

**REPORT ON**  
**GEOTECHNICAL INVESTIGATION FOR CONSTRUCTION OF A MONUMENT AT**  
**BHUJ, KUTCH FOR EARTHQUAKE AFFECTED PEOPLE**  
**BY GUJARAT DISASTER MANAGEMENT AUTHORITY**

**FORWARDED TO :**

**M/S VASTUSHILP CONSULTANTS**  
**AHMEDABAD.**

**BY**

**ANANDJIWALA TECHNICAL CONSULTANCY**  
**AHMEDABAD.**  
**(MARCH 2011)**

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**GENERAL :** **CEO, Gujarat State Disaster Managemnet Authority** proposed to construct a monument at Bhuj, Kutch for earthquake affected people.

The Consultant for the project is **M/S Vastushilp Consultants, Ahmedabad**. The Geotechnical Investigation work was entrusted to **Anandjiwala Technical Consultancy, Ahmedabad**.

The object of investigation is to determine the sub surface conditions at the site and to provide information that would assist the Structural Engineer in the design of foundation.

**Location :** The total area of the site is 406 acre at Bhuj, Kutch. Out of that GSDMA is developing 259 acres in Phase-I.

**FIELD INVESTIGATION :** Seven 100 mm. dia bores were put down to the depth of 10.00 mt. at proposed site of construction by our skilled and experienced site personnel by using Rotary drilling in December 2010 and January 2011.

**Standard Penetration Test :** The standard penetration tests were carried out by split spoon sampler confirming to IS 2131-1981. The split spoon sampler assembly is divided in three parts. One is cutting shoe of 38 mm inside dia and 51 mm out side diameter with 75 mm length. The second is split body of same diameter and 508 mm in length. The third is driving head with ball of same dia meters and 180 mm in length. The drive weight assembly consist of 65 kg. weight hammer and 750 mm free fall guide rod.

Before conducting the Standard Penetration Test we had cleaned the bore by shell then lowered the S.P.T. sampler with 'A' rod and conducted the Standard Penetration Test in accordance with IS 2131-1981.

**Undisturbed Sample :** The undisturbed samples were collected at every 3.0 mt. depth interval in thin walled sampling tube of 65 mm inside diameter and 3 mm thick wall tube.  
The thin wall sampling tube confirming to IS 2132-1981 consist of cutting shoe sampling tube and driving head with ball. The tests were conducted in accordance with IS 2132-1981.

**LABORATORY TESTING :**

The Laboratory testings should be carried out on both disturbed and undisturbed samples. The following tests should be carried out on disturbed / undisturbed samples.

- (1) Mechanical Analysis
- (2) Atterberg Limit
- (3) Specific Gravity

**UNDISTURBED SAMPLE :**

- (1) Field Density
- (2) Moisture Content
- (3) Grain Size Analysis
- (4) Atterberg Limit
- (5) Specific Gravity

- (1) The Grain Size Analysis Tests should be carried out in accordance with IS 2720(Part IV)-1992.
- (2) The Atterberg limit test apparatus are (1) Casagrand and (2) Cone Penetrometer in accordance with IS 9259-1979 and 11196-1985 respectively. We will carry out the Test by using both equipments with respect to the soil behaviour and as per the IS- 2720 ( Part-V)-1991.
- (3) Specific Gravity : The specific gravity of the soil samples should be carried out in accordance with IS-2720 (Part- 3/Sec-1)-1980 for fine grain soil and IS 2720 (Part-3/ Sec - 2)-1980 for medium and coarse grain soil.
- (4) Field density and moisture content should be carried out in accordance with IS 2720 (Part-2)-1973.
- (5) Direct Shear Test : The direct shear tests should be carried out by small size box shear test in accordance with IS- 2720 (Part-13 )-1986 and apparatus confirming to IS-11229-1985.

**SUB SOIL PROFILE :**

The bore logs data reveal the soil formation as under.

**BH-1 ( North : 4935.74 East : 5698.83 )**

The first layer from 0.00 mt. to 1.80 mt. is made up of Greyish Brownish medium to fine grained non plastic silty sand mixed with little kankkars.

The next layer from 1.80 mt. to 5.00 mt. is made up of Brownish highly over consolidated silty sand giving the effect of sand stone.

The core recovery in this layer is 23 % to 34 %.  
The RQD is 10 % to 25 %.

The next layer from 5.00 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 38 % to 41 %.  
The RQD is 24 % to 29 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in December 2010.

**BH-2 ( North : 4619.75 East : 5585.91 )**

The first layer from 0.00 mt. to 1.70 mt. is made up of Greyish Brownish medium to fine grained non plastic silty sand mixed with little kankkars.

The next layer from 1.70 mt. to 5.30 mt. is made up of Brownish highly over consolidated silty sand giving the effect of sand stone.

The core recovery in this layer is 22 % to 34 %.  
The RQD is 14 % to 25 %.

The next layer from 5.30 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 36 % to 44 %.  
The RQD is 25 % to 32 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in January 2011.

**BH-3 ( North : 4443.27 East : 5632.20)**

The first layer from 0.00 mt. to 0.60 mt. is made up of Reddish poorly graded fine sand.

The next layer from 0.60 mt. to 6.20 mt. is made up of highly weathered disintegrated rock pieces.

The core recovery in this layer is Nil.

The next layer from 6.20 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 10 % to 14 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in January 2011.

**BH-4 ( North : 4355.77 East : 5862.75)**

The first layer from 0.00 mt. to 2.20 mt. is made up of Reddish medium to fine grained silty sand mixed with little clay particles of low plasticity and kankars.

The next layer from 2.20 mt. to 3.70 mt. is made up of Greyish rounded boulders.

The layer from 3.70 mt. to 5.80 mt. is made up of Reddish medium to fine grained silty sand mixed with little clay particles of low plasticity and kankars.

The next layer from 5.80 mt. to 6.80 mt. is made up of highly weathered disintegrated rock pieces.

The core recovery in this layer is Nil.

The next layer from 6.80 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 8 % to 15 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in January 2011.

**BH-5 ( North : 4296.17 East : 5196.93)**

The first layer from 0.00 mt. to 0.70 mt. is made up of Reddish poorly graded fine sand.

The next layer from 0.70 mt. to 6.30 mt. is made up of highly weathered disintegrated rock pieces.

The core recovery in this layer is Nil.

The next layer from 6.30 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 11 % to 15 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in February 2011.

**BH-6 ( North : 4181.22 East : 4813.13)**

The first layer from 0.00 mt. to 1.80 mt. is made up of Reddish Brown medium to fine grained non plastic silty sand mixed kankkars.

The next layer from 1.80 mt. to 5.60 mt. is made up of Brownish highly over consolidated silty sand giving the effect of sand stone.

The core recovery in this layer is 24 % to 36 %.  
The RQD is 16 % to 28 %

The next layer from 5.60 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 34 % to 46 %.  
The RQD is 25 % to 35 %

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in February 2011.

**BH-7 ( North : 4364.68 East : 4737.15)**

The first layer from 0.00 mt. to 1.70 mt. is made up of Reddish Brown medium to fine grained non plastic silty sand mixed kankkars.

The next layer from 1.70 mt. to 5.20 mt. is made up of Brownish highly over consolidated silty sand giving the effect of sand stone.

The core recovery in this layer is 22 % to 35 %.  
The RQD is 14 % to 28 %.

The next layer from 5.20 mt. to 10.00 mt. is made up of moderately weathered highly over consolidated sand stone.

The core recovery in this layer is 32 % to 42 %.  
The RQD is 24 % to 29 %.

**WATER TABLE :**

The water table was not encountered in the borehole during the boring in February 2011.



**SAFE BEARING CAPACITY  
CALCULATION: FOR BH-1 & BH-2**

The foundation proposed is Open Footing at 2.0 mt. depth below ground level.

- (a) Type of foundation considered : Open Footing.
- (b) Depth of foundation below G.L.: 2.0 mt.
- (c) Size of foundation : 2.5 mt. x 2.5 mt.

Considering the Shear Parameter at 3.0 mt. below G.L.

$$C = 0.0 \text{ kg / cm}^2 \quad \phi = 30^\circ 12' \quad \gamma_d = 1.82 \text{ t/m}^2$$

For the values of  $\phi > 28^\circ$ , general shear failure is likely to occur.

$$N_c = 30.14 \quad N_q = 18.40 \quad N_\gamma = 22.40$$

$$\begin{aligned} q_d &= cN_c + q * (N_q - 1) + 0.5 * \gamma * B * N_\gamma * w \\ &= (0.0 * 30.14) + (1.82 * 2.0) * (18.40 - 1) + \\ &\quad (0.5 * 1.82 * 2.5 * 22.40 * 1.0) \\ &= 0 + 63.33 + 50.96 \\ &= 114.29 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q_{\text{safe}} &= q_d / \text{FOS} \\ &= 114.29 / 2.5 \\ &= 45.71 \text{ t/m}^2 \end{aligned}$$

Say 46.00 t/m<sup>2</sup>

**Based on Standard**

Observed 'N' Value at 1.50 mt. depth is 33 in BH-1

N value correction for overburden pressure .  
According to IS 6403- 1971 Appendix - C .

$$\begin{aligned} N \text{ corrected} &= 'N' \frac{3.5}{P + 0.7} \\ &= 33 \times \frac{3.5}{(0.00182 \times 200) + 0.7} \\ &= 108.53 \end{aligned}$$

but limiting to factor 2 the corrected 'N' will be 66  
( As per Gibbs & Holtz -1957 )

$$\begin{aligned} qd &= 5.54 (N - 3) \left( \frac{B + 30}{2B} \right)^2 \\ &= 5.54 (66 - 3) \left( \frac{250 + 30}{2 \times 250} \right)^2 \\ &= 109.43 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q \text{ net} &= \frac{qd}{\text{Factor of Safty}} \\ &= \frac{109.43}{2.5} \\ &= 43.77 \text{ t/m}^2 \\ &\text{Say } 43.50 \text{ t/m}^2 \end{aligned}$$

**RECOMMENDATIONS :  
& CONCLUSIONS BH-1 & 2 :**

- 1) Water table was not encountered in the boreholes BH-1 & BH-2 during the investigations in December 2010 and January 2011.
- 2) Safe Bearing Capacity for proposed structures for Isolated Column footing at 2.00 mt. is as below.

Size of Footing mt. x mt.	Safe Bearing Capacity (t/m <sup>2</sup> )	
	Based on Shear	Based on SPT
2.50 x 2.50	46.00	<b>43.50</b>
3.0 x 3.0	50.00	<b>42.00</b>

Looking to the site conditions and variation in encountered soil strata we recommend to reduce the bearing capacity by 25 %.

i.e. at 2.00 mt. depth for 2.50 mt. x 2.50 mt. of open footing the recommended SBC would be 33.50 t/m<sup>2</sup>

- 3) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.

**FOR ANANDJIWALA TECHNICAL CONSULTANCY**

**SAFE BEARING CAPACITY  
CALCULATION: FOR BH-3**

**Bearing Capacity calculations**

**Based Clause : 6 of IS Code : 12070-1987 :**

Bearing capacity calculations :

Type of Footing : Isolated Column Footing

Size of Footing : 2.50 mt. x 2.50 mt.

Depth of Footing : 2.00 mt.

For the safe bearing pressure

$$q_s = q_c N_j$$

Where  $q_s$  = Safe bearing pressure (gross)

$q_c$  = average uniaxial compressive strength of rock cores

$N_j$  = Empirical coefficient depending on the spacing of discontinuities.

As RQD is low, value of  $N_j$  is taken as 0.1  
(table-4, clause 6.2 of IS 12070-1987)

$$q_s = q_c N_j$$

$$= 37.74 \times 0.1$$

$$= 3.77$$

$$= 37.70 \text{ t/m}^2$$

$$\text{say } 38.00 \text{ t/m}^2$$

**RECOMMENDATIONS  
& CONCLUSIONS BH-3 :**

- 1) Water table was not encountered in the bore hole during the investigation in January 2011.
- 2) We recommend 38.00 t/m<sup>2</sup> as Safe Bearing Capacity for Isolated Footing of size 2.50 mt. x 2.50 mt. at depth 2.00 mt. for design purpose.
- 3) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.

**FOR ANANDJIWALA TECHNICAL CONSULTANCY**

**SAFE BEARING CAPACITY  
CALCULATION: FOR BH-4**

The foundation proposed is Open Footing at 2.0 mt. depth below ground level.

- (a) Type of foundation considered : Open Footing.
- (b) Depth of foundation below G.L.: 2.0 mt.
- (c) Size of foundation : 2.5 mt. x 2.5 mt.

Considering the Shear Parameter at 4.5 mt. below G.L.

$$C = 0.0 \text{ kg / cm}^2 \quad \phi = 30^\circ 00' \quad \gamma_d = 1.84 \text{ t/m}^2$$

For the values of  $\phi > 28^\circ$ , general shear failure is likely to occur.

$$N_c = 30.14 \quad N_q = 18.40 \quad N_\gamma = 22.40$$

$$\begin{aligned} q_d &= cN_c' + q * (N_q' - 1) + 0.5 * \gamma * B * N_\gamma' * w \\ &= (0.0 * 30.14) + (1.84 * 2.0) * (18.40 - 1) + \\ &\quad (0.5 * 1.84 * 2.5 * 22.40 * 1.0) \\ &= 0 + 64.03 + 51.52 \\ &= 115.55 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q_{\text{safe}} &= q_d / \text{FOS} \\ &= 115.55 / 2.5 \\ &= 46.22 \text{ t/m}^2 \end{aligned}$$

Say 46.00 t/m<sup>2</sup>

**Based on Standard**

By considering 'N' Value at 1.50 mt. depth 50 in B H-4

N value correction for overburden pressure .  
According to IS 6403-1971 Appendix - C .

$$\begin{aligned} N \text{ corrected} &= 'N' \frac{3.5}{P + 0.7} \\ &= 50 \times \frac{3.5}{(0.00184 \times 200) + 0.7} \\ &= 163.50 \end{aligned}$$

but limiting to factor 2 the corrected 'N' will be 100  
( As per Gibbs & Holtz -1957 )

$$\begin{aligned} qd &= 5.54 (N - 3) \left( \frac{B + 30}{2B} \right)^2 \\ &= 5.54 (100 - 3) \left( \frac{250 + 30}{2 \times 250} \right)^2 \\ &= 167.81 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q \text{ net} &= \frac{qd}{\text{Factor of Safty}} \\ &= \frac{167.81}{2.5} \\ &= 67.12 \text{ t/m}^2 \\ &\text{Say } 67.00 \text{ t/m}^2 \end{aligned}$$

**RECOMMENDATIONS :  
& CONCLUSIONS BH-4**

- 1) Water table was not encountered in the borehole BH-4 during the investigations in January 2011.
- 2) Safe Bearing Capacity for proposed structures for Isolated Column footing at 2.00 mt. is as below.

Size of Footing mt. x mt.	Safe Bearing Capacity (t/m <sup>2</sup> )	
	Based on Shear	Based on SPT
2.50 x 2.50	46.00	<b>67.00</b>
3.0 x 3.0	50.00	<b>65.00</b>

We recommend lower value as safe Bearing capacity from above table.

Looking to the site conditions and variation in encountered soil strata we recommend to reduce the bearing capacity by 25 %.

i.e. at 2.00 mt. depth for 2.50 mt. x 2.50 mt. of open footing the recommended SBC would be 35.00 t/m<sup>2</sup>

- 3) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.

**FOR ANANDJIWALA TECHNICAL CONSULTANCY**



**SAFE BEARING CAPACITY  
CALCULATION: FOR BH-5**

**Bearing Capacity calculations**

**Based Clause : 6 of IS Code : 12070-1987 :**

Bearing capacity calculations :

Type of Footing : Isolated Column Footing

Size of Footing : 2.50 mt. x 2.50 mt.

Depth of Footing : 2.00 mt.

For the safe bearing pressure

$$q_s = q_c N_j$$

Where  $q_s$  = Safe bearing pressure (gross)

$q_c$  = average uniaxial compressive strength of rock cores

$N_j$  = Empirical coefficient depending on the spacing of discontinuities.

As RQD is low, value of  $N_j$  is taken as 0.1  
(table-4, clause 6.2 of IS 12070-1987)

$$q_s = q_c N_j$$

$$= 37.74 \times 0.1$$

$$= 3.77$$

$$= 37.70 \text{ t/m}^2$$

$$\text{say } 38.00 \text{ t/m}^2$$

**RECOMMENDATIONS  
& CONCLUSIONS BH-5 :**

- 1) Water table was not encountered in the bore hole during the investigation in February 2011.
- 2) We recommend 38.00 t/m<sup>2</sup> as Safe Bearing Capacity for Isolated Footing of size 2.50 mt. x 2.50 mt. at depth 2.00 mt. for design purpose.
- 3) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.

**FOR ANANDJIWALA TECHNICAL CONSULTANCY**

**SAFE BEARING CAPACITY  
CALCULATION: FOR BH-6 & BH-7**

The foundation proposed is Open Footing at 2.0 mt. depth below ground level.

- (a) Type of foundation considered : Open Footing.
- (b) Depth of foundation below G.L.: 2.0 mt.
- (c) Size of foundation : 2.5 mt. x 2.5 mt.

Considering the Shear Parameter at 3.0 mt. below G.L.

$$C = 0.0 \text{ kg / cm}^2 \quad \phi = 30^\circ 36' \quad \gamma_d = 1.83 \text{ t/m}^2$$

For the values of  $\phi > 28^\circ$ , general shear failure is likely to occur.

$$N_c = 30.14 \quad N_q = 18.40 \quad N_\gamma = 22.40$$

$$\begin{aligned} q_d &= cN_c + q * (N_q - 1) + 0.5 * \gamma * B * N_\gamma * w \\ &= (0.0 * 30.14) + (1.83 * 2.0) * (18.40 - 1) + \\ &\quad (0.5 * 1.83 * 2.5 * 22.40 * 1.0) \\ &= 0 + 63.68 + 51.24 \\ &= 114.92 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q_{\text{safe}} &= q_d / \text{FOS} \\ &= 114.92 / 2.5 \\ &= 45.96 \text{ t/m}^2 \end{aligned}$$

Say 46.00 t/m<sup>2</sup>

**Based on Standard**

Observed 'N' Value at 1.50 mt. depth is 32 in BH-6 & 7

N value correction for overburden pressure .  
According to IS 6403- 1971 Appendix - C .

$$\begin{aligned} N \text{ corrected} &= 'N' \frac{3.5}{P + 0.7} \\ &= 35 \times \frac{3.5}{(0.00183 \times 200) + 0.7} \\ &= 105.02 \end{aligned}$$

but limiting to factor 2 the corrected 'N' will be 64  
( As per Gibbs & Holtz -1957 )

$$\begin{aligned} qd &= 5.54 ( N - 3 ) \left( \frac{B + 30}{2B} \right)^2 \\ &= 5.54 ( 64 - 3 ) \left( \frac{250 + 30}{2 \times 250} \right)^2 \\ &= 105.53 \text{ t/m}^2 \end{aligned}$$

$$\begin{aligned} q \text{ net} &= \frac{qd}{\text{Factor of Safty}} \\ &= \frac{105.53}{2.5} \\ &= 42.21 \text{ t/m}^2 \\ &\text{Say } 42.00 \text{ t/m}^2 \end{aligned}$$

**RECOMMENDATIONS :  
& CONCLUSIONS BH-6 & 7 :**

- 1) Water table was not encountered in the boreholes BH-6 & BH7 during the investigations in February 2011.
- 2) Safe Bearing Capacity for proposed structures for Isolated Column footing at 2.00 mt. is as below.

Size of Footing mt. x mt.	Safe Bearing Capacity (t/m <sup>2</sup> )	
	Based on Shear	Based on SPT
2.50 x 2.50	46.00	<b>42.00</b>
3.0 x 3.0	50.00	<b>41.00</b>

Looking to the site conditions and variation in encountered soil strata we recommend to reduce the bearing capacity by 25 %.

i.e. at 2.00 mt. depth for 2.50 mt. x 2.50 mt. of open footing the recommended SBC would be 31.50 t/m<sup>2</sup>

- 3) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.

**FOR ANANDJIWALA TECHNICAL CONSULTANCY**

## PERMEABILITY RESULTS FOR CHECK DAM

<u>Marking</u>	<u>Location</u>		<u>Permeability</u> cm/sec.
	North	East	
CBH-1	5054.04	5535.68	$10.4 \times 10^{-3}$
CBH-2	4913.86	5645.63	$1.73 \times 10^{-3}$
CBH-3	4723.56	5750.92	$6.82 \times 10^{-3}$
CBH-4	4702.89	5569.47	$7.26 \times 10^{-3}$
CBH-5	4587.55	5772.08	$7.77 \times 10^{-3}$
CBH-6	4579.74	5674.95	$1.6 \times 10^{-5}$
CBH-7	4527.01	5559.64	$3.01 \times 10^{-6}$
CBH-8	4419.98	5719.96	$3.33 \times 10^{-5}$
CBH-9	4424.34	5855.75	$2.77 \times 10^{-7}$
CBH-10	4184.86	5783.46	$2.82 \times 10^{-6}$
CBH-11	4039.16	5744.06	$2.46 \times 10^{-5}$
CBH-12	4076.15	5558.03	$7.22 \times 10^{-3}$
CBH-13	4142.78	5498.04	$6.56 \times 10^{-3}$
CBH-14	4053.55	5415.37	$7.29 \times 10^{-3}$

## PERMEABILITY RESULTS FOR CHECK DAM

<u>Marking</u>	<u>Location</u>		<u>Permeability</u> cm/sec.
	North	East	
CBH-15	4084.91	5293.20	$6.11 \times 10^{-3}$
CBH-16	4061.18	5191.77	$6.46 \times 10^{-3}$
CBH-17	4190.83	5162.93	$6.72 \times 10^{-3}$
CBH-18	4148.23	4997.24	$7.24 \times 10^{-3}$
CBH-19	4230.64	4955.97	$6.55 \times 10^{-3}$
CBH-20	4020.78	4963.59	$6.59 \times 10^{-3}$
CBH-21	4121.65	4756.48	$7.77 \times 10^{-3}$
CBH-22	4212.76	4710.73	$3.14 \times 10^{-3}$
CBH-23	4306.58	4587.77	$5.6 \times 10^{-3}$
CBH-24	4176.25	4440.34	$6.2 \times 10^{-3}$
CBH-25	4851.46	5753.90	$6.50 \times 10^{-4}$
CBH-26	4738.22	5490.34	$4.56 \times 10^{-3}$
BCH-27	4461.38	5809.59	$5.05 \times 10^{-3}$
CBH-28	4003.16	5470.44	$5.80 \times 10^{-3}$

## ROCK DATA

<u>BOREHOLE NO.</u>	<u>DEPTH</u> <u>mt.</u>	<u>CORE RECOVERY</u> <u>%</u>	<u>RQD</u> <u>%</u>
BH-1	1.80 mt. to 5.00 mt	23.00	10.00
	--	34.00	25.00
	5.00 mt. to 10.00mt.	41.00	26.00
		38.00	24.00
		40.00	29.00
		41.00	25.00
BH-2	1.70 mt. to 5.30 mt	22.00	14.00
	--	34.00	25.00
	5.30 mt. to 10.00mt.	44.00	32.00
		36.00	25.00
		42.00	27.00
		42.00	28.00
BH-3	6.20 mt. to 10.00 mt.	14.00	--
		12.00	--
		10.00	--
BH-4	6.80mt. to 10.00 mt.	8.00	--
		15.00	--
BH-5	6.30mt. to 10.00 mt.	15.00	--
		12.00	--
		11.00	--
BH-6	1.80 mt. to 5.60 mt	24.00	16.00
	--	36.00	28.00
	5.60 mt. to 10.00mt	34.00	25.00
		39.00	29.00
		46.00	35.00
BH-7	1.80 mt. to 5.60 mt	22.00	14.00
	--	35.00	28.00
	5.60 mt. to 10.00mt..	32.00	24.00
		35.00	25.00
		42.00	29.00



**TRIAL PIT PROFILE :**

The trial pit data reveal the soil formation as under.

**TP-1 ( North : 5054.04 East : 5535.68)**

The first layer from 0.00 mt. to 2.00 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-2 ( North : 4913.86 East : 5645.63)**

The first layer from 0.00 mt. to 1.50 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and little kankkars.

**TP-3 ( North : 4723.56 East : 5750.92)**

The first layer from 0.00 mt. to 1.50 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-4 ( North : 4702.89 East : 5569.47)**

The first layer from 0.00 mt. to 1.70 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-5 ( North : 4587.55 East : 5772.08 )**

The first layer from 0.00 mt. to 1.80 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-6 ( North : 4579.74 East : 5674.95 )**

The first layer from 0.00 mt. to 2.00 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-7 ( North : 4527.01 East : 5559.64 )**

The first layer from 0.00 mt. to 1.00 mt. is made up of Brownish Red gravels mixed with medium to fine grained non plastic silty sand.

**TP-8 ( North : 4419.98 East : 5719.96)**

The first layer from 0.00 mt. to 1.30 mt. is made up of Brownish Red gravels mixed with medium to fine grained non plastic silty sand.

**TP-9 ( North : 4424.34 East : 5855.75)**

The first layer from 0.00 mt. to 1.10 mt. is made up of Brownish Red mixture of gravels and medium to fine grained non plastic silty sand.

**TP-10 ( North : 4184.86 East : 5783.46)**

The first layer from 0.00 mt. to 0.50 mt. is made up of Brownish Red gravels mixed with medium to fine grained non plastic silty sand.

**TP-11 ( North : 4039.16 East : 5744.06)**

The first layer from 0.00 mt. to 1.70 mt. is made up of Brownish Red gravels mixed with medium to fine grained non plastic silty sand.

**TP-12 ( North : 4076.15 East : 5558.03 )**

The first layer from 0.00 mt. to 1.40 mt. is made up of Brownish Red mixture of gravels and medium to fine grained non plastic silty sand.

**TP- 13 ( North : 4142.78 East : 5498.04 )**

The first layer from 0.00 mt. to 0.50 mt. is made up of Brownish Red medium to fine grained non plastic silty sand mixed with kankars.

**TP- 14 ( North : 4053.55 East : 5415.37 )**

The first layer from 0.00 mt. to 1.30 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankars.

**TP- 15 ( North : 4084.91 East : 5293.20)**

The first layer from 0.00 mt. to 1.40 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 16 ( North : 4061.18 East : 5191.77)**

The first layer from 0.00 mt. to 1.45 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-17 ( North : 4190.83 East : 5162.93 )**

The first layer from 0.00 mt. to 1.50 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-18 ( North : 4148.23 East : 4997.24)**

The first layer from 0.00 mt. to 0.50 mt. is made up of Brownish Red gravels mixed with medium to fine grained non plastic silty sand.

**TP-19 ( North : 4230.64 East : 4955.97 )**

The first layer from 0.00 mt. to 1.50 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 20 ( North : 4020.78 East : 4963.59 )**

The first layer from 0.00 mt. to 1.50 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 21 ( North : 4121.65 East : 4756.48 )**

The first layer from 0.00 mt. to 2.00 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 22 ( North : 4212.76 East : 4710.73)**

The first layer from 0.00 mt. to 1.70 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 23 ( North : 4306.58 East : 4587.77)**

The first layer from 0.00 mt. to 1.70 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-24 ( North : 4176.25 East : 4440.34 )**

The first layer from 0.00 mt. to 1.90 mt. is made up of Brownish Red medium to fine grained non plastic silty sand mixed with kankkars.

**TP-25 ( North : 4851.46 East : 5753.90)**

The first layer from 0.00 mt. to 1.80 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP-26 ( North : 4738.22 East : 5490.34)**

The first layer from 0.00 mt. to 1.90 mt. is made up of Brownish Red medium to fine grained silty sand mixed with clay particles of low plasticity and kankkars.

**TP- 27 ( North : 4461.38 East : 5809.59 )**

The first layer from 0.00 mt. to 1.80 mt. is made up of Brownish Red medium to fine grained non plastic silty sand mixed with kankkars.

**TP- 28 ( North : 4003.16 East : 5470.44 )**

The first layer from 0.00 mt. to 1.80 mt. is made up of Brownish Red medium to fine grained non plastic silty sand mixed with kankkars.

**NOTATIONS**

f	Angle of friction
qd	Net ultimate bearing capacity
DS	Disturbed Sample
UDS	Undisturbed sample
DU	Direct Shear Undrained Test
NP	Non Plastic
LL	Liquid Limit
PL	Plastic Limit
N	SPT Value
BH	Bore Hole
C	Cohesion
g	Bulk density
B	Width of Footing in mt.
Nc, Nq & Ng	Bearing Capacity Factors
Sc, Sq & Sg	Shape Factors.
dc, dq & dg	Depth Factors.
ic, iq & ig	Inclination Factors.
w'	Correction factor for water table.
SC	Clayey Sand
SM	Silty sand
SW	Well graded sand
SP	Poorly graded sand
CH	Clay of high plasticity
CI	Clay of Intermediate plasticity
CL	Clay of Low plasticity
MH	Silt of high plasticity
MI	Silt of Intermediate plasticity
MH	Silt of low plasticity

**GENERAL REFERENCES**

Indian Standards	IS 2720 Part -II, Part -III, Part -IV, Part -V, Part -XIII Part -XXXI, IS - 1948, IS - 1904, IS:6409-1981 IS : 6403-1971 IS 456-2000, IS 2720(Part IV & V)-1985. IS 9259-1979 & 11196-1985, IS-11229-1985.
Alam Singh	Modern Geotechnical Engineering.
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Kaniraj S. R.	Design Aids in Soil Mechanics and Foundation Engineering.
Lambe T. W.	Soil Testing for Engineers.
Murthy V. N. S.	Soil Mechanics and Foundation Engineering.
Nayak N. V.	Foundation Engineering Manual.
Peck, R. S. Hanson W. E.	Foundation Engineering.

**NAME OF SITE :** Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO. :** 1

Location : ( North : 4935.74 East : 5698.83)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS	
					(M)		5	15	25	35	45					
Rotary Drilling	----- Nil -----	100 mm.	1.80 mt	1		Greyish Brownish medium to fine grained non plastic silty sand mixed with kankkars.							*	Not Encountered	N = 33	
			3.20 mt	3		Brownish highly over consolidated silty Sand giving the effect of sandstone.						*	CR = 23.0 % RQD = 10.0%			
			5.00 mt	5		Moderately weathered highly over consolidated sandstone.										CR = 34.0% RQD = 25.0%
				7			CR = 41.0 % RQD = 26.0%									
				9			CR = 38.0 % RQD = 24.0%									
				10			CR = 40.0 % RQD = 29.0% CR = 41.0.0 % RQD = 25.0%									
	11											Bore terminated				
	13															
	15															

**ANANDJIWALA TECHNICAL CONSULTANCY**

9, Shivranjani Shopping Centre, 132' Ring Road, Sattelite, Ahmedabad -15 Tel : 26762598, 9426703481

**NAME OF SITE :** Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO. :** 2

Location : ( North : 4619.75 East : 5585.91)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS
							5	15	25	35	45				
Rotary Drilling	----- Nil -----	100 mm.	1.70 mt	1		Greyish Brownish medium to fine grained non plastic silty sand mixed with kankkars.							*	Not Encountered	N = 33
			3.60 mt	3		Brownish highly over consolidated silty sand giving the effect of sandstone.						*	*		
				4.70 mt	5	Moderately weathered highly over consolidated sandstone.							*		CR = 34.0% RQD = 25.0%
			7										CR = 44.0 % RQD = 32.0%		
			9										CR = 36.0 % RQD = 25.0%		
			10										CR = 42.0 % RQD = 27.0% CR = 42.0.0 % RQD = 28.0%		
11											Bore terminated				
				13											
				15											

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**NAME OF SITE** : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO.** : 3

Location : ( North : 4443.27 East : 5632.20)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS	
					(M)		5	15	25	35	45					
Rotary Drilling	----- Nil -----	100 mm.	0.60 m	0		Reddish poorly graded fine sand.(SP)								*	Not Encountered	CR = 14.0 % CR = 12.0 % CR = 10.0 % Bore terminated
			5.60 mt	1		Highly weathered disintegrated rock pieces.										
				3												
				5												
				7												
3.80 mt	7		Moderately weathered highly over consolidated sandstone.								*					
	9											*				
	10											*				
	11															
	13															
	15															

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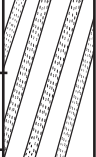
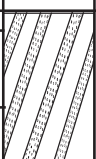
**NAME OF SITE :** Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO. :** 4

Location : ( North : 4355.77 East : 5862.75)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS
							5	15	25	35	45				
Rotary Drilling	Nil	100 mm.	2.20 mt	1		Reddish medium to fine grained non plastic silty sand Mixed with clay of low plasticity and kankkars.(SC)							*	Not Encountered	N = >75
			1.50 mt	3		Greyish rounded boulders							*		
			2.10 mt	5		Reddish medium to fine grained non plastic silty sand Mixed with clay of low plasticity and kankkars.(SC)						*			
			1.0 mt	7		Highly weathered highly consolidated sandstone.									
			3.20 mt	9		Moderately Weathered highly over consolidated sandstone.									
				10											
				11										Bore terminated	
				13											
				15											

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**NAME OF SITE** : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO.** : 5

Location : ( North : 4296.17 East : 5196.93)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS										
							5	15	25	35	45														
Rotary Drilling	----- Nil -----	100 mm.	0.70 mt	1	Reddish poorly graded fine sand.(SP)							*	Not Encountered	CR = 15.0 % CR = 12.0 % CR = 11.0 % Bore terminated											
			5.60 mt	3	Highly weathered disintegrated rock pieces.																				
				5																					
				7																					
			3.70 mt	9	Moderately weathered highly over consolidated sand stone.											*									
				10											*										
				11											*										
																		13							
																		15							

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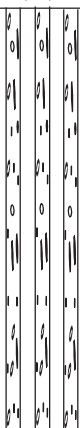
**NAME OF SITE :** Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO. :** 6

Location : ( North : 4181.22 East : 4813.13)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS
							5	15	25	35	45				
Rotary Drilling	Nil	100 mm.	1.80 mt	1		Reddish Brown medium to fine grained non plastic silty sand mixed with kankkars.							*	Not Encountered	N = 32
			3.80 mt	3 5		Brownish highly over consolidated silty Sand giving the effect of sandstone.						*	*		
			4.40 mt	7 9 10	Moderately weathered highly over consolidated sandstone.								CR = 36.0% RQD = 28.0%		
													CR = 34.0 % RQD = 25.0%		
													CR = 39.0 % RQD = 29.0%		
				11 13 15										CR = 46.0.0 % RQD = 35.0%	
														Bore terminated	

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**NAME OF SITE :** Smritivan Project at Bhuj for Gujarat State Disaster Management Authority

**EXPLORATION BORE HOLE NO. :** 7

Location : ( North : 4364.68 East : 4737.15)

Water Table : Not Encountered

**BORE LOG**

Method of boring	Casings	Bore diameter	Thickness of layer	Depth (meter)	SOIL	VISUAL SOIL DESCRIPTION	PENETRATION TEST N - VALUES					Undisturbed Sample	Disturbed Sample	Water Table	REMARKS
					(M)		5	15	25	35	45				
Rotary Drilling	----- Nil -----	100 mm.	1.70 mt	1		Reddish Brown medium to fine grained non plastic silty sand mixed with kankkars.							*		N = 32
			3.50 mt	3		Brownish highly over consolidated silty Sand giving the effect of sandstone.								*	
				5									*		CR = 35.0% RQD = 28.0%
				7	Moderately weathered highly over consolidated sandstone.										
			9												CR = 35.0 % RQD = 25.0%
10													CR = 42.0.0 % RQD = 29.0%		
			11												Bore terminated
				13											
				15											

**ANANDJIWALA TECHNICAL CONSULTANCY**

9, Shivranjani Shopping Centre, 132' Ring Road, Sattelite, Ahmedabad -15 Tel : 26762598, 9426703481

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority									TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1				
		Location : ( North : 4935.74 East : 5698.83)									WATER TABLE : Not Encountered			BH. NO. : BH - 1				
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	--	--	10	80	---10--	--	NP	--	SM	--	--	--	--	--	--	--
2	1.50	SPT	33	--	11	84	---5----	--	NP	--	SM	--	--	--	--	--	--	--
3	3.00	UDS	--	2.60	12	79	---9----	--	NP	--	SM	1.82	5.8	DS	0.0	30°36'	--	--
4	4.50	DS	--	--	22	72	---6----	--	NP	--	SM	--	--	--	--	--	--	--
5	6.00																	
6	7.50																	
7	9.00																	
8	10.00																	

Moderately weathered highly consolidated sandstone.

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority										TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1			
		Location : ( North : 4619.75 East : 5585.91)										WATER TABLE : Not Encountered			BH. NO. : BH - 2			
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	--	--	11	81	--8--	--	NP	--	SM	--	--	--	--	--	--	--
2	1.50	SPT	33	--	12	82	--6---	--	NP	--	SM	--	--	--	--	--	--	--
3	3.00	UDS	--	2.60	22	73	---5---	--	NP	--	SM	1.83	5.5	DS	0.0	30°00'	--	--
4	4.50	DS	--	--	22	72	---6---	--	NP	--	SM	--	--	--	--	--	--	--
5	6.00																	
6	7.50																	
7	9.00																	
8	10.00																	

Moderately weathered highly consolidated sandstone.

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority										TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1			
		Location : ( North : 4443.27 East : 5632.20)										WATER TABLE : Not Encountered			BH. NO. : BH - 3			
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	-	-	14	80	-6-	-	NP	-	SP	-	-	-	-	-	-	-
2	1.50																	
3	3.00																	
4	4.50																	
5	6.00																	
6	7.50	DS	-	-	24	68	-8-	-	NP	-	SM	-	-	-	-	-	-	-
7	9.00	DS	-	-	24	70	-6-	-	NP	-	SM	-	-	-	-	-	-	-
8	10.00	DS	-	-	25	66	-9-	-	NP	-	SM	-	-	-	-	-	-	-

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples



# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority									TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1				
		Location : ( North : 4355.77 East : 5862.75)									WATER TABLE : Not Encountered			BH. NO. : BH - 4				
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	-	-	11	63	--26--	28	21	7	SC	-	-	-	-	-	-	-
2	1.50	SPT	> 75	-	12	65	---23---	27	20	7	SC	---	-	-	-	-	-	-
3	3.00	--	-	-	Rounded boulders													
4	4.50	UDS	-	2.61	12	63	----25----	31	22	9	SC	1.84	5.5	DS	0.0	30°00'	-	-
5	6.00																	
6	7.50				Moderately to highly weathered highly over consolidated sandstone.													
7	9.00																	
8	10.00																	

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority									TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1				
		Location : ( North : 4296.17 East : 5196.93)									WATER TABLE : Not Encountered			BH. NO. : BH - 5				
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	--	--	10	74	--16--	--	NP	--	SP	--	--	--	--	--	--	--
2	1.50																	
3	3.00				Highly weathered disintegrated rock pieces..													
4	4.50																	
5	6.00																	
6	7.50	DS	--	--	22	65	---13---	--	NP	--	SM	--	--	--	--	--	--	--
7	9.00	DS	--	--	25	68	----7----	--	NP	--	SM	--	--	--	--	--	--	--
8	10.00	DS	--	--	26	62	----12----	--	NP	--	SM	--	--	--	--	--	--	--

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority									TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1				
		Location : ( North : 4181.22 East : 4813.13 )									WATER TABLE : Not Encountered			BH. NO. : BH - 6				
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	--	--	11	84	--5--	--	NP	--	SM	--	--	--	--	--	--	--
2	1.50	SPT	32	--	14	81	---5---	--	NP	--	SM	---	--	--	--	--	--	--
3	3.00	UDS	--	2.61	14	79	----7----	--	NP	--	SM	1.83	5.1	DS	0.0	30°00'	--	--
4	4.50	DS	--	--	15	77	---8---	--	NP	--	SM	--	--	--	--	--	--	--
5	6.00																	
6	7.50																	
7	9.00																	
8	10.00																	

Moderately weathered highly consolidated sandstone.

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

# ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD

SOIL PROFILE		PROJECT : Smritivan Project at Bhuj for Gujarat State Disaster Management Authority										TERMINATION DEPTH : 10.00 mt			TABLE NO. : 1			
		Location : ( North : 4364.68 East : 4737.15 )										WATER TABLE : Not Encountered			BH. NO. : BH - 7			
Sr. No.	Depth in Mtrs. from G.L.	SAMPLES	SPT Value 'N'	Specific Gravity G	GRAIN SIZE ANALYSIS			ATTERBERG'S LIMITS			IS Classification	FD gm/cc.	MC %	SHEAR PARAMETERS			CONSOLIDATION	
					Gravel %	Sand %	Silt + Clay %	LL %	PL %	PI %				Type	C Kg/cm <sup>2</sup>	φ	cc	eo
1	0.00	DS	--	--	9	88	--3--	--	NP	--	SM	--	--	--	--	--	--	--
2	1.50	SPT	32	--	13	79	--8---	--	NP	--	SM	---	--	--	--	--	--	--
3	3.00	UDS	--	2.60	13	81	---6---	--	NP	--	SM	1.83	5.4	DS	0.0	30 <sup>0</sup> 36'	--	--
4	4.50	DS			15	80	--5---	--	NP	--	SM	--	--	--	--	--	--	--
5	6.00																	
6	7.50																	
7	9.00																	
8	10.00																	

Moderately weathered highly consolidated sandstone.

Remark : φ Values are taken from graph of relationship between φ and N-values from IS 6403:1981 in absence of UDS samples

**Grain Size Analysis**

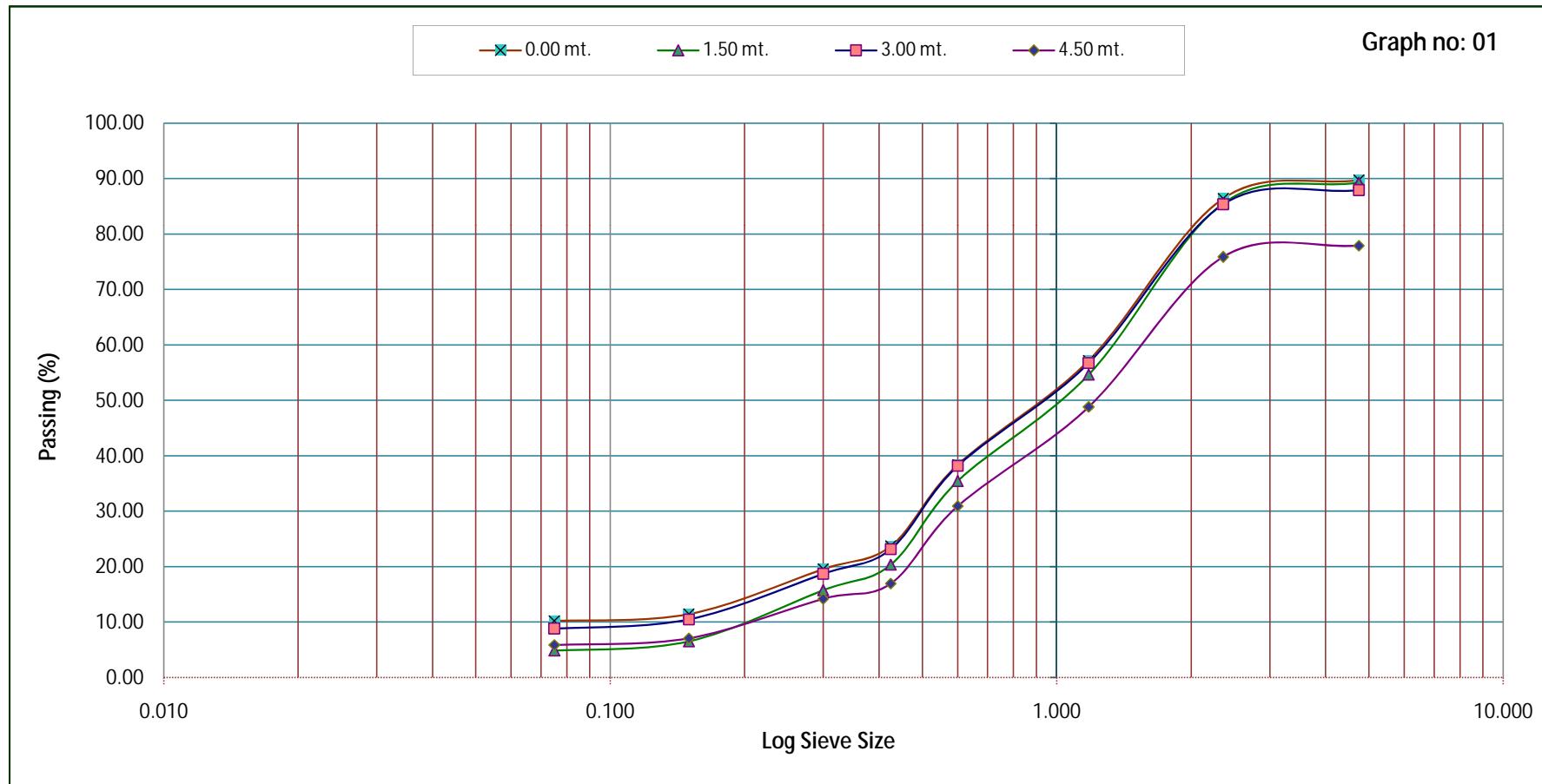
**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

\* 5.00 mt to 10.00 mt. Moderately weathered Highly consolidated Sandstone.

**Location :** North : 4935.74 East : 5698.83

**BORE NO. :** BH-1

**DEPTH :** 10.00 mt.



**Grain Size Analysis**

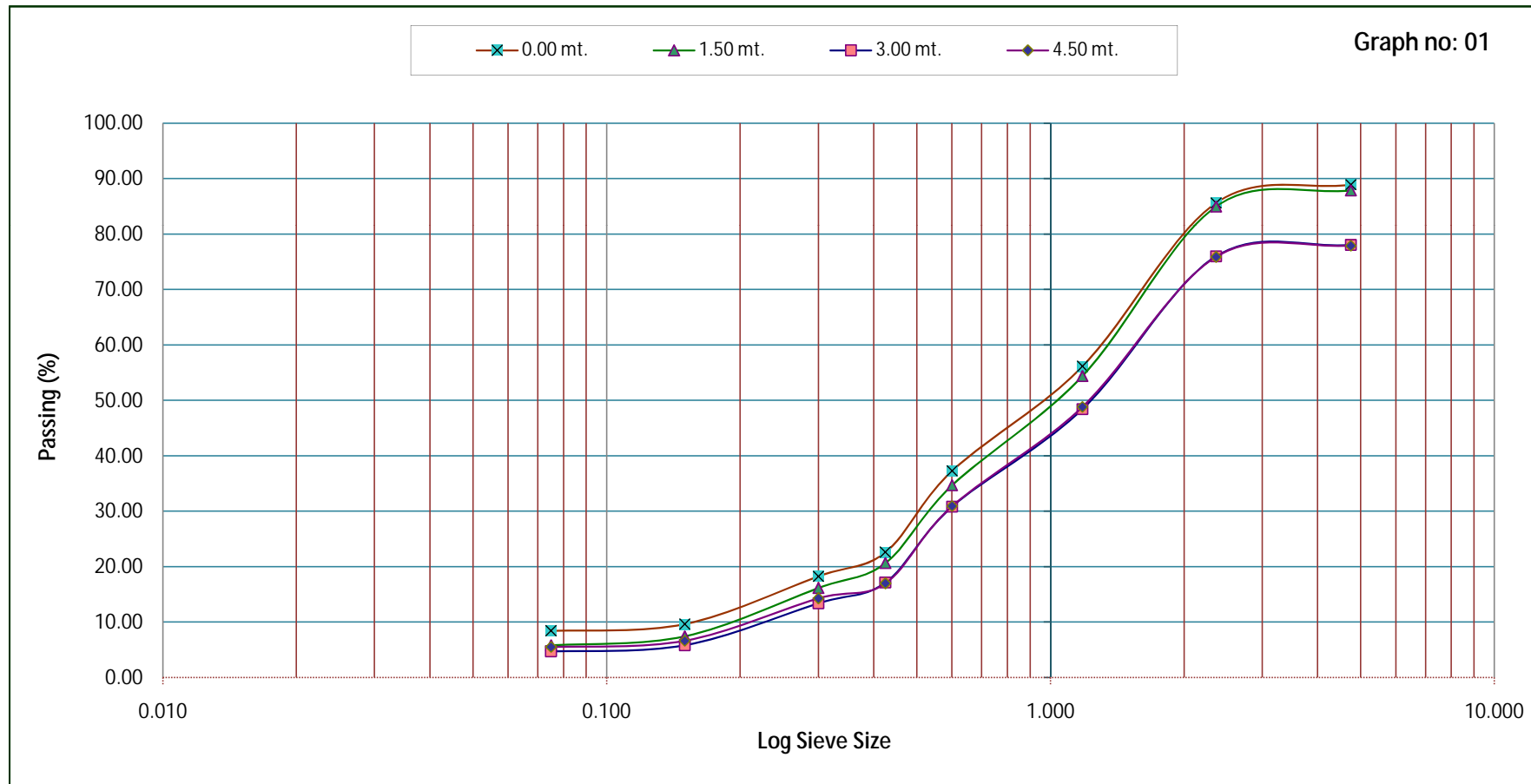
**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

\* 5.30 mt.to 10.00 mt. Moderately weathered Highly consolidated Sandstone.

**Location :** North : 4619.75 East : 5585.91

**BORE NO. :** BH-2

**DEPTH :** 10.00 mt.



**Grain Size Analysis**

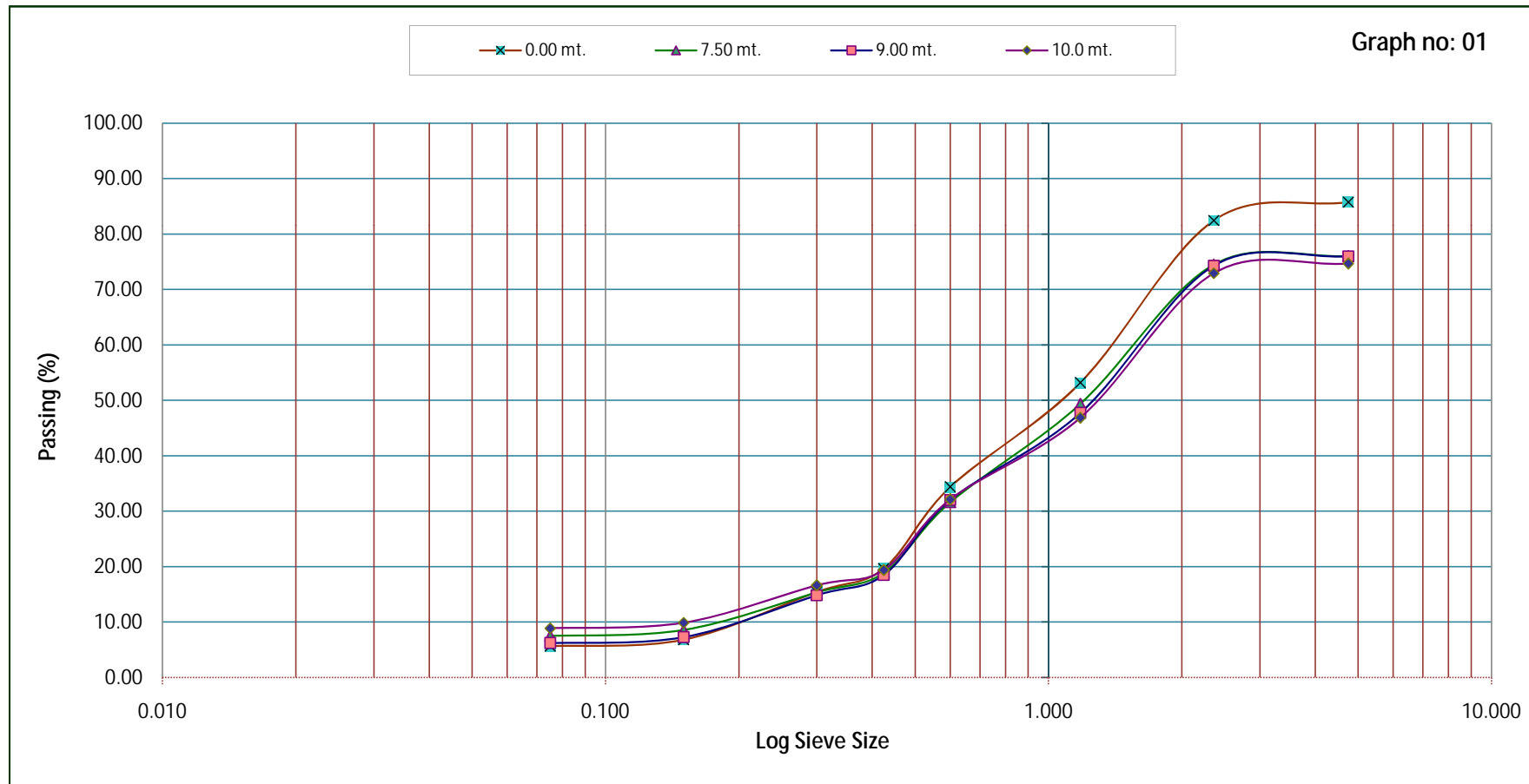
**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

\* 0.60 mt. to 6.20 mt. highly weathered disintegrated rock pieces.

**Location :** North : 4443.27 East : 5632.20

**BORE NO. :** BH-3

**DEPTH :** 10.00 mt.



**Grain Size Analysis**

**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

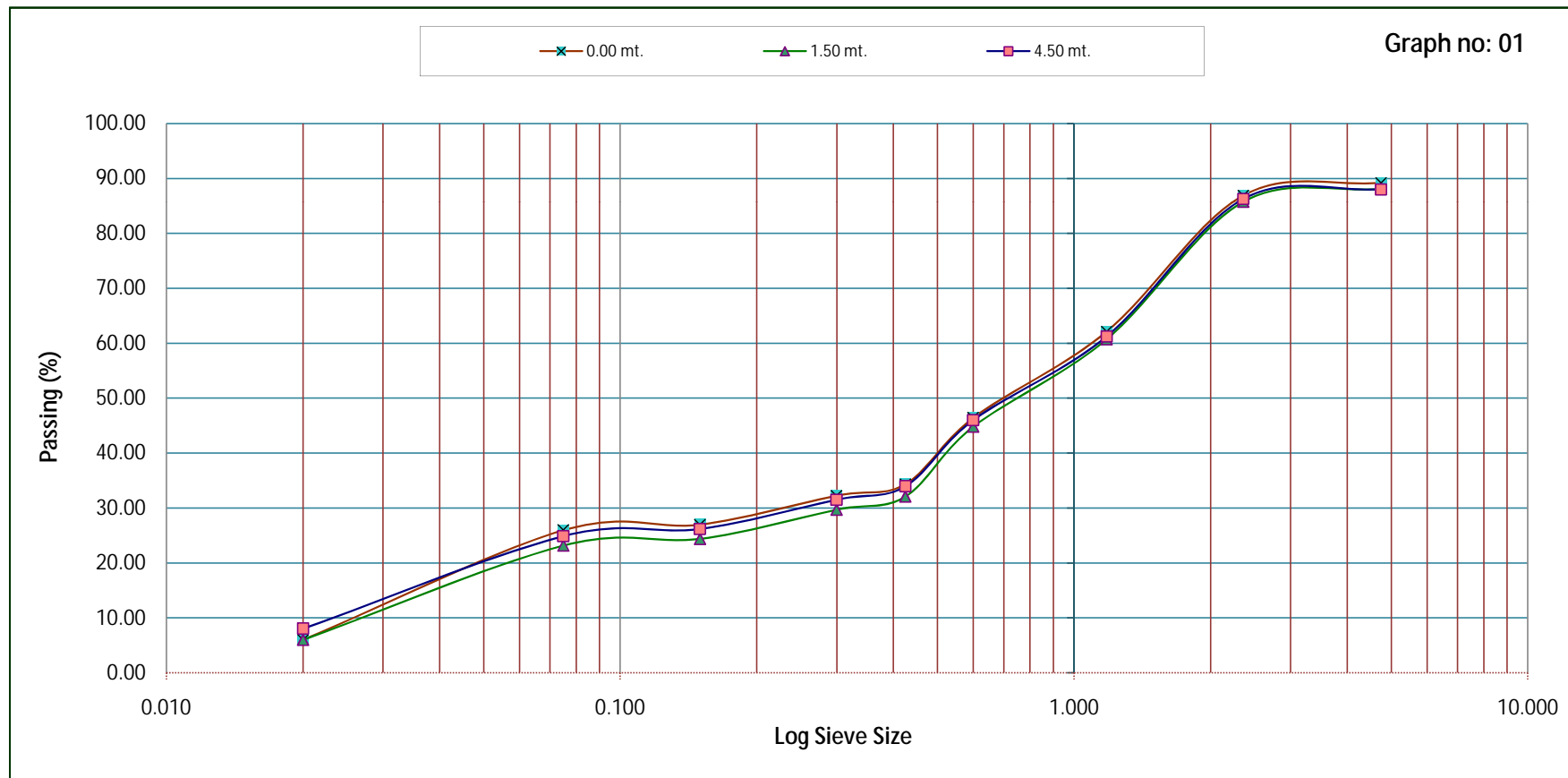
\* 2.20 mt. to 3.70 mt. rounded bulders.

\* 5.80 mt. to 10.00 mt. moderately to highly weathered highly over consolidated sand stone.

Location : North : 4355.77 East : 5862.75

**BORE NO. :** BH-4

**DEPTH :** 10.00 mt.





**Grain Size Analysis**

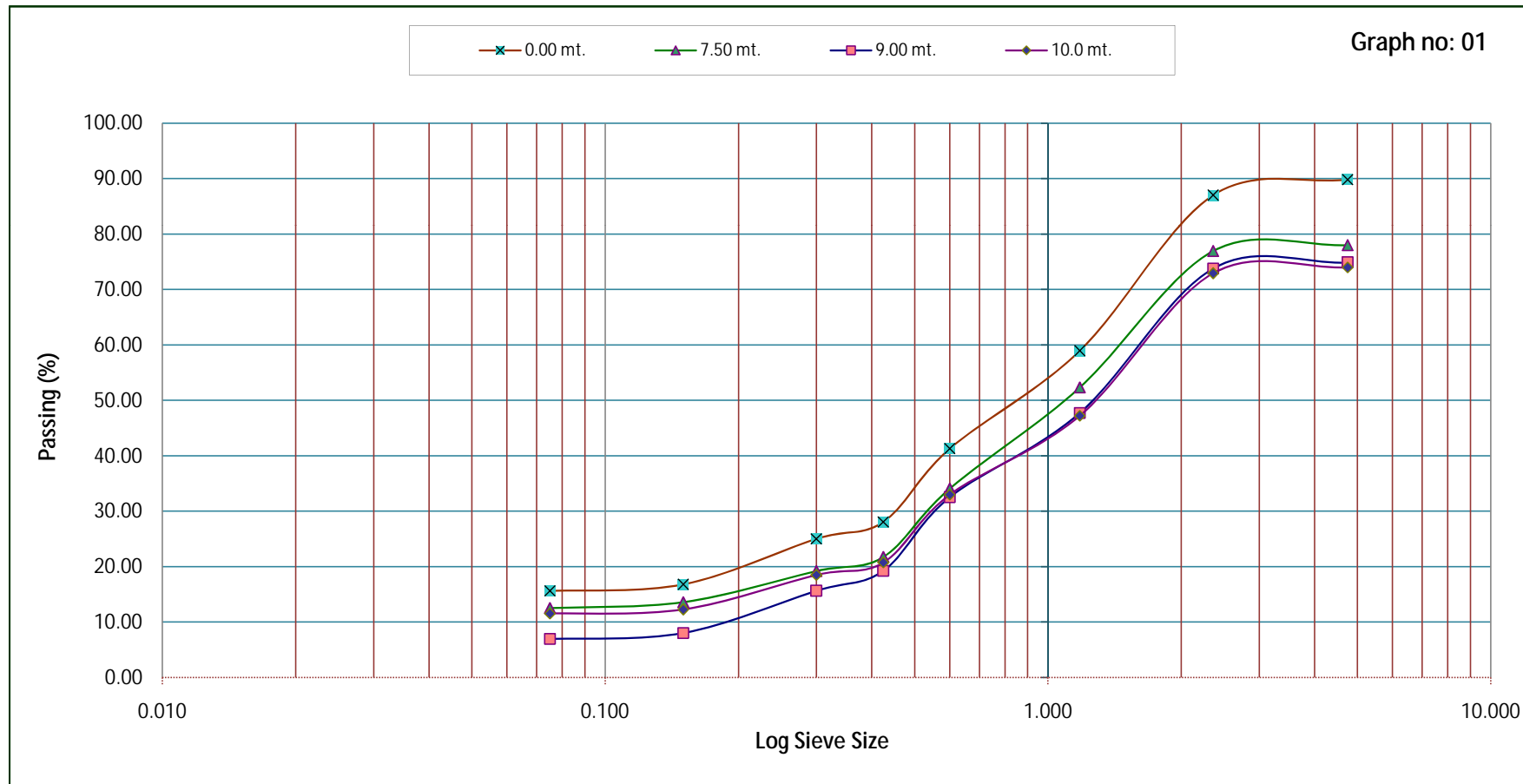
**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

\* 0.70 mt. to 6.30 mt. highly weathered disintegrated rock pieces.

**Location :** North : 4296.17 East : 5196.93

**BORE NO. :** BH-5

**DEPTH :** 10.00 mt.



**Grain Size Analysis**

**PROJECT :** Smritivan Project at Bhuj Gujarat State Disaster Management Authority.

\* 5.60 mt to 10.00 mt. Moderately weathered Highly consolidated Sandstone.

**Location :** North : 4181.22 East : 4813.13

**BORE NO. :** BH-6

**DEPTH :** 10.00 mt.

