Mechanical Analysis<br>(IS: 2720 - Part-4 : 1985) |        |        |        | Consistency Limits<br>(IS: 2720- Part-5 : 1985) |           |                                    | Shrinkage Limit<br>(IS: 2720- Part-6 : 1972) | Free Swell Index %<br>(IS:2720 - Part-40 : 1977 ) | Triaxial Test<br>(IS:2720 Part-11: 1993) |  |               | Vertical Consolidation<br>(IS:2720 Part-15 : 1965) |                       | Specific Gravity<br>(IS:2720 Part-03) | Remarks |
|---------|------------|---------------|--|---------------------|--|--|---|--------|--------|--------|---|-----------|------------------------------------|--|---|--|--|---------------|--|-----------------------|---------------------------------------|---------|
|         |            |               | Wet Density (gm/cc)                        | Dry Density (gm/cc) |  |  | Gravel %  | Sand % | Silt % | Clay % | Liquid %  | Plastic % | Plasticity Index, I <sub>p</sub> % |  |   | Type                                     | Cohesion C <sub>u</sub> kg/cm <sup>2</sup> | Degree $\phi$ | Comp. Index C <sub>c</sub> (Lab)                   | Initial Void Ratio, e |                                       |         |
| B 31-01 | 0.00-0.40  | DS-01         | ---  | ---                 | ---  | SC                                     | 12  | 53     | 21     | 14     | 34  | 23        | 11                                 | 22   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.65                                  |         |
| B 31-02 | 0.00-0.20  | DS-01         | ---  | ---                 | ---  | CI                                     | 7   | 37     | 23     | 32     | 47  | 24        | 23                                 | 20   | ---   | ---                                      | ---  | ---           | ---  | ---                   | 2.62                                  |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |
|         |            |               |  |                     |  |  |   |        |        |        |   |           |                                    |  |   |  |  |               |  |                       |                                       |         |

|        |                   |       |  |       |  |           |                                      |
|--------|-------------------|-------|--|-------|--|-----------|--------------------------------------|
| CHEM : | Chemical Analysis | Tuu : | Triaxial Test ( Unconsolidated Undrained ) | SP :  | Swelling Pressure or Swelling Potential Test | $\phi$ :  | Angle of Internal Friction           |
| COMP : | Compaction Test   | Tcu : | Triaxial Test ( Consolidated Undrained )   | SPT : | Standard Penetration Test Sample             | Cu :      | Undrained Cohesion                   |
| DS :   | Direct Shear      | Tcd : | Triaxial Test ( Consolidated Drained )     | UDS : | Undisturbed Soil Sample                      | $\phi'$ : | Effective Angle of Internal Friction |
| K :    | Permeability Test | NP :  | Non Plastic                                | VL :  | Laboratory Vane Shear Test                   | Cu' :     | Effective Cohesion                   |
| FSI :  | Free Swell Test   | SL :  | Shrinkage Limit Test                       | UC :  | Unconfined Compression Test                  | NPO :     | Not Possible                         |

S & R Geotechniques Pvt. Ltd.

JOB NO : PNSI0206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



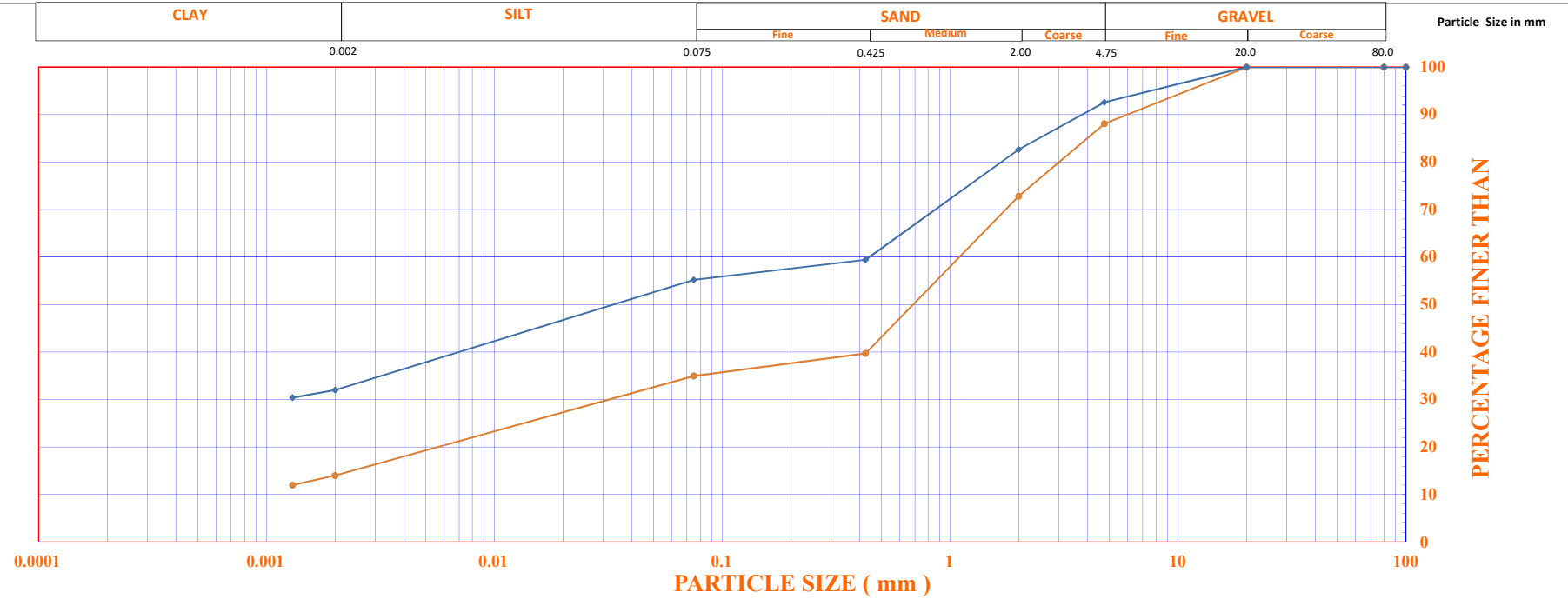
(Atul Chaudhari - Technical Manager)  
Authorized By

# GRAIN SIZE DISTRIBUTION CURVE (IS 2720: PART 4)

**Project :-** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Location:-** Bridge No. 31

S & R Geotechniques Pvt. Ltd.



JOB NO : PNSI0206

| Symbol | BH No.  | Depth* (m) | Classification (IS 1498) | Gravel | Sand | Silt | Clay | $\Phi_{10\%}$ | $\Phi_{30\%}$ | $\Phi_{60\%}$ | Coeff. of Uniformity, $C_u = D_{60} / D_{10}$ | Coeff. Of Curvature $C_c = D_{30}^2 / (D_{60} * D_{10})$ | Liquid Limit, $W_L$ | Plastic Limit, $W_P$ | Plasticity Index, $I_p$ | Remarks |
|--------|---------|------------|--------------------------|--------|------|------|------|---------------|---------------|---------------|---|--|---------------------|----------------------|-------------------------|---------|
| ●—●    | B 31-01 | 0.00-0.40  | SC                       | 12     | 53   | 21   | 14   | ---           | ---           | ---           | ---   | ---  | 34                  | 23                   | 11                      | DS-01   |
| ■—■    | B 31-02 | 0.00-0.20  | CI                       | 7      | 37   | 23   | 32   | ---           | ---           | ---           | ---   | ---  | 47                  | 24                   | 23                      | DS-01   |
| ▲—▲    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| *—*    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |
| ◆—◆    |         |            |                          |        |      |      |      |               |               |               |   |  |                     |                      |                         |         |

*(Signature)*

(Pooja Patil - Report Engineer)  
Prepared By

*(Signature)*

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



*(Signature)*

(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

|                     |   |  |               |
|---------------------|---|--|---------------|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep.-6/R1  | DATE :   | 30.05.2023    |
| Project :-          | Geotechnical Investigation For DMIDC Dighi Port Industrial Area, Indapur. |  |               |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | Orientation of Loading axis with respect to anisotropy : | Perpendicular |
| Client :-           | M/s. P.N.Shidore Civil Engineers Pvt.Ltd.                                 | Environmental condition at storage:                      | (± 2) 27.0 °C |
| Location :-         | Bridge No. 31   | Room Temperature:  | 27.0 °C       |
| Co-Ordinates :-     | ----  | Pace Rate (KN/Sec) :                                     | 1.5           |

| Sr. No. | Bore Hole No. | Core No. | Depth, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Uniaxial Compressive Strength (IS 9143:1979) | Modulus of Elasticity (IS 9221:1979) | Poisson's Ratio (IS 9221:1979) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|---------------|----------|----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|--|--------------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |               |          |          | cm        | cm      | cm        |               |                   |                   | kN           | kg/cm <sup>2</sup>                           | kg/cm <sup>2</sup>                   | ----                           | %                        | %                                | g/cm <sup>3</sup>           | g/cm <sup>3</sup>            |                                  |         |
| 1       | B 31-1        | 4        | 1.10     | 5.45      | 11.71   | -----     | 2.15          | 1.000             | soaked            | 243.6        | 1064.7                                       | -----                                | -----                          | 0.34                     | 0.12                             | -----                       | -----                        | -----                            |         |
| 2       | B 31-1        | 8        | 2.00     | 5.46      | 11.75   | -----     | 2.15          | 1.000             | Soaked            | 267.3        | 1164.0                                       | -----                                | -----                          | 0.36                     | 0.12                             | -----                       | -----                        | -----                            |         |
| 3       | B 31-2        | 22       | 5.50     | 5.46      | 11.68   | -----     | 2.14          | 1.000             | Soaked            | 244.7        | 1065.6                                       | -----                                | -----                          | 0.37                     | 0.13                             | -----                       | -----                        | -----                            |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |
|         |               |          |          |           |         |           |               |                   |                   |              |  |                                      |                                |                          |                                  |                             |                              |                                  |         |

S & R Geotechniques Pvt. Ltd.

JOB NO. :

PNS10206

(Pooja Patil - Report Engineer)  
Prepared By

(Atul Bopche - Dy. Technical Manager)  
Reviewed By



(Atul Chaudhari - Technical Manager)  
Authorised By



## TEST RESULTS OF ROCK CORES

|                     |   |                                     |               |
|---------------------|---|-------------------------------------|---------------|
| Report No. :-       | SRGeo/Lab/PNS10206/Rep.-6/R1  | DATE :                              | 30.05.2023    |
| Project :-          | Geotechnical Investigation For DMIDC Dighi Port Industrial Area, Indapur. |                                     |               |
| Principal Client :- | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  | Direction of Loading:               | Axial         |
| Client :-           | M/s. P.N Shidore Civil Engineer Pvt.Ltd                                   | Environmental condition at storage: | (± 2) 27.0 °C |
| Location :-         | Bridge No. 31   | Room Temperature:                   | 27.0 °C       |

| Sr. No. | Bore Hole No.* | Core No.* | Depth*, m | Diameter, | Height, | Thickness | H : D (1:H/D) | Correction Factor | Condition of Test | Failure Load | Point Load Index (IS 8764:1998) | Brazilian Test (IS 10082:1981) | Porosity (IS 13030:1991) | Water Absorption (IS 13030:1991) | Dry Density (IS 13030:1991) | Bulk Density (IS 13030:1991) | Specific Gravity (IS 1122: 1974) | Remarks |
|---------|----------------|-----------|-----------|-----------|---------|-----------|---------------|-------------------|-------------------|--------------|---------------------------------|--------------------------------|--------------------------|----------------------------------|-----------------------------|------------------------------|----------------------------------|---------|
|         |                |           |           | cm        | cm      | cm        |               |                   |                   | kN           |                                 |                                |                          |                                  |                             |                              |                                  |         |
| 1       | B 31-2         | 14        | 3.10      | 5.45      | 6.34    | -----     | 1.16          | 0.86              | Soaked            | 27.1         | 97.13                           | --                             | 1.08                     | 0.40                             | 2.71                        | 2.72                         | 2.73                             |         |
|         |                |           |           |           |         |           |               |                   |                   |              |                                 |                                |                          |                                  |                             |                              |                                  |         |
|         |                |           |           |           |         |           |               |                   |                   |              |                                 |                                |                          |                                  |                             |                              |                                  |         |
|         |                |           |           |           |         |           |               |                   |                   |              |                                 |                                |                          |                                  |                             |                              |                                  |         |
|         |                |           |           |           |         |           |               |                   |                   |              |                                 |                                |                          |                                  |                             |                              |                                  |         |
|         |                |           |           |           |         |           |               |                   |                   |              |                                 |                                |                          |                                  |                             |                              |                                  |         |

S & R Geotechniques Pvt. Ltd.

JOB NO. :

PNSI0206

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Authorised By



## S & R Geotechniques Pvt. Ltd.

Report No: SRGeo/LAB/PNS10206/Rep-06/R1

Date: 30.05.2023

### SILT FACTOR As per IRC:5-2015

**Project :** Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur.

**Principal Client :** M/s. EGIS Consulting Engineers Pvt. Ltd.

**Client :** M/s. P. N. Shidore Civil Engineers (I) Pvt. Ltd.

**Sample ID:** Bridge No.31 (From River Bed).

**Coordinates:** ----

Table No. 01

| Sieve Designation | Sieve Opening | Weight of Soil | Percent Retained |
|-------------------|---------------|----------------|------------------|
|                   | (mm)          | Retained (gm)  |                  |
| 4.750 mm          | 4.750         | 11.21          | 11.21            |
| 2.000 mm          | 2.000         | 13.83          | 13.83            |
| 1.180 mm          | 1.180         | 16.12          | 16.12            |
| 0.600 mm          | 0.600         | 9.14           | 9.14             |
| 0.300 mm          | 0.300         | 3.76           | 3.76             |
| 0.150 mm          | 0.150         | 5.10           | 5.10             |
| 0.075 mm          | 0.075         | 2.75           | 2.75             |
| Pan               |               | 38.09          | 38.09            |
| Total             |               | 100.00         | 100.00           |

Table No. 02

| Sieve No.         | Average Size (mm) | Percentage of Weight Retained | Column (2) x Column (3) |
|-------------------|-------------------|-------------------------------|-------------------------|
| 1                 | 2                 | 3                             | 4                       |
| 4.750 mm          | 4.75              | 11.21                         | 53.25                   |
| 4.750 to 2.000 mm | 3.38              | 13.83                         | 46.68                   |
| 2.000 to 1.180 mm | 1.59              | 16.12                         | 25.63                   |
| 1.180 to 0.600 mm | 0.89              | 9.14                          | 8.13                    |
| 0.600 to 0.300 mm | 0.45              | 3.76                          | 1.69                    |
| 0.300 to 0.150 mm | 0.23              | 5.10                          | 1.15                    |
| 0.150 to 0.075 mm | 0.11              | 2.75                          | 0.31                    |
| 0.075 mm & below  | 0.04              | 38.09                         | 1.43                    |
|                   |                   | Total                         | 138.266                 |

Weighted mean diameter

$$d_m = 1.382664$$

Say **1.38**

Where,

$$\text{Silt Factor } k_{sf} = 1.76\sqrt{d_m}$$

$$K_{sf} = 2.07$$

So, Silt Factor = 2.07

**S & R Geotechniques Pvt. Ltd.**

**JOB NO.**

**PNS10206**

(Pooja Patil - Report Engineer)

Prepared By

(Atul Bopche - Dy. Technical Manager)

Reviewed By



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Authorised By

\*\*\* End of Report\*\*\*







## S & R Geotechniques Pvt. Ltd.

|                       |   |                 |
|-----------------------|---|-----------------|
| Report No. :          | SRGeo/Lab/PNS10206/Rep.-6/R0  | Date:30.05.2023 |
| Lab Reference No. :   | Lab/2023/May/Chem/L-08  | Page:2 of 2     |
| Name of the Project : | Geotechnical Investigation For DMIDC Dighi port Industrial Area, Indapur. |                 |
| Principal Client:     | M/s. EGIS Consulting Engineers Pvt. Ltd.                                  |                 |
| Client Name:          | M/s. P.N.Shidhore Civil Engineers (I) Pvt.Ltd.                            |                 |

### Annexure -1 Summary of Laboratory Test Results of Water Chemical

| Sr. No. | BH No. | Type of Sample | Chemical Analysis of Water Samples     |  |  |  | Remarks |
|---------|--------|----------------|--|--|--|--|---------|
|         |        |                | pH Value<br>IS 3025 (Part 11):<br>1983 | Sulphate<br>(as $\text{SO}_4^{2-}$ )<br>IS 3025 (Part 24):1986 | Sulphite<br>(as $\text{SO}_3^{2-}$ )<br>IS 3025 (Part 24):1986 | Chloride<br>IS 3025 (Part 32):<br>1988 |         |
|         |        |                |  | mg/l   | mg/l   | mg/l                                   |         |
| 1       | B31-1  | Water Sample   | 6.11                                   | 18.93  | 15.77  | 20.49                                  |         |

  
Prepared By  
(Akshata Ghone- Chemist)

  
Checked By  
(Yogesh Navkar-Quality Manager)



  
Authorized By  
(J.S.Salunkhe-M.D. & Tech. Manager)

\*\*\*\*\*END OF REPORT\*\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 01)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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## Geotechnical Investigation Report (Bridge No. 01)

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| 2.2 Subsurface Conditions                                     | 4        |
| 2.3 Groundwater Levels  | 5        |
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## Geotechnical Investigation Report (Bridge No. 01)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

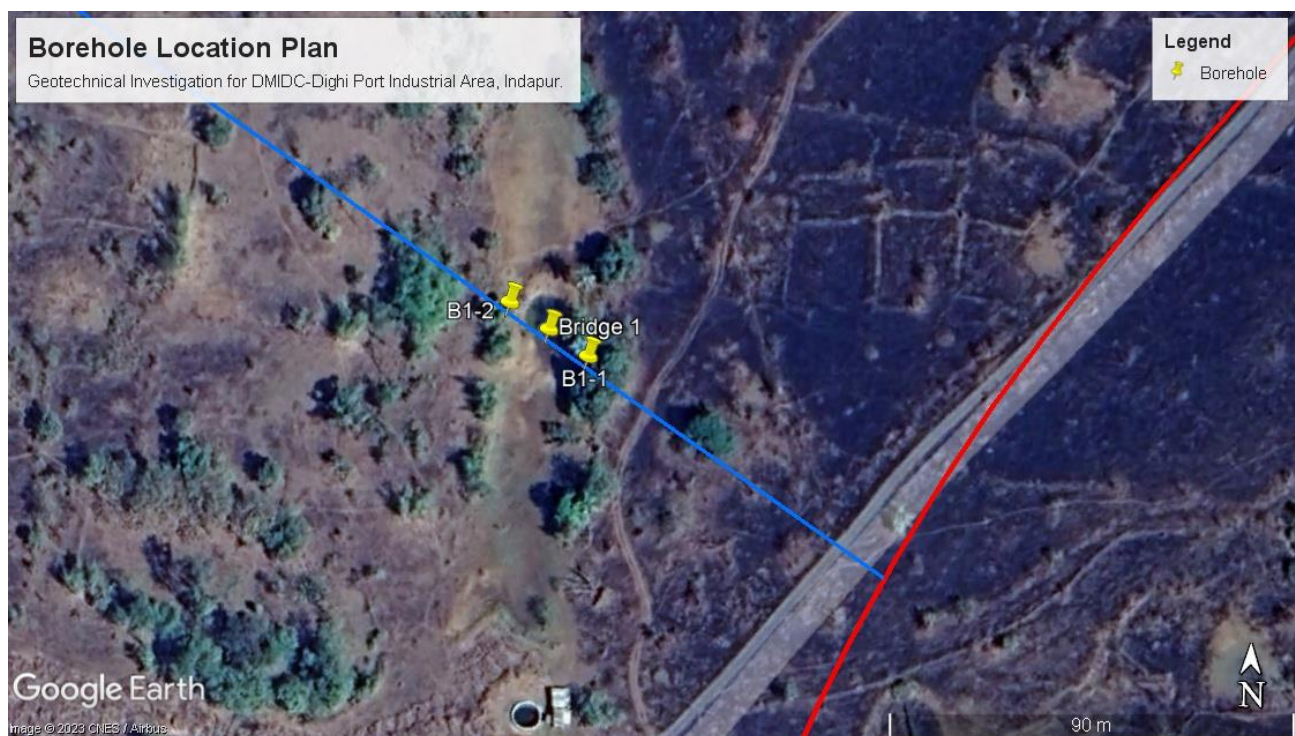
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B1-1, B1-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth  |
|--------------|----------|---------|--------|
| B1-1         | 2035168  | 319508  | 10.10m |
| B1-2         | 2035170  | 319488  | 9.10m  |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 2.85m to 3.40m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 2.85m to 3.40m below ground surface. Core Recoveries varied between 53% and 72%, while Rock Quality Designation (RQD) ranged between 0% and 24%. Compressive strength of rock core sample ranges from 1320kg/cm<sup>2</sup> to 1380kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 4.00m to 4.75m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 4.00m to 4.75m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 82% and 97%, while Rock Quality Designation (RQD) ranged between 33% and 87%. Compressive strength of rock core sample ranges from 1330kg/cm<sup>2</sup> to 1410kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 9.10m to 10.10m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Due to 100% water loss, groundwater was not found below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 2.85m to 3.40m below ground surface. In this layer compressive strength of rock core samples ranged between 1320kg/cm<sup>2</sup> to 1380kg/cm<sup>2</sup>. As per minimum compressive strength 1320kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below:

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B1-1             | 2.85m | 4.75m     |
| B1-2             | 3.40m | 4.00m     |

Maximum settlement of foundations on native soil and hard strata will be less than 25mm and 12mm respectively. A modulus of subgrade reactions of 1000 t/m<sup>3</sup> and 8300 t/m<sup>3</sup> can be utilized for design of foundations respectively. Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

For Bridge no. 1, groundwater sample was collected for chemical analysis from the site and not from the boreholes. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |





## **APPENDIX I**

### **CALCULATIONS FOR BEARING CAPACITY AND SETTLEMENT**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -2.85m to -3.40m |
| Layer II, Moderately weathered rock |                  |
|                                     | -4.00m to -4.75m |
| Layer III, Hard Basalt Bedrock      |                  |

(Allowable bearing capacity =  $(N_j) \times Q_u$  (Ref. 3, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (Ref. 4, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 13200 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 13200 = 1320 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## Calculation of Settlements of Spread Foundations (3m X 3m) Exerting Pressure of 100t/m<sup>2</sup>:

$$\text{Settlement} = S = q_0 B' \frac{1 - \mu^2}{E_s} m I_s I_f$$

Where,

$q_0$  = Footing Pressure = 100 t/m<sup>2</sup>

$B' = B/2$  (Where B is the width of pressure distribution)

$\mu$  = Poisson's ratio = 0.25

E = Modulus of Elasticity

$I_s$  = Influence Factor (Obtained from Table 5-2, Reference No. 1)

$I_f$  = Depth Factor (Obtained from Figure 5-7, Reference No. 1)

$m = 4$  for center of footing

E value for Basalt bedrock = 17,00,000 t/m<sup>2</sup> (Reference No. 1)

Using 1/10<sup>th</sup> of this value, E = 1,70,000 t/m<sup>2</sup>

$L' = 3/2 = 1.5$ ,  $B' = 3/2 = 1.5$ ,  $H = 15\text{m}$ , and  $D = 4.0\text{m}$

Therefore,  $M = L'/B' = 1$ ; and  $N = H/B' = 10$  and  $D/B' = 1.33$

Corresponding,  $I_s = 0.51$ , Conservative  $I_f = 1.0$  (From Table 5-2, Reference 1)

$$\begin{aligned} \text{Settlement of Layer} = S_1 &= 100 \times 1.5 \times \frac{1 - 0.25^2}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times \frac{0.9375}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 5.514 \times 10^{-6} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 0.000005514 \times 4 \times 0.51 \times 1.0 \\ &= 0.001687284 = 0.002\text{m} = 2\text{mm} \end{aligned}$$

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.




P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                |                                 |                                 |                                     |   |                         |   |                 |                          |                |        |                          |      |       |       |
|---|--------|------------------------------|--------------------------------|---------------------------------|---------------------------------|-------------------------------------|---|-------------------------|---|-----------------|--------------------------|----------------|--------|--------------------------|------|-------|-------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                |                                 |                                 |                                     | Client :EGIS Consulting Engineers Pvt. Ltd. |                         |   |                 |                          |                |        |                          |      |       |       |
| Type of Boring  |        | Calyx with Bent. with casing |                                | Calyx with Bent. without casing |                                 | Job No. : BRIDGE 1                  |   |                         |   |                 |                          |                |        |                          |      |       |       |
| Dia of Hole (mm):   |        | 100.00                       |                                | 75.00                           |                                 | Bore Hole No.: B1-1                 |   |                         |   |                 |                          |                |        |                          |      |       |       |
| Depth (M):  |        | 0.00-1.50                    |                                | 1.50-10.10                      |                                 | Co-ordinates : N=2035168, E=319508  |   |                         |   |                 |                          |                |        |                          |      |       |       |
| Commenced on : 31 March 2023  |        |                              | Completed on : 02 April 2023   |                                 |                                 | Ground Bed RL: 96.39M               |   |                         |   |                 |                          |                |        |                          |      |       |       |
| Water Struc :   |        |                              | Ground Water : 100% water loss |                                 |                                 | Location of Bore Hole : As per plan |   |                         |   |                 |                          |                |        |                          |      |       |       |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata          | Symbol                          | SPT Record                      |                                     |   |                         |   | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                  |      |       |       |
|   |        |                              |                                |                                 | 0-150                           | 150-300                             | 300-450                                     | 450-600                 | N |                 |                          |                |        |                          |      |       |       |
| 0.00  |        | 0.00 - 1.00                  | MURUM, PEBBLES and COBBLES     |                                 |                                 |                                     |   |                         |   | DS-1            |                          |                |        |                          |      |       |       |
|   |        | 1.00 - 2.00                  |                                |                                 |                                 |                                     |   |                         |   | 1 TO 7          |                          |                |        |                          | 0.55 | 55.00 | 0.00  |
|   |        | 2.00 - 3.40                  |                                |                                 |                                 |                                     |   |                         |   | 8 TO 15         |                          |                |        |                          | 1.00 | 71.00 | 35.00 |
| 3.40  | 3.40   | 3.40 - 4.75                  | GREY MODERATELY WEATHERED ROCK |                                 |                                 |                                     |   |                         |   | 16 TO 21        | 0.97                     | 72.00          | 24.00  |                          |      |       |       |
| 4.75  | 4.75   | 4.75 - 6.25                  | GREY JOINTED BASALT            |                                 |                                 |                                     |   |                         |   | 22 TO 30        | 1.45                     | 97.00          | 62.00  | Inclined _vertical veins |      |       |       |
|   |        | 6.25 - 7.75                  | 31 TO 41                       |                                 |                                 |                                     |   |                         |   | 1.23            | 82.00                    | 35.00          |        |                          |      |       |       |
|   |        | 7.75 - 8.85                  | 42 TO 44                       |                                 |                                 |                                     |   |                         |   | 0.98            | 89.00                    | 64.00          |        |                          |      |       |       |
|   |        | 8.85 To 10.10                | 45 TO 50                       |                                 |                                 |                                     |   |                         |   | 1.18            | 94.00                    | 72.00          |        |                          |      |       |       |
| 10.10   |        |                              |                                |                                 | Bore Hole Terminated at : 10.10 |                                     |   |                         |   |                 |                          |                |        |                          |      |       |       |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                |                                 |                                 |                                     |   |                         |   |                 |                          |                |        |                          |      |       |       |
| No. of disturbed Sample : 1   |        |                              |                                | No. of U.D.S. : 0               |                                 |                                     |   | No. of Vane Test : 0    |   |                 |                          |                |        |                          |      |       |       |
|   |        |                              |                                | No. of S.P.T. : 0               |                                 |                                     |   | No. of Water Sample : 0 |   |                 |                          |                |        |                          |      |       |       |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                                |   |            |                                     |   |                         |   |                 |                          |                |        |                |      |
|---|--------|------------------------------|--------------------------------|---|------------|-------------------------------------|---|-------------------------|---|-----------------|--------------------------|----------------|--------|----------------|------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                                |   |            |                                     | Client :EGIS Consulting Engineers Pvt. Ltd. |                         |   |                 |                          |                |        |                |      |
| Type of Boring  |        | Calyx with Bent. with casing |                                | Calyx with Bent. without casing   |            | Job No. : BRIDGE 1                  |   |                         |   |                 |                          |                |        |                |      |
| Dia of Hole (mm):   |        | 100.00                       |                                | 75.00   |            | Bore Hole No.: B1-2                 |   |                         |   |                 |                          |                |        |                |      |
| Depth (M):  |        | 0.00-2.00                    |                                | 2.00-9.10   |            | Co-ordinates : N=2035170, E=319488  |   |                         |   |                 |                          |                |        |                |      |
| Commenced on : 29 March 2023  |        |                              | Completed on : 31 March 2023   |   |            | Ground Bed RL: 96.60M               |   |                         |   |                 |                          |                |        |                |      |
| Water Struc :   |        |                              | Ground Water : 100% water loss |   |            | Location of Bore Hole : As per plan |   |                         |   |                 |                          |                |        |                |      |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata          | Symbol  | SPT Record |                                     |   |                         |   | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks        |      |
|   |        |                              |                                |   | 0-150      | 150-300                             | 300-450                                     | 450-600                 | N |                 |                          |                |        |                |      |
| 0.00  |        | 0.00 - 0.30                  | MURUM, PEBBELS AND COBBLES     |   |            |                                     |   |                         |   | DS-1            |                          | 46.00          | 0.00   |                |      |
|   |        | 0.30 - 1.50                  |                                |   |            |                                     |   |                         |   | 1 TO 10         |                          |                |        |                | 0.55 |
|   |        | 1.50 - 2.85                  |                                |   |            |                                     |   |                         |   | 11 TO 20        |                          |                |        |                | 0.60 |
| 2.85  | 2.85   | 2.85 - 4.00                  | GREY MODERATELY WEATHERED ROCK |  |            |                                     |   |                         |   | 21 TO 30        | 0.61                     | 53.00          | 0.00   |                |      |
| 4.00  | 4.00   | 4.00 - 5.00                  | GREY JOINTED BASALT            |  |            |                                     |   |                         |   | 31 TO 38        | 0.86                     | 86.00          | 33.00  | Inclined veins |      |
|   |        | 5.00 - 6.50                  |                                |   |            |                                     |   |                         |   | 39 TO 47        | 1.40                     | 93.00          | 87.00  |                |      |
|   |        | 6.50 - 7.90                  |                                |   |            |                                     |   |                         |   | 48 TO 58        | 1.30                     | 93.00          | 58.00  |                |      |
|   |        | 7.90 - 9.10                  |                                |   |            |                                     |   |                         |   | 59 TO 64        | 1.01                     | 84.00          | 59.00  |                |      |
| 9.10  |        |                              |                                |   |            |                                     |   |                         |   |                 |                          |                |        |                |      |
| Bore Hole Terminated at : 9.10  |        |                              |                                |   |            |                                     |   |                         |   |                 |                          |                |        |                |      |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                                |   |            |                                     |   |                         |   |                 |                          |                |        |                |      |
| No. of disturbed Sample : 1   |        |                              |                                | No. of U.D.S. : 0   |            |                                     |   | No. of Vane Test : 0    |   |                 |                          |                |        |                |      |
|   |        |                              |                                | No. of S.P.T. : 0   |            |                                     |   | No. of Water Sample : 0 |   |                 |                          |                |        |                |      |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



## TEST REPORT

PAGE 2 OF 2

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev. No. - 03                       | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

## TEST REPORT NO. &amp; DATE

R&amp;D/LAB/SAN/2023-24/SAN0000223/00494

ULR No. : TC528223000005818F

12/04/2023

1. Name &amp; Address of Client

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | CN No.15 B1-2 |       |    |    | CN No. 12 B1-1          |       |    |    | --   |       |    |    | --   |       |   |   |
|--|---|------------------------------------|---------------|-------|----|----|-------------------------|-------|----|----|------|-------|----|----|------|-------|---|---|
| Sample No. :   |   | --                                 |               |       |    |    |                         |       |    |    | --   |       |    |    | --   |       |   |   |
| Depth, m :   |   | --                                 | 0.0 to 30.0m  |       |    |    | 0.0 to 1.0m             |       |    |    | --   |       |    |    | --   |       |   |   |
| Description :  |   | --                                 | Silty Sand    |       |    |    | Silty Sand with gravels |       |    |    | --   |       |    |    | --   |       |   |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 40            |       |    |    | 44                      |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Plastic Limit                           |                                    | 26            |       |    |    | 28                      |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Plasticity Index                        |                                    | 14            |       |    |    | 16                      |       |    |    | --   |       |    |    | --   |       |   |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                     | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 4+48          |       |    |    | 4+28                    |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Sand                                    |                                    | 36            |       |    |    | 46                      |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Gravel                                  |                                    | 12            |       |    |    | 22                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Bulk Density,T/m <sup>3</sup>           | IS 2720 Part-13                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Water Content,%                         | IS 2720 Part-13                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
| Unconfined compression test                                | Shear Strength (kg/cm <sup>2</sup> )    | IS 2720 Part-10                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  |   |                                    | --            | --    | -- | -- | --                      | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10          | 10-20 | -  | -  | 5-10                    | 10-20 | -  | -  | 5-10 | 10-20 | -  | -  | 5-10 | 10-20 | - | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                    | -             | -     | -  | -  | -                       | -     | -  | -  | -    | -     | -  | -  | -    | -     | - | - |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | -             | -     | -  | -  | -                       | -     | -  | -  | -    | -     | -  | -  | -    | -     | - | - |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Specific gravity   |   | IS 2720 Part-3                     | 2.61          |       |    |    | 2.62                    |       |    |    | --   |       |    |    | --   |       |   |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Heavy Compaction   | Optimum Moist-Cont.,%                   | Heavy Compaction IS 2720 Part-8    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Unsoaked %                              |                                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| **Coefficient of Curvature (Cc)                            |   |                                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |
| Triaxial Compression                                       |   |                                    | --            |       |    |    | --                      |       |    |    | --   |       |    |    | --   |       |   |   |

## Triaxial Compression

TUU : Unconsolidated Undrained

## Unconfined Compression

UCU : Undisturbed

UCR : Remoulded

\*\* - Indicates Calculated Parameters

## Direct Shear

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

## Consolidation Test

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

SST/N/LAB/Tech Report/2023-24/turbhe/test report/NABL/Phy/Soil/SAN0000223

\*\*\*\*\*End of Report\*\*\*\*\*

Goregaon (Laboratory)  
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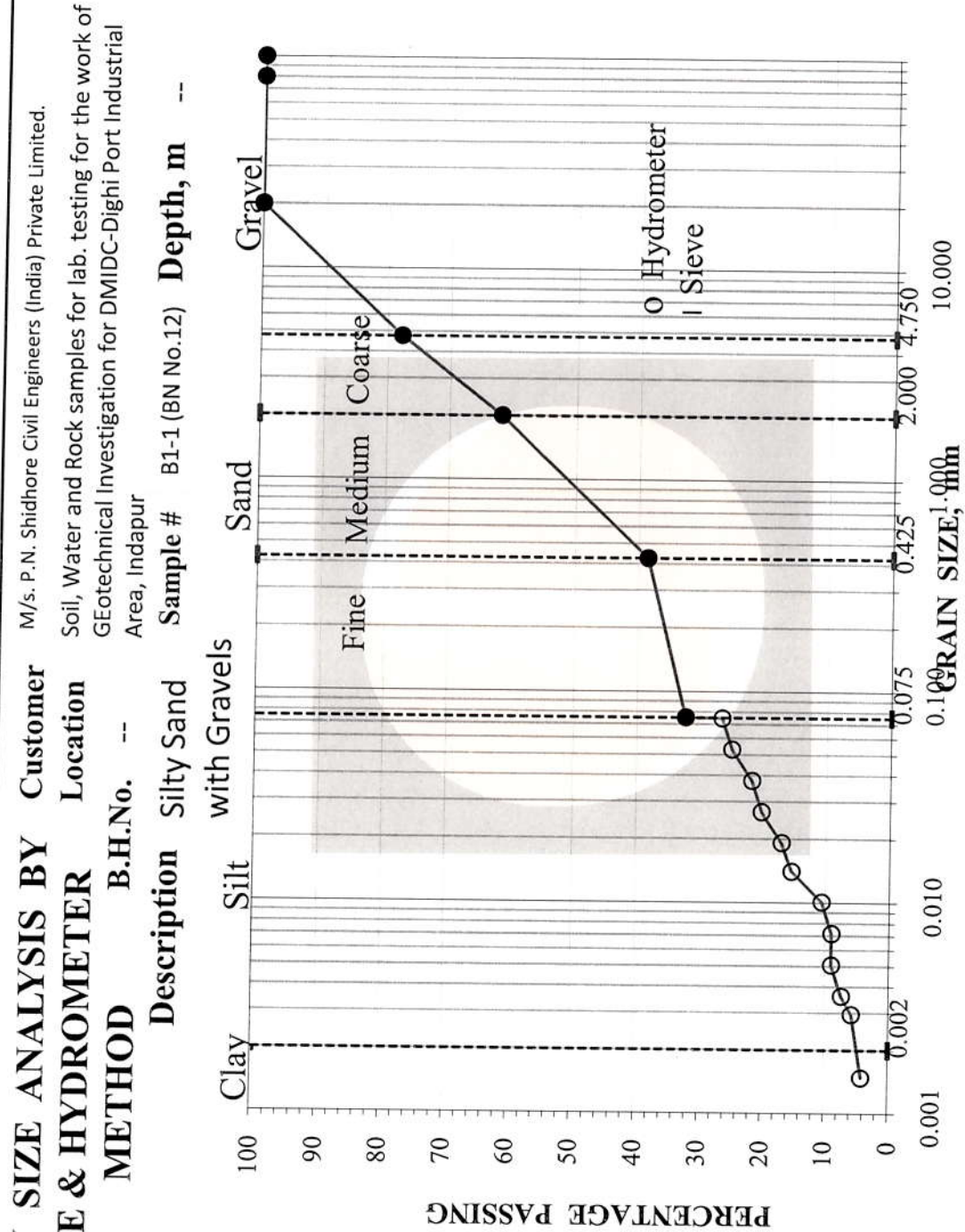
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2



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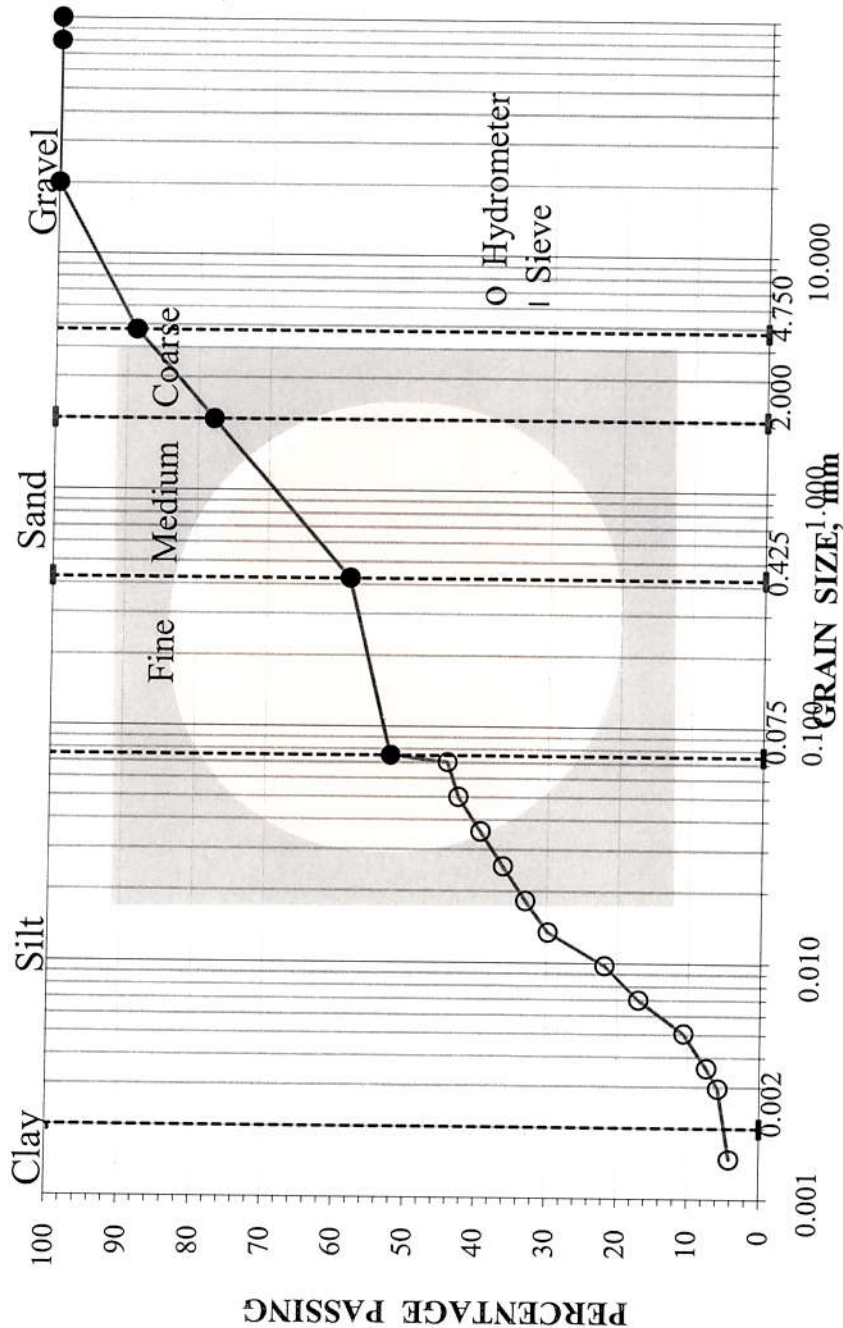


M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMDC-Dighi Port Industrial  
Area, Indapur

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER  
METHOD**

B.H.No. --

Description Silty Sand Sample # B1-2 (CN No. 15) Depth, m --



2



*"Intelligence with Integrity"*

ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

PAGE 1 OF 1



TC-5282

**TEST REPORT NO. & DATE**R&D/LAB/SAN/2023-24/SAN0016023/00671  
ULR No.: TC528223000005995F  
15/04/2023

## 1. Name &amp; Address of Customer

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22 Dtd. 08.04.2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

i) Description

Rock

ii) Quantity

04 Nos.

iii) Date of receipt

08/04/2023

iii) Condition

Acceptable

## 6. Test method followed

As Mentioned Below.

## 7. Date of Testing From

11/04/2023 to 15/04/2023

**TEST REPORT**

| SR. No.              | ID. Mark                     | Depth | Dia.  | Area            | Length | Dry Density                      | Load   | Compressive strength            | Compressive strength corrected | SP. Gravity                     | Porosity                     | Water Absorption               | Hardness by Moh's scale |
|----------------------|------------------------------|-------|-------|-----------------|--------|----------------------------------|--------|---------------------------------|--------------------------------|---------------------------------|------------------------------|--------------------------------|-------------------------|
|                      |                              | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>                | N      | N / mm <sup>2</sup>             | forL/D- N /mm <sup>2</sup>     |                                 | %                            | %                              |                         |
| Test Method Followed |                              |       |       |                 |        | (IS:13030):<br>1991<br>(RA 2021) |        | (IS:9143):<br>1979<br>(RA 2021) |                                | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) | IS 13630<br>(Part 13):<br>2019 |                         |
| 1                    | BH No. B1-1<br>(Piece No.24) | 5.00  | 54.34 | 2317.98         | 110.76 | --                               | 326400 | 141                             | 141                            | --                              | 0.014                        | 0.46                           | --                      |
| 2                    | BH No. B1-1<br>(Piece No.10) | 2.10  | 54.18 | 2304.35         | 109.74 | --                               | 316500 | 137                             | 138                            | --                              | 0.010                        | 0.34                           | --                      |
| 3                    | BH No. B1-2<br>(Piece No.41) | 5.10  | 54.50 | 2331.65         | 112.06 | --                               | 306700 | 132                             | 132                            | --                              | 0.011                        | 0.39                           | --                      |
| 4                    | BH No. B1-2<br>(Piece No.51) | 7.0   | 54.36 | 2319.68         | 110.84 | --                               | 307000 | 132                             | 133                            | --                              | 0.010                        | 0.33                           | --                      |

Parameters for Classification as per IS 13030:2019

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- \* Data provided by Customer

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0016023

  
**Vikram B. Parmar**  
 Nodal Quality Manager  
 Authorised Signatory

\*\*\*\*\*End of Report\*\*\*\*\*



*"Intelligence with Integrity"*

ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 | PAGE 1 OF 1     |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |



TC-5282

TEST REPORT NO. &amp; DATE

R&amp;D/LAB/SAN/2023-24/SAN0016023/00859

ULR No. : TC528223000006183F

17/04/2023

1. Name &amp; Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur  
PNS/Structwel/22 Dtd. 25.03.2023

3. Customer's Reference

4. Location of performance of test

At Laboratory

5. Sample

i) Description

Construction Water

ii) Quantity

01 No.

iii) Date of receipt

08/04/2023

iv) Condition

Acceptable

6. Test method followed

Mentioned Below

7. Date of Testing

14/04/2023

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER**\* ID Mark. : ~~BH.No.~~ Bridge No. 1-1

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.62    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 22      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 19      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

Swati Sonawane  
Manager - Chemical

Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0016023

\*\*\*\*\* End of Report \*\*\*\*\*

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 02)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
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## Geotechnical Investigation Report (Bridge No. 02)

### Table of Contents

| Section   | Page No. |
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| 2.0 Exploration Procedure                                     | 3        |
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## Geotechnical Investigation Report (Bridge No. 02)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

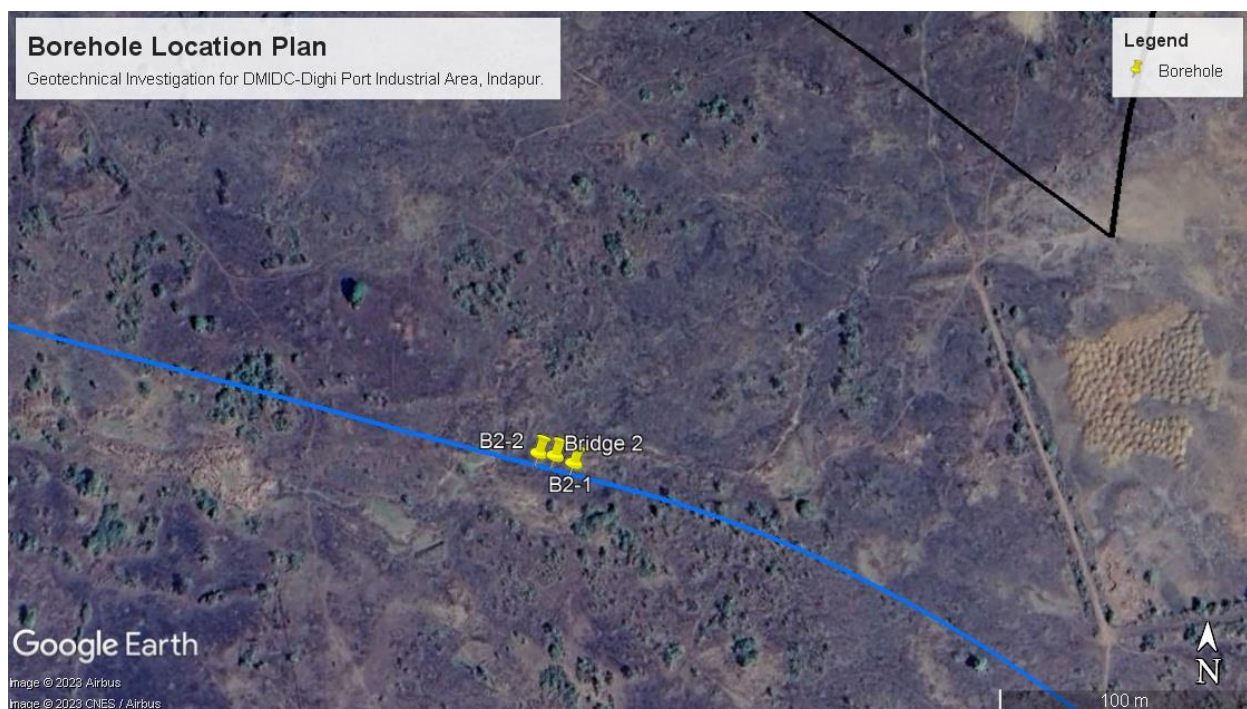


## 2.1 Exploration Scope

Two boreholes (B2-1, B2-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B2-1         | 2035358  | 319123  | 7.10m |
| B2-2         | 2035360  | 319112  | 8.80m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at existing ground surface. Core Recoveries varied between 55% and 69%, while Rock Quality Designation



(RQD) ranged between 0% and 55%. Compressive strength of rock core sample ranges from 270kg/cm<sup>2</sup> to 530kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 2.00m to 3.60m below ground surface.

#### Layer II: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 2.00m to 3.60m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 86% and 93%, while Rock Quality Designation (RQD) ranged between 46% and 91%. Compressive strength of rock core sample ranges from 500kg/cm<sup>2</sup> to 690kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 7.10m to 8.80m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depth from 1.0m to 2.0m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### **3.0 Foundation Recommendations**

Spread foundations for proposed structure at a depth of 1.50m below ground on moderately weathered rock (MWR). In this layer compressive strength of rock core samples ranged between 280kg/cm<sup>2</sup> to 530kg/cm<sup>2</sup>. As per minimum compressive strength 280kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 1.50m can be designed for a maximum net allowable

bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below.

**Table B**  
**Depths from Ground Surface**

| <b>Borehole Numbers</b> | <b>MWR</b> | <b>Hard Rock</b> |
|-------------------------|------------|------------------|
| B2-1                    | 0.00m      | 2.00m            |
| B2-2                    | 0.00m      | 3.60m            |

Maximum settlement of foundations on native soil and hard strata will be less than 25mm and 12mm respectively. A modulus of subgrade reactions of 1000 t/m<sup>3</sup> and 8300 t/m<sup>3</sup> can be utilized for design of foundations respectively. Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsoon).

### **3.1 Foundation Protection:**

Groundwater samples were collected for chemical analysis from the site. Results of Chemical analysis are enclosed in the Annexure. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



**APPENDIX I**  
**CALCULATIONS FOR BEARING CAPACITY AND SETTLEMENT**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                    |                  |
|------------------------------------|------------------|
|                                    | GL +0.0m         |
| Layer I, Moderately weathered rock |                  |
|                                    | -2.00m to -3.60m |
| Layer II, Hard Basalt Bedrock      |                  |

(Allowable bearing capacity =  $(N_j) \times Q_u$  (Ref. 3, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (Ref. 4, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 2800 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 2800 = 280 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## Calculation of Settlements of Spread Foundations (3m X 3m) Exerting Pressure of 100t/m<sup>2</sup>:

$$\text{Settlement} = S = q_0 B' \frac{1 - \mu^2}{E_s} m I_s I_f$$

Where,

$q_0$  = Footing Pressure = 100 t/m<sup>2</sup>

$B' = B/2$  (Where B is the width of pressure distribution)

$\mu$  = Poisson's ratio = 0.25

E = Modulus of Elasticity

$I_s$  = Influence Factor (Obtained from Table 5-2, Reference No. 1)

$I_f$  = Depth Factor (Obtained from Figure 5-7, Reference No. 1)

$m = 4$  for center of footing

E value for Basalt bedrock = 17,00,000 t/m<sup>2</sup> (Reference No. 1)

Using 1/10<sup>th</sup> of this value, E = 1,70,000 t/m<sup>2</sup>

$L' = 3/2 = 1.5$ ,  $B' = 3/2 = 1.5$ ,  $H = 15\text{m}$ , and  $D = 2.0\text{m}$

Therefore,  $M = L/B = 1$ ; and  $N = H/B' = 10$  and  $D/B = 0.66$

Corresponding,  $I_s = 0.51$ , Conservative  $I_f = 1.0$  (From Table 5-2, Reference 1)

$$\begin{aligned} \text{Settlement of Layer} = S_1 &= 100 \times 1.5 \times \frac{1 - 0.25^2}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times \frac{0.9375}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 5.514 \times 10^{-6} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 0.000005514 \times 4 \times 0.51 \times 1.0 \\ &= 0.001687284 = 0.002\text{m} = 2\text{mm} \end{aligned}$$

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.



| BORE LOG  |        |                              |  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
|---|--------|------------------------------|--|------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|----------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |  |                              |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                            |
| Type of Boring  |        | Calyx with Bent. with casing |  |                              | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 2                  |   |   |                          |                |        |                            |
| Dia of Hole (mm):   |        | 100.00                       |  |                              | 75.00                           |         |         | Bore Hole No.: B2-1                 |   |   |                          |                |        |                            |
| Depth (M):  |        | 0.00-0.00                    |  |                              | 0.00-7.10                       |         |         | Co-ordinates : N=2035358, E=319123  |   |   |                          |                |        |                            |
| Commenced on : 03 April 2023  |        |                              |  | Completed on : 05 April 2023 |                                 |         |         | Ground Bed RL: 95.08M.              |   |   |                          |                |        |                            |
| Water Struc :   |        |                              |  | Ground Water : 1.00M.        |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                            |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                                    | Symbol                       | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                    |
|   |        |                              |  |                              | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                            |
| 0.00  |        | 0.00 - 1.30                  | REDDISH GREY MODERATELY WEATHERED ROCK                   | <div></div>                  |                                 |         |         |                                     |   | 1 TO 7                                      | 0.71                     | 55.00          | 12.00  |                            |
|   |        | 1.30 - 2.00                  |  | <div></div>                  |                                 |         |         |                                     |   | 8 TO 10                                     | 0.40                     | 57.00          | 39.00  |                            |
|   | 2.00   |                              |  | <div></div>                  |                                 |         |         |                                     |   |   |                          |                |        |                            |
| 2.00  |        | 2.00 - 3.50                  | REDDISH GREY AMYGDALOIDAL BASALT and GREY JOINTED BASALT | <div></div>                  |                                 |         |         |                                     |   | 11 TO 14                                    | 1.40                     | 93.00          | 90.00  | Inlined and vertical veins |
|   |        | 3.50 - 4.90                  |  | <div></div>                  |                                 |         |         |                                     |   | 15 TO 22                                    | 1.20                     | 86.00          | 64.00  |                            |
|   |        | 4.90 - 6.10                  |  | <div></div>                  |                                 |         |         |                                     |   | 23 TO 30                                    | 1.05                     | 88.00          | 46.00  |                            |
|   |        | 6.10 - 7.10                  |  | <div></div>                  |                                 |         |         |                                     |   | 31 TO 37                                    | 0.92                     | 92.00          | 50.00  |                            |
|   | 7.10   |                              |  | <div></div>                  |                                 |         |         |                                     |   |   |                          |                |        |                            |
|   |        |                              |  |                              | Bore Hole Terminated at : 7.10  |         |         |                                     |   |   |                          |                |        |                            |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |  |                              |                                 |         |         |                                     |   |   |                          |                |        |                            |
| No. of disturbed Sample : 0   |        |                              |  |                              | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                            |
|   |        |                              |  |                              | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                            |



# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |  |   |                                 |         |         |                                     |   |   |                          |                |        |         |
|---|--------|------------------------------|--|---|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |  |   |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |        | Calyx with Bent. with casing |  |   | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 2                  |   |   |                          |                |        |         |
| Dia of Hole (mm):   |        | 100.00                       |  |   | 75.00                           |         |         | Bore Hole No.: B2-2                 |   |   |                          |                |        |         |
| Depth (M):  |        | 0.00-0.00                    |  |   | 0.00-8.80                       |         |         | Co-ordinates : N=2035360, E=319112  |   |   |                          |                |        |         |
| Commenced on : 03 April 2023  |        |                              |  | Completed on : 05 April 2023  |                                 |         |         | Ground Bed RL: 94.84M.              |   |   |                          |                |        |         |
| Water Struc :   |        |                              |  | Ground Water : 2.00M.   |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |         |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                            | Symbol  | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |        |                              |  |   | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |         |
| 0.00  |        | 0.00 - 0.80                  | REDDISH GREY MODERATELY WEATHERED ROCK           |   |                                 |         |         |                                     |   | 1 TO 6                                      | 0.50                     | 63.00          | 0.00   |         |
|   |        | 7 TO 11                      |  |   |                                 |         |         |                                     |   | 0.86  | 66.00                    | 55.00          |        |         |
|   |        | 12 TO 19                     |  |   |                                 |         |         |                                     |   | 1.03  | 69.00                    | 35.00          |        |         |
| 3.60  |        |                              |  |   |                                 |         |         |                                     |   |   |                          |                |        |         |
| 3.60  |        | 3.60 - 5.10                  | GREY JOINTED BASALT and GREY AMYGDALOIDAL BASALT |  |                                 |         |         |                                     |   | 20 TO 30                                    | 1.39                     | 93.00          | 51.00  |         |
|   |        | 31 TO 37                     |  |   |                                 |         |         |                                     |   | 1.31  | 87.00                    | 61.00          |        |         |
|   |        | 38 TO 41                     |  |   |                                 |         |         |                                     |   | 1.01  | 92.00                    | 64.00          |        |         |
|   |        | 42 TO 45                     |  |   |                                 |         |         |                                     |   | 1.01  | 92.00                    | 91.00          |        |         |
| 8.80  |        |                              |  |   |                                 |         |         |                                     |   |   |                          |                |        |         |
| Bore Hole Terminated at : 8.80  |        |                              |  |   |                                 |         |         |                                     |   |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |  |   |                                 |         |         |                                     |   |   |                          |                |        |         |
| No. of disturbed Sample : 0   |        |                              |  |   | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |         |
| No. of S.P.T. : 0   |        |                              |  |   | No. of Water Sample : 0         |         |         |                                     |   |   |                          |                |        |         |

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**TEST REPORT**

PAGE 2 OF 2

|                                    |                      |
|------------------------------------|----------------------|
| STRUCTWEL/Level/IV/PHY/TR/Soil/061 |                      |
| Rev. No. - 03                      | Dtd. 30/08/2022      |
| Discipline: Mechanical             | Group: Soil and Rock |

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2023-24/SAN0016023/00762

ULR No. : TC528223000006086F

15/04/2023

1. Name &amp; Address of Client

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | Bridge 2-1    |       |   | Bridge 2-2              |      |       | -- |   |      | --    |   |   |
|--|---|------------------------------------|---------------|-------|---|-------------------------|------|-------|----|---|------|-------|---|---|
| Sample No. :   |   | --                                 | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Depth, m :   |   | --                                 | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Description :  |   | --                                 | Sandy Gravels |       |   | Silty Sand with gravels |      |       | -- |   |      | --    |   |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 41            |       |   | 33                      |      |       | -- |   |      | --    |   |   |
|  | Plastic Limit                           |                                    | 27            |       |   | NP                      |      |       | -- |   |      | --    |   |   |
|  | Plasticity Index                        |                                    | 14            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                     | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 5+34          |       |   | 13                      |      |       | -- |   |      | --    |   |   |
|  | Sand                                    |                                    | 29            |       |   | 63                      |      |       | -- |   |      | --    |   |   |
|  | Gravel                                  |                                    | 32            |       |   | 24                      |      |       | -- |   |      | --    |   |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Bulk Density,T/m <sup>3</sup>           |                                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Water Content,%                         | IS 2720 Part-13                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10          | 10-20 | - | -                       | 5-10 | 10-20 | -  | - | 5-10 | 10-20 | - | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                    | -             | -     | - | -                       | -    | -     | -  | - | -    | -     | - | - |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | -             | -     | - | -                       | -    | -     | -  | - | -    | -     | - | - |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Specific gravity   |   | IS 2720 Part-3                     | 2.63          |       |   | 2.6                     |      |       | -- |   |      | --    |   |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Optimum Moist-Cont.,%                   | Heavy Compaction IS 2720 Part-8    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
|  | Unsoaked %                              |                                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| **Coefficient of Curvature (Cc)                            |   |                                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |
| Triaxial Compression                                       |   |                                    | --            |       |   | --                      |      |       | -- |   |      | --    |   |   |

Triaxial Compression

TUU : Unconsolidated Undrained

Unconfined Compression

UCU : Undisturbed

UCR : Remoulded

Direct Shear

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

Consolidation Test

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

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\*\*\*\*\*

End of Report

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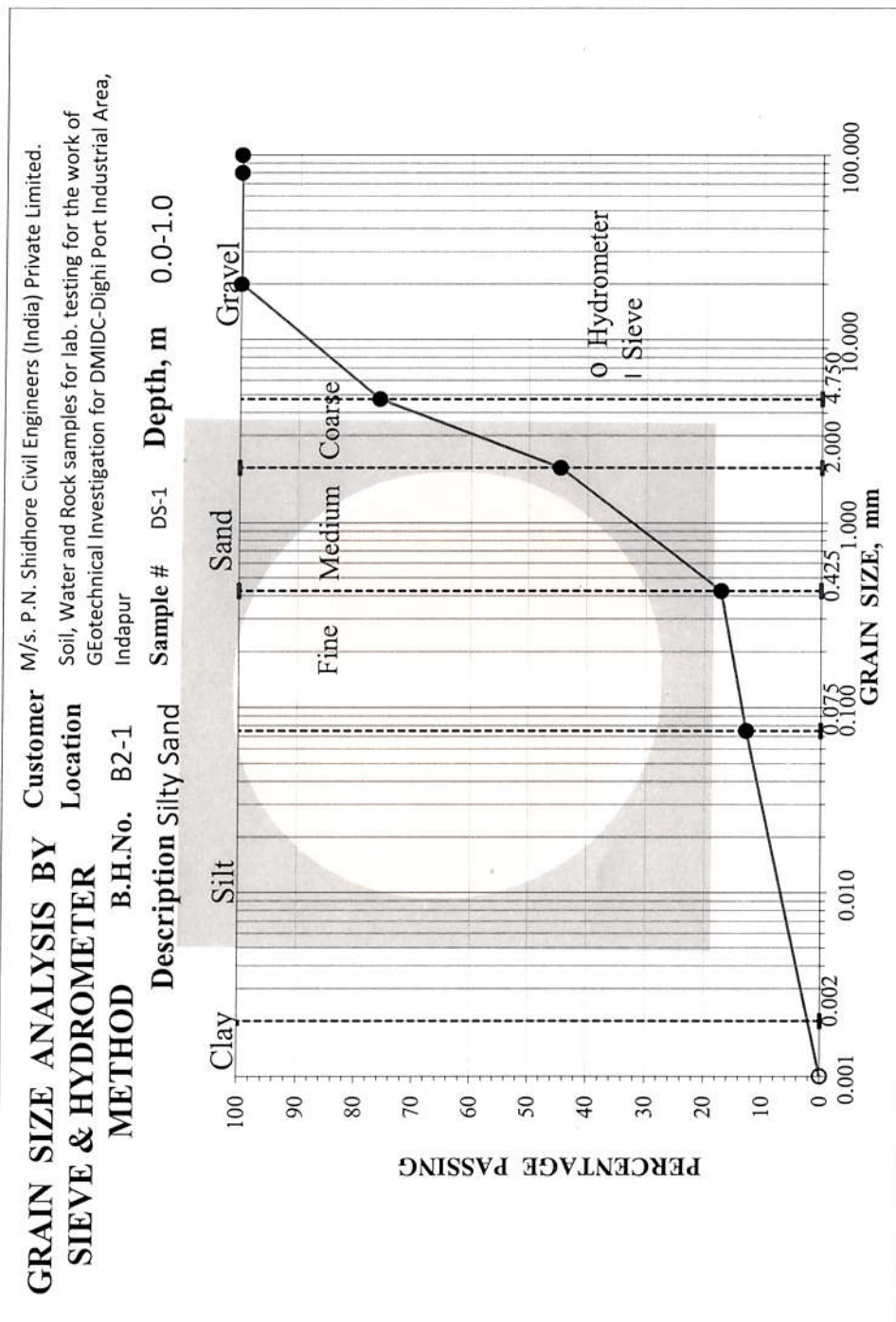
Vikram B. Parmar  
Nodal Quality Manager  
Authorized Signatory

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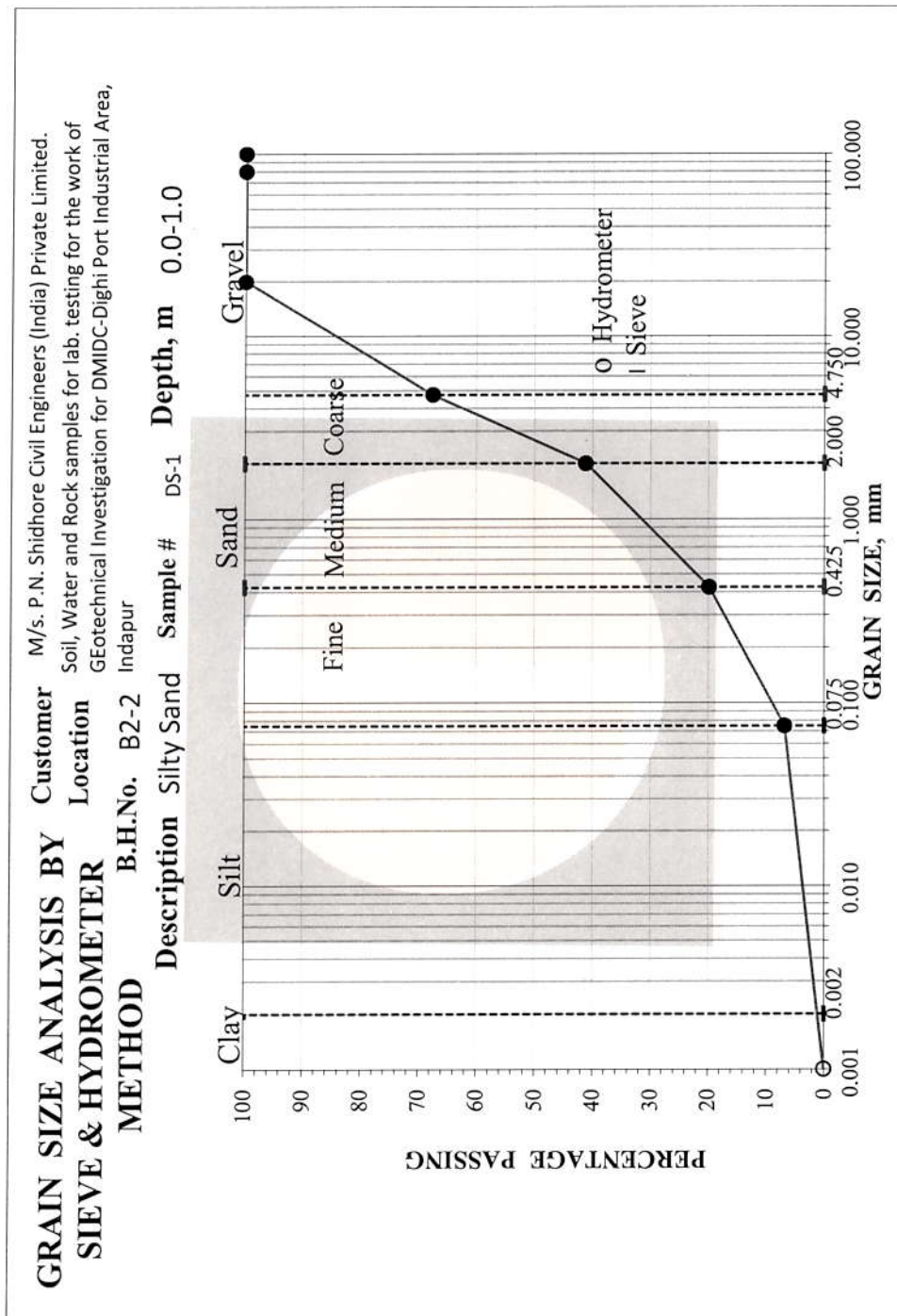


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**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

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**TEST REPORT NO. & DATE**

R&D/LAB/SAN/2023-24/SAN0016023/00761  
ULR No. : TC528223000006085F  
15/04/2023

**1. Name & Address of Customer**

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

**2. Project / Site**

Soil, Water and Rock samples for lab. testing for the work of Geotechnical  
Investigation for DMIDC-Dighi Port Industrial Area, Indapur

**3. Customer's Reference**

PNS/Structwel/22 Dtd. 08.04.2023

**4. Location of test Performance**

At Laboratory

**5. Sample**

**i) Description**

Rock

**ii) Quantity**

04 Nos.

**iii) Date of receipt**

08/04/2023

**iii) Condition**

Acceptable

**6. Test method followed**

As Mentioned Below.

**7. Date of Testing From**

11/04/2023 to 15/04/2023

**TEST REPORT**

| SR. No.              | ID. Mark                  | Depth | Dia.  | Area            | Length | Dry Density                | Load   | Compressive strength      | Compressive strength corrected | SP. Gravity               | Porosity                  | Water Absorption | Hardness by Moh's scale  |
|----------------------|---------------------------|-------|-------|-----------------|--------|----------------------------|--------|---------------------------|--------------------------------|---------------------------|---------------------------|------------------|--------------------------|
|                      |                           | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>          | N      | N / mm <sup>2</sup>       | for L/D- N / mm <sup>2</sup>   |                           | %                         | %                |                          |
| Test Method Followed |                           |       |       |                 |        | (IS:13030): 1991 (RA 2021) |        | (IS:9143): 1979 (RA 2021) |                                | (IS 1122): 1974 (RA 2017) | (IS:13030):1991 (RA 2021) |                  | IS 13630 (Part 13): 2019 |
| 1                    | BH No. B2-1 (Piece No.15) | 3.50  | 54.40 | 2323.10         | 110.0  | --                         | 116900 | 50                        | 50                             | --                        | 0.010                     | 0.37             | --                       |
| 2                    | BH No. B2-1 (Piece No.8)  | 1.30  | 54.67 | 2346.21         | 93.40  | --                         | 65400  | 28                        | 27                             | --                        | 0.011                     | 0.33             | --                       |
| 3                    | BH No. B2-2 (Piece No.25) | 4.00  | 54.30 | 2314.56         | 110.00 | --                         | 160300 | 69                        | 69                             | --                        | 0.012                     | 0.40             | --                       |
| 4                    | BH No. B2-2 (Piece No.7)  | 0.80  | 54.00 | 2289.06         | 112.14 | --                         | 121300 | 53                        | 53                             | --                        | 0.010                     | 0.33             | --                       |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- \* Data provided by Customer

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SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0016023

Vikram B. Parmar  
Nodal Quality Manager  
Authorized Signatory

\*\*\*\*\*End of Report\*\*\*\*\*



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**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1



TC-5282

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0016023/00818****ULR No. : TC528223000006142F****17/04/2023****1. Name & Address of Customer**M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur**3. Customer's Reference**

PNS/Structwel/22 Dtd. 25.03.2023

**4. Location of performance of test**

At Laboratory

**5. Sample**

i) Description

**Construction Water**

ii) Quantity

01 No.

iii) Date of receipt

08/04/2023

iv) Condition

Acceptable

**6. Test method followed**

Mentioned Below

**7. Date of Testing**

14/04/2023

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER****\* ID Mark. : BH.No. Bridge No. 2-1**

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.56    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 21      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 18      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

**NOTE :**

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- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

Swati Sonawane  
Manager - Chemical

Check ed by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0016023

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

\*\*\*\*\* End of Report \*\*\*\*\*



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**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 | PAGE 1 OF 1     |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |



TC-5282

|                                    |  |
|------------------------------------|--|
| TEST REPORT NO. & DATE             | R&D/LAB/SAN/2023-24/SAN0016023/00860<br>ULR No. : TC528223000006184F<br>17/04/2023   |
| 1. Name & Address of Customer      | M/s.P.N. Shidhore Civil Engineers (India) Private Limited.<br>Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,<br>Kalyan (W) - 421301. |
| 2. Project / Site                  | Soil, Water and Rock samples for lab. testing for the work of<br>GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur  |
| 3. Customer's Reference            | PNS/Structwel/22 Dtd. 25.03.2023   |
| 4. Location of performance of test | At Laboratory  |
| 5. Sample                          |  |
| i) Description                     | Construction Water   |
| ii) Quantity                       | 01 No.   |
| iii) Date of receipt               | 08/04/2023   |
| iv) Condition                      | Acceptable   |
| 6. Test method followed            | Mentioned Below  |
| 7. Date of Testing                 | 14/04/2023   |

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER**

\* ID Mark. : BH.No. Bridge No. 2-2

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.69    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 20      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 17      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

*Swati*  
Swati Sonawane  
Manager - Chemical  
Checked by

*Vikram B. Parmar*  
Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0016023

\*\*\*\*\* End of Report \*\*\*\*\*



# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 04)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

Prabhakar Apt, B Wing,  
3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)





## **Geotechnical Investigation Report (Bridge No. 04)**

### **Table of Contents**

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| 2.1 Exploration Scope   | 4               |
| 2.2 Subsurface Conditions                                     | 4               |
| 2.3 Groundwater Levels  | 5               |
| 3.0 Foundation Recommendations                                | 6               |
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| Appendix I - Calculations for Bearing Capacity and Settlement | 8               |
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## Geotechnical Investigation Report (Bridge No. 04)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

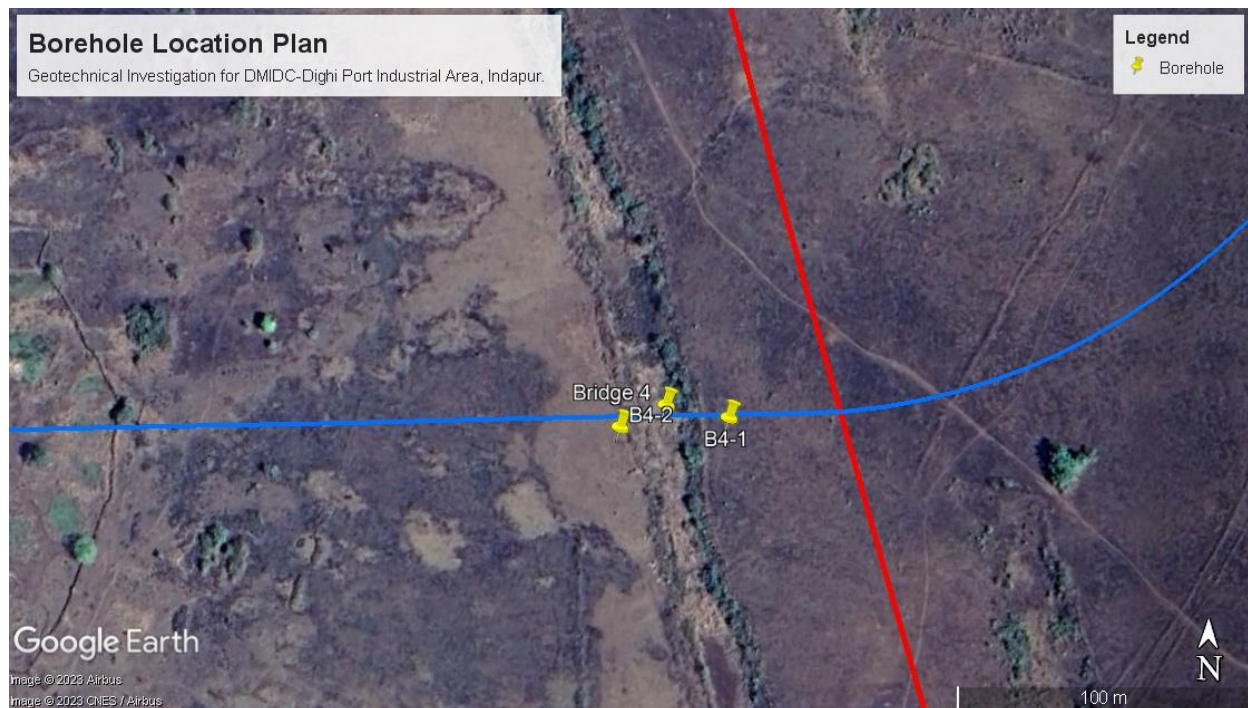
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B4-1, B4-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth  |
|--------------|----------|---------|--------|
| B4-1         | 2033726  | 319801  | 10.00m |
| B4-2         | 2033722  | 319763  | 10.10m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. Based on Standard Penetration Tests (SPT) conducted in this layer encountered refusals. The lower boundary of this layer was encountered at depths of 2.25m to 2.60m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 2.25m to 2.60m below ground surface. Core Recoveries varied between 44% and 74%, while Rock Quality Designation (RQD) ranged between 0% and 45%. Compressive strength of rock core sample ranges from 770kg/cm<sup>2</sup> to 1210kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.80m to 5.00m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.80m to 5.0m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 75% and 100%, while Rock Quality Designation (RQD) ranged between 0% and 93%. Compressive strength of rock core sample ranges from 1080kg/cm<sup>2</sup> to 1150kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 10.00m to 10.10m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depth 6.0m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.75m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 2.25m to 2.60m below ground surface. In this layer compressive strength of rock core samples ranged between 770 kg/cm<sup>2</sup> and 1210 kg/cm<sup>2</sup>.

As per minimum compressive strength 770kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below.

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B4-1             | 2.25m | 5.00m     |
| B4-2             | 2.60m | 3.80m     |

Maximum settlement of foundations on native soil and hard strata will be less than 25mm and 12mm respectively. A modulus of subgrade reactions of 1000 t/m<sup>3</sup> and 8300 t/m<sup>3</sup> can be utilized for design of foundations respectively. Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Groundwater samples were collected for chemical analysis from the site. Results of Chemical analysis are enclosed in the Annexure. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I**

### **CALCULATIONS FOR BEARING CAPACITY AND SETTLEMENT**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
| _____                               | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
| _____                               | -2.25m to -2.60m |
| Layer II, Moderately weathered rock |                  |
| _____                               | -3.80m to -5.00m |
| Layer III, Hard Basalt Bedrock      |                  |

(Allowable bearing capacity =  $(N_j) \times Q_u$  (Ref. 3, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (Ref. 4, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 7700 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 7700 = 770 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**



## Calculation of Settlements of Spread Foundations (3m X 3m) Exerting Pressure of 100t/m<sup>2</sup>:

$$\text{Settlement} = S = q_0 B' \frac{1 - \mu^2}{E_s} m I_s I_f$$

Where,

$q_0$  = Footing Pressure = 100 t/m<sup>2</sup>

$B' = B/2$  (Where B is the width of pressure distribution)

$\mu$  = Poisson's ratio = 0.25

E = Modulus of Elasticity

$I_s$  = Influence Factor (Obtained from Table 5-2, Reference No. 1)

$I_f$  = Depth Factor (Obtained from Figure 5-7, Reference No. 1)

$m = 4$  for center of footing

E value for Basalt bedrock = 17,00,000 t/m<sup>2</sup> (Reference No. 1)

Using 1/10<sup>th</sup> of this value, E = 1,70,000 t/m<sup>2</sup>

$L' = 3/2 = 1.5$ ,  $B' = 3/2 = 1.5$ ,  $H = 15\text{m}$ , and  $D = 3.8\text{m}$

Therefore,  $M = L'/B' = 1$ ; and  $N = H/B' = 10$  and  $D/B' = 1.27$

Corresponding,  $I_s = 0.51$ , Conservative  $I_f = 1.0$  (From Table 5-2, Reference 1)

$$\begin{aligned} \text{Settlement of Layer} = S_1 &= 100 \times 1.5 \times \frac{1 - 0.25^2}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times \frac{0.9375}{1,70,000} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 5.514 \times 10^{-6} \times 4 \times 0.51 \times 1.0 \\ &= 150 \times 0.000005514 \times 4 \times 0.51 \times 1.0 \\ &= 0.001687284 = 0.002\text{m} = 2\text{mm} \end{aligned}$$

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.

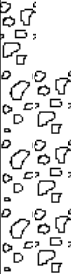




## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
|---|--------|------------------------------|---|---|------------|------------------------------------|---------|---|----|-----------------|--------------------------|----------------|--------|--------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |   |            |                                    |         | Client :EGIS Consulting Engineers Pvt. Ltd. |    |                 |                          |                |        |                          |
| Type of Boring  |        | Calyx with Bent. with casing |   | Calyx with Bent. without casing   |            | Job No. : BRIDGE 4                 |         |   |    |                 |                          |                |        |                          |
| Dia of Hole (mm):   |        | 100.00                       |   | 75.00   |            | Bore Hole No.: B4-1                |         |   |    |                 |                          |                |        |                          |
| Depth (M):  |        | 0.00-1.75                    |   | 1.75-10.00  |            | Co-ordinates : N=2033726, E=319801 |         |   |    |                 |                          |                |        |                          |
| Commenced on : 24 March 2023  |        |                              |   | Completed on : 25 March 2023  |            |                                    |         | Ground Bed RL: 92.36M                       |    |                 |                          |                |        |                          |
| Water Struc :   |        |                              |   | Ground Water : 6.00M. Seasonal.   |            |                                    |         | Location of Bore Hole : As per plan         |    |                 |                          |                |        |                          |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                   | Symbol  | SPT Record |                                    |         |   |    | Sample Ref. No. | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                  |
|   |        |                              |   |   | 0-150      | 150-300                            | 300-450 | 450-600                                     | N  |                 |                          |                |        |                          |
| 0.00  |        | 0.00 - 1.00                  | MURUM, PEBBLES and COBBLES              |   |            |                                    |         |   |    | DS-1            |                          |                |        |                          |
|   |        | 1.00 - 1.50                  |   |   |            |                                    |         |   |    | 1 TO 3          | 0.20                     | 40.00          | 0.00   |                          |
|   |        | 1.50 - 1.75                  |   |   | 35         | 55                                 | 0       | 0   | 55 | SPT-1           |                          |                |        |                          |
|   |        | 1.75 - 2.25                  |   |   |            |                                    |         |   |    | 4 TO 7          | 0.30                     | 60.00          | 0.00   |                          |
| 2.25  |        | 2.25                         |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
| 2.25  |        | 2.25 - 3.00                  | BROWNISH GREY MODERATELY WEATHERED ROCK |  |            |                                    |         |   |    | 8 TO 13         | 0.33                     | 44.00          | 0.00   |                          |
|   |        | 3.00 - 4.00                  |   |   |            |                                    |         |   |    | 14 TO 17        | 0.64                     | 64.00          | 45.00  |                          |
|   |        | 4.00 - 4.50                  |   |   |            |                                    |         |   |    | 18 TO 21        | 0.30                     | 60.00          | 0.00   |                          |
|   |        | 4.50 - 5.00                  |   |   |            |                                    |         |   |    | 22 TO 24        | 0.37                     | 74.00          | 26.00  |                          |
| 5.00  |        | 5.00                         |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
| 5.00  |        | 5.00 - 6.00                  | GREY BASALT                             |  |            |                                    |         |   |    | 25 TO 31        | 0.98                     | 98.00          | 60.00  | Inclined _vertical veins |
|   |        | 6.00 - 7.50                  |   |   |            |                                    |         |   |    | 32 TO 39        | 1.40                     | 90.00          | 80.00  |                          |
|   |        | 7.50 - 9.00                  |   |   |            |                                    |         |   |    | 40 TO 43        | 1.45                     | 96.00          | 93.00  |                          |
|   |        | 9.00 To 10.00                |   |   |            |                                    |         |   |    | 44 TO 47        | 1.00                     | 100.00         | 86.00  |                          |
| 10.00   |        |                              |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
| Bore Hole Terminated at : 10.00   |        |                              |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |   |            |                                    |         |   |    |                 |                          |                |        |                          |
| No. of disturbed Sample : 1   |        |                              |   | No. of U.D.S. : 0   |            |                                    |         | No. of Vane Test : 0                        |    |                 |                          |                |        |                          |
|   |        |                              |   | No. of S.P.T. : 1   |            |                                    |         | No. of Water Sample : 0                     |    |                 |                          |                |        |                          |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                         |
|---|---------------|------------------------------|--|---------------------------------|---------------------------------|---------|---------|-------------------------------------|----------|---|--------------------------|----------------|--------|-------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |               |                              |  |                                 |                                 |         |         |                                     |          | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                         |
| Type of Boring  |               | Calyx with Bent. with casing |  |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 4                  |          |   |                          |                |        |                         |
| Dia of Hole (mm):   |               | 100.00                       |  |                                 | 75.00                           |         |         | Bore Hole No.: B4-2                 |          |   |                          |                |        |                         |
| Depth (M):  |               | 0.00-1.75                    |  |                                 | 1.75-10.10                      |         |         | Co-ordinates : N=2033722, E=319763  |          |   |                          |                |        |                         |
| Commenced on : 24 March 2023  |               |                              |  | Completed on : 25 March 2023    |                                 |         |         | Ground Bed RL: 92.08M               |          |   |                          |                |        |                         |
| Water Struc :   |               |                              |  | Ground Water : 6.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |          |   |                          |                |        |                         |
| From (M)  | To (M)        | Sample Depth (M)             | Description of Strata                  | Symbol                          | SPT Record                      |         |         |                                     |          | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                 |
|   |               |                              |  |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N        |   |                          |                |        |                         |
| 0.00  |               | 0.00 - 1.50                  | MURUM, PEBBLES and COBBLES             |                                 |                                 |         |         |                                     |          | 1 TO 3                                      | 0.20                     | 13.00          | 0.00   |                         |
|   |               | 1.50 - 1.70                  |  |                                 | 35                              | 55      | 0       | 0                                   | 55       | SPT-1                                       | 0.15                     | 50.00          | 0.00   |                         |
|   |               | 1.70 - 2.00                  |  |                                 |                                 |         |         |                                     |          | 4 TO 7                                      | 0.26                     | 43.00          | 0.00   |                         |
|   |               | 2.00 - 2.60                  |  |                                 |                                 |         |         |                                     |          | 8 TO 11                                     |                          |                |        |                         |
| 2.60  | 2.60          |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                         |
| 2.60  |               | 2.60 - 3.80                  | BROWNISH GREY MODERATELY WEATHERD ROCK |                                 |                                 |         |         |                                     |          | 12 TO 21                                    | 0.93                     | 74.00          | 0.00   |                         |
| 3.80  | 3.80          |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                         |
| 3.80  |               | 3.80 - 4.30                  | GREY BASALT                            |                                 |                                 |         |         |                                     |          | 22 TO 25                                    | 0.38                     | 76.00          | 0.00   | Inclind _vertical veins |
|   | 4.30 - 5.10   |                              |  |                                 |                                 |         |         |                                     | 26 TO 30 | 0.60  | 75.00                    | 0.00           |        |                         |
|   | 5.10 - 6.60   |                              |  |                                 |                                 |         |         |                                     | 31 TO 36 | 1.50  | 100.00                   | 80.00          |        |                         |
|   | 6.60 - 8.10   |                              |  |                                 |                                 |         |         |                                     | 37 TO 42 | 1.46  | 97.00                    | 76.00          |        |                         |
|   | 8.10 - 9.10   |                              |  |                                 |                                 |         |         |                                     | 43 TO 44 | 0.81  | 81.00                    | 80.00          |        |                         |
|   | 9.10 To 10.10 |                              |  |                                 |                                 |         |         |                                     |          | 45 TO 49                                    | 0.80                     | 80.00          | 62.00  |                         |
| 10.10   |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                         |
|   |               |                              |  |                                 | Bore Hole Terminated at : 10.10 |         |         |                                     |          |   |                          |                |        |                         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                         |
| No. of disturbed Sample : 0   |               |                              |  |                                 | No. of U.D.S. : 0               |         |         |                                     |          | No. of Vane Test : 0                        |                          |                |        |                         |
|   |               |                              |  |                                 | No. of S.P.T. : 1               |         |         |                                     |          | No. of Water Sample : 0                     |                          |                |        |                         |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

**TEST REPORT**

PAGE 2 OF 2

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/TV/ PHY/TR/Soil/061 |                      |
| Rev. No. - 03                       | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2023-24/SAN0000223/00495

ULR No. : TC528223000005819F

12/04/2023

## 1. Name &amp; Address of Client

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                | CN. No. 4 B4-1        |       |    |    | CN No.4A B4-2        |       |    |    | --   |       |    |    | --   |       |   |   |
|--|---|---------------------------------|-----------------------|-------|----|----|----------------------|-------|----|----|------|-------|----|----|------|-------|---|---|
| Sample No. :   |   | --                              | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| Depth, m :   |   | --                              | 0.0 to 1.0m           |       |    |    | 0.0 to 1.50m         |       |    |    | --   |       |    |    | --   |       |   |   |
| Description :  |   | --                              | Clayey Silt with Sand |       |    |    | Silty Clay with Sand |       |    |    | --   |       |    |    | --   |       |   |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                  | 47                    |       |    |    | 46                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Plastic Limit                           |                                 | 27                    |       |    |    | 24                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Plasticity Index                        |                                 | 20                    |       |    |    | 22                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                  | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                  | 11+59                 |       |    |    | 12+57                |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Sand                                    |                                 | 22                    |       |    |    | 19                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Gravel                                  |                                 | 8                     |       |    |    | 12                   |       |    |    | --   |       |    |    | --   |       |   |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)             | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                 | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Angle                                   | Direct Shear Test               | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Bulk Density,T/m <sup>3</sup>           | (DUU, DCU & DCD)                | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Water Content,%                         | IS 2720 Part-13                 | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                 | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                 | --                    | --    | -- | -- | --                   | --    | -- | -- | --   | --    | -- | -- | --   | --    |   |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                 | 5-10                  | 10-20 | -  | -  | 5-10                 | 10-20 | -  | -  | 5-10 | 10-20 | -  | -  | 5-10 | 10-20 | - | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>  |                                 | -                     | -     | -  | -  | -                    | -     | -  | -  | -    | -     | -  | -  | -    | -     | - |   |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                 | -                     | -     | -  | -  | -                    | -     | -  | -  | -    | -     | -  | -  | -    | -     | - |   |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                  | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| Specific gravity   |   | IS 2720 Part-3                  | 2.57                  |       |    |    | 2.59                 |       |    |    | --   |       |    |    | --   |       |   |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Optimum Moist-Cont.,%                   | Heavy Compaction IS 2720 Part-8 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
|  | Unsoaked %                              |                                 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                         | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| **Coefficient of Curvature (Cc)                            |   |                                 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                 | --                    |       |    |    | --                   |       |    |    | --   |       |    |    | --   |       |   |   |

## Triaxial Compression

TUU : Unconsolidated Undrained

## Unconfined Compression

UCU : Undisturbed

UCR : Remoulded

## Direct Shear

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

## Consolidation Test

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

\*\* - Indicates Calculated Parameters

Checked By

Vikram B. Parmar

Nodal Quality Manager

Authorised Signatory

SST/N/LAB/Tech Report/2023-24/turbhe/test report/NABL/Phy/Soil/SAN0000223

\*\*\*\*\*End of Report\*\*\*\*\*





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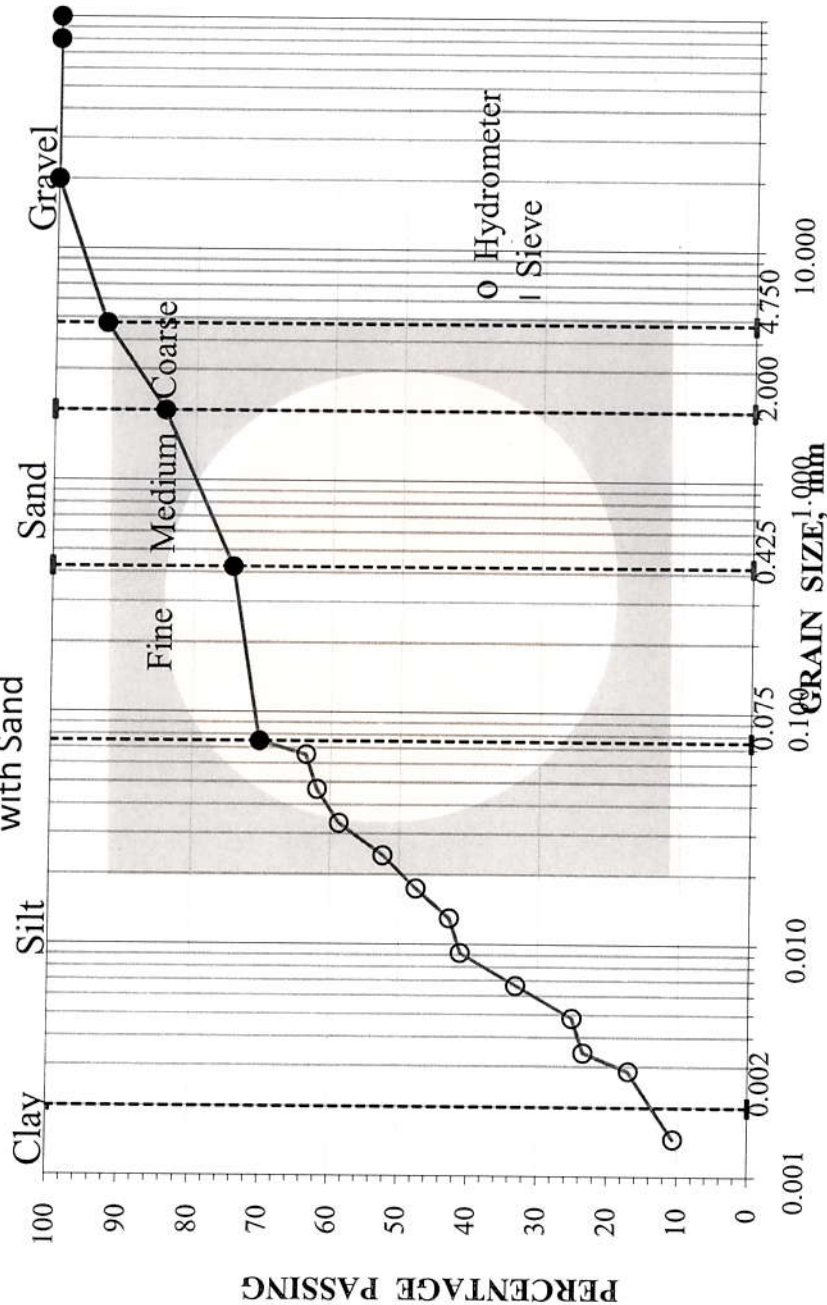


TC-5282

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER  
METHOD**

**Customer** M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMIDC-Dighi Port Industrial  
Area, Indapur  
**B.H.No.** --

**Description** Clayey Silt with Sand  
**Sample #** B4-1 (BN No. 4)  
**Depth, m** --



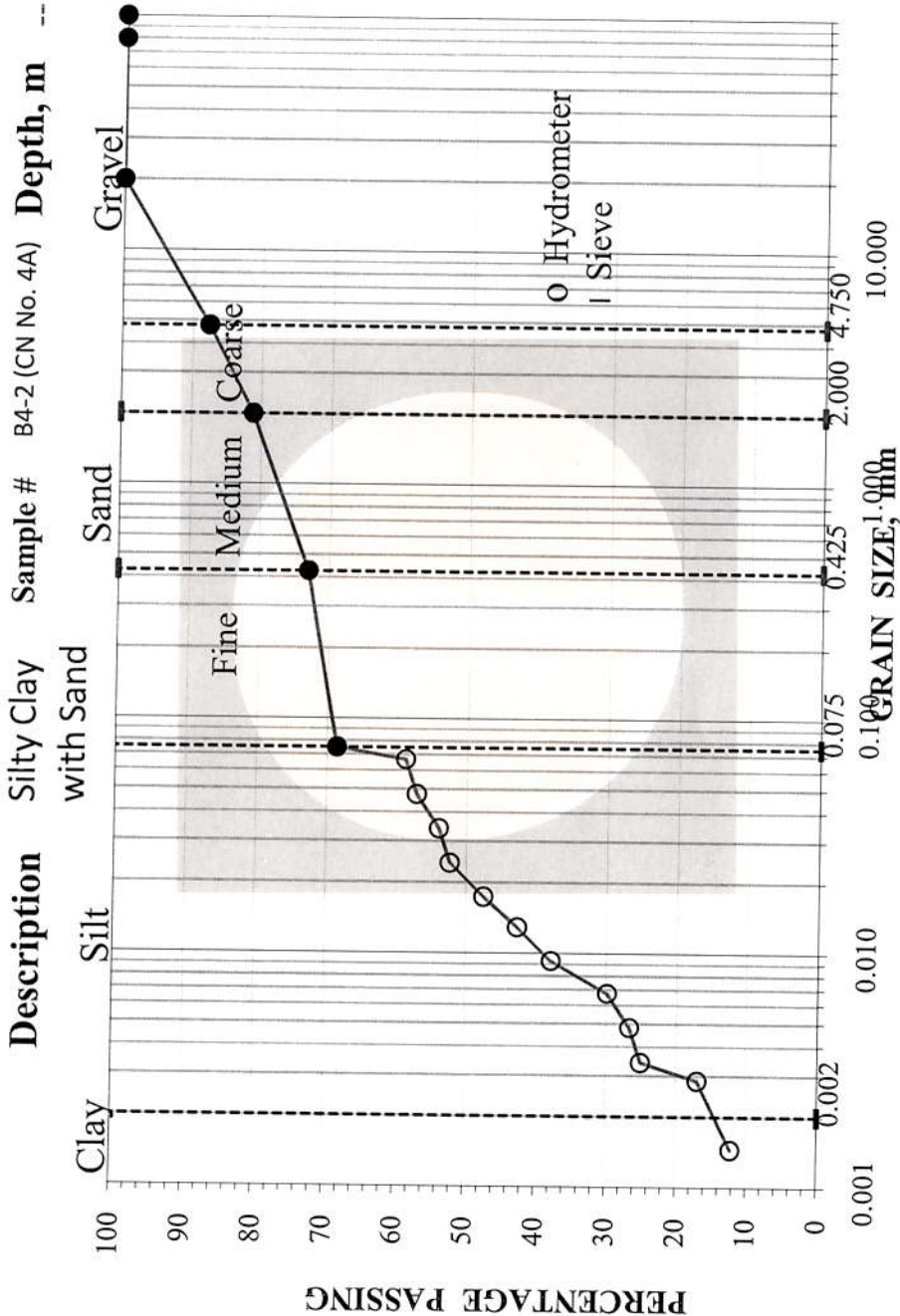


ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

**GRAIN SIZE ANALYSIS BY SIEVE & HYDROMETER METHOD**  
Customer: M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Location: Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation for DMDC-Dighi Port Industrial Area, Indapur  
Description: Silty Clay with Sand  
Sample #: B4-2 (CN No. 4A)  
Depth, m: --



2





ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/TV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE**R&D/LAB/SAN/2022-23/SAN0000223/00492  
ULR No. : TC528223000005816F  
12/04/2023

## 1. Name &amp; Address of Customer

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

Ltr. Dtd. 01.04.2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

## i) Description

Rock

## ii) Quantity

04 Nos.

## iii) Date of receipt

01/04/2023

## iii) Condition

Acceptable

## 6. Test method followed, if any

As Mentioned Below.

## 7. Date of Testing From

03/04/2023 to 05/04/2023

**TEST REPORT**

| SR. No.              | ID. Mark                     | Depth<br>mtr. | Dia.<br>mm. | Area<br>mm <sup>2</sup> | Length<br>mm. | Dry<br>Density<br>kg/m <sup>3</sup> | Load<br>N | Compressive<br>strength<br>N / mm <sup>2</sup> | Compressive<br>strength<br>corrected<br>for L/D- N / mm <sup>2</sup> | SP.<br>Gravity                  | Porosity<br>%                | Water<br>Absorption<br>% | Hardness<br>by Moh's<br>scale  |
|----------------------|------------------------------|---------------|-------------|-------------------------|---------------|-------------------------------------|-----------|--|--|---------------------------------|------------------------------|--------------------------|--------------------------------|
| Test Method Followed |                              |               |             |                         |               | (IS:13030):<br>1991<br>(RA 2021)    |           | (IS:9143):<br>1979<br>(RA 2021)                |  | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) |                          | IS 13630<br>(Part 13):<br>2019 |
| 1                    | BH No. B4-1<br>(Piece No.14) | 3.0M          | 54.54       | 2335.07                 | 110.94        | --                                  | 180100    | 77   | 77   | --                              | 0.010                        | 0.33                     | --                             |
| 2                    | BH No. B4-1<br>(Piece No.32) | 6.20M         | 54.20       | 2306.05                 | 113.02        | --                                  | 246500    | 107  | 108  | --                              | 0.010                        | 0.33                     | --                             |
| 3                    | BH No. B4-2<br>(Piece No.16) | 3.20M         | 54.74       | 2352.23                 | 110.76        | --                                  | 284100    | 121  | 121  | --                              | 0.008                        | 0.28                     | --                             |
| 4                    | BH No. B4-2<br>(Piece No.35) | 6.0M          | 54.46       | 2328.22                 | 111.06        | --                                  | 265800    | 114  | 115  | --                              | 0.010                        | 0.33                     | --                             |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength<br>(N/mm <sup>2</sup> ) |
|---------|----------------------|--|
| 1       | Exceptionally Strong | > 250                                  |
| 2       | Very Strong          | 100-250                                |
| 3       | Strong               | 50-100                                 |
| 4       | Average              | 25-50                                  |
| 5       | Weak                 | 10-25                                  |
| 6       | Very Weak            | 2-10                                   |
| 7       | Extremely Weak       | < 2                                    |

**NOTE :**

- \* --Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN00000223

Vikram S. Parmar  
Nodal Quality Manager  
Authorised Signatory

\*\*\*\*\*End of Report\*\*\*\*\*

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## TEST REPORT

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1

## TEST REPORT NO. &amp; DATE

R&amp;D/LAB/SAN/2023-24/SAN0000223/00256

ULR No. : TC528223000005581F

06/04/2023

## 1. Name &amp; Address of Customer

M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

Ltr. Dtd. 01.04.2023

## 4. Location of performance of test

At Laboratory

## 5. Sample

- i) Description
- ii) Quantity
- iii) Date of receipt
- iv) Condition

Construction Water

01 No.

01/04/2023

Acceptable

## 6. Test method followed

Mentioned Below

## 7. Date of Testing

05/04/2023

## CHEMICAL ANALYSIS OF CONSTRUCTION WATER

\* ID Mark. : BH No. B4-1

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.24    | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 12      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 12      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

## NOTE :

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit

\* Data provided by Customer.

Swati  
Swati Sonawane  
Manager - Chemical

Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0000223

\*\*\*\*\* End of Report \*\*\*\*\*

Vikram B. Parmar  
Nodal Quality Manager  
Authorized Signatory





# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 09)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

Prabhakar Apt, B Wing,  
3<sup>rd</sup> Floor, Gaondevi Chowk,  
Kalyan – 421301, Maharashtra  
Email: [info@pnsco.in](mailto:info@pnsco.in), [pnsco@yahoo.com](mailto:pnsco@yahoo.com)



## Geotechnical Investigation Report (Bridge No. 09)

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## Geotechnical Investigation Report (Bridge No. 09)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

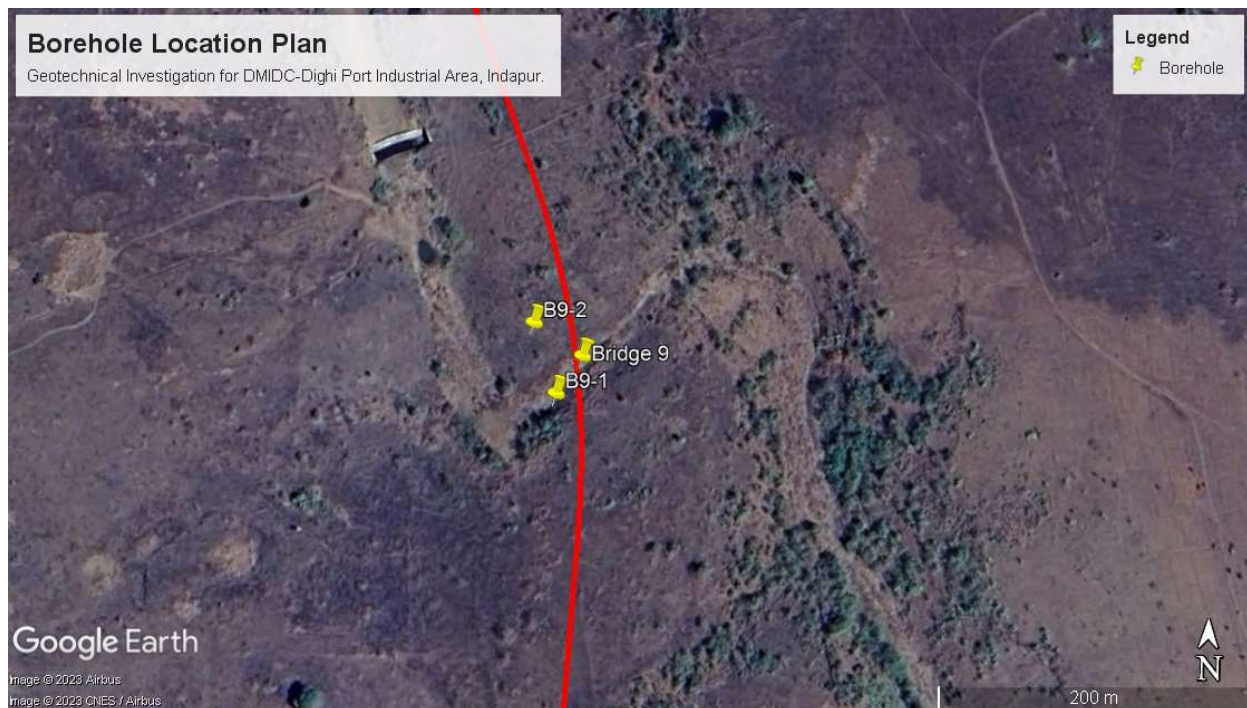
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B9-1, B9-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth |
|--------------|----------|---------|-------|
| B9-1         | 2033255  | 319978  | 9.60m |
| B9-2         | 2033279  | 319970  | 8.00m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. The lower boundary of this layer was encountered at depths of 1.00m to 2.70m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 1.00m to 2.70m below ground surface. Core Recoveries varied between 66% and 77%, while Rock Quality Designation (RQD) ranged between 0% and 45%. Compressive strength of rock core sample ranges from 1350kg/cm<sup>2</sup> to 1440kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 3.00m to 4.50m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 3.00m to 4.50m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 80% and 100%, while Rock Quality Designation (RQD) ranged between 53% and 92%. Compressive strength of rock core sample ranges from 970kg/cm<sup>2</sup> to 1710kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 8.00m to 9.60m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depth from 4.0m to 5.0m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 1.50m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 1.00m to 2.70m below ground surface. In this layer compressive strength of rock core samples ranged between 1350 kg/cm<sup>2</sup> and 1440 kg/cm<sup>2</sup>.

As per minimum compressive strength 970kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below.

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B9-1             | 1.00m | 4.50m     |
| B9-2             | 2.70m | 3.00m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsoon).



### 3.1 Foundation Protection:

Groundwater samples were collected for chemical analysis from the site. Results of Chemical analysis are enclosed in the Annexure. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -1.00m to -2.70m |
| Layer II, Moderately weathered rock |                  |
|                                     | -3.00m to -4.50m |
| Layer III, Hard Basalt Bedrock      |                  |

(Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 9700 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 9700 = 970 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II BORELOGS AND LAB TEST REPORTS**

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |                            |                                 |                                 |         |         |                                     |    |   |                          |                |        |                        |
|---|--------|------------------------------|----------------------------|---------------------------------|---------------------------------|---------|---------|-------------------------------------|----|---|--------------------------|----------------|--------|------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |                            |                                 |                                 |         |         |                                     |    | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                        |
| Type of Boring  |        | Calyx with Bent. with casing |                            |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 9                  |    |   |                          |                |        |                        |
| Dia of Hole (mm):   |        | 100.00                       |                            |                                 | 75.00                           |         |         | Bore Hole No.: B9-2                 |    |   |                          |                |        |                        |
| Depth (M):  |        | 0.00-1.00                    |                            |                                 | 1.00-8.00                       |         |         | Co-ordinates : N=2033279, E=319970  |    |   |                          |                |        |                        |
| Commenced on : 24 March 2023  |        |                              |                            | Completed on : 25 March 2023    |                                 |         |         | Ground Bed RL: 87.21M               |    |   |                          |                |        |                        |
| Water Struc :   |        |                              |                            | Ground Water : 5.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |    |   |                          |                |        |                        |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata      | Symbol                          | SPT Record                      |         |         |                                     |    | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                |
|   |        |                              |                            |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N  |   |                          |                |        |                        |
| 0.00  |        | 0.00 - 1.50                  | MURUM, PEBBLES and COBBLES |                                 |                                 |         |         |                                     |    | 1 TO 10                                     | 1.00                     | 60.00          | 0.00   |                        |
|   |        | 1.50 - 2.70                  |                            |                                 |                                 |         |         |                                     |    | 11 TO 14                                    | 0.75                     | 62.00          | 21.00  |                        |
|   | 2.70   | 3.00                         |                            |                                 |                                 |         |         |                                     |    | 15 TO 17                                    | 0.20                     | 66.00          | 0.00   |                        |
| 2.70  | 3.00   | 2.70 - 3.00                  | MODERATELY WEATHERED ROCK  |                                 |                                 |         |         |                                     |    | 18 TO 22                                    | 1.37                     | 91.00          | 75.00  | Vertical ,inclnd veins |
| 3.00  |        | 3.00 - 4.50                  | GREY BASALT                |                                 |                                 |         |         |                                     |    | 23 TO 34                                    | 1.20                     | 80.00          | 65.00  |                        |
|   |        | 4.50 - 6.00                  |                            |                                 |                                 |         |         |                                     |    | 35 TO 38                                    | 1.48                     | 98.00          | 90.00  |                        |
|   |        | 6.00 - 7.50                  |                            |                                 |                                 |         |         |                                     |    |   |                          |                |        |                        |
|   | 8.00   | 7.50 - 8.00                  |                            |                                 |                                 |         |         |                                     | 39 | 0.49  | 98.00                    | 92.00          |        |                        |
|   |        |                              |                            |                                 | Bore Hole Terminated at : 8.00  |         |         |                                     |    |   |                          |                |        |                        |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |                            |                                 |                                 |         |         |                                     |    |   |                          |                |        |                        |
| No. of disturbed Sample : 0   |        |                              |                            |                                 | No. of U.D.S. : 0               |         |         |                                     |    | No. of Vane Test : 0                        |                          |                |        |                        |
|   |        |                              |                            |                                 | No. of S.P.T. : 0               |         |         |                                     |    | No. of Water Sample : 0                     |                          |                |        |                        |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                         |       |
|---|-------------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|---|---|--------------------------|----------------|--------|-------------------------|-------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |             |                              |   |                                 |                                 |         |         |                                     |   | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                         |       |
| Type of Boring  |             | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 9                  |   |   |                          |                |        |                         |       |
| Dia of Hole (mm):   |             | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B9-1                 |   |   |                          |                |        |                         |       |
| Depth (M):  |             | 0.00-1.00                    |   |                                 | 1.00-9.60                       |         |         | Co-ordinates : N=2033255, E=319978  |   |   |                          |                |        |                         |       |
| Commenced on : 22 March 2023  |             |                              |   | Completed on : 23 March 2023    |                                 |         |         | Ground Bed RL: 84.00M               |   |   |                          |                |        |                         |       |
| Water Struc :   |             |                              |   | Ground Water : 4.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |   |   |                          |                |        |                         |       |
| From (M)  | To (M)      | Sample Depth (M)             | Description of Strata                   | Symbol                          | SPT Record                      |         |         |                                     |   | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                 |       |
|   |             |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N |   |                          |                |        |                         |       |
| 0.00  | 1.00        | 0.00 - 1.00                  | MURUM, PEBBLES and COBBLES              |                                 |                                 |         |         |                                     |   | 1 TO 3                                      | 0.15                     | 15.00          | 0.00   |                         |       |
| 1.00  |             | 1.00 - 2.00                  | BROWNISH GREY MODERATELY WEATHERED ROCK |                                 |                                 |         |         |                                     |   | 4 TO 11                                     | 0.77                     | 77.00          | 43.00  |                         |       |
|   | 2.00 - 3.00 |                              |   |                                 |                                 |         |         |                                     |   | 12 TO 14                                    | 0.76                     | 76.00          | 54.00  |                         |       |
|   | 3.00 - 4.50 |                              |   |                                 |                                 |         |         |                                     |   | 15 TO 17                                    | 1.00                     | 66.00          | 53.00  |                         |       |
| 4.50  | 9.60        | 4.50 - 6.00                  | GREY BASALT                             |                                 |                                 |         |         |                                     |   | 18 TO 23                                    | 1.50                     | 100.00         | 86.00  | Vertical_inclined veind |       |
|   |             | 6.00 - 7.00                  |   |                                 |                                 |         |         |                                     |   |   | 24 TO 28                 | 0.97           | 97.00  |                         | 90.00 |
|   |             | 7.00 - 8.50                  |   |                                 |                                 |         |         |                                     |   |   | 29 TO 37                 | 1.20           | 80.00  |                         | 53.00 |
|   |             | 8.50 - 9.60                  |   |                                 |                                 |         |         |                                     |   |   | 38 TO 44                 | 1.08           | 98.00  |                         | 67.00 |
|   |             |                              |   |                                 | Bore Hole Terminated at : 9.60  |         |         |                                     |   |   |                          |                |        |                         |       |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |             |                              |   |                                 |                                 |         |         |                                     |   |   |                          |                |        |                         |       |
| No. of disturbed Sample : 0   |             |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |   | No. of Vane Test : 0                        |                          |                |        |                         |       |
|   |             |                              |   |                                 | No. of S.P.T. : 0               |         |         |                                     |   | No. of Water Sample : 0                     |                          |                |        |                         |       |

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**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev. No. - 03                       | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2023-24/SAN0000223/00496

ULR No. : TC528223000005820F

12/04/2023

1. Name &amp; Address of Client

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMIDC-Dighi Port Industrial Area, Indapur

| Ref. No./ID. Mark/B.H. No.:                                |   | IS CODE FOLLOWED                   | CN No. 2 B9-1         |       |    |   | CN No. 88 B9-2       |       |    |   | --   |       |   |   | --   |       |    |   |
|--|---|------------------------------------|-----------------------|-------|----|---|----------------------|-------|----|---|------|-------|---|---|------|-------|----|---|
| Sample No. :   |   | --                                 | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| Depth, m :   |   | --                                 | 0.0 to 1.0m           |       |    |   | 0.0 to 1.50m         |       |    |   | --   |       |   |   | --   |       |    |   |
| Description :  |   | --                                 | Clayey Silt with Sand |       |    |   | Silty Clay with Sand |       |    |   | --   |       |   |   | --   |       |    |   |
| Atterberg Limits   | Liquid Limit                            | IS 2720-Part 5                     | 41                    |       |    |   | 50                   |       |    |   | --   |       |   |   | --   |       |    |   |
|  | Plastic Limit                           |                                    | 26                    |       |    |   | 25                   |       |    |   | --   |       |   |   | --   |       |    |   |
|  | Plasticity Index                        |                                    | 15                    |       |    |   | 25                   |       |    |   | --   |       |   |   | --   |       |    |   |
|  | ShrinkageLim.                           | IS 2720-Part 6                     | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                             | IS 2720-Part 4                     | 7+66                  |       |    |   | 11+62                |       |    |   | --   |       |   |   | --   |       |    |   |
|  | Sand                                    |                                    | 23                    |       |    |   | 20                   |       |    |   | --   |       |   |   | --   |       |    |   |
|  | Gravel                                  |                                    | 4                     |       |    |   | 7                    |       |    |   | --   |       |   |   | --   |       |    |   |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                               | Triaxial Test (TUU)                |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  | Cohesion,kg/cm <sup>2</sup>             | IS 2720 Part-11                    |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  | Angle                                   | Direct Shear Test (DUU, DCU & DCD) |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  | Bulk Density,T/m <sup>3</sup>           | IS 2720 Part-13                    |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  | Water Content, %                        |                                    |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  |   |                                    |                       |       | -- |   |                      |       | -- |   |      | --    |   |   |      |       | -- |   |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                | IS 2720 Part-10                    |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
|  | Shear Strength (kg/cm <sup>2</sup> )    |                                    |                       | --    |    |   |                      | --    |    |   | --   |       |   |   |      | --    |    |   |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>        | IS 2720 Part-15                    | 5-10                  | 10-20 | -  | - | 5-10                 | 10-20 | -  | - | 5-10 | 10-20 | - | - | 5-10 | 10-20 | -  | - |
|  | Mv, m <sup>2</sup> /Tx10 <sup>4</sup>   |                                    | -                     | -     | -  | - | -                    | -     | -  | - | -    | -     | - | - | -    | -     | -  | - |
|  | Cv,m <sup>2</sup> /yr x10 <sup>-2</sup> |                                    | -                     | -     | -  | - | -                    | -     | -  | - | -    | -     | - | - | -    | -     | -  | - |
| Natural Moisture Content %                                 |   | IS 2720 Part-1                     | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| Specific gravity   |   | IS 2720 Part-3                     | 2.62                  |       |    |   | 2.58                 |       |    |   | --   |       |   |   | --   |       |    |   |
| Compaction   | Max dry density, g/cm <sup>3</sup>      | Light Compaction IS 2720 Part-7    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| Heavy Compaction   | Optimum Moist-Cont.,%                   | Heavy Compaction IS 2720 Part-8    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| California Bearing Ratio                                   | Soaked %                                | IS 2720 Part-16                    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
|  | Unsoaked %                              |                                    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| **Coefficient of Uniformity (Cu)                           |   | IS 1498                            | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| **Coefficient of Curvature (Cc)                            |   |                                    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| Free Swell Index (%)                                       |   | IS 2720 Part-40                    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |
| Swelling Pressure (kg/cm <sup>2</sup> )                    |   | IS 2720 Part-41                    | --                    |       |    |   | --                   |       |    |   | --   |       |   |   | --   |       |    |   |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

\*\* - Indicates Calculated Parameters

Checked By  
*Sarah*Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

SST/N/LAB/Tech Report/2023-24/turbhe/test report/NABL/Phy/Soil/SAN0000223

\*\*\*\*\*End of Report\*\*\*\*\*

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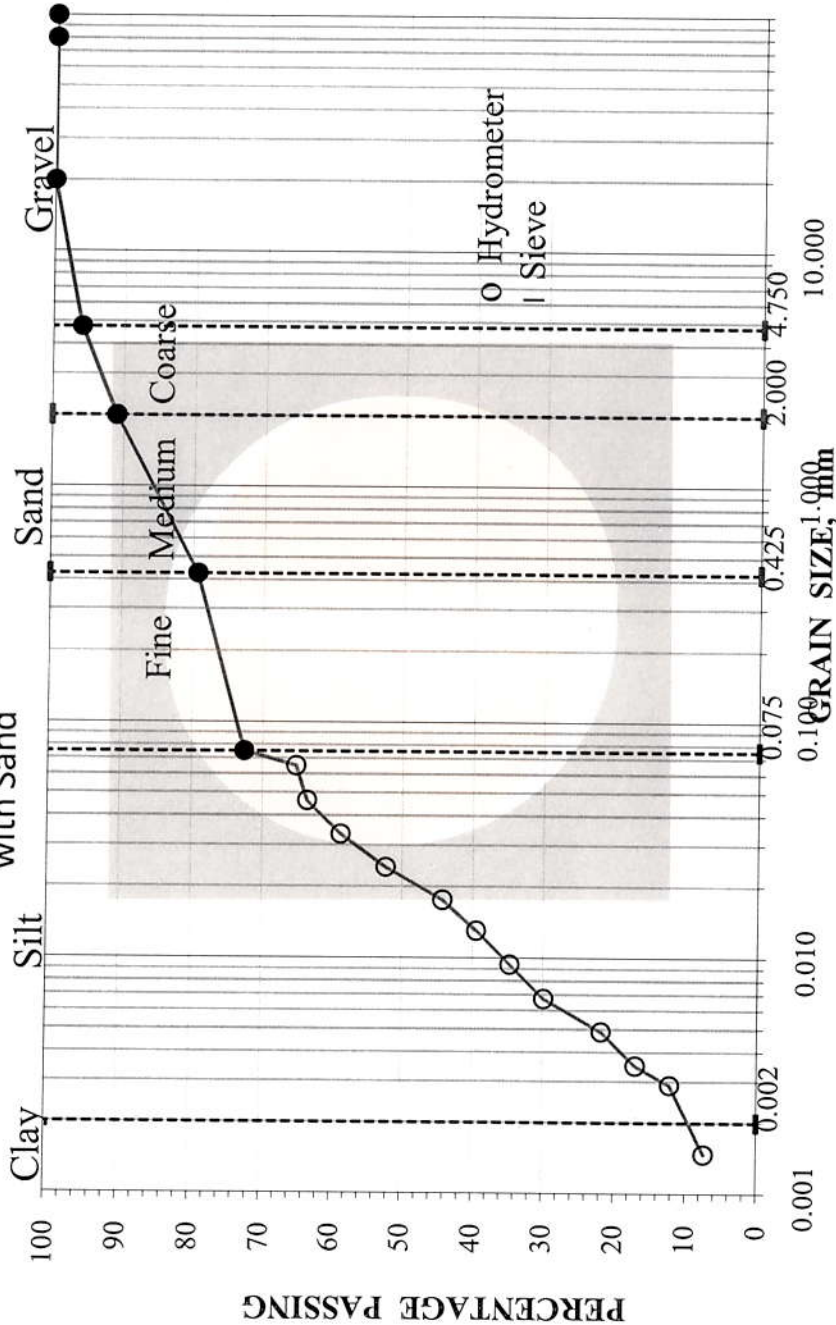


ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



**GRAIN SIZE ANALYSIS BY SIEVE & HYDROMETER METHOD**

**Customer** M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur  
**Description** Clayey Silt with Sand  
**B.H.No.** --  
**Sample #** B9-1 (CN No.2)  
**Depth, m** --



2



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

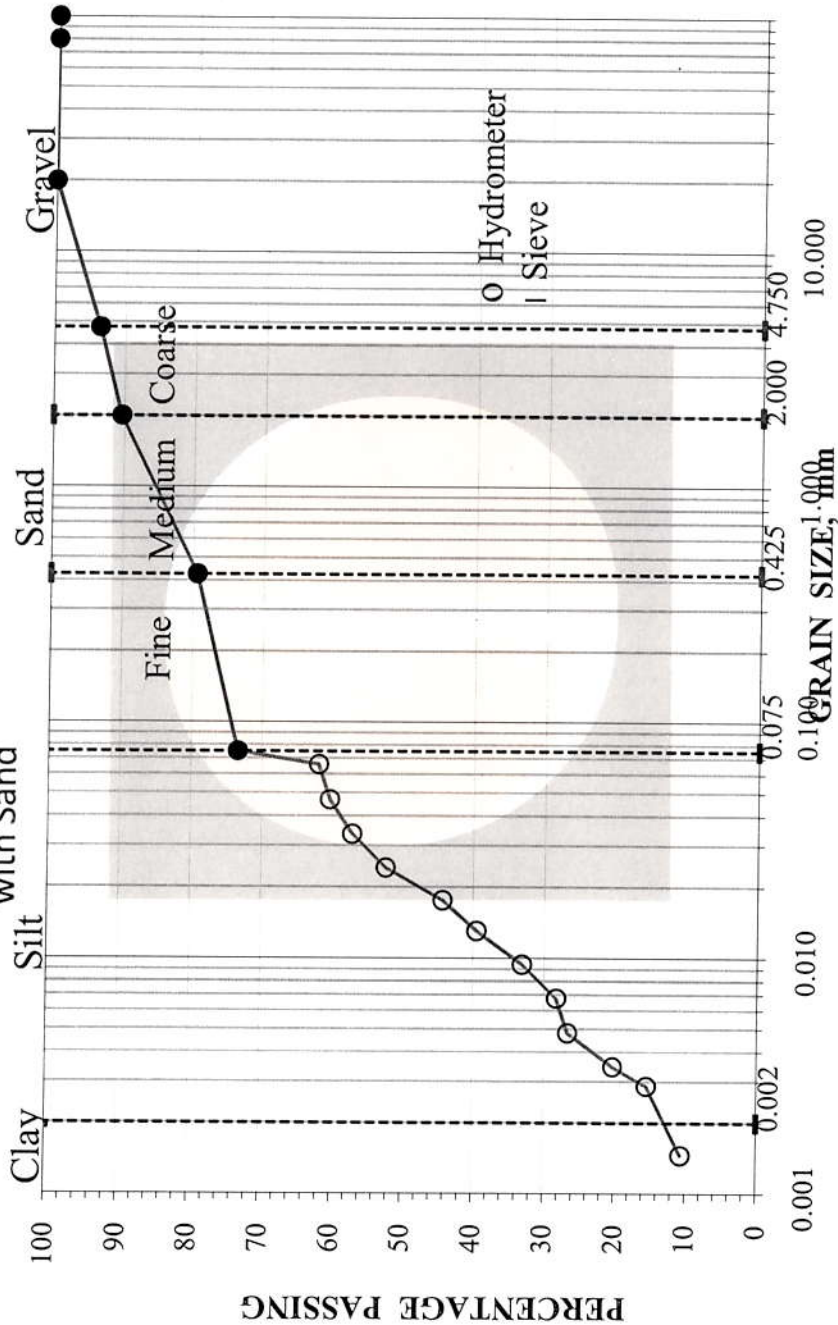


TC-5282

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER  
METHOD**

**Customer** M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMDC-Dighi Port Industrial  
Area, Indapur  
**B.H.No.** --

**Description** Silty Clay with Sand  
**Sample #** B9-2 (CN No. 88)  
**Depth, m** --



2





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TC-5282

**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 | PAGE 1 OF 1           |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

**TEST REPORT NO. & DATE**R&D/LAB/SAN/2023-24/SAN0000223/00493  
ULR No. : TC528223000005817F  
12/04/2023**1. Name & Address of Customer**M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMIDC-Dighi Port Industrial Area, Indapur**3. Customer's Reference**

Ltr. Dtd. 01.04.2023

**4. Location of test Performance**

At Laboratory

**5. Sample**

i) Description

Rock

ii) Quantity

04 Nos.

iii) Date of receipt

01/04/2023

iii) Condition

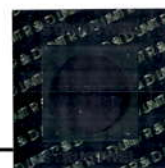
Acceptable

**6. Test method followed, if any**

As Mentioned Below.

**7. Date of Testing From**

03/04/2023 to 05/04/2023

**TEST REPORT**

| Sr. No.              | ID. Mark                     | Depth | Dia.  | Area            | Length | Dry Density                      | Load   | Compressive strength            | Compressive strength corrected | SP. Gravity                     | Porosity                     | Water Absorption | Hardness by Moh's scale        |
|----------------------|------------------------------|-------|-------|-----------------|--------|----------------------------------|--------|---------------------------------|--------------------------------|---------------------------------|------------------------------|------------------|--------------------------------|
|                      |                              | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>                | N      | N / mm <sup>2</sup>             | for L/D- N / mm <sup>2</sup>   |                                 | %                            | %                |                                |
| Test Method Followed |                              |       |       |                 |        | (IS:13030):<br>1991<br>(RA 2021) |        | (IS:9143):<br>1979<br>(RA 2021) |                                | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) |                  | IS 13630<br>(Part 13):<br>2019 |
| 1                    | BH No. B9-1<br>(Piece No.12) | 2.20M | 54.12 | 2299.24         | 110.34 | --                               | 308100 | 134                             | 135                            | --                              | 0.010                        | 0.32             | --                             |
| 2                    | BH No. B9-1<br>(Piece No.23) | 6.0M  | 54.16 | 2302.64         | 83.51  | --                               | 235600 | 102                             | 97                             | --                              | 0.018                        | 0.49             | --                             |
| 3                    | BH No. B9-2<br>(Piece No.10) | 1.50M | 54.76 | 2353.95         | 112.42 | --                               | 337600 | 143                             | 144                            | --                              | 0.009                        | 0.34             | --                             |
| 4                    | BH No. B9-2<br>(Piece No.32) | 5.60M | 54.12 | 2299.24         | 110.06 | --                               | 391600 | 170                             | 171                            | --                              | 0.008                        | 0.26             | --                             |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- \* -Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0000223

  
**Vikram S. Parmar**  
 Nodal Quality Manager  
 Authorised Signatory

\*\*\*\*\*End of Report\*\*\*\*\*



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282



TC-5282

**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 | PAGE 1 OF 1     |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0000223/00257****ULR No. : TC528223000005582F****06/04/2023****1. Name & Address of Customer**M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur**3. Customer's Reference**

Ltr. Dtd. 01.04.2023

**4. Location of performance of test**

At Laboratory

**5. Sample**

i) Description

**Construction Water**

ii) Quantity

01 No.

iii) Date of receipt

01/04/2023

iv) Condition

Acceptable

**6. Test method followed**

Mentioned Below

**7. Date of Testing**

05/04/2023

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER**

\* ID Mark. : BH No. B9-1

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.21</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>12</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>13</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

**Swati Sonawane**  
**Manager - Chemical**

Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0000223

\*\*\*\*\* End of Report \*\*\*\*\*

**Vikram B. Parmar**  
**Nodal Quality Manager**  
Authorised Signatory





# **GEOTECHNICAL INVESTIGATION FOR DMIDC - DIGHI PORT INDUSTRIAL AREA**

## **Geotechnical Investigation Report (Bridge No. 13)**

*Prepared by*



**P. N. Shidhore Civil Engineers (I) Pvt. Ltd.**

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3<sup>rd</sup> Floor, Gaondevi Chowk,  
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## Geotechnical Investigation Report (Bridge No. 13)

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## Geotechnical Investigation Report (Bridge No. 13)

### 1.0 Introduction

The National Industrial Corridor Development Corporation with the State of Maharashtra is developing a state-of-the-art Industrial city near Mangaon, Raigad District. For this purpose, Egis Consulting India Pvt. Limited has been awarded the work for the Detailed Master Plan and Preliminary Engineering Design. As a part of the Preliminary Engineering design, Geotechnical survey work is being undertaken for the design of bridge structures. For this purpose, Egis has appointed PNSCO in March 2023. This report presents results of the geotechnical investigation along with foundation recommendations for the proposed minor bridge.

### 2.0 Exploration Procedure

The sub-surface investigation was completed generally as per IS: 1892-1979. The field investigation was carried out using a rotary machine. Casing was used to support sides of borehole until sufficiently stiff strata was encountered. Standard Penetration Tests (i.e. SPT) were carried out in soil in accordance with IS 2131-1981. Using this procedure, a 2" outside diameter split-barrel sampler is driven into the soil by 63.5 kg. weight falling through 75 cm height. After an initial set of 15cm, the number of blows required to drive the sampler an additional 30 cm, is known as the "penetration resistance" or "N value".

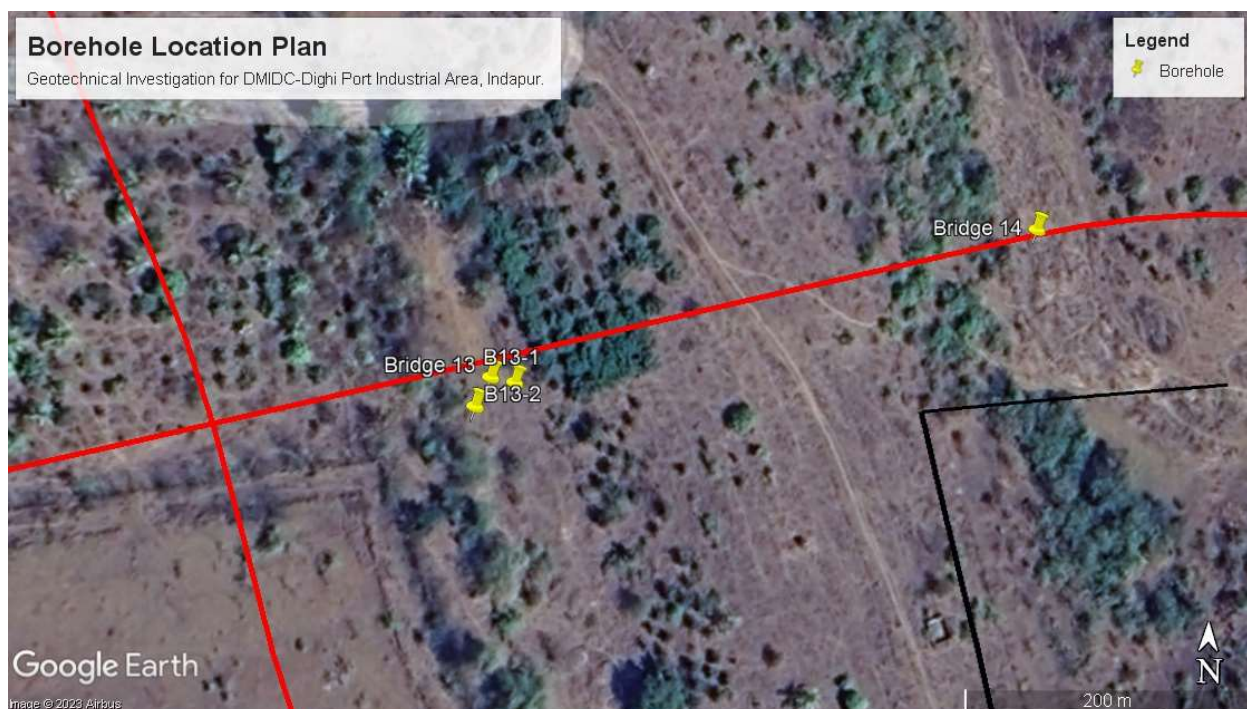
When SPT refusal was obtained in hard strata, rock coring was done using diamond bit and double tube core barrel to obtain rock samples. Percent Rock Core Recovery and Rock Quality Designation (RQD%) were determined.  $RQD \text{ in } \% = (\text{Sum of length of rock pieces in cms, each having lengths greater than 10cms} \div \text{Total length of core run}) \times 100$ .

## 2.1 Exploration Scope

Two boreholes (B13-1, B13-2) were completed for the project as illustrated on the Borehole Location Plan. Borehole termination depths are summarized in Table A below.

**Table A**  
**Borehole Details**

| Borehole No. | Northing | Easting | Depth  |
|--------------|----------|---------|--------|
| B13-1        | 2032811  | 320115  | 10.55m |
| B13-2        | 2032806  | 320107  | 11.15m |



## 2.2 Subsurface Conditions

Subsurface profile at this site generally consists of residual soil includes pebbles, cobbles etc. overlying moderately weathered rock and then by hard basalt bedrock. Encountered soil/rock layers are described below;

### Layer I: Residual Soil

Residual soils, consisting mostly of brownish sandy silty clay, pebbles, cobbles were encountered in boreholes. Based on Standard Penetration Tests (SPT) conducted in this



layer encountered 'N' value 21 to refusals. The lower boundary of this layer was encountered at depths of 2.10m to 4.20m below ground.

#### Layer II: Moderately weathered bedrock (MWR)

Brownish grey Moderately weathered bedrock was encountered at depths of 2.10m to 4.20m below ground surface. Core Recoveries varied between 37% and 59%, while Rock Quality Designation (RQD) ranged between 11% and 33%. Compressive strength of rock core sample is 500kg/cm<sup>2</sup>. The lower boundary of this layer was encountered at depths of 5.0m to 6.0m below ground surface.

#### Layer III: Hard Basalt bedrock (HR)

Grey basalt bedrock was encountered at depths of 5.0m to 6.0m below ground surface in the boreholes. The bedrock was sound, generally improving with depth, inclined and vertical veins are observed. Core Recoveries varied between 87% and 100%, while Rock Quality Designation (RQD) ranged between 62% and 92%. Compressive strength of rock core sample ranges from 320kg/cm<sup>2</sup> to 710kg/cm<sup>2</sup>. The boreholes were terminated in this hard bedrock layer at depths of 10.55m to 11.15m below ground surface.

### **2.3 Ground Water Levels**

Groundwater accumulation in the boreholes was monitored during and after completion of drilling activities. Groundwater was encountered at depths between 4.50m to 6.0m below ground surface in the boreholes. Seasonal and annual fluctuations in ground water levels can be expected.

### 3.0 Foundation Recommendations

Spread foundations for proposed structure at a depth of 2.1m below ground on native soils, can be designed for a maximum net allowable bearing capacity of 20 t/m<sup>2</sup>.

Alternatively, moderately weathered rock (MWR) was encountered at depths of 2.10m to 4.20m below ground surface. In this layer compressive strength of rock core samples ranged between 500 kg/cm<sup>2</sup> and 580 kg/cm<sup>2</sup>.

As per minimum compressive strength 320kg/cm<sup>2</sup> of bedrock the spread foundations for proposed structure supported on this bedrock at minimum depth of 3.0m can be designed for a maximum net allowable bearing capacity of 100 t/m<sup>2</sup>. Depths from ground surface of MWR & hard rock are given in Table B below.

**Table B**  
**Depths from Ground Surface**

| Borehole Numbers | MWR   | Hard Rock |
|------------------|-------|-----------|
| B13-1            | 2.10m | 5.00m     |
| B13-2            | 4.20m | 6.00m     |

Excavation sides should be sloped at a maximum slope of 1:1 (Horizontal: Vertical) or flatter. Continuous dewatering may be required in footing excavations (During Monsson).

### 3.1 Foundation Protection:

Groundwater samples were collected for chemical analysis from the site. Results of Chemical analysis are enclosed in the Annexure. Based on chemical results, the site falls under Class I for sulphates and chlorides (As per IS456-2000, Plain and Reinforced Concrete - Code of Practice. and as per CIRIA Special Publication No. 31). A 'Moderate' exposure condition was assigned to this site. Hence, following precautions shall be taken to protect concrete and reinforcement in foundations:

|   |                       |
|---|-----------------------|
| Type of Cement:                             | OPC or PPC            |
| Minimum Grade of Reinforced Concrete:       | M25                   |
| Minimum Cement Content for Spread Footings: | 280 kg/m <sup>3</sup> |
| Maximum Water Cement Ratio:                 | 0.55                  |
| Minimum Cover to Reinforcement:             | 50mm                  |



## **APPENDIX I CALCULATIONS FOR BEARING CAPACITY**

## Calculation of Allowable Bearing Capacity for Spread Foundations on Rock:

|                                     |                  |
|-------------------------------------|------------------|
|                                     | GL +0.0m         |
| Layer I, Residual soil, boulders    |                  |
|                                     | -2.10m to -4.20m |
| Layer II, Moderately weathered rock |                  |
|                                     | -5.0m to -6.00m  |
| Layer III, Hard Basalt Bedrock      |                  |

Allowable bearing capacity =  $(N_j) \times Q_u$  (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Clause 6.2, pg. 7)

Where,

$N_j$  = Joint condition factor = 0.1 to 0.4 (IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks, Table 4, clause 6.2, pg. 9)

Assumed as 0.1 for hard rock

$Q_u$  = Rock Compressive strength = minimum of 3200 t/m<sup>2</sup> (Annexure, Laboratory Test Result)

Therefore, Allowable Bearing Capacity =  $0.1 \times 3200 = 320 \text{ t/m}^2$

**Restricted to 100 t/m<sup>2</sup>.**

## REFERENCES

- 1) Foundation Analysis and Design, J.E. Bowles, McGraw Hill Publication, 5th Edition, 1996. (Table 5-2, Figure 5-7, Reference No. 1)
- 2) IS: 6403:1981, Code of Practice for Design and Construction of Shallow Foundations on Soils.
- 3) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Clause 6.2, pg. 7)
- 4) IS: 12070: 1987, Code of Practice for Design and Construction of Shallow Foundations on Rocks. (Table 4, clause 6.2, pg. 9)
- 5) IS: 456:2000, Plain and Reinforced Concrete - Code of Practice.
- 6) CIRIA Special Publication No. 31.



## **APPENDIX II**

### **BORELOGS AND LAB TEST REPORTS**



# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |        |                              |   |                                 |                                 |         |         |                                     |    |   |                          |                |        |         |
|---|--------|------------------------------|---|---------------------------------|---------------------------------|---------|---------|-------------------------------------|----|---|--------------------------|----------------|--------|---------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |        |                              |   |                                 |                                 |         |         |                                     |    | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |         |
| Type of Boring  |        | Calyx with Bent. with casing |   |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 13                 |    |   |                          |                |        |         |
| Dia of Hole (mm):   |        | 100.00                       |   |                                 | 75.00                           |         |         | Bore Hole No.: B13-1                |    |   |                          |                |        |         |
| Depth (M):  |        | 0.00-2.10                    |   |                                 | 2.10-10.55                      |         |         | Co-ordinates : N=2032811, E=320115  |    |   |                          |                |        |         |
| Commenced on : 10 March 2023  |        |                              |   | Completed on : 12 March 2023    |                                 |         |         | Ground Bed RL: 83.50M               |    |   |                          |                |        |         |
| Water Struc :   |        |                              |   | Ground Water : 6.00M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |    |   |                          |                |        |         |
| From (M)  | To (M) | Sample Depth (M)             | Description of Strata                   | Symbol                          | SPT Record                      |         |         |                                     |    | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks |
|   |        |                              |   |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N  |   |                          |                |        |         |
| 0.00  |        | 0.00 - 1.00                  | MURUM, PEBBLES and COBBLES              |                                 |                                 |         |         |                                     |    | DS-1  |                          |                |        |         |
|   |        | 1.00 - 1.50                  |   |                                 |                                 |         |         |                                     |    |   | WS-1                     |                |        |         |
|   |        | 1.50 - 2.10                  |   |                                 | 7                               | 10      | 11      | 16                                  | 21 | SPT-1                                       |                          |                |        |         |
|   |        | 2.10                         |   |                                 |                                 |         |         |                                     |    |   |                          |                |        |         |
| 2.10  |        | 2.10 - 3.00                  | BROWNISH GREY MODERATELY WEATHERED ROCK |                                 |                                 |         |         |                                     |    | 1 TO 5                                      | 0.34                     | 37.00          | 13.00  |         |
|   |        | 3.00 - 4.00                  |   |                                 |                                 |         |         |                                     |    | 6 TO 9                                      | 0.50                     | 50.00          | 11.00  |         |
|   |        | 4.00 - 5.00                  |   |                                 |                                 |         |         |                                     |    | 10 TO 12                                    | 0.44                     | 44.00          | 33.00  |         |
|   |        | 5.00                         |   |                                 |                                 |         |         |                                     |    |   |                          |                |        |         |
| 5.00  |        | 5.00 - 6.10                  | GREY AMYGDALOIDAL BASALT                |                                 |                                 |         |         |                                     |    | 13 TO 15                                    | 1.04                     | 94.00          | 92.00  |         |
|   |        | 6.10 - 7.60                  |   |                                 |                                 |         |         |                                     |    | 16 TO 21                                    | 1.48                     | 98.00          | 86.00  |         |
|   |        | 7.60 - 9.10                  |   |                                 |                                 |         |         |                                     |    | 22 TO 31                                    | 1.48                     | 98.00          | 86.00  |         |
|   |        | 9.10 To 10.55                |   |                                 |                                 |         |         |                                     |    | 32 TO 37                                    | 1.27                     | 87.00          | 84.00  |         |
|   |        | 10.55                        |   |                                 |                                 |         |         |                                     |    |   |                          |                |        |         |
|   |        |                              |   |                                 | Bore Hole Terminated at : 10.55 |         |         |                                     |    |   |                          |                |        |         |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standerd Penetration Test,C-Core, W-Water Sample, V-Vane Test |        |                              |   |                                 |                                 |         |         |                                     |    |   |                          |                |        |         |
| No. of disturbed Sample : 1   |        |                              |   |                                 | No. of U.D.S. : 0               |         |         |                                     |    | No. of Vane Test : 0                        |                          |                |        |         |
|   |        |                              |   |                                 | No. of S.P.T. : 1               |         |         |                                     |    | No. of Water Sample : 1                     |                          |                |        |         |

# Report Sheet

Project : Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.

P. N. Shidhore  
Civil Engineers (I) Pvt. Ltd.  
Kalyan(W).0251-2206495.

| BORE LOG  |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                                |
|---|---------------|------------------------------|--|---------------------------------|---------------------------------|---------|---------|-------------------------------------|----------|---|--------------------------|----------------|--------|--------------------------------|
| Site :Geotechnical Investigation for DMIDC-Dighi Port Industrial Area.                                    |               |                              |  |                                 |                                 |         |         |                                     |          | Client :EGIS Consulting Engineers Pvt. Ltd. |                          |                |        |                                |
| Type of Boring  |               | Calyx with Bent. with casing |  |                                 | Calyx with Bent. without casing |         |         | Job No. : BRIDGE 13                 |          |   |                          |                |        |                                |
| Dia of Hole (mm):   |               | 100.00                       |  |                                 | 75.00                           |         |         | Bore Hole No.: B13-2                |          |   |                          |                |        |                                |
| Depth (M):  |               | 0.00-4.20                    |  |                                 | 4.20-11.15                      |         |         | Co-ordinates : N=2032806, E=320107  |          |   |                          |                |        |                                |
| Commenced on : 13 March 2023  |               |                              |  | Completed on : 15 March 2023    |                                 |         |         | Ground Bed RL: 83.50M.              |          |   |                          |                |        |                                |
| Water Struc :   |               |                              |  | Ground Water : 4.50M. Seasonal. |                                 |         |         | Location of Bore Hole : As per plan |          |   |                          |                |        |                                |
| From (M)  | To (M)        | Sample Depth (M)             | Description of Strata                  | Symbol                          | SPT Record                      |         |         |                                     |          | Sample Ref. No.                             | Sl. No. of core recovery | Core Rcvry (%) | R.Q.D. | Remarks                        |
|   |               |                              |  |                                 | 0-150                           | 150-300 | 300-450 | 450-600                             | N        |   |                          |                |        |                                |
| 0.00  |               | 0.00 - 1.50                  | MURUM, PEBBLES and COBBLES             |                                 |                                 |         |         |                                     |          | DS-1  |                          |                |        |                                |
|   |               | 1.50 - 2.10                  |  |                                 | 7                               | 10      | 11      | 0                                   | 21       | SPT-1                                       |                          |                |        |                                |
|   |               | 2.10 - 3.00                  |  |                                 |                                 |         |         |                                     |          | WS-1  |                          |                |        |                                |
|   |               | 3.00 - 3.20<br>3.20 - 4.20   |  |                                 | 30                              | 52      | 0       | 0                                   | 52       | SPT-2<br>1 TO 4                             | 0.29                     | 29.00          | 0.00   |                                |
| 4.20  |               | 4.20 - 5.00                  | BROWNISH GREY MODERATELY WEATHERD ROCK |                                 |                                 |         |         |                                     |          | 5 TO 9                                      | 0.42                     | 52.00          | 33.00  |                                |
| 5.00 - 6.00   |               |                              |  |                                 |                                 |         |         |                                     | 10 TO 18 | 0.59  | 59.00                    | 22.00          |        |                                |
| 6.00  |               | 6.00 - 7.50                  | GREY BASALT                            |                                 |                                 |         |         |                                     |          | 19 TO 24                                    | 1.49                     | 99.00          | 92.00  | Vertical veins, Inclined viens |
|   | 7.50 - 8.65   |                              |  |                                 |                                 |         |         |                                     |          | 25 TO 29                                    | 1.03                     | 88.00          | 83.00  |                                |
|   | 8.65 - 9.65   |                              |  |                                 |                                 |         |         |                                     |          | 30 TO 32                                    | 1.00                     | 100.00         | 90.00  |                                |
|   | 9.65 To 11.15 |                              |  |                                 |                                 |         |         |                                     |          | 33 TO 45                                    | 1.48                     | 98.00          | 62.00  |                                |
| 11.15   |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                                |
| Bore Hole Terminated at : 11.15   |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                                |
| D-Disturbed Sample, U-Undisturbed Sample, P-Standard Penetration Test,C-Core, W-Water Sample, V-Vane Test |               |                              |  |                                 |                                 |         |         |                                     |          |   |                          |                |        |                                |
| No. of disturbed Sample : 1   |               |                              |  |                                 | No. of U.D.S. : 0               |         |         |                                     |          | No. of Vane Test : 0                        |                          |                |        |                                |
|   |               |                              |  |                                 | No. of S.P.T. : 2               |         |         |                                     |          | No. of Water Sample : 1                     |                          |                |        |                                |



ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|                                     |                      |
|-------------------------------------|----------------------|
| STRUCTWEL/Level/IV/ PHY/TR/Soil/061 |                      |
| Rev. No. - 03                       | Dtd. 30/08/2022      |
| Discipline: Mechanical              | Group: Soil and Rock |

PAGE 2 OF 2

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2023-24/SAN0659322/00488

ULR No. : TC528223000005812F

12/04/2023

## 1. Name &amp; Address of Client

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of  
Geotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur

TC-5282

| Ref. No./ID. Mark/B.H. No.:                                | IS CODE FOLLOWED                         | CN No.15 B-13-1                    | CN No.4A B-13-2   | -- | -- |
|--|--|------------------------------------|---|----|----|
| Sample No. :   | --                                       | --                                 | --  | -- | -- |
| Depth, m :   | --                                       | --                                 | --  | -- | -- |
| Description :  | --                                       | Silty Sand with gravels            | Silty Sand with gravels                                     | -- | -- |
| Atterberg Limits   | Liquid Limit                             | 39                                 | 44  | -- | -- |
|  | Plastic Limit                            | 28                                 | 26  | -- | -- |
|  | Plasticity Index                         | 11                                 | 18  | -- | -- |
|  | ShrinkageLim.                            | --                                 | --  | -- | -- |
| % Grain size by Sieve & Hydrometer                         | Clay + Silt                              | 5+46                               | 10+30   | -- | -- |
|  | Sand                                     | 28                                 | 37  | -- | -- |
|  | Gravel                                   | 21                                 | 23  | -- | -- |
| Shear Strength : Triaxial / Unconfined compression, Direct | Test Code                                | Triaxial Test (TUU)                | --  | -- | -- |
|  | Cohesion, kg/cm <sup>2</sup>             | IS 2720 Part-11                    | --  | -- | -- |
|  | Angle                                    | Direct Shear Test (DUU, DCU & DCD) | --  | -- | -- |
|  | Bulk Density, T/m <sup>3</sup>           | --                                 | --  | -- | -- |
|  | Water Content, %                         | IS 2720 Part-13                    | --  | -- | -- |
| Unconfined compression test                                | qu (kg/cm <sup>2</sup> )                 | --                                 | --  | -- | -- |
|  | Shear Strength (kg/cm <sup>2</sup> )     | IS 2720 Part-10                    | --  | -- | -- |
| Consolidation Test   | Pressure Range, T/m <sup>2</sup>         | IS 2720 Part-15                    | 5-10 10-20 - - 5-10 10-20 - - 5-10 10-20 - - 5-10 10-20 - - | -- | -- |
|  | Mv, m <sup>2</sup> /Tx10 <sup>-4</sup>   | --                                 | --  | -- | -- |
|  | Cv, m <sup>2</sup> /yr x10 <sup>-2</sup> | --                                 | --  | -- | -- |
| Natural Moisture Content %                                 | IS 2720 Part-1                           | --                                 | --  | -- | -- |
| Specific gravity   | IS 2720 Part-3                           | 2.63                               | 2.59  | -- | -- |
| Compaction   | Max dry density, g/cm <sup>3</sup>       | Light Compaction IS 2720 Part-7    | --  | -- | -- |
| Heavy Compaction   | Optimum Moist Cont., %                   | Heavy Compaction IS 2720 Part-8    | --  | -- | -- |
| California Bearing Ratio                                   | Soaked %                                 | IS 2720 Part-16                    | --  | -- | -- |
|  | Unsoaked %                               | --                                 | --  | -- | -- |
| **Coefficient of Uniformity (Cu)                           | IS 1498                                  | --                                 | --  | -- | -- |
| **Coefficient of Curvature (Cc)                            | --                                       | --                                 | --  | -- | -- |
| Free Swell Index (%)                                       | IS 2720 Part-40                          | --                                 | --  | -- | -- |
| Swelling Pressure (kg/cm <sup>2</sup> )                    | IS 2720 Part-41                          | --                                 | --  | -- | -- |

**Triaxial Compression**

TUU : Unconsolidated Undrained

**Unconfined Compression**

UCU : Undisturbed

UCR : Remoulded

**Direct Shear**

DUD : Unconsolidated Drained

DUU : Unconsolidated Undrained

DCU : Consolidated Undrained

DCD : Consolidated Drained

**Consolidation Test**

Mv : Coefficient of volume decrease

Cv : Coefficient of consolidation

Checked By

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

SST/N/LAB/Tech Report/2023-24/turbhe/test report/NABL/Phy/Soil/SAN0659322

\*\*\*\*\*End of Report\*\*\*\*\*



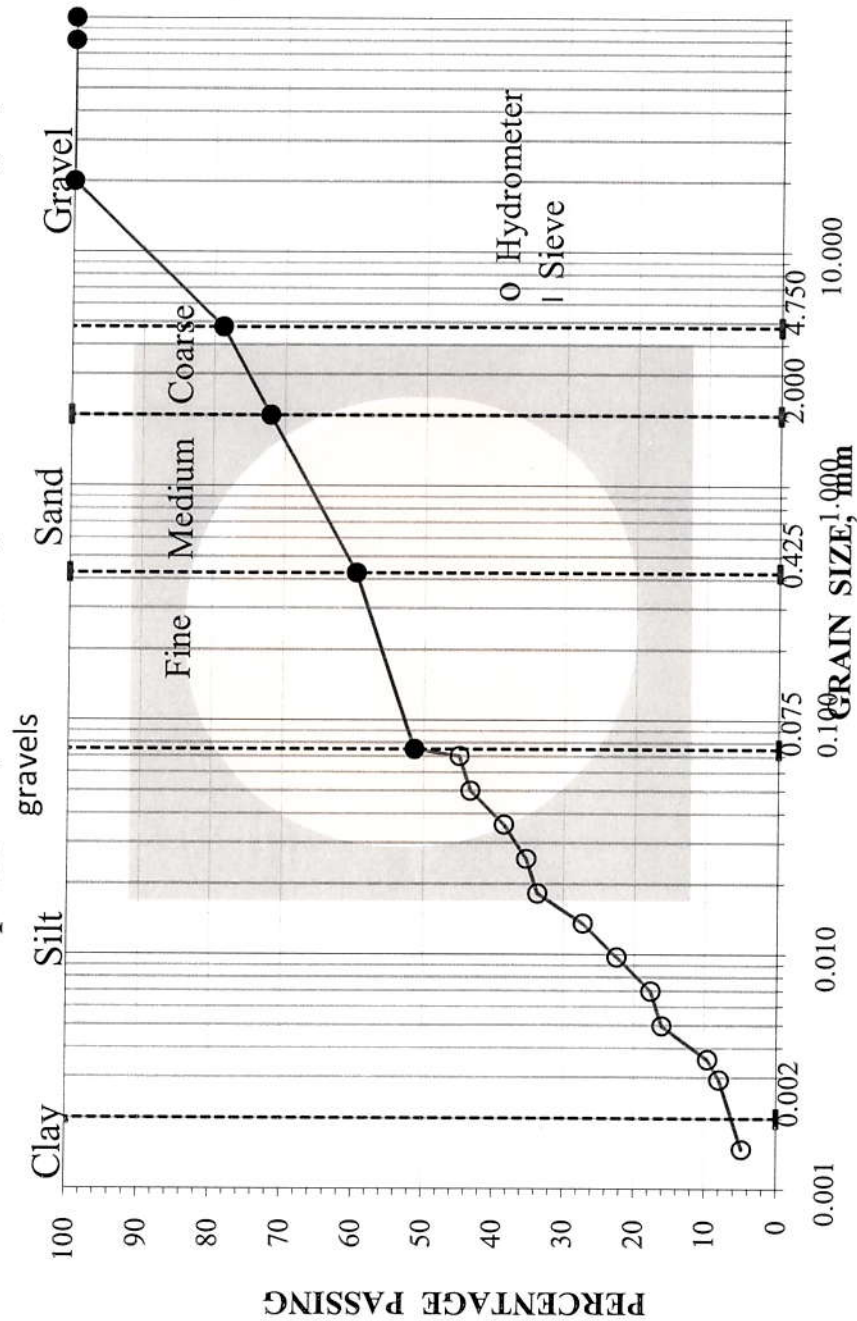


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**GRAIN SIZE ANALYSIS BY SIEVE & HYDROMETER METHOD**

**Customer** M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of Geotechnical Investigation for DMDC-Dighi Port Industrial Area, Indapur  
**B.H.No.** --  
**Description** Silty Sand with gravels  
**Sample #** Cn. No.15 B-13-1  
**Depth, m** --



*(Signature)*



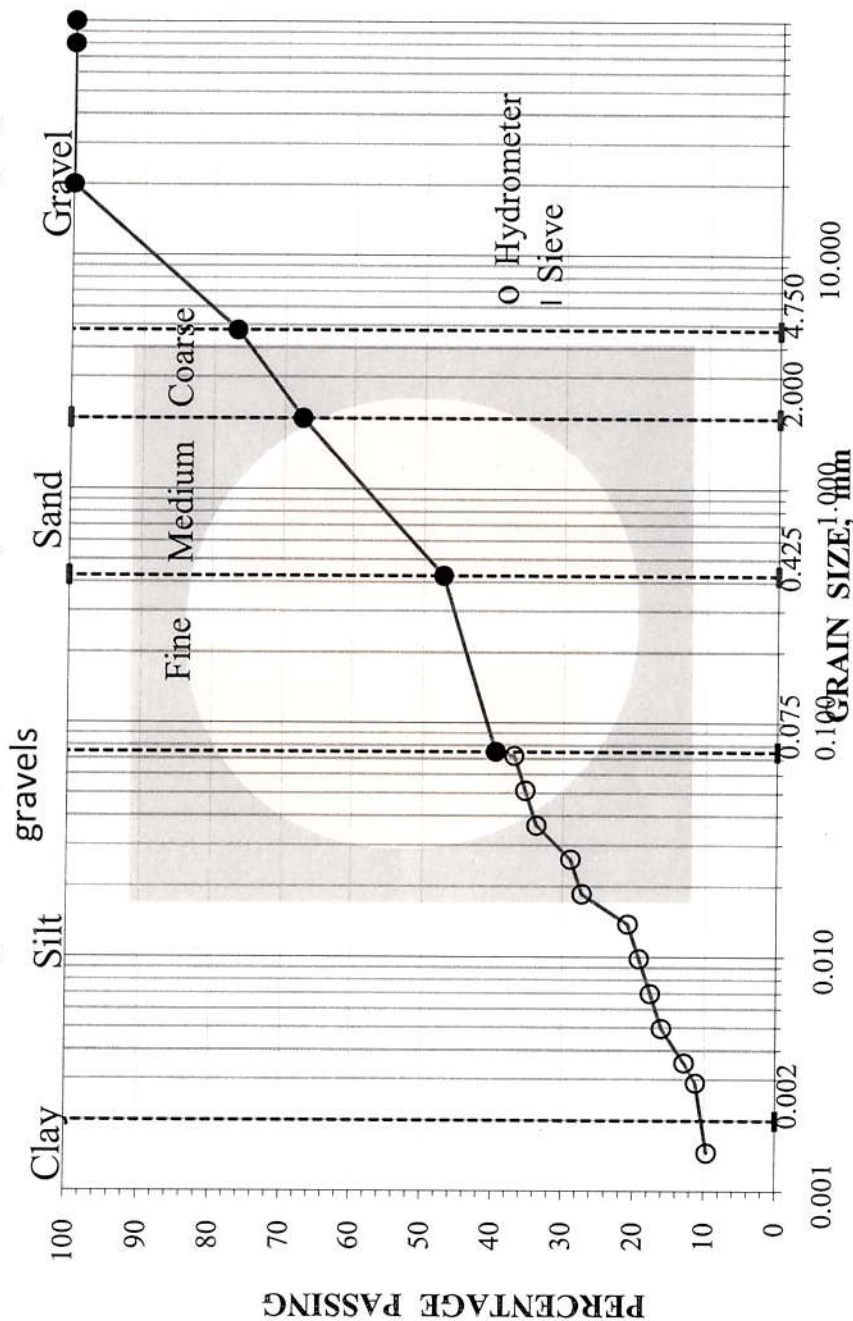
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TC-5282

**GRAIN SIZE ANALYSIS BY  
SIEVE & HYDROMETER  
METHOD**

**Customer** M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
**Location** Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation for DMDC-Dighi Port Industrial Area, Indapur  
**B.H.No.** --  
**Description** Silty Sand with gravels  
**Sample #** Cn. No.4A B-13-2  
**Depth, m** --







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**TEST REPORT**

|                                       |                       |
|---------------------------------------|-----------------------|
| STRUCTWEL/NM/Level/IV/PHY/TR/Rock/059 |                       |
| Rev. No. 05                           | Rev. Date: 30/08/2022 |
| Discipline: Mechanical                | Group: Soil and Rock  |

PAGE 1 OF 1

**TEST REPORT NO. & DATE**

R&amp;D/LAB/SAN/2022-23/SAN0659322/00490

ULR No. : TC528223000005814F

12/04/2023

## 1. Name &amp; Address of Customer

M/s. P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.

## 2. Project / Site

Soil, Water and Rock samples for lab. testing for the work of GEotechnical Investigation  
for DMDC-Dighi Port Industrial Area, Indapur

## 3. Customer's Reference

PNS/Structwel/22 Dtd. 25.03.2023

## 4. Location of test Performance

At Laboratory

## 5. Sample

## i) Description

Rock

## ii) Quantity

04 Nos.

## iii) Date of receipt

25/03/2023

## iii) Condition

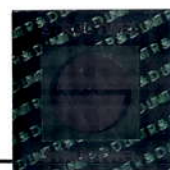
Acceptable

## 6. Test method followed, if any

As Mentioned Below.

## 7. Date of Testing From

28/03/2023 to 31/03/2023

**TEST REPORT**

| SR. No.              | ID. Mark       | Depth | Dia.  | Area            | Length | Dry Density                      | Load   | Compressive strength            | Compressive strength corrected | SP. Gravity                     | Porosity                     | Water Absorption | Hardness                       |
|----------------------|----------------|-------|-------|-----------------|--------|----------------------------------|--------|---------------------------------|--------------------------------|---------------------------------|------------------------------|------------------|--------------------------------|
|                      |                | mtr.  | mm.   | mm <sup>2</sup> | mm.    | kg/m <sup>3</sup>                | N      | N / mm <sup>2</sup>             | for L/D- N / mm <sup>2</sup>   |                                 | %                            | %                | by Moh's scale                 |
| Test Method Followed |                |       |       |                 |        | (IS:13030):<br>1991<br>(RA 2021) |        | (IS:9143):<br>1979<br>(RA 2021) |                                | (IS 1122):<br>1974<br>(RA 2017) | (IS:13030):1991<br>(RA 2021) |                  | IS 13630<br>(Part 13):<br>2019 |
| 1                    | Bridge No.13-1 | 4.00  | 54.82 | 2359.11         | 110.64 | --                               | 118800 | 50                              | 50                             | --                              | 0.013                        | 0.47             | --                             |
| 2                    | Bridge No.13-1 | 9.00  | 54.64 | 2343.64         | 112.32 | --                               | 136200 | 58                              | 58                             | --                              | 0.009                        | 0.35             | --                             |
| 3                    | Bridge No.13-2 | 6.30  | 54.52 | 2333.36         | 112.06 | --                               | 164800 | 71                              | 71                             | --                              | 0.013                        | 0.45             | --                             |
| 4                    | Bridge No.13-2 | 9.65  | 54.53 | 2334.21         | 100.40 | --                               | 76500  | 33                              | 32                             | --                              | 0.011                        | 0.40             | --                             |

Parameters for Classification as per Strength of Intact Rock Material as per IS 13365:1998 Part 1(RA 2021)

| Sr. No. | Classification       | Comp. Strength (N/mm <sup>2</sup> ) |
|---------|----------------------|-------------------------------------|
| 1       | Exceptionally Strong | > 250                               |
| 2       | Very Strong          | 100-250                             |
| 3       | Strong               | 50-100                              |
| 4       | Average              | 25-50                               |
| 5       | Weak                 | 10-25                               |
| 6       | Very Weak            | 2-10                                |
| 7       | Extremely Weak       | < 2                                 |

**NOTE :**

- Classification shall be used for feasibility studies & preliminary designs only.
- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- \*- Data provided by Customer

Checked By

SST/N/LAB/Tech Report/2023-24/Test Report/Nabl/Phy/Rock/SAN0659322

Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

\*\*\*\*\*End of Report\*\*\*\*\*

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**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1



TC-5282

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0659322/00811****ULR No. : TC528223000006135F****17/04/2023****1. Name & Address of Customer**M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur  
PNS/Structwel/22 Dtd. 25.03.2023**3. Customer's Reference****4. Location of performance of test**

At Laboratory

**5. Sample**

i) Description

**Construction Water**

ii) Quantity

01 No.

iii) Date of receipt

25/03/2023

iv) Condition

Acceptable

**6. Test method followed**

Mentioned Below

**7. Date of Testing**

11/04/2023

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER****\* ID Mark. : BH.No. Bridge No. 13-1**

| Test Parameter   | Test Method Followed  | Results     | Permissible Limits   |                                    |
|--|---|-------------|--|------------------------------------|
|  |   |             | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |             | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | <b>7.09</b> | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | <b>14</b>   | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | <b>13</b>   | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --          | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --          | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --          | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --          | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --          | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

*Swati*  
Swati Sonawane  
Manager - Chemical  
Checked by

*Vikram B. Parmar*  
Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0659322

\*\*\*\*\* End of Report \*\*\*\*\*



*"Intelligence with Integrity"*

ISO/IEC 17025 Accredited Laboratory by NABL Vide Certificate Number TC - 5282

**TEST REPORT**

|   |                 |
|---|-----------------|
| STRUCTWEL/NM/Level/IV/CHE/TR/Construction Water/001 |                 |
| Rev. No. - 06                                       | Dtd. 20/08/2022 |
| Discipline: Chemical                                | Group: Water    |

PAGE 1 OF 1



TC-5282

**TEST REPORT NO. & DATE****R&D/LAB/SAN/2023-24/SAN0659322/00766****ULR No. : TC528223000006090F****17/04/2023****1. Name & Address of Customer**M/s.P.N. Shidhore Civil Engineers (India) Private Limited.  
Prabhakar Apt., "B" Wing, 3rd floor, Gaondevi Chowk,  
Kalyan (W) - 421301.**2. Project / Site**Soil, Water and Rock samples for lab. testing for the work of  
GEotechnical Investigation for DMIDC-Dighi Port Industrial Area, Indapur  
PNS/Structwel/22 Dtd. 25.03.2023**3. Customer's Reference****4. Location of performance of test**

At Laboratory

**5. Sample**

- i) Description
- ii) Quantity
- iii) Date of receipt
- iv) Condition

**Construction Water**01 No.  
25/03/2023  
Acceptable**6. Test method followed**

Mentioned Below

**7. Date of Testing**

11/04/2023

**CHEMICAL ANALYSIS OF CONSTRUCTION WATER****\* ID Mark. : BH.No. Bridge No. 13-2**

| Test Parameter   | Test Method Followed  | Results | Permissible Limits   |                                    |
|--|---|---------|--|------------------------------------|
|  |   |         | IS 456 : 2000 (RA 2021)                                    |                                    |
|  |   |         | Mixing and Curing<br>Clause 5:4 Table 1                    | Ground Clause<br>8:2:2:4 & Table 4 |
| pH   | IS 3025 (Part 11) : 2022                                    | 7.8     | Not less than 6  | From 6 to 9                        |
| Chlorides (mg/ltr)   | IS 3025:1988 Part 32<br>(RA 2019)<br>(Argentometric Method) | 14      | 2000 Max.<br>(Plain Concrete) 500<br>(Reinforced Concrete) | --                                 |
| Sulphates as SO <sub>3</sub> (mg/ltr.)   | IS 3025 Part 24/Sec 1) : 2022<br>(Gravimetric Method)       | 14      | 400 Max.   | Refer Table 4                      |
| Volatile (Organic) Residue (mg/ltr.)   | IS 3025 (Part 18) : 2022                                    | --      | 200 Max.   | --                                 |
| Fixed (Inorganic) Residue (mg/ltr.)  | IS 3025 (Part 18) : 2022                                    | --      | 3000 Max.  | --                                 |
| Total Suspended Matter (mg/ltr.)   | IS 3025 (Part 17) : 2022                                    | --      | 2000 Max.  | --                                 |
| Total Alkalinity (To neutralize 100 ml water sample, 0.02 N, H <sub>2</sub> SO <sub>4</sub> required) mL | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 25 Max.  | --                                 |
| Total Hardness as CaCO <sub>3</sub> mg/L   | IS 3025:2009 Part 21<br>(RA 2019) (EDTA method)             | --      | --   | --                                 |
| Acidity (To neutralize 100 ml water sample, 0.02 N, NaOH required) mL                                    | IS 456:2000 (RA 2021),<br>(Indicator Method)                | --      | 5 Max.   | --                                 |

**NOTE :**

- This test report refers only to the sample submitted for testing.
- This test report is valid at the time of and under the conditions specified herein.
- This test report may not be reproduced in part, without the permission of this laboratory.
- Any correction invalidates this test report.
- BDL - Below Detection Limit
- \* Data provided by Customer.

*Swati*  
Swati Sonawane  
Manager - Chemical  
Checked by

Suchita/N/LAB/Tech Report/2023-24/Test Report/Nabl/Che/Water/SAN0659322

\*\*\*\*\* End of Report \*\*\*\*\*

*Vikram B. Parmar*  
Vikram B. Parmar  
Nodal Quality Manager  
Authorised Signatory