

REPORT ON

**SUB-SURFACE SOIL INVESTIGATION
FOR PROPOSED**

LEARNING CENTRE BUILDING

OF

STATE BANK OF INDIA

AT

Central Zone, Mahatma Gandhi Road, City Centre,

Durgapur,

Dist.- Burdwan, West Bengal

**Report Submitted to: Ghosh, Bose & Associates Pvt. Ltd.
8, Ho Chi Minh Sarani, KOLKATA - 700071**



Report Submitted by:

GEOTECHNICAL ENGINEERS CONSORTIUM

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NOVEMBER, 2010

JOB No.2101101



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Specialised in : **Soil & Rock Investigation, Structural & Foundation Design.**

Ref. No.: ST/RPT/21011001/2

Date : 20th NOVEMBER, 2010

To :

Chief Manager (Civil),
State Bank of India,
Local Head Office,
Kolkata-700001

Submitted through :

Ghosh, Bose & Associates Pvt. Ltd.,
8, Harrington Mansion,
8, Ho Chi Minh Sarani,
Kolkata -700 071

Subject : Submission of **Plate Load Test report** related to **Geotechnical Investigation Work** for proposed **Learning Centre of State Bank of India at City Centre, Durgapur, Dist.-Burdwan, West Bengal.**

Ref. : Project Consultants Letter no.- GBPL/566/317/2010 dt. 09/09/2010

Dear Sir,

We are submitting the complete report in 6 (Six) no. of hard copies as per specifications and requirements of your project for Boring Works with all our observations and recommendations. If you need any further assistance related to the report, please feel free to knock us.

With Thanks,

For GEOTECHNICAL ENGINEERS CONSORTIUM

(MANASIJ DUTTA)

M.E., B.C.E.

C.E., MIGS

— Geotechnical Engineer



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Specialised in : **Soil & Rock Investigation, Structural & Foundation Design.**

Ref. No.: ST/RPT/21011001/1

Date : 9th NOVEMBER, 2010

To :

Chief Manager (Civil),
State Bank of India,
Local Head Office,
Kolkata-700001

Submitted through :

Ghosh, Bose & Associates Pvt. Ltd.,
8, Harrington Mansion,
8, Ho Chi Minh Sarani,
Kolkata -700 071

Subject : Submission of **Geotechnical Investigation Report** for proposed **Learning Centre of State Bank of India at City Centr, Durgapur, Dist.-Burdwan, West Bengal.**

Ref. : Project Consultants Letter no.- GBPL/566/317/2010 dt. 09/09/2010

Dear Sir,

We are submitting the complete report in 6 (Six) no. of hard copies as per specifications and requirements of your project for Boring Works with all our observations and recommendations. If you need any further assistance related to the report, please feel free to knock us. Plate Load Test report will be submitted to you within next 10 days.

With Thanks,

For GEOTECHNICAL ENGINEERS CONSORTIUM

Manasij Dutta

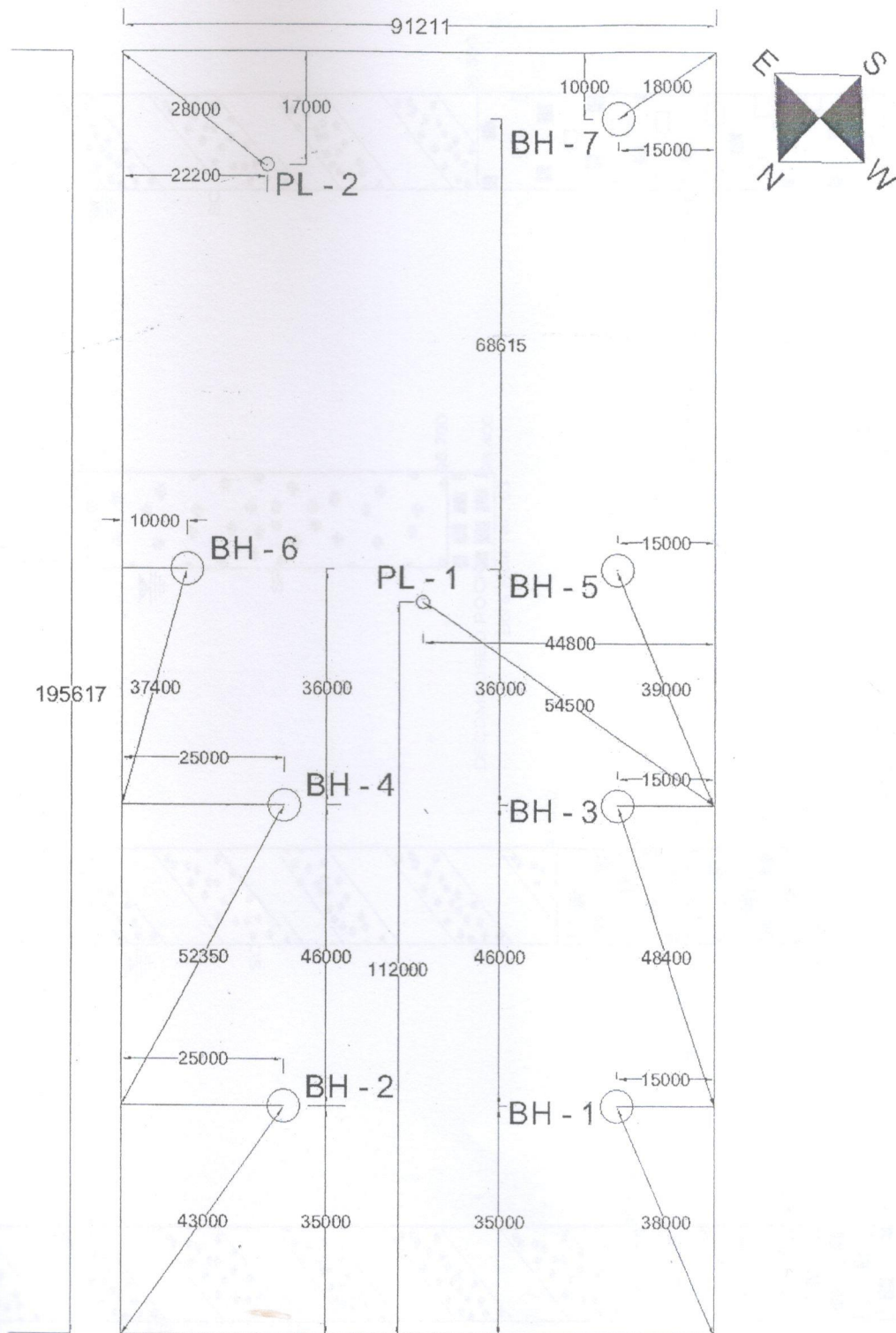
(MANASIJ DUTTA)

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— Geotechnical Engineer

BOREHOLE LOCATION PLAN



**Project: Proposed construction of Learning Centre of State Bank of India at
City Centre, Durgapur, Dist.- Burdwan, West Bengal.**

1. PROJECT DETAILS, OBJECT & SCOPE OF INVESTIGATION

Proposed project is construction of Learning Centr for State Bank of India at Mahatma Gandhi Road, Central Zone,, Durgapur, Dist.- Burdwan, West Bengal.

For design and construction of foundation of the above project, Geotechnical Investigation was required. Project Consultant M/S. Ghosh, Bose & Associates Pvt. Ltd., 8 Ho Chi Minh Sarani, Kolkata-700071 awarded this job to Geotechnical Engineers Consortium, 52C/1A/1, Babu Bagan Lane, Dhakuria, Kolkata-700031.

The purpose of this investigation work is to collect the information of the sub-surface geological deposition within the maximum depth of probable soil-structure interaction for all type of foundation (shallow or deep) and its corresponding engineering parameters. These information will guide to decide type of foundation, its depth, sizes, and their corresponding Allowable Bearing Capacities which are absolutely related to the stability, serviceability and economy of the structure. Precisely, the Allowable Bearing Capacities are to be found for all type of foundation at economic depth below the average ground level. In order to fulfil the above-mentioned object, the entire investigation programme has been selected as follow.

Sinking of 7 nos. Borehole at different predetermined locations each of dia 150mm for boring and Drilling of NX size core .

Collection of representative disturbed and undisturbed soil samples from each exploratory boreholes at suitable intervals for visual identification and laboratory tests.

Carry out of Standard Penetration Test in the boreholes as per the provisions laid down in relevant IS Code of Practices.

Measurement of Ground Water Table after completion of boring / drilling works. After the completion of all above mentioned field works including sample collections, laboratory tests were to conduct on representative soil and rock samples to find out Engineering parameters related to design of foundations. Following laboratory tests were to conduct on the

undisturbed soil samples.

For Soil: -

- a) Natural Moisture Content.
- b) Atterberg Limits on cohesive / semi cohesive samples.
- c) Bulk Density and Dry Density.
- d) Unconfined / Tri-axial Compression Tests.
- e) Direct Box Shear Test on cohesion less soil.
- f) Specific Gravity.
- g) Oedometer (Consolidation) Tests.
- h) Swelling Potential Index and Pressure if required.

For Soil and Water Sample: -

Chemical analysis for Chloride, Sulphates and pH as per specification.

All the field and laboratory test results were to present in proper tabular form with this report.

From field and laboratory activities, complete formation to be understood with Geo-technical Engineering view and guidelines for foundation design and construction methodology to be reported.

2. PROGRAMME AND EXECUTION OF FIELD INVESTIGATION

(i) BORING AND SAMPLING

To get an overall about the whole site, the depths of boreholes are chosen so that the choice of any type foundation design can be fulfilled. All boreholes are sunk as per the provisions laid in code of IS: 1982-1979. The boring has been done by wash boring technique after encountering the water level. Before that, shell and auger boring technique has been adopted. Minimum depth interval maintained between successive SPT and collection of UD samples is 1.5 metre. During the execution of field works, representative soil samples were from the exploratory boreholes. Soil samples collected were of two categories viz. Disturbed and undisturbed. Disturbed soil samples were those in which the natural structure of the soil grains are modified and those samples were collected from the cutting shoe of the tube sampler after conducting SP Test. These disturbed soil were utilised for the visual

identification and classification of the sub-soil depositions.

Representative undisturbed soils from the exploratory boreholes at desired depth are collected with the help of a thin walled mild steel sampler of 100mm diameter and 450mm length. The attachments have been designed so as to conform the specifications provided in IS: 2331-1972. After collecting sample tube from the borehole, molten wax was poured each side of the tube in layers each of thickness 25mm and then the samples were transported to the laboratory for conducting the tests to identify the engineering properties of the soil.

(ii) STANDARD PENETRATION TEST

Standard Penetration Tests were conducted inside the boreholes as per the provisions laid down in IS : 2131-1981. The sampler, known as Split Spoon Sampler is of standard size as mentioned in the code. The split spoon sampler (length 600mm, O. D. 50mm and I. D. 35mm) was advanced by driving with a hammer weighing 63.5kg falling freely a height of 750mm. The split spoon sampler was attached in all tests at the bottom of the drill rod taken to be specific depth of test.

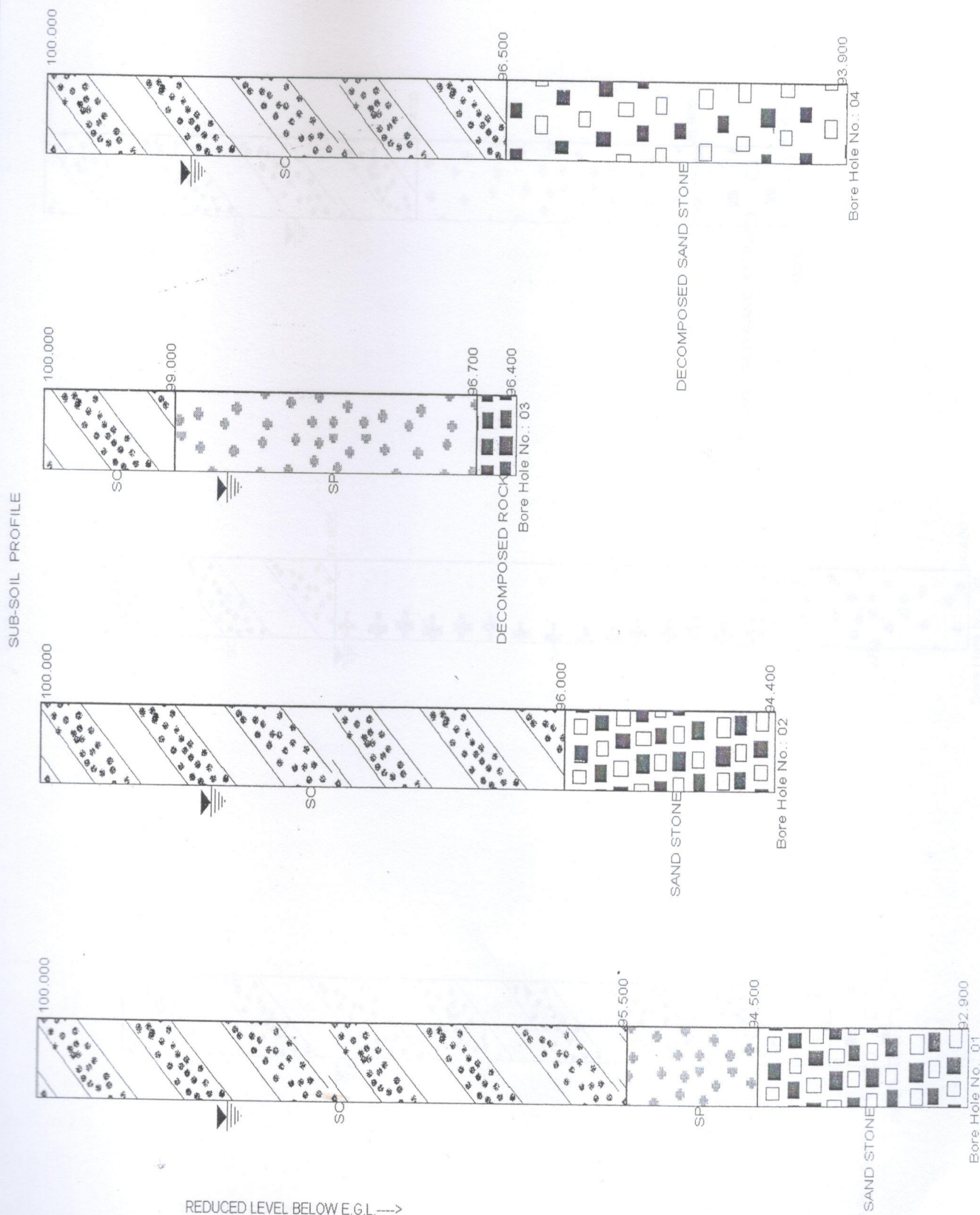
A record of number of blows was maintained from penetration of 600mm depth. The number of blows required for the penetration of mid 300mm is considered as the recorded 'N'-value of soil at that depth. The soil removed from the sampler is considered as 'Disturbed samples'.

In the data section of the report SP Test results are given corresponding to the depth for different boreholes and plotted curves are also attached.

(iii) GROUND WATER OBSERVATION

Ground Water observation in each borehole were made during boring and 24-hours after completion of each borehole. The depth at which the ground water encountered first was mentioned as 'Ground Water Struck' and the water level found after 24-hours is termed as 'Ground Water Table'. Ground Water Table fluctuates with the seasonal variation of Ground Water Level depending on permeability of the soil/rock stratification. In all the boreholes of this work, Ground Water found at depth for different boreholes and those are mentioned in respective borelog. Ground Water found here is within the permissible content of Chloride, Sulphite etc. yielding normal environment to structure. Chloride and Sulphite contents are within the range of 10 to 28 mg/ltr and 3 to 36 mg/ltr respectively. pH value range is 4.9 to 5.3.

CROSS SECTIONAL PROFILE



SAMPLE CALCULATION

SBI Office at Durgapur

Foundation type : Square ; Foundation Level (metre) : (-) 1.5 ; Size (metre) : 2.0 (Size)

Failure Mode General Shear Failure ; GWT (m) : 0.0

Avg. Bulk Density of Soil above Foundation, $Mt/m^3 = 1.92$ Avg. Bulk Density of Soil below Foundation, $Mt/m^3 = 1.92$ Bulk Density of Soil Stratum below Foundation resting stratum, $Mt/m^3 = 1.93$

Thickness of foundation resting stratum below foundation = 3.0 m

Influence Depth of Shear Failure = $0.7 * 2.0 = 1.40 \text{ metr} < 3.0$

So, Bearing Capacity will be computed with single layer property

For Stratum immediate below Foundation, 6.00 Mt/m^2 and $\phi = 0^\circ$ Water Table Correction Factor, $W' = 0.50$ (Considered) ; Factor of Safety = 3.00 $N_c = 5.1 \quad N_q = 1.0 \quad N_\gamma = 0.0 \quad S_c = 1.3 \quad S_q = 1.2 \quad S_\gamma = 0.8 \quad d_c = 1.2 \quad d_q = 1.00 \quad d_\gamma = 1.0$ So, $Q_{ult_net} = 46 \text{ Mt/m}^2$ and So, $Q_{safe_net} = 15.4 \text{ Mt/m}^2$ For Stratum next to immediate below Foundation, $C = 1 \text{ Mt/m}^2$ and $\phi = 32^\circ$ Water Table Correction Factor, $W' = 0.50$ (Considered) ; Factor of Safety = 3 $N_c = 35.5 \quad N_q = 23.2 \quad N_\gamma = 30.2 \quad S_c = 1.3 \quad S_q = 1.2 \quad S_\gamma = 0.8 \quad d_c = 1.27 \quad d_q = 1.14 \quad d_\gamma = 1.14$ So, $Q_{ult_net} = 149 \text{ Mt/m}^2$ and $Q_{safe_net} = 49.8 \text{ Mt/m}^2$ So, Weighted Average $Q_{safe_net} = 15.4 \text{ Mt/m}^2$ ESTIMATION OF TOTAL SETTLEMENT POTENTIALIMMEDIATE SETTLEMENT POTENTIALFor Stratum Immediate Below Foundation $\mu = 0.5$ and $E = 2150 \text{ Mt/m}^2$

$$S_{i1} = 15 * 2.0 * \{1 - (0.5)^2\} * 0.95 / 2150 = 10 \text{ mm}$$

For Stratum Immediate Below Foundation $\mu = 0.35$ and $E = 2400 \text{ Mt/m}^2$

$$S_{i2} = 2.1 * 2.0 * \{1 - (0.4)^2\} * 0.95 / 2400 = 1 \text{ mm}$$

$$\text{So, } \Sigma S_i = S_{i1} + S_{i2} = 10 + 1 = 12 \text{ mm}$$

$$\text{So, Corrected Elastic Settlement} = 5 \text{ mm}$$



Bearing Capacity Table No - 1

Foundation Depth (D_f), metre = 1.5

SBI Office at Durgapur

Sl. No.	Foundation Type	Width / Diameter, metre	Length, metre	Safe Bearing Capacity, Mt/m^2	For Safe Bearing Capacity, Immediate Settlement, mm	For Safe Bearing Capacity, Consolidation Settlement, mm	For Allowable Bearing Capacity, Immediate Settlement, mm	For Allowable Bearing Capacity, Consolidation Settlement, mm	Allowable Bearing Capacity, Mt/m^2
1	Square footing	1.0	1.0	17.4	3	29	3	29	17.4
2		1.5	1.5	16.0	4	38	4	38	16.0
3		2.0	2.0	15.4	5	46	5	46	15.4
4		2.5	2.5	15.0	7	51	7	51	15.0
5		3.0	3.0	14.7	9	56	9	56	14.7
6		3.5	3.5	14.5	10	60	10	60	14.5
7		4.0	4.0	14.4	12	63	12	63	14.4
8		4.5	4.5	16.1	16	71	13	62	13.0
9	Rectangular Footing	1.5	3.00	13.6	4	34	4	34	13.6
10		2.0	3.0	13.4	6	42	6	42	13.4
11		2.0	4.0	13.0	6	41	6	41	13.0
12		2.5	3.75	13.0	8	47	8	47	13.0
13		2.5	5.0	12.7	8	46	8	46	12.7
14		3.0	4.50	12.8	10	51	10	51	12.8
15		3.0	6.0	12.4	9	50	9	50	12.4
16	Strip	1.0		13.7	5	24	5	24	13.7
17		1.3		13.1	6	29	6	29	13.1
18		1.5		12.7	7	33	7	33	12.7
19		2.0		12.1	9	39	9	39	12.1
20		2.5		11.8	12	44	12	44	11.8

Bearing Capacity Table No - 1

Foundation Depth (D_f), metre = 1.5

SBI Office at Durgapur

Sl. No.	Foundation Type	Width / Diameter, metre	Length, metre	Safe Bearing Capacity, Mt/m^2	For Safe Bearing Capacity, Immediate Settlement, mm	For Safe Bearing Capacity, Consolidation Settlement, mm	For Allowable Bearing Capacity, Immediate Settlement, mm	For Allowable Bearing Capacity, Consolidation Settlement, mm	Allowable Bearing Capacity, Mt/m^2
1	Square footing	1.0	1.0	17.4	3	29	3	29	17.4
2		1.5	1.5	16.0	4	38	4	38	16.0
3		2.0	2.0	15.4	5	46	5	46	15.4
4		2.5	2.5	15.0	7	51	7	51	15.0
5		3.0	3.0	14.7	9	56	9	56	14.7
6		3.5	3.5	14.5	10	60	10	60	14.5
7		4.0	4.0	14.4	12	63	12	61	13.6
8		4.5	4.5	16.1	16	71	12	60	12.1
9	Rectangular Footing	1.5	3.00	13.6	4	34	4	34	13.6
10		2.0	3.0	13.4	6	42	6	42	13.4
11		2.0	4.0	13.0	6	41	6	41	13.0
12		2.5	3.75	13.0	8	47	8	47	13.0
13		2.5	5.0	12.7	8	46	8	46	12.7
14		3.0	4.50	12.8	10	51	10	51	12.8
15		3.0	6.0	12.4	9	50	9	50	12.4
16	Strip	1.0		13.7	5	24	5	24	13.7
17		1.3		13.1	6	29	6	29	13.1
18		1.5		12.7	7	33	7	33	12.7
19		2.0		12.1	9	39	9	39	12.1
20		2.5		11.8	12	44	12	44	11.8

CONCLUSIVE SUMARRY

Based on field and laboratory test results , their analysis and previous discussions followings are summarised.

1. Entire investigation work is done by the sinking of 7 (seven) no. of boreholes at predetermined locations selected by the consultant of the project and those are shown in ' Borehole Location Plan ' enclosed with this report .
2. The site is almost plane and a bit sloped to the extent of around 1 metre level difference.
3. As per the termination criteria of boring works , maximum depth of boring was 7 metre .
4. Ground Water level found at 1.5 metre depth during the period of field investigation in late September . Regarding sub - surface water quality , pH value is around 5 . Chloride , Sulphate and Sulphite content is well within the permissible limit for construction water quality.
5. Sub - surface soil is of residual type originated from shale - sand stone of lower Gondwana deposition of Raniganje range . Top soil is basically stiff , sandy clay of colour mottled reddish brown and pale whitish grey . Below this , fully decomposed sand stone found followed by presumably fractured and partially decomposed rock bed . Cross - sectional profile is enclosed with this report .
6. For all locations , optimum foundation depth suggested as 1.5 metre . Allowable Bearing Capacity for all probable size and type of foundation is given in ' Bearing Capacity Table ' .
7. All Back - up data of conclusive report is given in Annuexure part of this report .



9th November, 2010

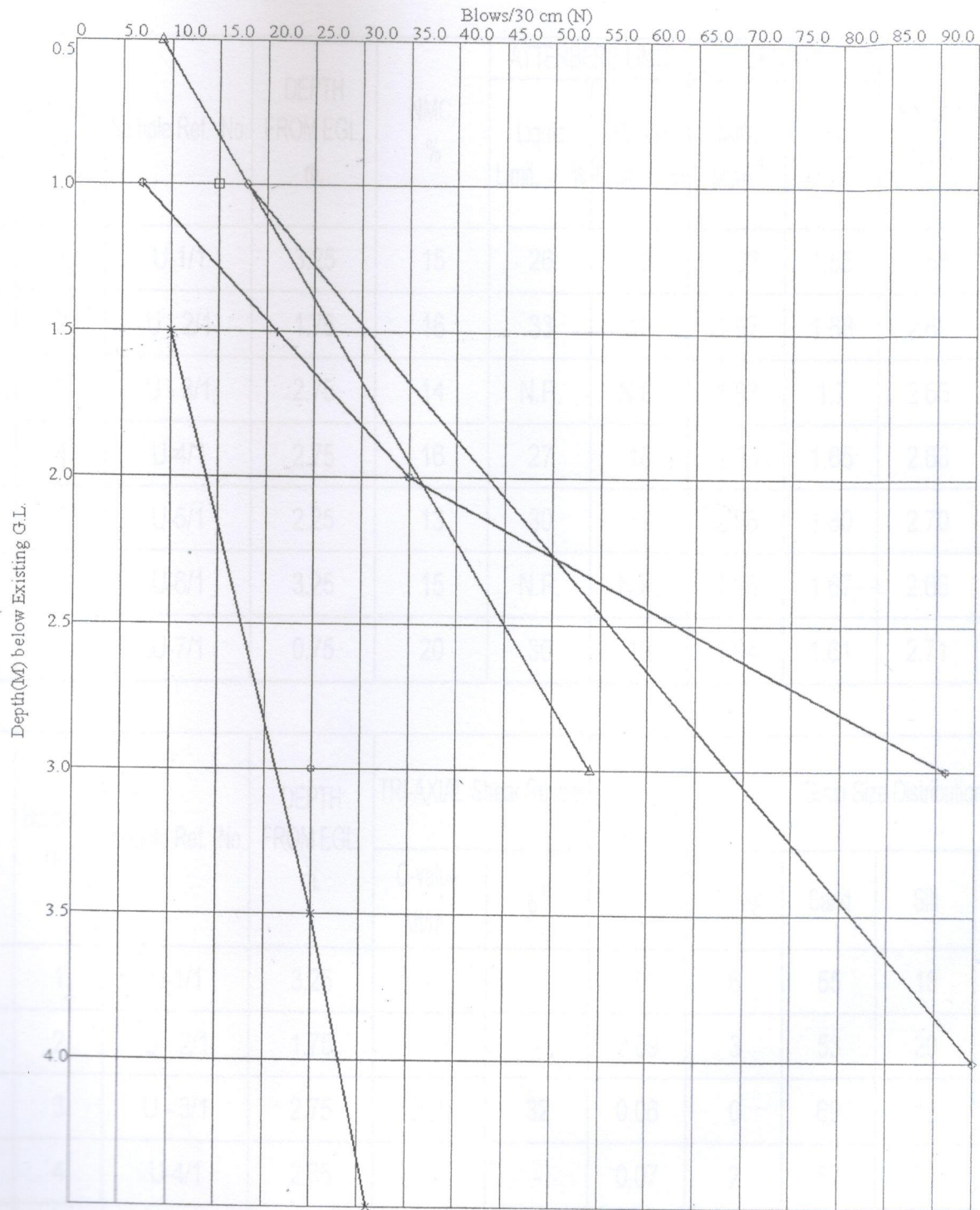
KOLKATA.

For GEOTECHNICAL ENGINEERS CONSORTIUM

(MANASIJ DUTTA)

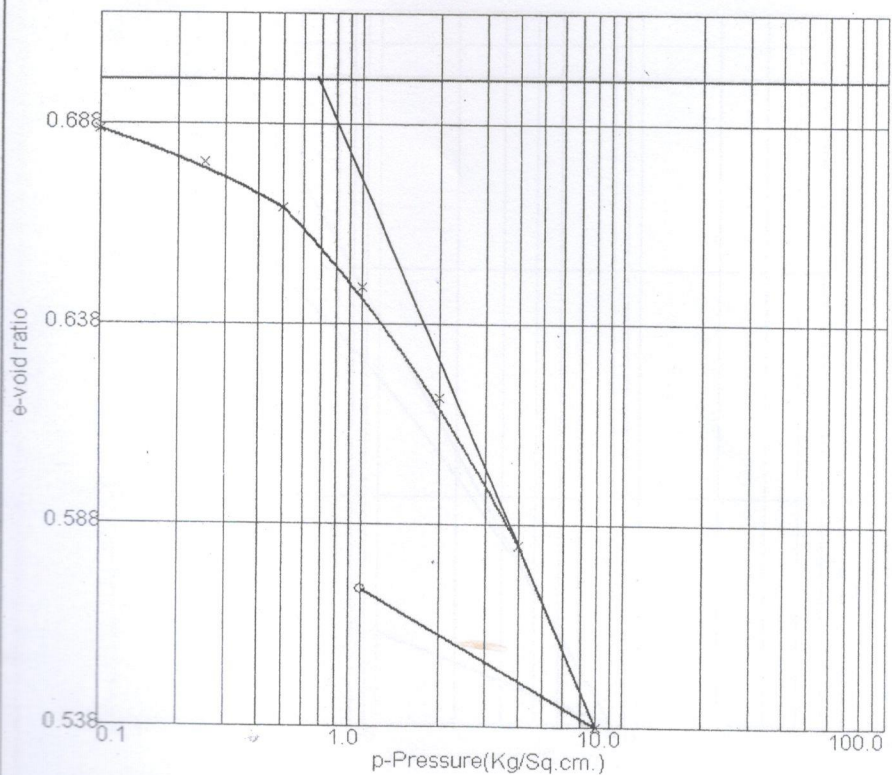
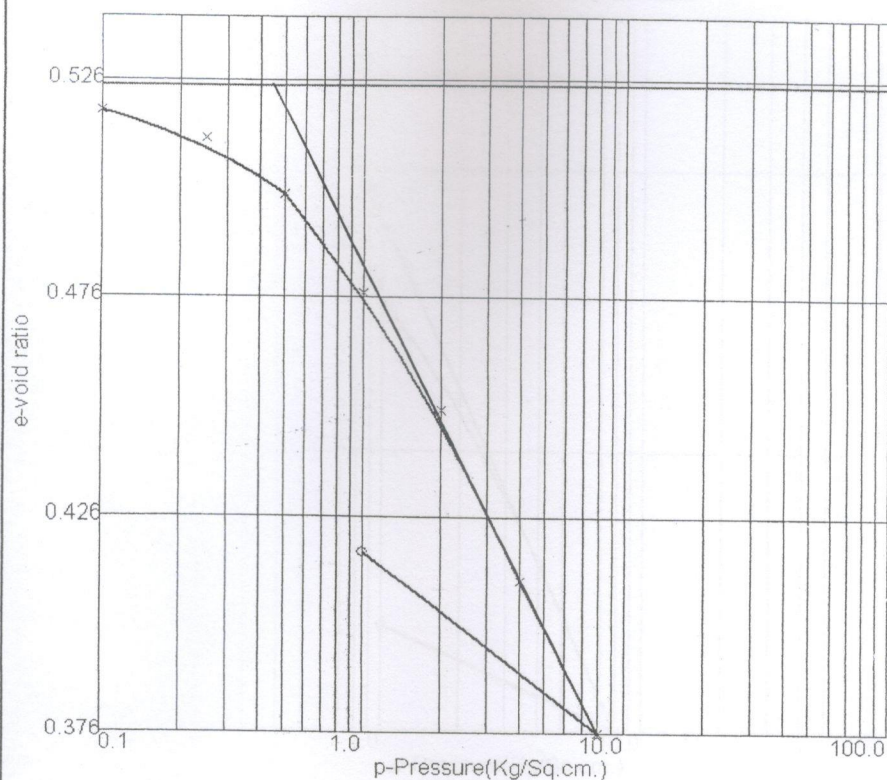
M.E, B.C.E.
MIGS., MASCE, MIRC, CE
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DEPTH VS. 'N' VALUE CURVES



BORE HOLE NO.	POINT TYPE
BH-1	x
BH-2	o
BH-3	□
BH-4	△
BH-5	+
BH-6	+
BH-7	Φ

e - Log P CURVES



GRAIN SIZE DISTRIBUTION CURVES

