

8. その他の資料・情報

8-1 テクニカルノート

8-2 土質試験結果

8-1 テクニカルノート

Technical Note

Following items were discussed and agreed by DPHE and the Basic Design Team.

1 Building / facility

1.1 Central laboratory

As attached drawings.(attachment 1 and 2)

1.2 Zonal laboratories in Jhenaida and Noakhali.

Renovation work to make the laboratories as attached drawings. (attachment 3 and 4)

2 Equipment

Major equipment as attached list.(attachment 5)

3 Operation and maintenance

3.1 Staffing

Organization chart and staffing plan for the central laboratory and zonal laboratories as attached list. Mandate of each division is as attached.(attachment 6, 7 and 8)

3.2 Operation and maintenance

Budget required for the operation and maintenance will be further studied by the Team and will be reported in end of May or early June.

4 Undertaking of Bangladeshi side

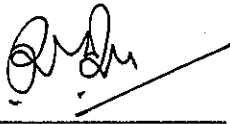
Undertaking required by the Government of Bangladesh for the Japan's Grant Aid system is agreed and confirmed as Minutes of Discussions signed on March 4th, 2004. Further detail was agreed for following items.

- The existing building, facilities, stocked material and any others things currently occupying the project site of the central laboratory shall be removed and make a vacant lot. Additional space around the site shall be secured for the stock area of construction materials. Dead line for the above shall be before the commencement of detailed design work (currently assumed at September, 2004).
- The above land clearance schedule shall be prepared and submitted to BD2 study team (attachment 9).



- The facility/equipment shall be moved and the room shall be cleared for the renovation work at the zonal laboratories in Jhenaida and Noakhali. .
 - New manpower setup (Water Quality Monitoring & Surveillance Circle and zonal laboratories in Jhenaida and Noakhali) shall be established under revenue budget with the staff as agreed upon in item 3.1.
 - Necessary items including office furniture and chemical shall be secured.
 - Any permit and clearance required by the law of the Bangladesh for the central laboratory as well as for renovation of zonal laboratory shall be obtained before July, 2004.
5. A function of central laboratory as stated in the Minutes of Discussions (Attachment 7. (3)) signed on March 4, 2004, "to analyze water sample from rural areas where zonal laboratories can not cover" shall be corrected as "to analyze water sample from rural areas which zonal laboratories can not cover in terms of parameter".
6. The final components of the Project (basic design of the building and equipment) shall be assessed in Japan and shall be decided after the assessment.

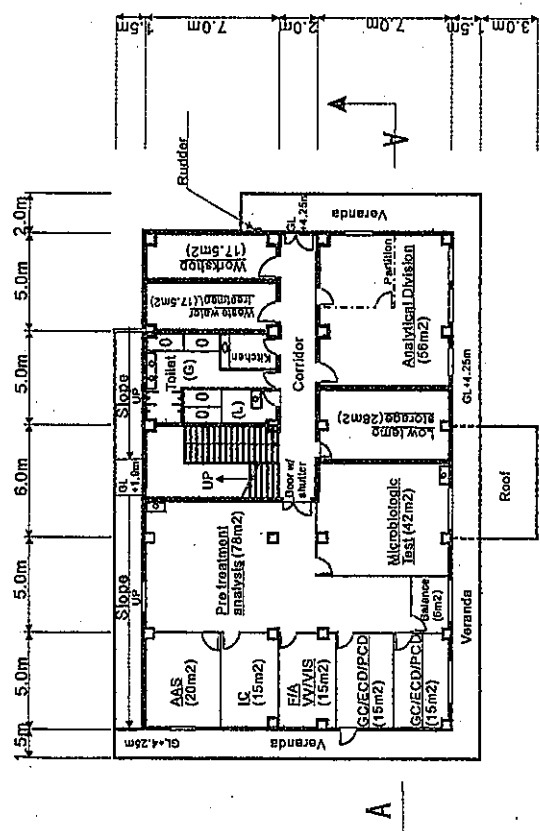
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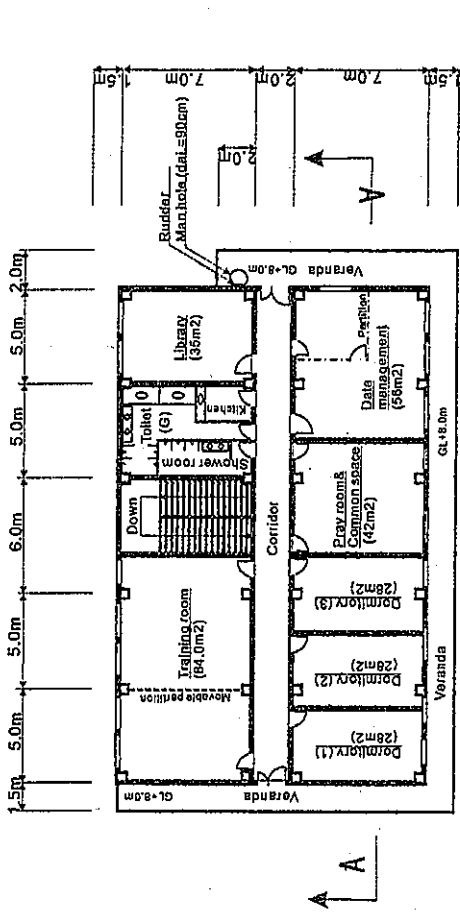
Amanullah Al Mahmood
Superintending Engineer
Department of Public Health Engineering
Ministry of Local Government Rural Development & Cooperatives
The People's Republic of Bangladesh



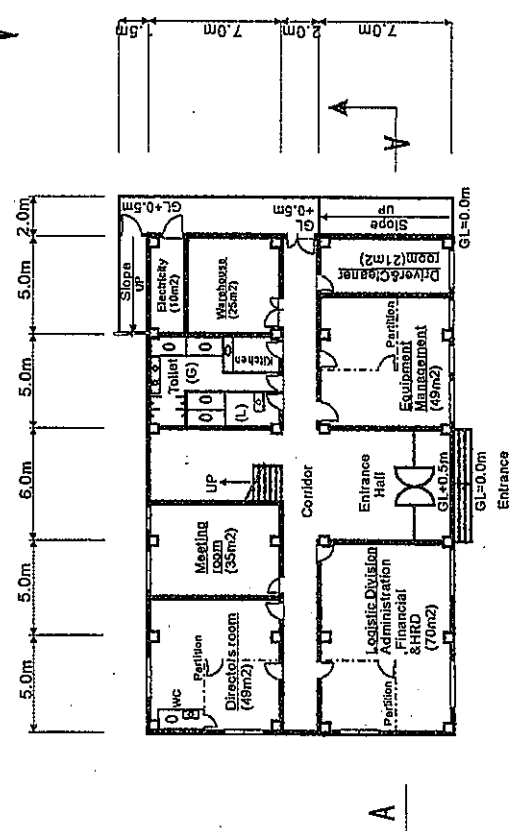
Munehiro Fukuda
Operation & maintenance/Water Quality Analysis 1
Basic Design Study Team
Japan International Cooperation Agency
Japan



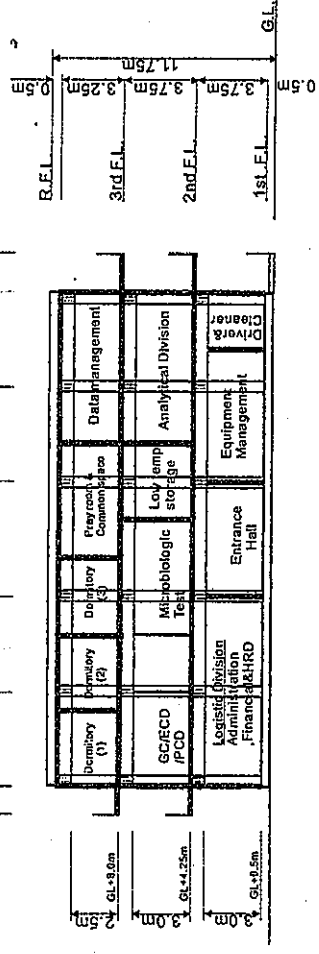
Plan of 1st Floor
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Plan of 2nd Floor
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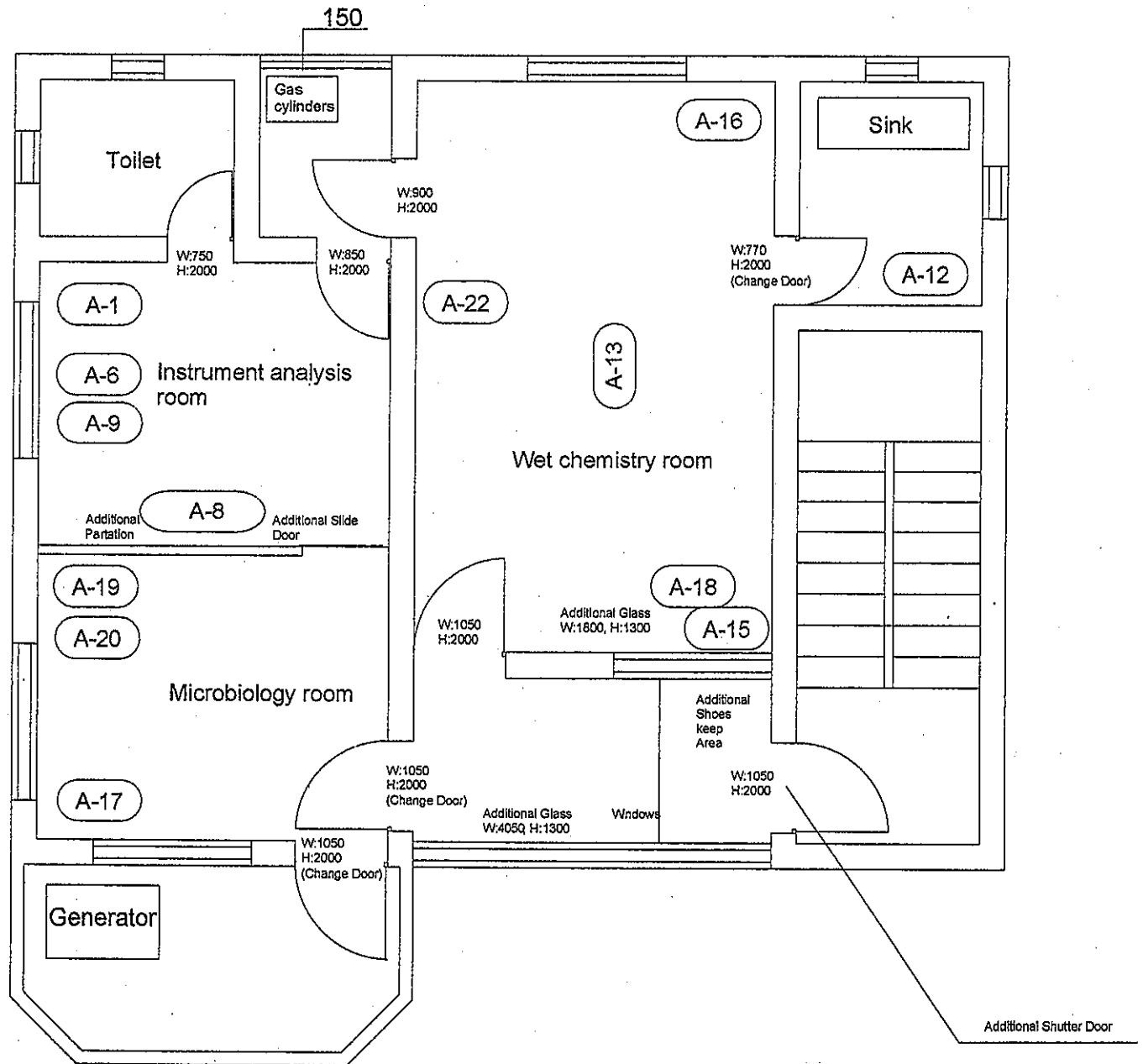


Plan of Ground Floor
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A-A Section
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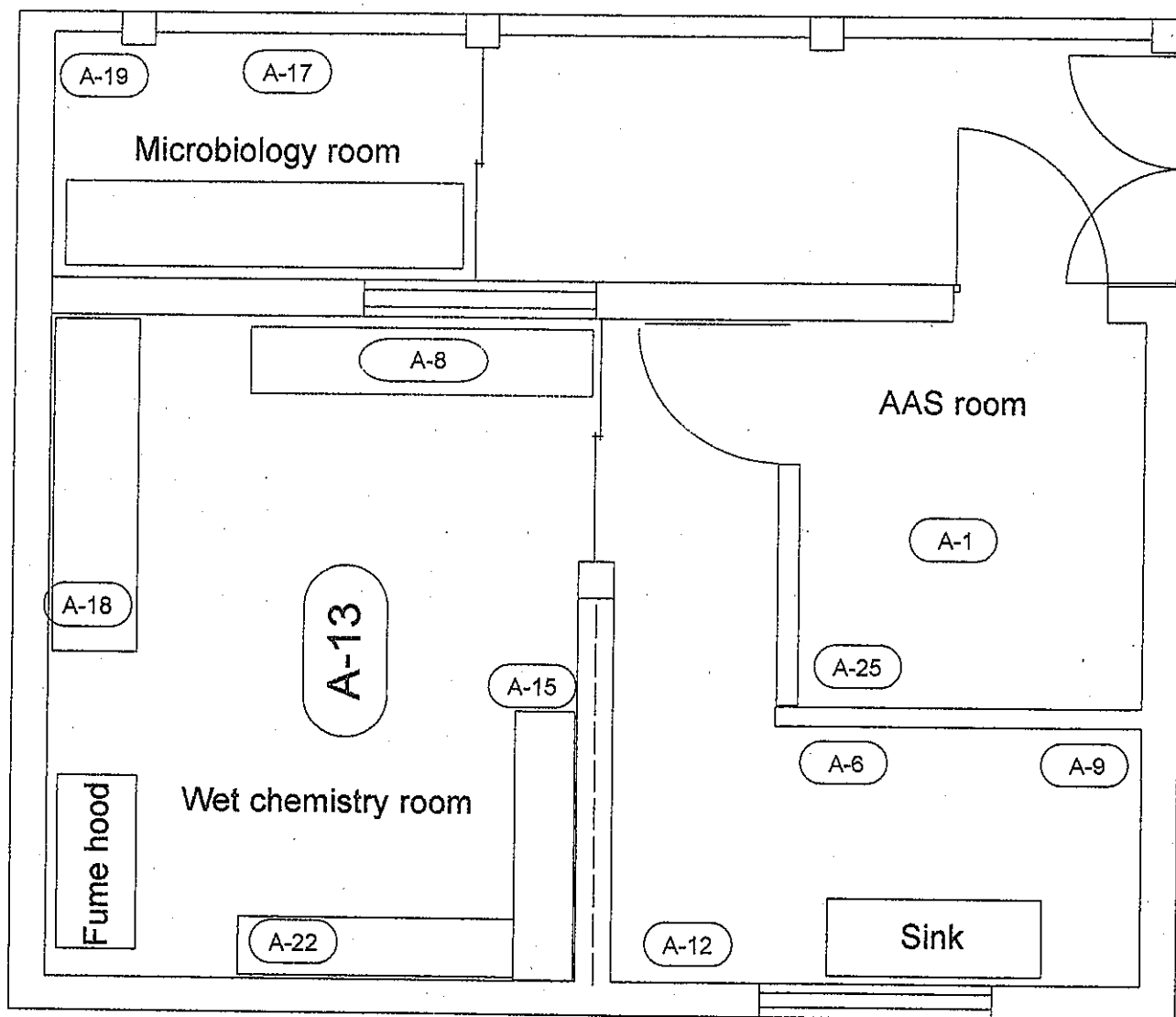
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Jhenaida Laboratory

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Noakhali Laboratory

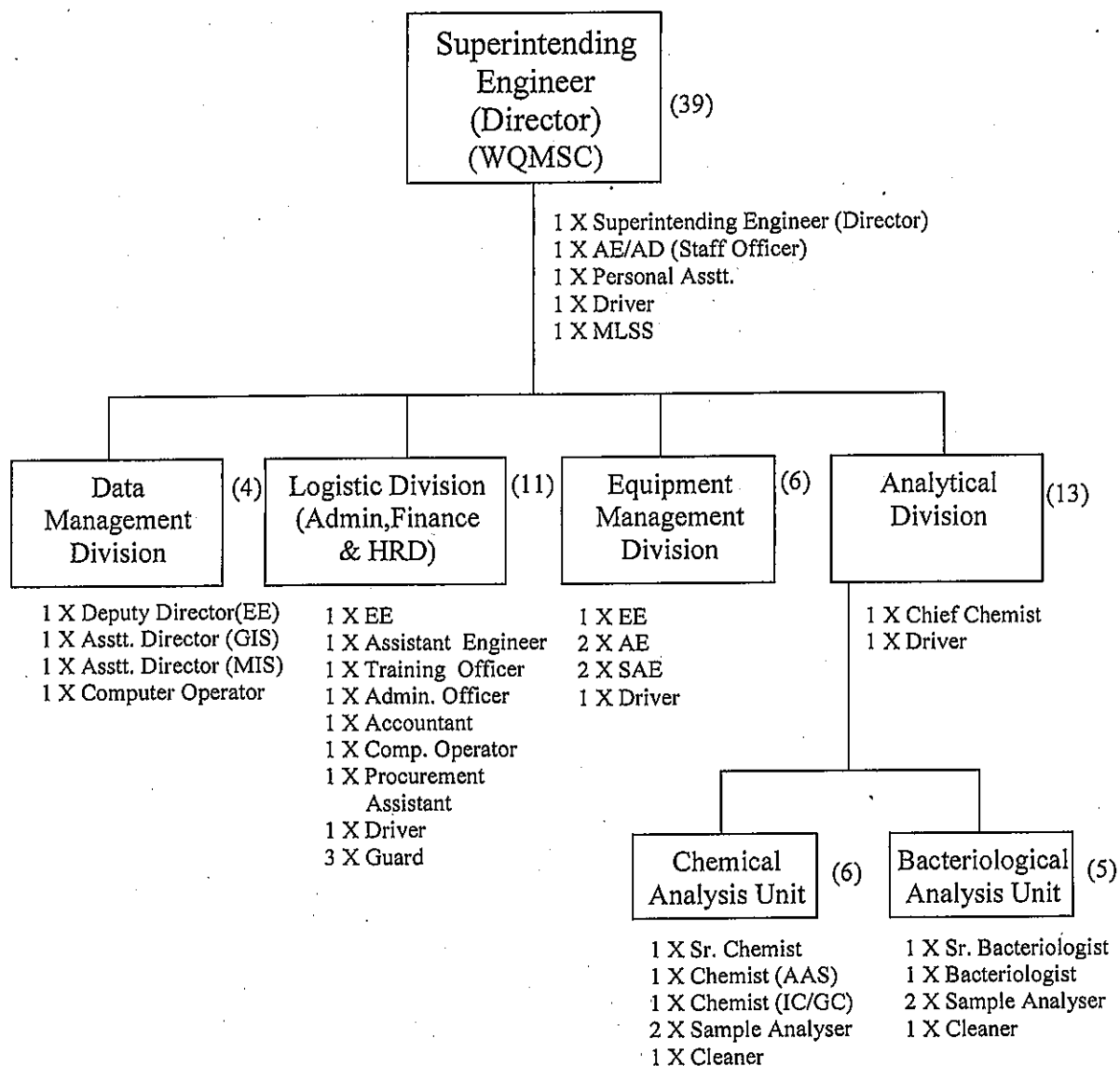
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List of major equipment

No.	Item	Number of procurement			
		Central	Jhenaida	Noakhali	Total
A. Laboratory apparatus					
A-1	Atomic absorption spectrophotometer	3	0	1	4
A-2	Atomic absorption spectrophotometer for Hg analysis	1	0	0	1
A-3	Ion chromatograph	2	0	0	2
A-4	Gas chromatograph with purge & trap device	2	0	0	2
A-5	Flow injection analyzer	2	0	0	2
A-6	UV-VIS spectrophotometer	2	1	1	4
A-7	Infrared spectrophotometer	1	0	0	1
A-8	Ion meter with selective electrode	8	8	7	23
A-9	Turbidity meter	1	1	0	2
A-10	TOC analyzer	1	0	0	1
A-11	Microwave digestion apparatus	1	0	0	1
A-12	Pure water apparatus	1	1	1	3
A-13	Work table	2	1	1	4
A-14	Side work table	14	0	0	14
A-15	Balance table	2	1	1	4
A-16	Draft chamber with treatment for acid fume and solvent	2	0	0	2
	Draft chamber without treatment	0	1	0	1
A-17	Bio clean bench (installation type)	1	0	0	1
	Bio clean bench (desktop type)	0	1	1	2
A-18	Precision balance	2	1	1	4
A-19	Autoclave	1	1	1	3
A-20	Incubator	2	1	0	3
A-21	Hot-air sterilizer	1	0	0	1
A-22	Drying oven	2	1	1	4
A-23	Refrigerator for reagent	3	0	0	3
A-24	Portable toxicity test kit	1	0	0	1
A-25	Dehumidifier	5	0	1	6
A-26	Rotary evaporator	1	0	0	1
A-27	Pipette washer	1	0	0	1
A-28	Shaker	1	0	0	1
A-29	Others	1	1	1	3
A-30	Glassware	1	1	1	3
A-31	Reagents	1	0	0	1
B. Vehicle					
B-1	4WD	2	0	0	2
B-2	Micro bus	1	0	0	1
B-3	Pickup truck	1	0	0	1
C. Training equipment					
C-1	Projector	1	0	0	1
C-2	Opaque projector	1	0	0	1
C-3	Screen	2	0	0	2
C-4	Laptop PC	1	0	0	1
C-5	Digital camera	1	0	0	1
C-6	Portable water quality testing sensor	12	0	0	12
C-7	Portable water quality testing kit	12	0	0	12
C-8	Printer	1	0	0	1
C-9	Photocopy machine	1	0	0	1
D. Data management equipment for water quality results					
D-1	Server PC	1	0	0	1
D-2	Desktop PC	10	0	0	10
D-3	Printer	1	0	0	1
D-4	Scanner	1	0	0	1
D-11	Digitizer	1	0	0	1
D-12	Software	1	0	0	1

DPHE Central Laboratory



WQMSC : Water Quality Monitoring & Surveillance Circle.

Proposed manpower set up for Zonal Laboratory at Jhinaidah

Sl No.	Description of the posts	No of Post
01	Senior Chemist	1
02.	Junior Chemist	1
03.	Sample analyzer	2
04.	Computer operator	1
05.	Sample collector	2
06	Driver	1
07.	Cleaner(Full time)/MLSS	1
Total:		9

Proposed manpower set up for Zonal Laboratory at Noakhali

Sl No.	Description of the posts	No of Post
01	Senior Chemist	1
02.	Junior Chemist	1
03.	Sample analyzer	2
04.	Computer operator	1
05.	Sample collector	2
06	Driver	1
07.	Cleaner(Full time)/MLSS	1
Total:		9




DPHE Central Laboratory

Responsibilities of Manpower setup

Superintending Engineer(Director)

- Overall management of laboratories of DPHE
- Coordination within & outside DPHE
- Planning for ISO-17025
- Communication & awareness building

Data Management Division

- Management of LIMS
- Data acquisition and storage
- Management & processing of data
- Publication of reports, maps etc.

Logistic Division

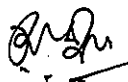
- Assist SE (Director) in Administration & Financial management
- Coordinate HRD functions
- Procurement, storage and supply of chemicals and others

Equipment Management Division

- Maintenance and Repair Management of equipment and Spares for all DPHE labs.
- Assist SE/Chief Chemist in the procurement of Equipments and Spares

Analytical Division

- Water Quality monitoring & surveillance
- Chemical analysis of samples
- Bacteriological analysis of samples
- Management of QA/QC programme for all Labs of DPHE
- On the Job Training for all laboratory personnel
- Carryout / Assist in Applied Research/Study



Project site clearance schedule

204										
	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	
Notify movement of staff			↑							
Movement of staff				↑						
Relocaion of equipment / Demolish of temporary structure						↑				
Land clearance							↑			
Preparatry works for implementation										↑

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Mr. Fickel

8-2 土質試驗結果

KOKUSAI KOGYO CO., Ltd.
5 Sanban-Cho, Chiyoda-ku, Tokyo, 102-0075 Japan

Report
on
Standard Penetration Test (Soil Test)
for the Project on Strengthening of Water
Examination System in the People's
Republic of Bangladesh

April - 2004



BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD.
House No.10, Road No.135, Gulshan-1, Dhaka-1212, Bangladesh

**Report on Standard Penetration Test (Soil Test) for the Project
on Strengthening of Water Examination System in the
People's Republic of Bangladesh**

Table of Contents

i	<i>Letter of Transmittal</i>
1	Introduction
2	Scope of Works
3	Methodology
3.1	Field Works
3.2	Laboratory Tests
3.3	Description of Soil Composition
3.4	Evaluation of Bearing Capacity of Soil
4	Time, Date and Weather Condition during Field Works
5	Physical and Engineering Properties of Soil
5.1	Physical Properties
5.2	Engineering Properties
6	Evaluation of Bearing Capacity
7	Laboratory Results for Different Bore Holes
8	Calculation of Bearing Capacity using "N" Value
9	Conclusion & Recommendation
10	Photographs
11	Figures
11.1	Site Plan
11.2	Bore Hole Logs
11.3	Grain Size Analysis Curves
11.4	Unconfined Compression Test Curves
11.5	Direct Shear Test Curves
11.6	Consolidation Test Curves

1 INTRODUCTION

M/S Kokusai Kogyo Co., Ltd. entrusted M/S Bangladesh Engineering & Technological Services (BETS) Ltd. with the assignment for completing all the Standard Penetration Test of the site for construction of Laboratory Building at Mohakhali in connection with the Project on Strengthening of Water Examination System in the People's Republic of Bangladesh. A contract to this effect was signed on the 15th day of April 2004 between the two parties for doing the soil test. The purposes of the investigations were for the safety as well as economy in design for the foundation structure of the proposed building.

This report contains information on scope of works, methodology of field investigation & laboratory investigations, discussion on physical and engineering properties, of sub-soil, evaluation at test data, analysis of bearing capacity, charts and graphs representing field and laboratory test results along with conclusion and recommendation.

2 SCOPE OF WORK

The scope of works includes all works such as mobilization preparation of equipment, soil test reporting etc. Specific scope of work involves performing Standard Penetration Test at 5 (five) points for designing the foundation of 3 (three) storied RCC building at Mohakhali DPHE land in the Dhaka City of Bangladesh.

Some additional but related investigations have been performed to obtain information relating to foundation condition commensurate with the magnitude and type of structure involved with the project. The soil investigations both in the field and in the laboratory were carried out in detail to evaluate the physical, mechanical and geotechnical properties of the soil. The followings are the detailed lists of investigations done.

A Field Investigations

- (i) Number of boring 5 (five) nos. to a depth of 12m (1 meter more than the average depth where SPT has been found to be more than 25.)
- (ii) SPT execution - 44 (forty four) nos. at interval of 1.00/1.5m
- (iii) Collection of 44 (forty four) nos. disturbed samples and 7 (seven) nos. undisturbed samples.
- (iv) Ground water level observation - 5 (five) nos.

B Laboratory Investigations

- | | | | |
|-------|-----------------------------|---|---------|
| (i) | Grain size analysis | - | 15 Nos. |
| (ii) | Atterberg limit test | - | 5 Nos. |
| (iii) | Sp. gravity test | - | 4 Nos. |
| (iv) | Moisture content test | - | 7 Nos. |
| (v) | Unconfined compression test | - | 7 Nos. |
| (vi) | Direct shear test | - | 9 Nos. |
| (vii) | Consolidation test | - | 5 Nos. |

The test results, analysis, discussions and recommendations which are presented in this report is valid only for the locations where the actual investigation have been carried out.

C Reporting Related to the Study are

Two (2) copies of report and one (1) set of digital data in English shall be submitted to the Client. The report shall include the following

- Columnar section including description of the faces of sample and "N" values
- Time and date of the beginning and completion of the test
- Weather conditions
- Observation of the test ground
- Change of the ground surface around the loading plate due to application of load
- Any unusual conditions observed during the test
- Photograph of sites and activities
- The result of calculation of the bearing power by using "N" values; etc.

3 METHODOLOGY

3.1 Field Works

The methodology of conducting field investigation is discussed below:

Location of bore hole

The locations of 5 bore holes were shown in the ground by the representative of the client. These were marked by pegs for subsequent identification during field work (shown in photograph).

Exploratory boring drilling

Drilling was executed by the method of wash boring. A hole was started by driving vertically a 4 inches dia steel casing into the ground to some depth and then the formation inside the casing was broken up by the repeated drops of a chopping bit attach to the lower end of the drilling pipe. The upper end of the same was fitted to swivel head through which water was forced at high pressure through pressure pipe. Forced water emerges at high velocity through the pores of the chopping bit and returns to the surface, carrying with it the broken-up soils. In this way drilling is advanced upto a level of 6 inches above the depth, where SPT has to be executed.

Standard Penetration Tests (SPT)

The Standard Penetration Tests (SPT) were performed in all the bore holes. The test were executed by using a thick walled split spoon sampler of 35mm internal and 50.8 mm outer dia and a 65 kg hammer falling freely from a constant height of 75 cm interval. The SPT value (N value) were taken as the; summation of the number of blows required in 2nd and 3rd 15 cm of penetration of sampler. The N-values are shown on the bore hole logs against the respective interval of tests.

The Standard Penetration Tests provide a fair knowledge on the density and consistency of the soil layer encountered and in addition yield disturbed/ semi-disturbed soil samples from within the split sampler used during the tests.

Disturbed sample collection

The disturbed samples were collected with the help of split spoon sampler used during Standard Penetration Tests. The collected samples were classified in-situ and were preserved in water tight polyethylene bags with proper identification marks for onward transmission to the laboratory for further analysis. The disturbed samples were also used to reconstruct depth wise stratification of bore holes depending on its classifications.

Undisturbed soil sample collection

Undisturbed soil samples were collected whenever feasible from the cohesive layers with the help of thin walled Shelby tubes. 76 mm dia thin walled Shelby tubes are penetrated into the undisturbed soil formation at the bottom of the bore hole by applying repeated but continuous force. The samples recovered within the Shelby tubes were wax sealed at both ends and transmitted to the laboratory with proper identification marks.

Recording of ground water table

The ground water table was recorded in each of the bore holes by rope/ sounding rod after 24 hours of completion of the drilling and sampling operation.

Correction of field SPT values

If the soil is very fine or silty saturated sand and the measured penetration resistance is greater than 15, then the field "N" value should be adjusted by

$$N = 15 + \frac{1}{2} (N' - 15) \quad \text{Where, } N = \text{Corrected SPT and } N' = \text{Field SPT}$$

3.2 Laboratory Tests

Different types of laboratory tests were performed in the laboratory to evaluate the physical and engineering properties of the sub-soil formation to facilitate determination of soil bearing capacities and to recommend foundation type and magnitude. Grain Size Analysis, Atterberg Limits and Sp. Gravity Tests were performed to ascertain the detail composition of the soil and to evaluate the physical parameters of the formation. These tests also help in classifying the soils properly for geological and geotechnical interpretation. Unconfined Compression, Density and Shear tests were done to evaluate the shear characteristics of the soils, which directly help in bearing capacity calculations. Consolidation tests provide data on consolidation behaviour of the sub-soil formation. The laboratory tests were performed as per AASHTO/ASTM Standard.

3.3 Description of Soil Composition

The following terms are generally used in reports for description of soil composition;

Trace	:	1 to 10%
Little	:	10 to 20%
Some	:	20 to 35%
Sandy	:	35 to 50% sand
Clayey	:	35 to 50% clay
Silty	:	35 to 50% silt

On the basis of N-Values the relative density/ consistency of soil formation may be said to vary as, very loose, loose, medium, dense, and very dense for non-cohesive soil and very soft, soft, medium stiff, very stiff and hard for cohesive soil (after K. Terzaghi and R.B. Peck). Based on N-values other very useful soil parameters may be obtained from the correlation charts given by different research workers. Two such useful correlation for cohesive and non-cohesive soils after Prof. K. Terzaghi are given below:

For cohesionless soil

SPT N Value	Approx. Ø	Density Index	Description	Density T/cu m
0-4	25-30	0	Very Loose	1.12-1.60
4	27-32	15	Loose	1.44-1.84
10	30-35	35	Medium	1.76-2.08
30	35-40	65	Dense	1.76-2.24
50	34-43	85	Very Dense	2.08-2.40

For cohesive soil

SPT (N) Value	qu t/sq m	Density t/cu m	Consistency
0	2		Very Soft
2	2.5	1.60-1.92	Soft
4	5.0	1.76-2.08	Medium
8	10.0	1.76-2.08	Stiff
16	20.0	1.92-2.24	Very Stiff
32	40.0	1.92-2.24	Hard

3.4 Evaluation of Bearing Capacity of Soil

The bearing capacity of the shallow foundation particularly for top layer of cohesive soil may be estimated from the SPT values, as suggested by Terzaghi, according to following Table.

Bearing Capacity of the shallow foundation, TSF (F.S.=3.0)

SPT range	Consistency	Allowable Bearing Capacity	
		Continuous Footing	Isolated Column Footing
0 - 2	Very soft	0.00 - 0.225	0.00 - 0.30
2 - 4	Soft	0.225 - 0.45	0.30 - 0.60
4 - 8	Medium	0.45 - 0.90	0.60 - 1.20
8 - 15	Stiff	0.90 - 1.80	1.20 - 2.40
15 - 30	Very stiff	1.80 - 3.60	2.40 - 4.80
>30	Hard	> 3.60	>4.80

4. TIME, DATE AND WEATHER CONDITION DURING FIELD WORKS

The field works of soil boring, sample collections etc were done during the 2 days of 17th and 18th April 2004. The field work started at 9 am in the morning and continued upto 5 pm in the evening. The weather was hot and dry with sunshine during the whole working period. The temperature and humidity of the 2 working days were as follows:-

Sl	Date	Temperature		Humidity	
		Day time	Night time	Morning	Evening
1	17 th April 2004	35 °	28 °	75 %	67 %
2	18 th April 2004	34 °	28 °	73%	67 %

5. PHYSICAL AND ENGINEERING PROPERTIES OF SOIL

5.1 Physical Properties

Stratification of soil

The top formation of soil extending to the depth of about 5.0 m to 6.90 m is predominated by cohesive soil consisting of reddish brown silty clay. Below this and upto the depth of investigation, layers of soil are non-cohesive in nature consisting of loose to dense sandy silt.

Consistency/Compactness

The layers of cohesive soil predominates in a medium to stiff consistency. The subsequent deep layers of non-cohesive soil usually have been observed in a loose to dense silty sand.

Natural moisture content, Unit weight & specific gravity

Natural moisture content the top layer of cohesive soil varied from 19.65%-25.71%. Dry unit weight of the same soil varied from 1.18 t/m^3 to 1.88 t/m^3 . Specific gravity of the investigated soil varied from 2.64 to 2.682

5.2 Engineering Properties

Cohesion

The values of cohesion, as reported from the performance of unconfined compression strength tests, vary from 0.01 kg/cm^2 to 0.10 kg/cm^2 .

Compressibility

The top formation of cohesive soil usually has been observed moderately compressible in nature, as the values of compression index vary from 0.175 to 0.225 and the corresponding value of the natural void ratio vary from 0.54 to 0.675.

Angle of internal friction

The values of the angle of internal friction, as obtained from the performance of Direct Shear Tests varied from 25° to 34° .

7 LABORATORY RESULTS FOR DIFFERENT BORE HOLES

Allowable bearing capacity of sub-soil, skin friction and end bearing capacity of piles /(ultimate) at whole depth using Standard Penetration Test (SPT) values and laboratory test results

Depth in Meter (M)	Standard Penetration resistance SPT/ Correct SPT	Unit weight in gm/ cm ²	Angle of internal friction cohesion of sub-soil. TSF	Allowable Bearing Capacity	Ultimate pile Bearing Capacity	
				Square Footing in TSF	Skin friction in TSF	End bearing capacity in TSF
<u>BH No.-1</u>						
1.5	11(11)	1.90	0° (0.83)	1.51	0.52	6.19

*Report on Standard Penetration Test (Soil Test) for the Project on
Strengthening of Water Examination System in the People's Republic of Bangladesh*

Depth in Meter (M)	Standard Penetration resistance SPT/ Correct SPT	Unit weight in gm/ cm ²	Angle of internal friction cohesion of sub-soil. TSF	Allowable Bearing Capacity	Ultimate pile Bearing Capacity	
				Square Footing in TSF	Skin friction in TSF	End bearing capacity in TSF
3.0	10(10)	1.88	0° (0.75)	1.40	0.45	5.53
4.5	11(11)	1.90	0° (0.83)	1.59	0.52	6.25
6.0	10(10)	1.71	25° (0.06)	2.23	0.23	6.50
7.5	14(14)	1.75	25° (0.08)	-	0.27	8.39
9.0	28(22)	1.88	32° (0.02)	-	0.58	27.65
10.5	31(23)	1.92	32° (0.05)	-	0.62	31.49
12.0	33(24)	1.94	32° (0.10)	-	0.65	33.51
<u>BH NO.-2</u>						
1.5	12(12)	1.92	0° (0.88)	1.59	0.53	6.35
3.0	9(9)	1.88	0° (0.66)	1.24	0.41	4.94
4.5	10(10)	1.87	0° (0.75)	1.44	0.45	5.65
6.0	11(11)	1.90	0° (0.81)	1.64	0.52	6.27
7.5	14(14)	1.73	28° (0.04)	-	0.32	31.65
9.0	20(18)	1.80	28° (0.06)	-	0.34	36.58
10.5	27(21)	1.87	28° (0.95)	-	0.48	52.62
11.0	30(23)	1.90	34° (0.02)	-	0.72	38.45
12.0	33(24)	1.94	34° (0.07)	-	0.85	45.23
<u>BH NO.-3</u>						
1.5	12(12)	1.90	0° (0.82)	1.49	0.49	6.05
3.0	12(12)	1.92	0° (0.88)	1.64	0.53	6.44
4.5	12(12)	1.92	0° (0.88)	1.66	0.53	6.57
6.0	11(11)	1.75	12° (0.43)	1.90	0.49	6.10
7.5	13(13)	1.78	12° (0.52)	-	0.52	7.23
9.0	21(18)	1.80	27° (0.02)	-	0.54	15.61
10.5	21(18)	1.80	27° (0.02)	-	0.54	15.85
11.0	32(24)	1.93	31° (0.06)	-	0.61	26.29
12.0	32(24)	1.93	31° (0.06)	-	0.61	26.57
<u>BH No.-4</u>						
1.5	7(7)	1.80	0° (0.55)	1.01	0.32	3.89
3.0	13(13)	1.93	0° (0.98)	1.82	0.58	6.88
4.5	11(11)	1.91	0° (0.81)	1.55	0.49	6.15
6.0	10(10)	1.70	26° (0.03)	2.19	0.21	5.86
7.0	11(11)	1.72	26° (0.05)	-	0.32	9.63
8.0	14(14)	1.75	26° (0.08)	-	0.35	10.23

Depth in Meter (M)	Standard Penetration resistance SPT/ Correct SPT	Unit weight in gm/ cm ²	Angle of internal friction cohesion of sub-soil. TSF	Allowable Bearing Capacity	Ultimate pile Bearing Capacity	
				Square Footing in TSF	Skin friction in TSF	End bearing capacity in TSF
9.5	26(21)	1.85	30° (0.04)	-	0.38	13.33
10.00	30(23)	1.90	33° (0.08)	-	0.65	33.09
12.00	32(24)	1.93	33° (0.10)	-	0.68	35.15
BH NO.-5						
1.5	8(8)	1.85	0° (0.61)	1.11	0.35	4.25
3.0	12(12)	1.91	0° (0.89)	1.65	0.53	6.44
4.5	10(10)	1.90	0° (0.75)	1.45	0.45	5.55
6.0	12(12)	1.79	10° (0.55)	2.04	0.40	6.10
7.0	13(13)	1.82	10° (0.62)	-	0.44	6.91
8.0	15(15)	1.75	29° (0.02)	-	0.42	14.49
9.0	25(20)	1.85	29° (0.05)	-	0.45	15.84
10.0	29(22)	1.90	34° (0.01)	-	0.71	38.41
12.0	33(24)	1.93	34° (0.03)	-	0.83	44.51

8 CALCULATION OF BEARING CAPACITY USING "N" VALUE

Assumption 1: Let us assume that a 3 storied building imposes a weight of 20 ton/ sq. meter on the foundation. (Ref: Indian Practical Civil Engineer's Hand Book, P. N. Khanna, 14th Edition, 1995, Engineers Publishers, New Delhi - 110001)

Assumption 2: The depth of footing will be 2.5m

As per Terzaghi, the semi empirical equation for square footing of size B:-

$$q_{ult} = 1.3CN_c + \gamma D_f N_q + 0.4 B \gamma N_r$$

Where C = Cohesion of soil

N_c , N_q & N_r are dimensionless bearing capacity factor that depend on the angle of internal friction (ϕ) of soil

B = minimum width of foundation

D_f = assuming effective depth of foundation or surcharge depth to be 2.5m below the surface level

For $\phi = 0^\circ$

$$N_c = 5.14, \quad N_q = 1.0, \quad N_r = 0$$

$$\begin{aligned} C &= \text{Cohesion of soil} \\ &= 0.78 \text{ t/sft} \\ &= (0.78 \times 1000 \times (1/1000) \times 9.8) / ((1/3.281) \times (1/3.281)) \text{ kN/m}^2 \\ &= 82.24 \text{ kN/m}^2 \end{aligned}$$

$$\begin{aligned} \therefore q_{ult} &= (1.3 C N_c + \gamma D_f N_q + 0.4 B \gamma N_r) \text{ kN/m}^2 \\ &= (1.3 \times 82.29 \times 5.14 + 17.3 \times 2.5 \times 1 + 0.4 \times B \times \gamma \times 0) \text{ kN/m}^2 \\ &= 592.84 \text{ kN/m}^2 \end{aligned}$$

$$\begin{aligned} \therefore q_{allowable} &= q_{ult} / 3 = (592.84 / 3) \text{ kN/m}^2 \\ &= 197.61 \text{ kN/m}^2 \\ &= 20.14 \text{ t/m}^2 > 20 \text{ t/m}^2 \end{aligned}$$

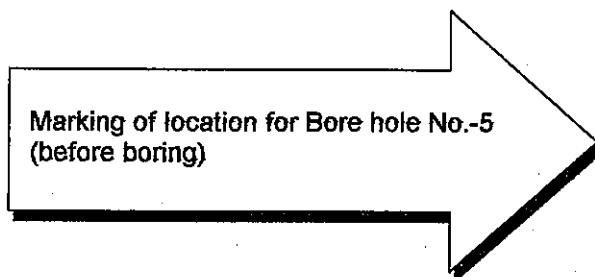
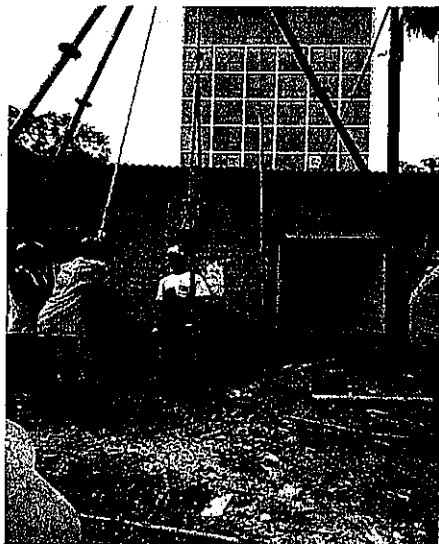
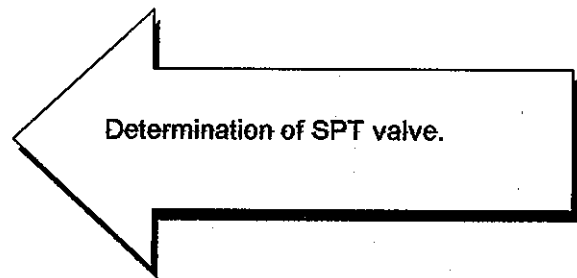
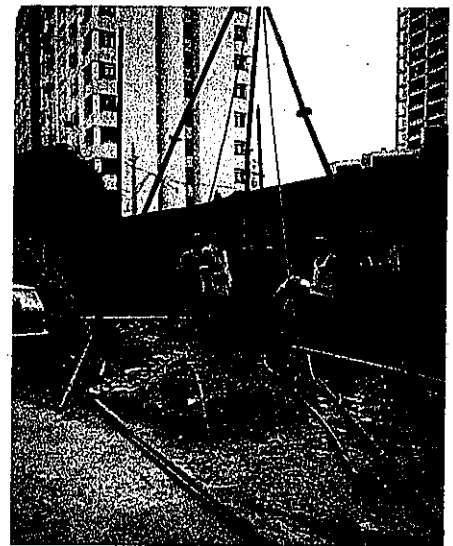
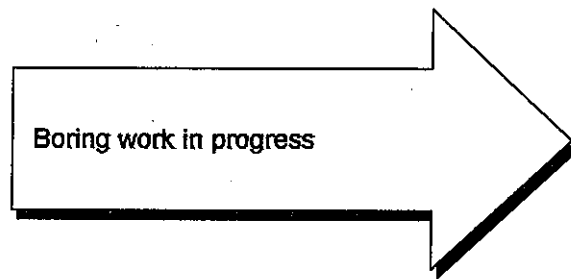
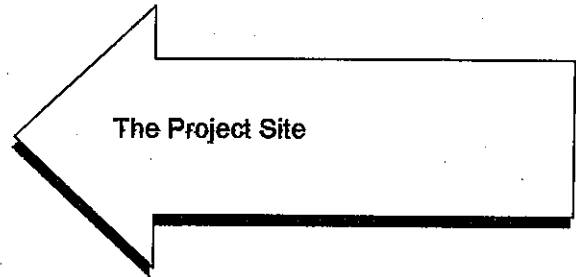
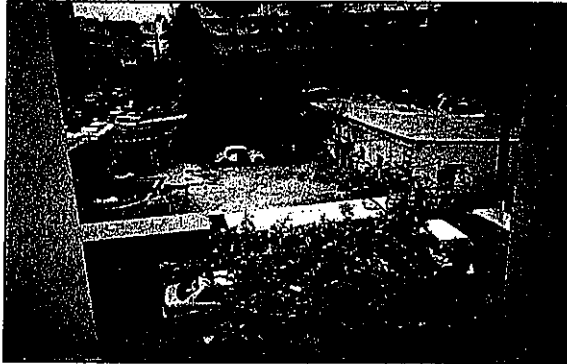
Hence the assumption of taking the depth of footing to be 2.5m is O.K.

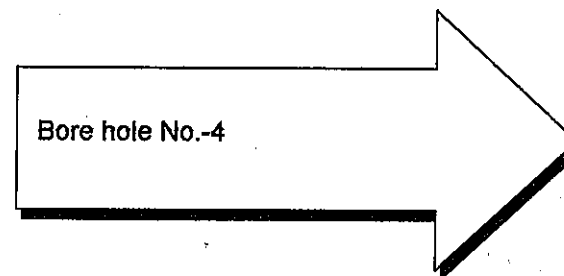
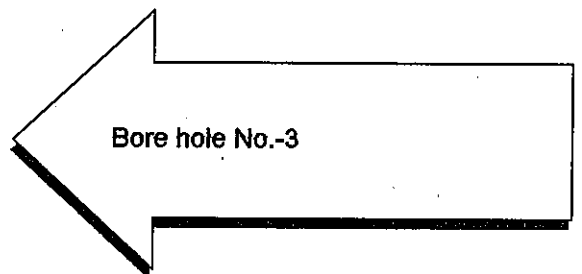
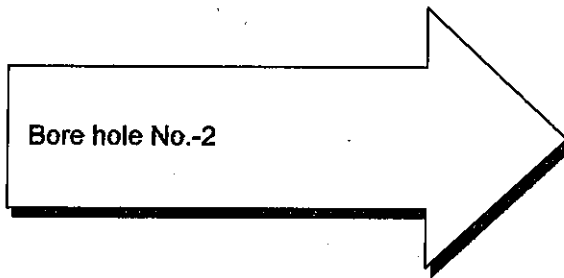
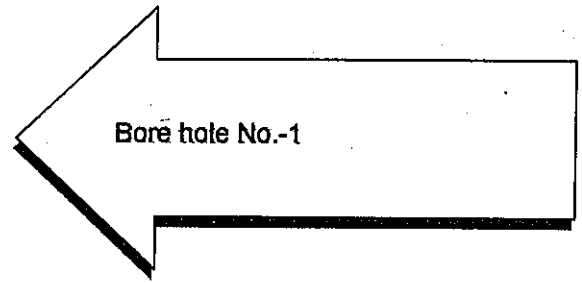
9 CONCLUSION AND RECOMMENDATION

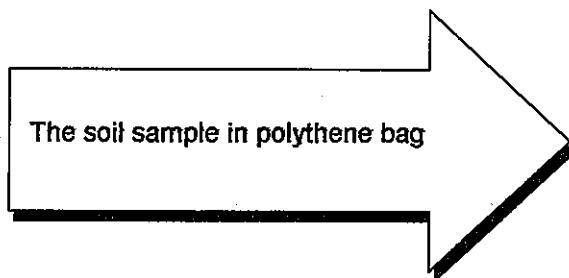
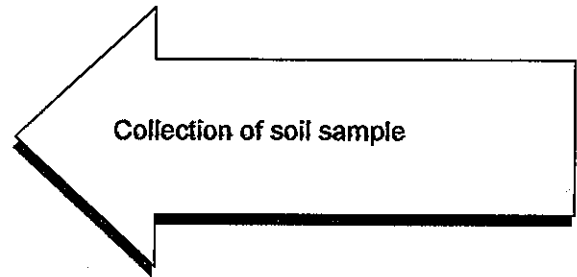
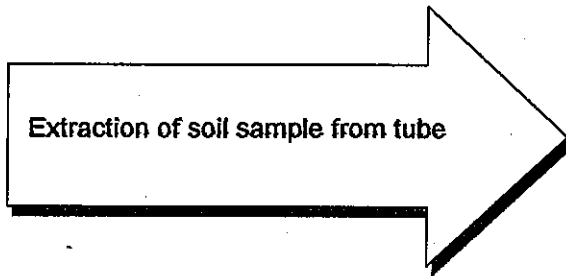
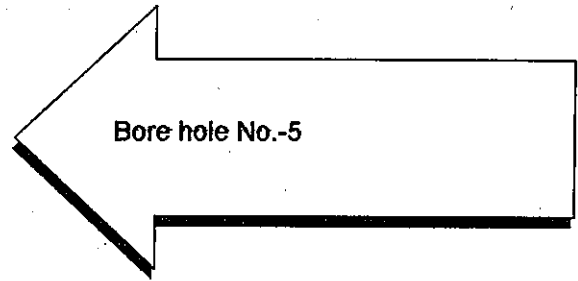
By analysing the field and laboratory test values it can be concluded that the over all strength parameter and bearing capacity of the site throughout the soil profiles are good. Hence shallow open footing foundation will be suitable form structural and economic consideration.

10 PHOTOGRAPHS

PHOTOGRAPHS







11. FIGURES

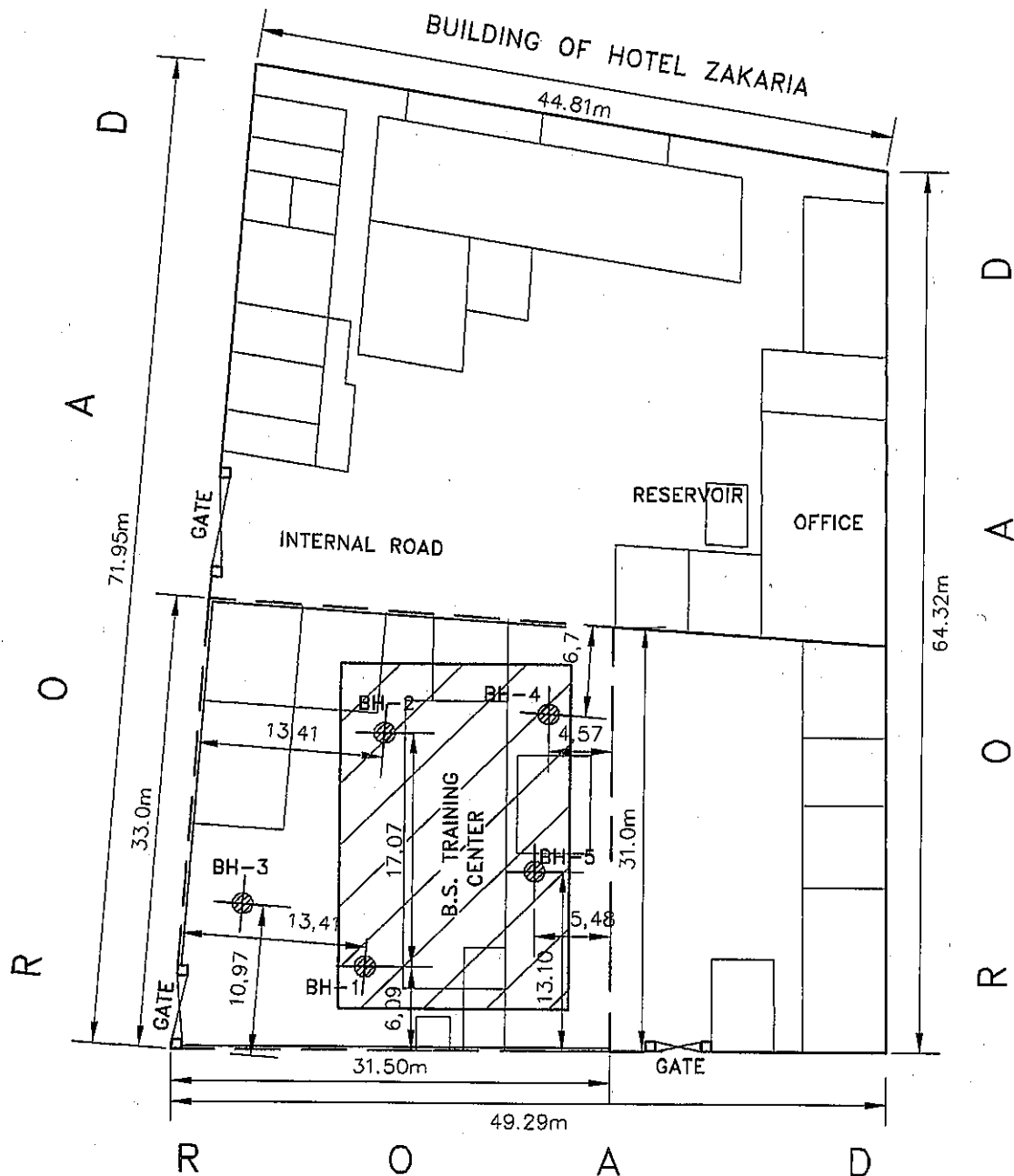
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TITLE :

PROJECT : STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT
ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN
THE PEOPLE'S REPUBLIC OF BANGLADESH.

SITE PLAN

LOCATION : 36-37 MOHAKHALI , DHAKA.

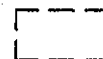


LEGEND :

EXISTING SHED



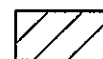
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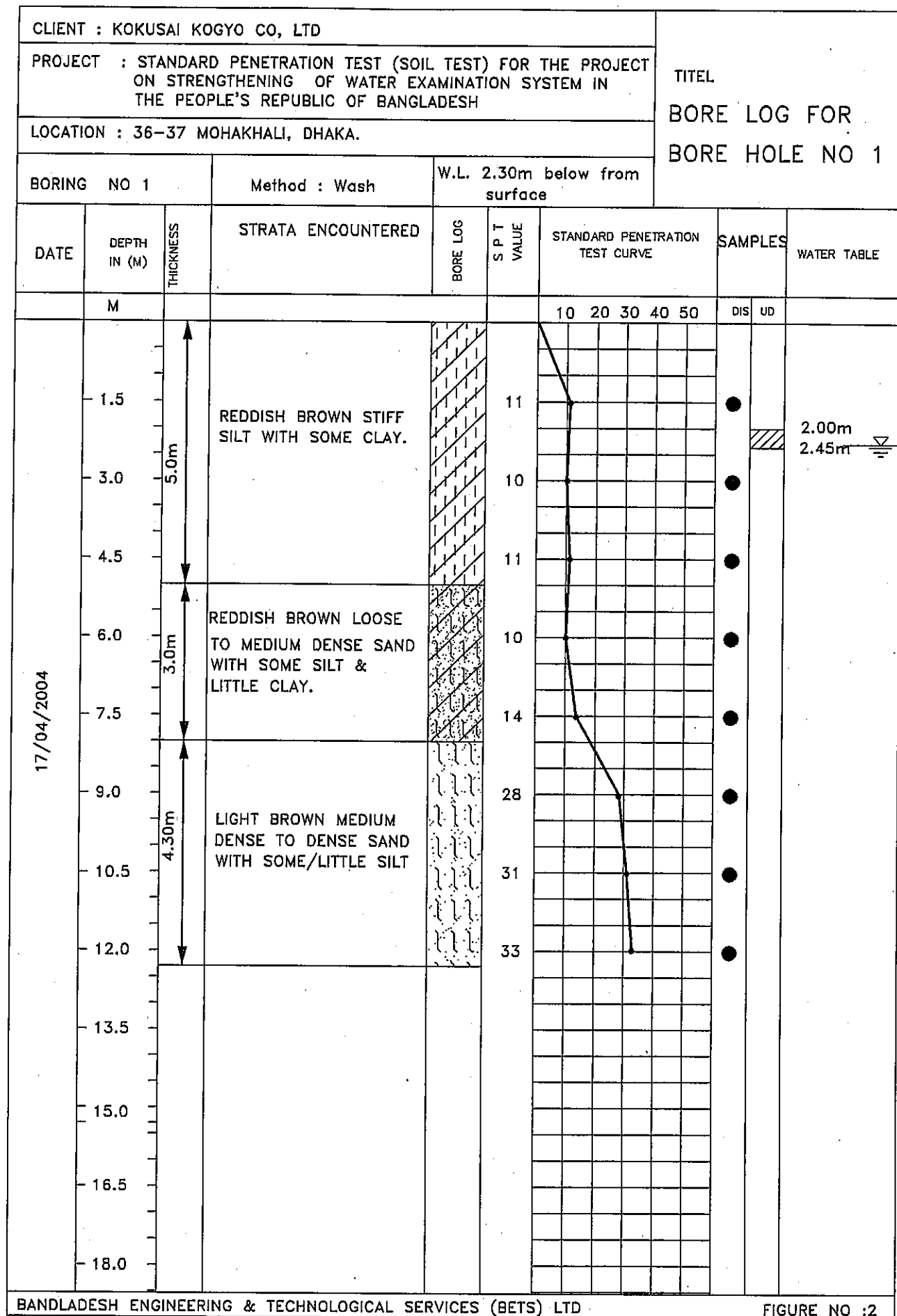


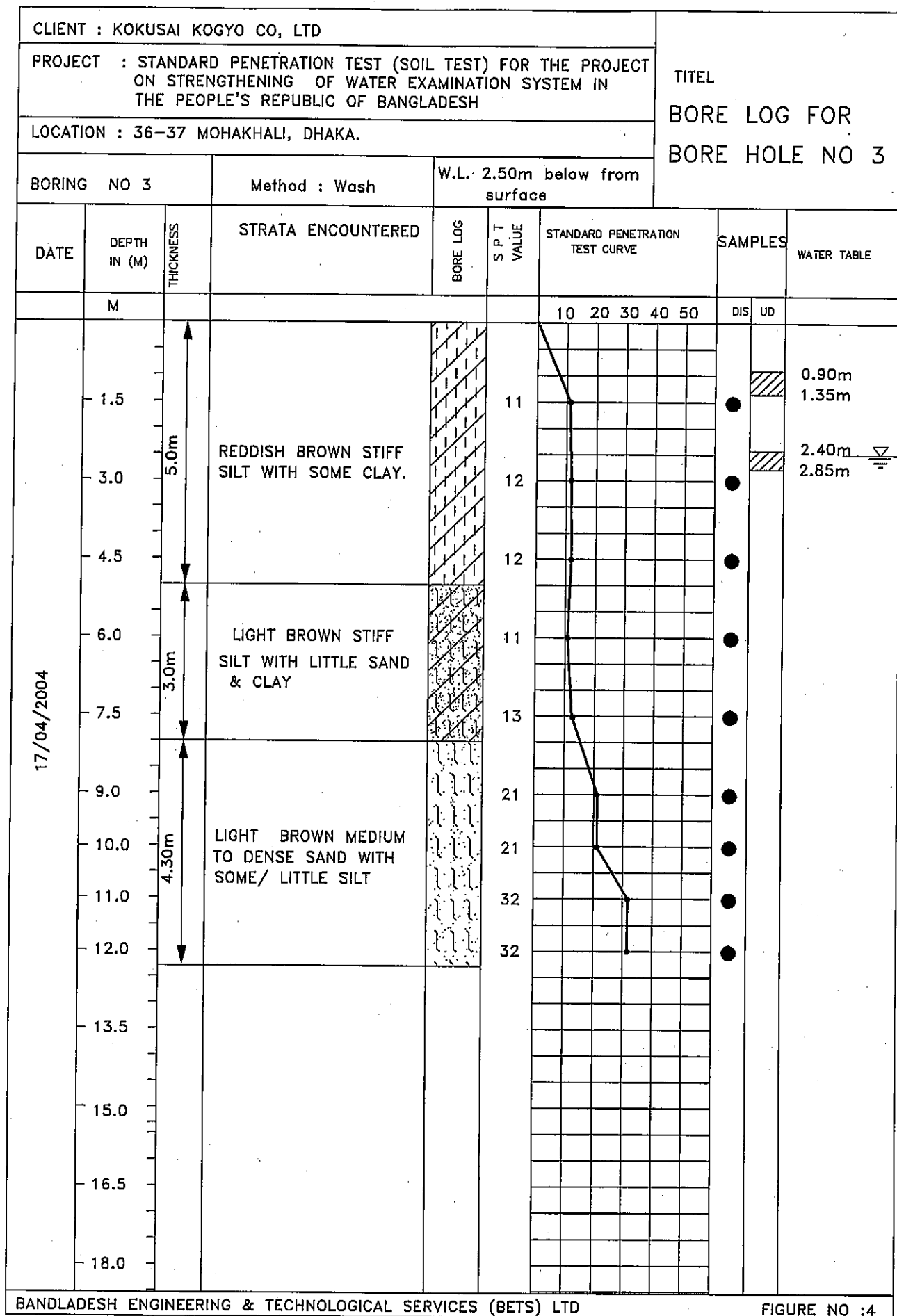
BORING POINT

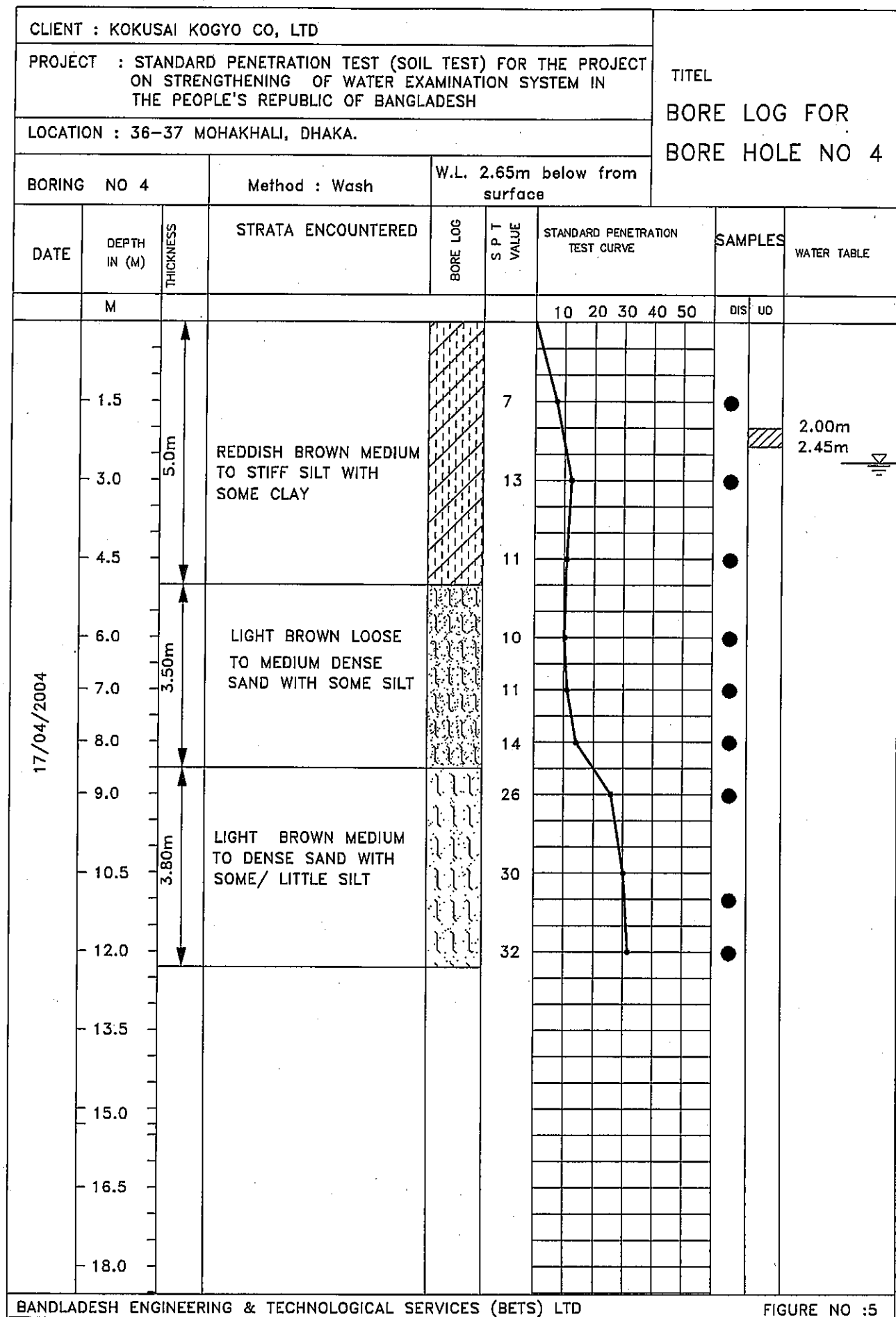


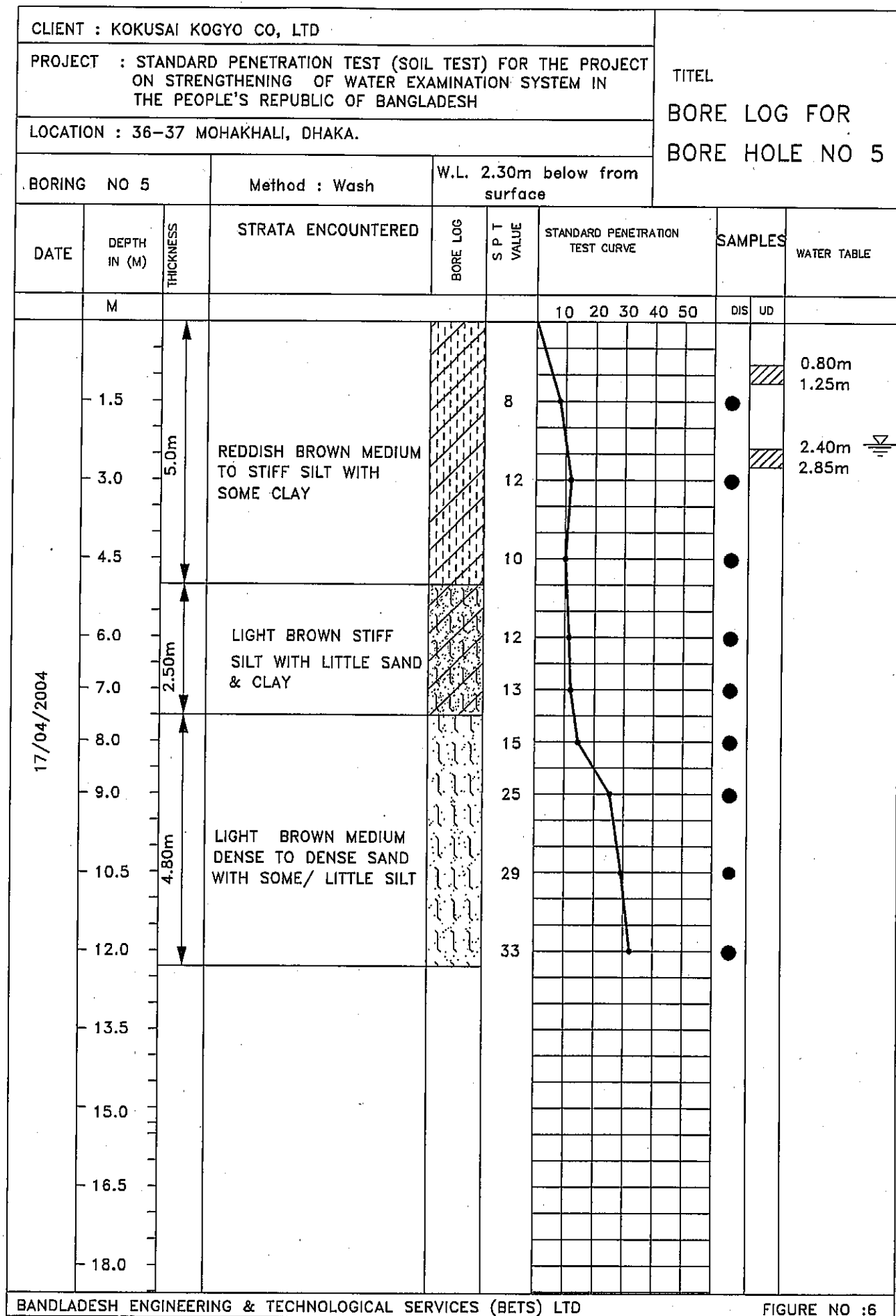
PROPOSED BUILDING LOCATION

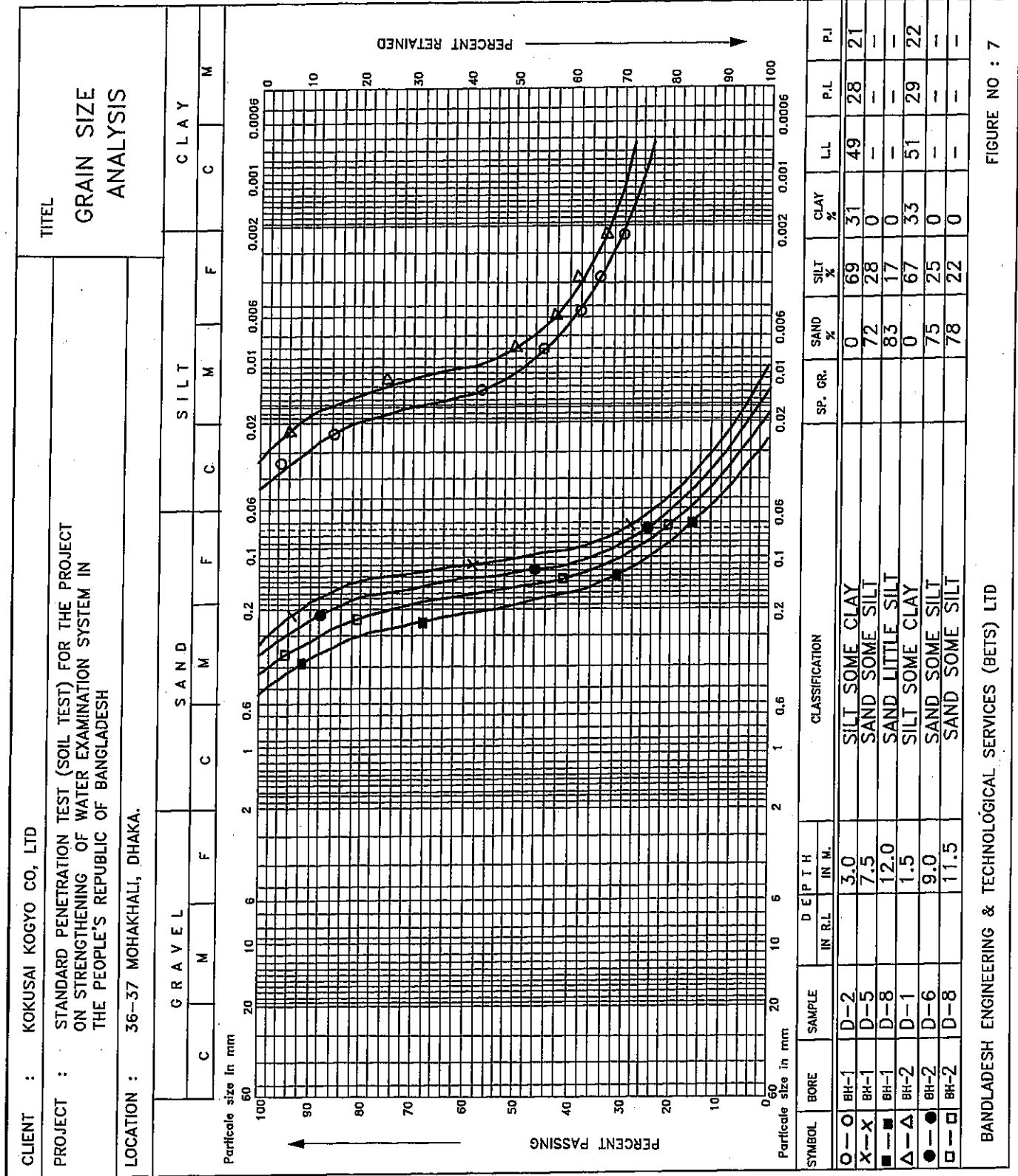


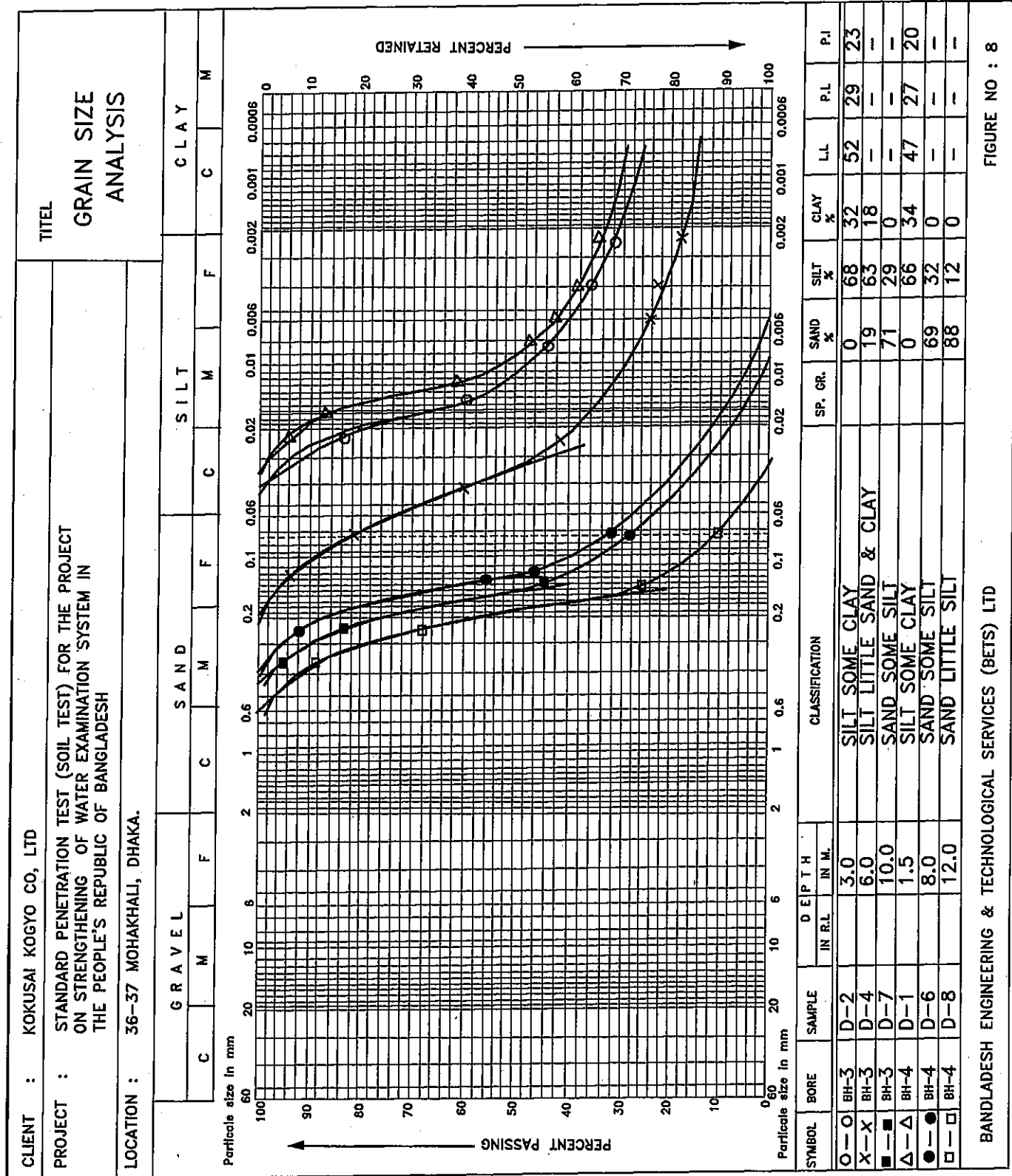


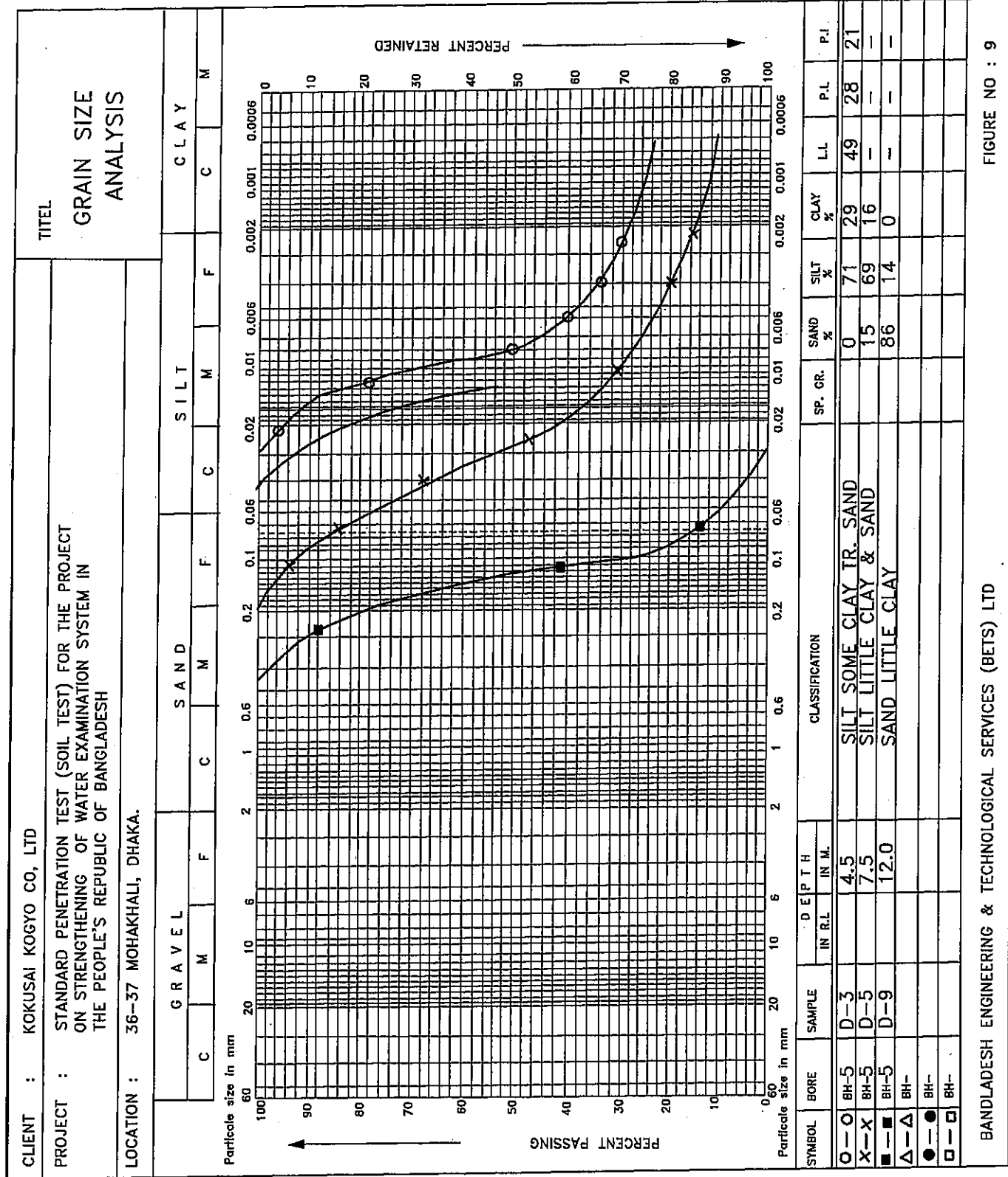




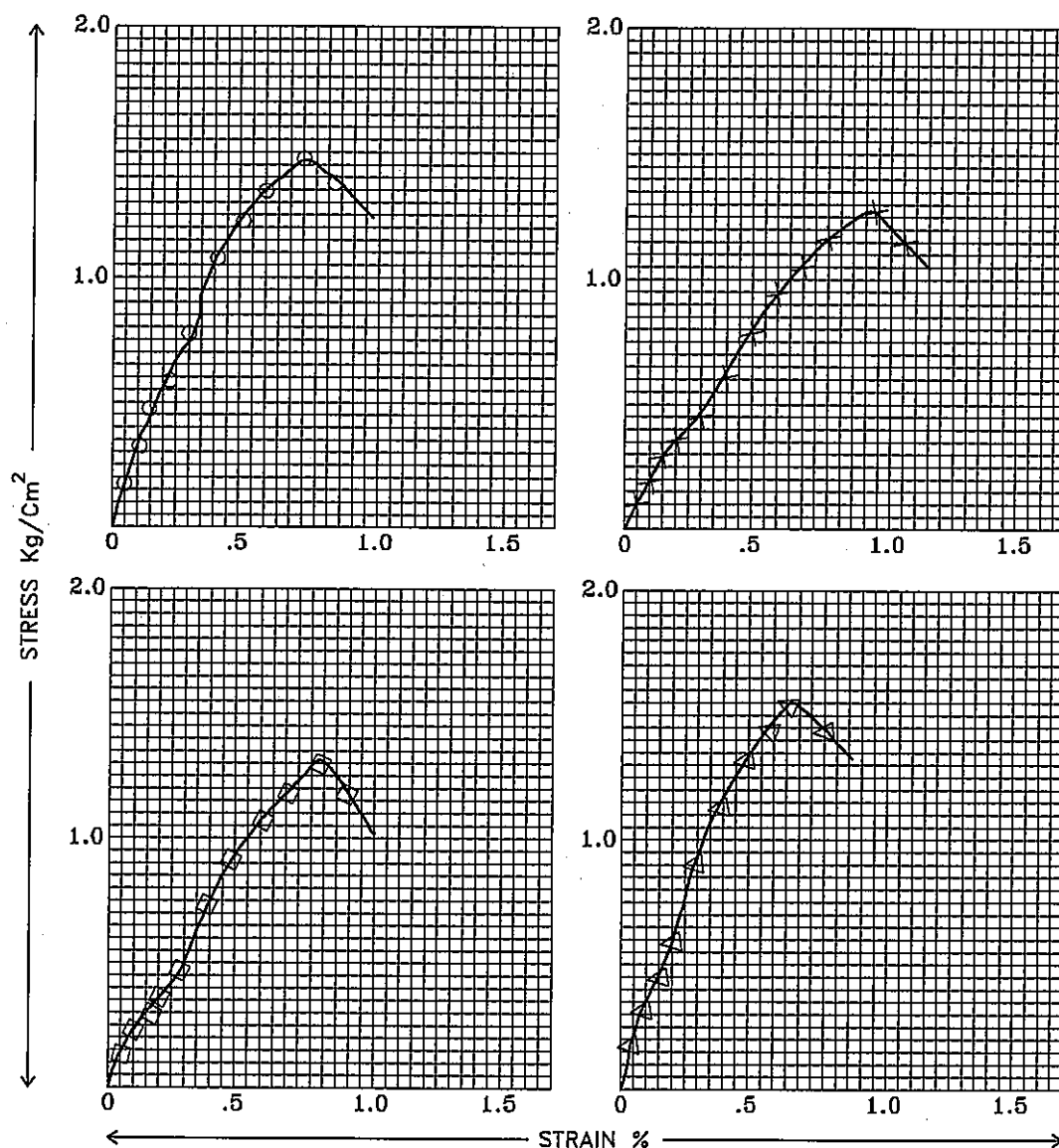






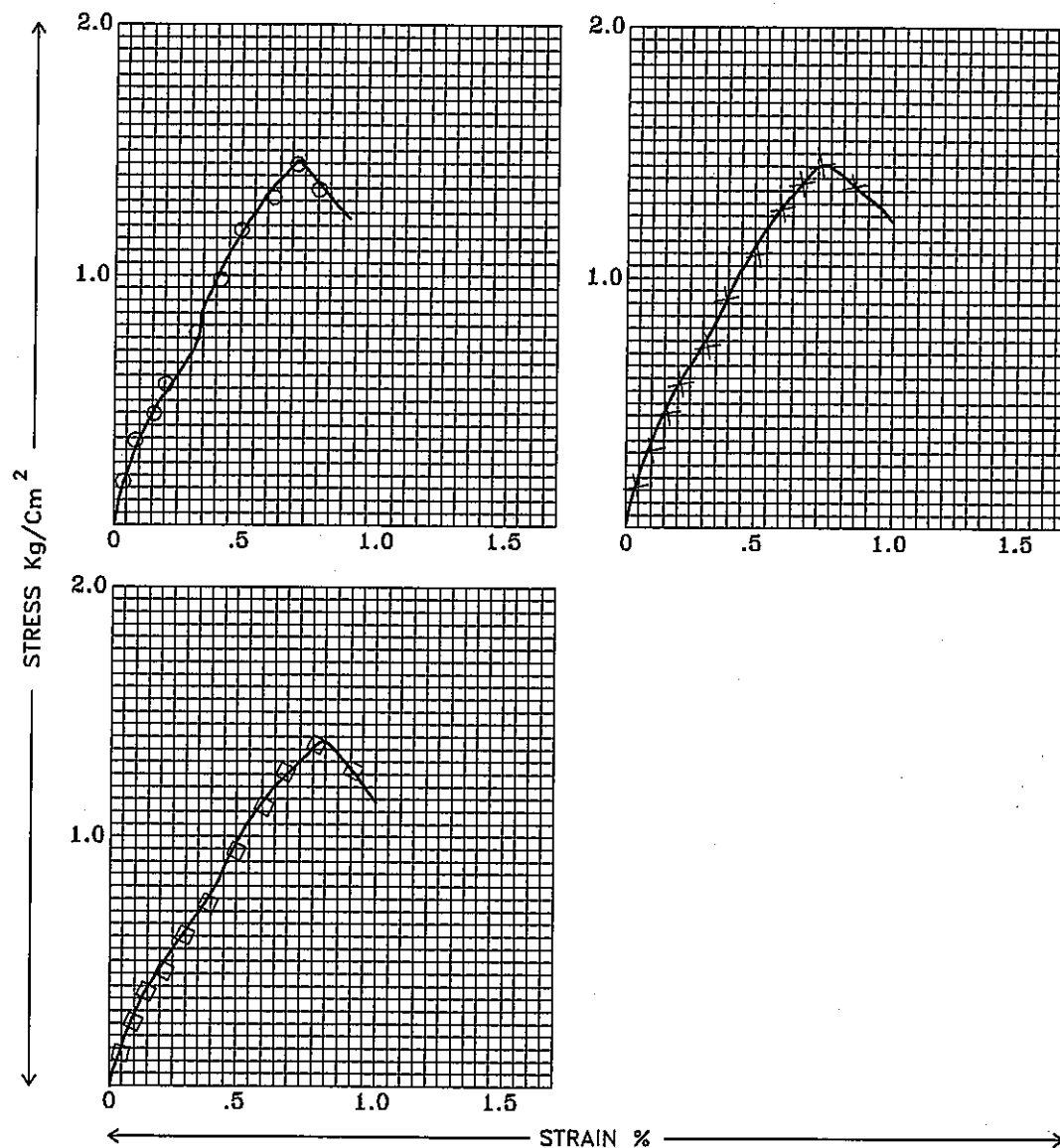


CLEINT:	KOKUSAI KOGYO CO., LIMITED	TITLE: UNCONFINED COMPRESSION TEST
PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	



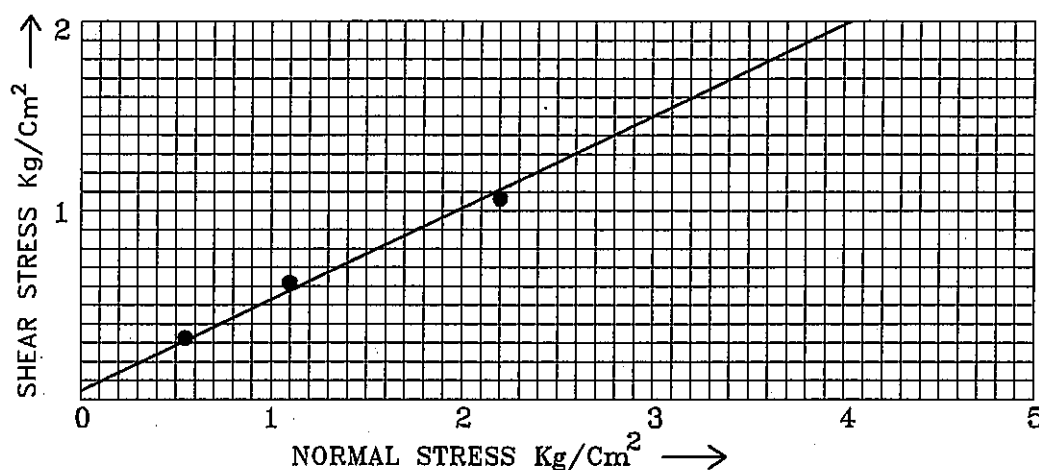
SYMBOL	B.H.NO.	SAMPLE	DEPTH IN M.	q/u Kg/Cm ²	%STRAIN	% WETT T/M ³	% DRY T/M ³	%MOISTURE
○—○	1	U-1	2.00-2.45	1.57	7.43	1.90	1.58	20.25
×—×	2	U-1	0.90-1.35	1.36	9.15	1.82	1.18	23.66
□—□	2	U-2	3.40-3.85	1.41	8.27	1.84	1.50	21.32
△—△	3	U-1	2.40-2.85	1.70	6.49	1.92	1.60	19.65

CLEINT:	KOKUSAI KOGYO CO., LIMITED	TITLE: UNCONFINED COMPRESSION TEST
PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	

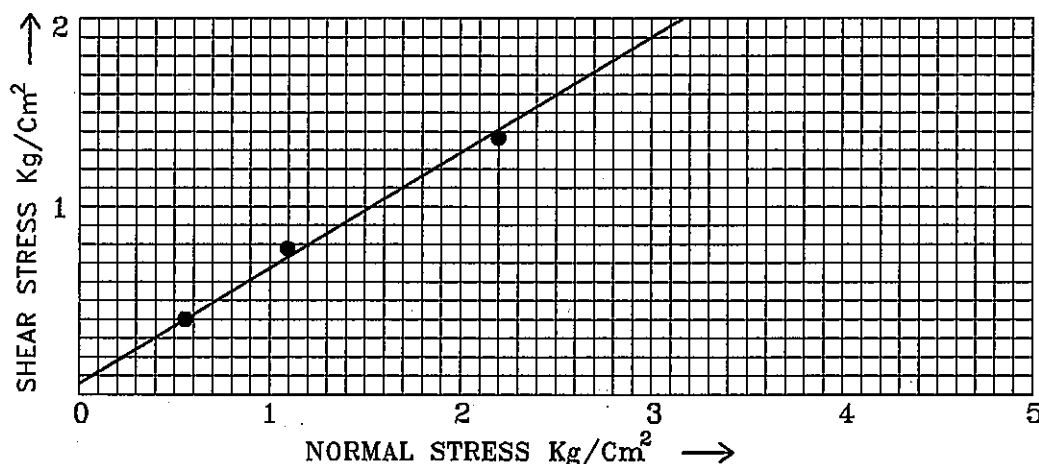


SYMBOL	S.H.NO.	SAMPLE	DEPTH IN M.	q/u Kg/Cm ²	%STRAIN	γ WETT T/M ³	γ DRY T/M ³	%MOISTURE
○—○	4	U-1	2.00-2.45	1.53	7.22	1.88	1.54	21.42
X—X	5	U-1	0.80-1.25	0.78	10.71	1.76	1.40	25.71
□—□	5	U-2	2.40-2.85	1.48	8.35	1.85	1.50	22.65
△—△								

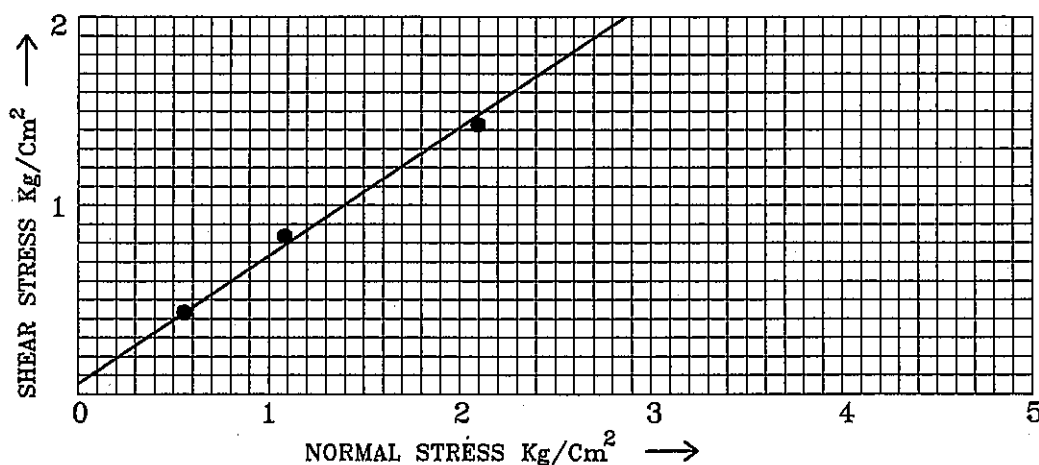
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PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	



BORING NO.	1
SAMPLE NO.	D-4
DEPTH IN M.	6.0
COHESION C Kg/Cm^2	0.06
ANGLE OF INTERNAL FRICTION	25°

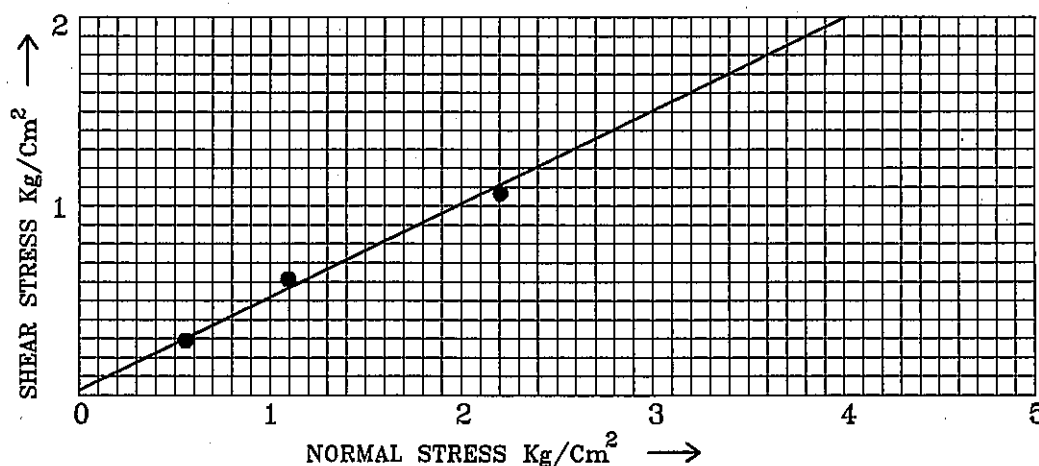
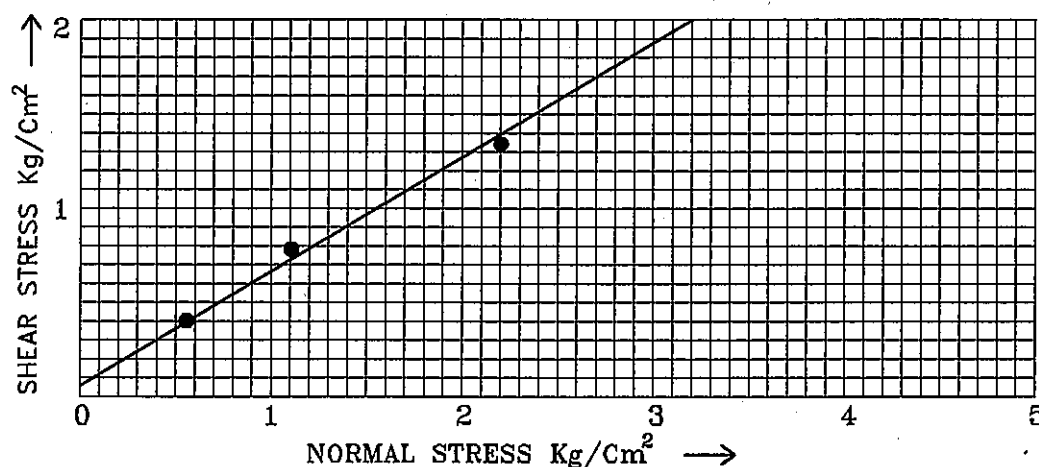
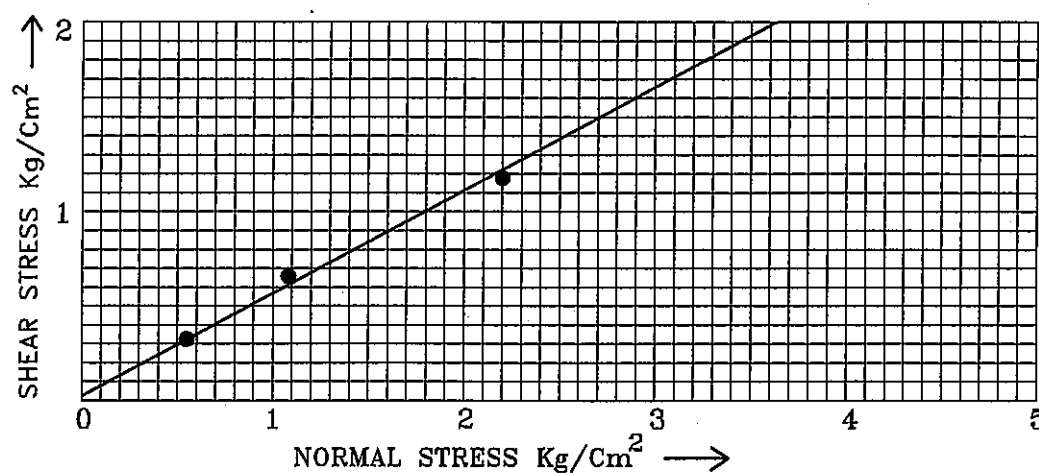


BORING NO.	1
SAMPLE NO.	D-7
DEPTH IN M.	10.5
COHESION C Kg/Cm^2	0.05
ANGLE OF INTERNAL FRICTION	32°

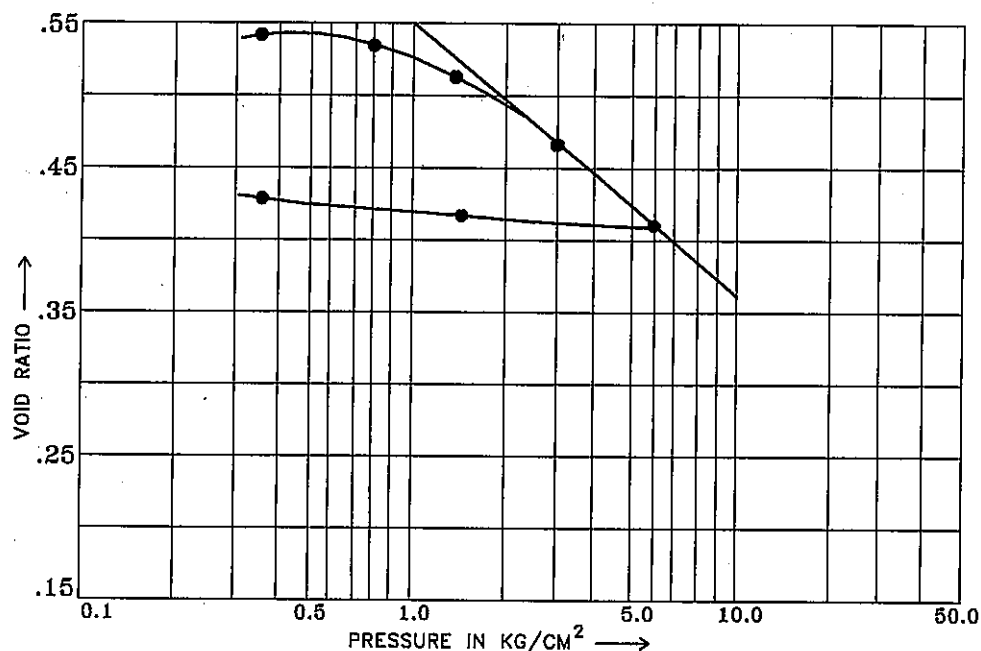


BORING NO.	2
SAMPLE NO.	D-9
DEPTH IN M.	12.0
COHESION C Kg/Cm^2	0.07
ANGLE OF INTERNAL FRICTION	34°

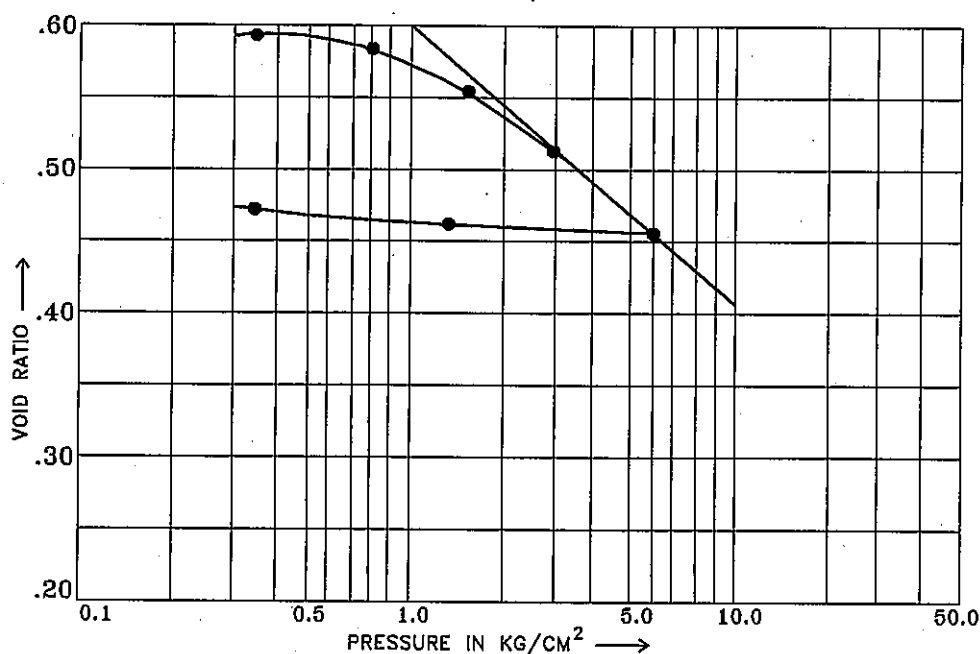
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PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	



CLEINT:	KOKUSAI KOGYO CO., LIMITED	TITLE: CONSOLIDATION TEST
PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	

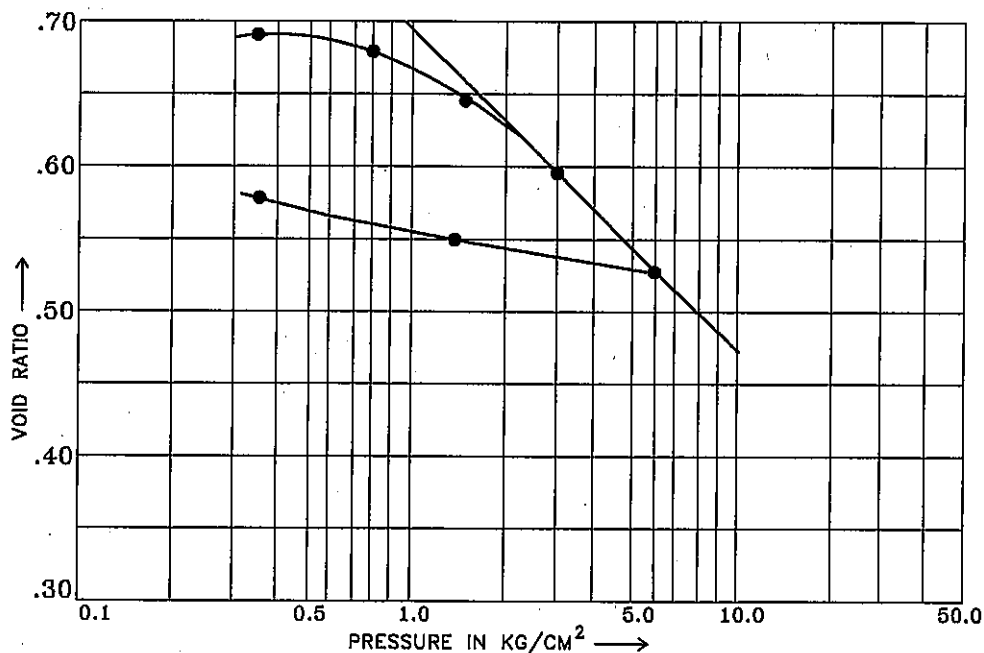


BORING NO.	1
SAMPLE NO.	U-1
DEPTH IN M.	2.00 2.45
MOISTURE CONTENT %	20.25
SPECIFIC GRAVITY	2.674
DRY DENSITY	1.58
INITIAL VOID RATIO E.	0.54
COMP. INDEX C _c	0.175



BORING NO.	2
SAMPLE NO.	U-2
DEPTH IN M.	3.40 3.85
MOISTURE CONTENT %	22.32
SPECIFIC GRAVITY	26.51
DRY DENSITY	1.50
INITIAL VOID RATIO E.	0.585
COMP. INDEX C _c	0.185

CLEINT:	KOKUSAI KOGYO CO., LIMITED	TITLE: CONSOLIDATION TEST
PROJECT:	STANDARD PENETRATION TEST (SOIL TEST) FOR THE PROJECT ON STRENGTHENING OF WATER EXAMINATION SYSTEM IN THE PEOPLE'S REPUBLIC OF BANGLADESH	
LOCATION:	36-37 MOHAKHALI, DHAKA.	



BORING NO.	5
SAMPLE NO.	U-1
DEPTH IN M.	0.80 1.25
MOISTURE CONTENT %	25.71
SPECIFIC GRAVITY	2.648
DRY DENSITY	1.40
INITIAL VOID RATIO E.	0.675
COMP. INDEX C _c	0.225