N.O.W:- CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW

कार्यालय लखनऊ केन्द्रीय मण्डल-I
के० लो० नि० वि०
फाइल 438
दिनांक 25/06/18

SOIL INVESTIGATION REPORT

Sri
AE(C)
① Pl keep in work file
② The copy on e-mail has been sent to consultant

CLIENT:

EXECUTIVE ENGINEER,
LUCKNOW CENTRAL DEVISION-1,
C.P.W.D, 3RD FLOOR KENDRIYA SECTOR - H, ALIGANJ, LUCKNOW - 226024.

CONSULTANT:

M/S SWATI STRUCTURE SOLUTIONS PVT. LTD.
DELHI OFFICE: 503, 5TH FLOOR, SACHDEVA CORPORATE TOWER, PLOT NO. 8, ROHINI,SEC-8,ROHINI, DELHI-110085, PH.: 011-47528888
LUCKNOW OFFICE: 12, SHYAM NAGAR, KHURRAM NAGAR, LUCKNOW-226022, MOB.: 9818732545
EMAIL: SWATICONSULTANT@GMAIL.COM

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1.0 INTRODUCTION

The work of Construction of SIDBI Head Office Building At Plot No.-7/8, Sector-7, Gomti Nagar Extension, Lucknow has been assigned to M/S Swati Structure Solutions Pvt. Ltd., having its address at 12, Shyam Nagar, Khurram Nagar, Lucknow-226022. The present structure is B+G+4 storied RCC framed structure. The report presents the details of field investigation carried out in the month of May-2018 and the results obtained from various field and laboratory tests and its computation. Foundation analysis has been done and recommendations made as regards to suitable type of foundations to be provided for the proposed structure.

2.0 SCOPE OF WORK

a) Mobilization and demobilization of all relevant men and machinery including all T&P required for carrying out soil investigation work as per direction of Engineer-in-charge.

b) Drilling 6 Nos. Bore holes up to the depth of 25.0 m or refusal whichever is earlier below the ground surface by Rotary and auger method.

c) Conducting Standard Penetration Test at 1.50m regular interval as per Indian Standard Specification.

d) Collection of disturbed and undisturbed soil samples from the bore holes at regular interval of 1.50m or change of strata.

e) Carrying out lab test to find physical properties of sub soil strata.

f) Recording of water table level in the bore hole after completion of bore hole.

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g) Preparation and submission of report incorporating all the data obtained from the field and laboratory tests.

h) Evaluation of SBC based on shear & settlement Criteria.

i) Calculation of Sulphate, Chloride and Alkali content in soil & water.

j) Computation of soil sub-grade reaction.

3.0 LOCATION OF BORE HOLES

The locations of six nos. of bore holes are shown in Bore Hole Location Plan of proposed site. The test locations were provided by the client

4.0 ORGANISATION OF REPORT

This report has been primarily designed to explain the whole study in a systematic way, keeping in view the various demands of designers as well as the client. This investigation is backed by its theoretical analysis based on relevant IS codes, field tests (SPT) and the various lab testing done on undisturbed and disturbed samples are presented here in this report through tabular and/or graphical form. Calculations are shown wherever necessary before incorporating any parameter in these recommendations. The chapter 'Introduction' describes the details of the project and various contents of this study. 'Site Reconnaissance' provides the general information regarding the site conditions, weather of the region, topography and the geology of the area. Details of various field and laboratory tests are given separately. Findings obtained during these tests are summarized in this report. Foundation Analysis has been carried out to determine the suitable type of foundation. Recommendations are

finalized in the concluding section. Various table, figures and graphs are given in the appendices and are quite self explanatory.

A list of Indian Standard (IS) Codes, referred for providing the recommendation and that which might be required to implements the same is also enclosed in this report in appendix-A.

5.0 FIELD INVESTIGATION

5.1 The general grain size distribution pattern in the bore-holes as observed has been given below:

Bore Hole (BH) No.	Subsoil Layers	Soil Type	Shear Parameters	
			Cohesion c in kg/cm^2	Action of friction (in Degree)
BH-1	Layer-1 (0.0m to 2.0m)	Sandy Silt with Clay	0.01	22^0
	Layer-2 (2.0m to 25.0m)	Sandy Soil	0.01	22^0
BH-2	Layer-1 (0.0m to 2.7m)	Sandy Silt with Clay	0.01	22^0
	Layer-2 (2.7m to 25.0m)	Sandy Soil	0.01	22^0
BH-3	Layer-1 (0.0m to 3.0m)	Sandy Silt with Clay	0.01	24^0
	Layer-2 (3.0m to 25.0m)	Sandy Soil	0.01	24^0

BH-4	Layer-1 (0.0m to 2.9m)	Sandy Silt with Clay	0.01	24^0
	Layer-2 (2.9m to 25.0m)	Sandy Soil	0.01	24^0
BH-5	Layer-1 (0.0m to 2.95m)	Sandy Silt with Clay	0.01	24^0
	Layer-2 (2.95m to 25.0m)	Sandy Soil	0.01	24^0
BH-6	Layer-1 (0.0m to 3.0m)	Sandy Silt with Clay	0.01	24^0
	Layer-2 (3.0m to 25.0m)	Sandy Soil	0.01	24^0

5.2 Subsurface Exploration

Subsurface Exploration was carried out in 6 nos. of bore holes at site using rotary and auger method of boring [BH1 to BH 6]. The depth of various bore- holes is taken from the existing ground surface. Disturbed and undisturbed samples are collected from bore- holes at various depths.

5.3 Boring

The bore holes of 150 mm dia. were drilled by rotary and Auger method up to the specified depth.

5.4 Standard Penetration Test (SPT)

Standard penetration tests as per IS: 2131-1981 was conducted at all the bore holes, each at 1.5m interval or change of strata. The tests were performed by using a standard split spoon sampler attached to 'A' rod placed at the test level in the bore hole. The sampler was driven to a depth of 45cm

by means of a standard hammer weighing 63.5 Kg. falling freely through a vertical height of 75 cm. Blows required for each 15 cm penetration (Total penetration 45cm) were recorded and the number of blows for last 30cm penetration of the sampler was taken as N_{SPT} values. Blows for first 15 cm penetration of the sampler in each test, were discarded owing to the possible disturbance of the strata during auguring operations. The observed and the corrected N_{SPT} values (IS: 2131-1981) are given with graphical representation and soil profile.

5.5 Undisturbed sampling

Undisturbed samples were collected from the bore holes at regular intervals. These samples were collected by attaching sampling tube to a drill rods and penetrating the tube through the strata as per IS: 2132. After the tube was filled, it was taken out and waxed at both ends to avoid any loss of moisture content. The samples were carefully labeled and duly recorded and thereafter sent to the laboratory for testing.

5.6 Ground Water Table

Water table as encountered in the various bore holes & it is vary approximately from 10.4m to 10.7m depth.

6.0 LABORATORY TESTS

A visual and discrete examination of all the soil samples collected was carried out for deciding the number and type of tests as well as the number of samples to be tested from each bore hole. Based on the strata met at site the following tests were conducted on samples to classify them and to evaluate their index and Engineering properties.

a) Grain size distribution
b) Bulk density and Moisture content
c) Direct Shear Test
d) Liquid limits and plastic limits

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

e) Specific Gravity

f) Sulphate, Chlorides, Alkali

6.1 Bulk Density and Natural Moisture Content

Undisturbed samples were collected from the boreholes in thin wall steel sample tubes by taking the dimensions and weight of these sample tubes, the bulk density of the soil is determined. Moisture content of the soil has been calculated by Oven Drying Method.

6.2 Grain Size Analysis

Grain size distribution of the soil is determined by sieving the soil sample in a set of IS sieves: *4.75mm, 2.36mm, 1.18mm, 0.60mm, 0.30mm, 0.15mm, 0.075mm* size. Grain Size Analysis curve has been plotted and attached in the appendices of this report for the soil samples collected from various depths of bore-holes.

6.3 Atterberg Limits

Atterberg Limits in the form of liquid limit, plastic limit and shrinkage limit are determined for the soil to establish its consistency. In the case of cohesion less soil, plastic limit is first determined and if it cannot be determined the soil sample is reported to be non-plastic.

6.4 Specific Gravity

Specific Gravity of the soil has been determined by Specific Gravity Bottle.

6.5 Direct Shear Test

A direct shear test is a laboratory or field test used by geotechnical engineers to measure the shear strength properties of soil or rock material, or of discontinuities in soil or rock masses.

The IS Code defining how the test should be performed are IS 2720 (Part XIII), respectively.

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

The test is performed on three or four specimens from undisturbed soil sample. A specimen is placed in a shear box which has two stacked rings to hold the sample; the contact between the two rings is at approximately the mid-height of the sample. A confining stress is applied vertically to the specimen, and the upper ring is pulled laterally until the sample fails, or through a specified strain. The load applied and the strain induced is recorded at frequent intervals to determine a stress-strain curve for each confining stress. Several specimens are tested at varying confining stresses to determine the shear strength parameters, the soil cohesion (c) and the angle of internal friction (commonly friction angle) (Φ). The results of the tests on each specimen are plotted on a graph with the peak (or residual) stress on the x-axis and the confining stress on the y-axis. The y-intercept of the curve which fits the test results is the cohesion, and the slope of the line or curve is the friction angle.

6.6 Curves developed from Field & Lab. Test Results

Using the data obtained from field and laboratory tests, the following relationships are plotted for each area separately.

a) Curves showing the variation of the standard penetration value "N" with depth of each bore hole.
b) Curves between Shear Stress and shear Strain in the Direct Shear Test for each bore hole.
c) Curves between Shear Stress and normal (Failure Plane) in the Direct Shear Test for each bore hole.
d) Curves showing Grain Size Analysis for each bore hole.

6.7 CHEMICAL ANALYSIS OF SUBSOIL WATER SAMPLES

Chemical analysis soil sample have been carried out for evaluation of pH value, sulphate content, calcium content, chloride content and total dissolved solids in water for each borehole has been conducted and the results are given below.

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

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BH No.	pH value	Nature of Sub Soil	Chloride Content (mg/l)	Calcium content (N/5g of soil)	Sulphate content (mg/l)
BH-1	7.7	Alkaline(Basic)	200	0.8	200
BH-2	7.6	Alkaline(Basic)	195	0.6	170
BH-3	7.8	Alkaline(Basic)	185	0.9	180
BH-4	7.6	Alkaline(Basic)	200	0.8	185
BH-5	7.8	Alkaline(Basic)	205	0.8	200
BH-6	7.8	Alkaline(Basic)	205	0.8	190

7.0 STRENGTH CHARACTERISTICS OF SOIL

At the proposed site 6 nos. of borehole was drilled up to the depth mentioned in the bore log data. This Bore hole was advanced by Shell and Auger method up to the depth specified below the ground surface. While advancing the bore holes SPT tests were conducted at regular intervals of 1.5m depth and representative samples were collected and analyzed for soil classification. Water table as encountered in the bore holes from 10.4m to 10.7m depth at the bore holes at the time of soil investigation. The SPT values obtained have been corrected for overburden pressure. These corrected values have been plotted against depth and are shown in the respective bore log. It has been seen from the plots that the SPT values varying from 8 to 41 has been achieved for various bore holes and at various depth as shown in bore log plot between SPT value and depth. Direct Shear Tests were conducted on undisturbed soil

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

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samples collected at regular intervals of 1.5m for evaluating the shear parameters. The results are shown in the bore log.

8.0 DESIGN METHODOLOGY

8.1 Isolated foundation

Since the structure to be constructed on this site is RCC framed structure with basement raft foundation has been analyzed, at a depth of 4m below EGL. An allowable settlement for raft foundation as 75mm has been considered as per IS: 1904 – 1986. The recommendation for Isolated footing shall also be given for small structure and boundary wall. The allowable settlement for Isolated footing shall be taken as 50mm.The evaluation of SBC of foundation has been done using following two criteria:

a) Shear Failure Criteria

The safe bearing pressure from interpolation of General& Local Shear failure criteria can be obtained, using the Equation given below

Q_{ab} =0.67C Nc Sc dc ic + q (Nq-1) sq dq iq + 0.5 B γ Nr Sr dr ir Rw1

Where

C = cohesion in KN/m^2

B = Width of the footing in m

d_q, d_γ, dc = Depth factors

Sq, Sγ, Sc = Shape factors

Iq, Iγ, Ic = Inclination factors

N'q, N'γ, N'c = Bearing capacity factor

q = Total surcharge at the base level of foundation

W' = Water table correction factor (Considered for flooding and heavy rain)

γ = Bulk unit wt. of foundation soil, in KN/m^3

Deletion.....Nil.....
Correction.....Nil.....
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b) Settlements:

i) Soil profiles are given for each bore holes. The Soil profile which is likely to cause greater settlements is to be considered for calculations.

ii) The imposed load at the foundation level is likely to compress the soil up to the depth of approximately equal to 1.5B below the foundations.

iii) The settlements can be calculated using IS-8009 part-I & II.

BASEMENT AREA

SAMPLE CALCULATION FOR RAFT FOUNDATION

SAFE BEARING CAPACITY		
Symbol	Description	Value
C	Cohesion	0.010
ϕ	Angle of shearing resistance of soil in degrees	24
ϕ_m	Angle of shearing resistance of soil in degrees $[\tan^{-1}(0.67(\tan\phi))]$	16.61
G	Specific Gravity	2.65
γ_d	Dry Density of Soil	14.00
e	Void ratio $[(G\gamma_w/\gamma_d)-1]$	0.89
N'c	Bearing Capacity Factor (Local Shear)	12.22
N'q	Bearing Capacity Factor (Local Shear)	4.73
N'γ	Bearing Capacity Factor (Local Shear)	3.53
	Shape of Base	RECTANGLE
Sc	Shape Factor (Rectangle)	1.10
Sq	Shape Factor (Rectangle)	1.10
Sr	Shape Factor (Rectangle)	0.80
D	Depth of Embedment of Foundation below basement level(m)	1.2
B	Width of Raft Foundation (m)	37
Nϕ	$\tan^2(\pi/4 + \phi/2)$	0.026
dc	Depth Factors $(1 + 0.2\ Dt/BV N\phi)$	1.00
Ic	Inclination Factors	1
Iq	Inclination Factors	1

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

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ir	Inclination Factors	1
γ	Density at Foundation Level	15.00 KN/m3
q	Total surcharge at the base level of foundation (γ X D)	18.00 KN/m3
dq = dr	Depth Factors (1 for $\phi < 10^{\circ}$)	-
dq = dr	Depth Factors ($1+0.1\ Dt/B\sqrt{N\phi}$ for $\phi < 10^{\circ}$)	1.001
Rw_1	Reduction Factor	0.75
Qu	Ultimat bearing capacity of Foundation	Qu = 0.5 C Nc Sc dc ic + q (Nq-1) sq dq iq + 0.5 B γ Nr Sr dr ir Rw1
Qu	**Ultimat bearing capacity of Foundation**	**662 KN/m2**
FS	Factor of Safety	2.5
qs	**Qu/FS**	**265.0 KN/m2**
	Allowable Bearing Capacity of Foundation	**26.50 t/m2**

9.0 DISCUSSION ON SOIL PROFILE

Results of field tests and lab tests indicate that there is sandy silt with clay up to a depth of 2.0-3.0m in almost all bore holes. It is followed by sandy soil up to a depth of 25.0m. Grain size distribution curve has been drawn for each bore hole separately as shown in the report. Direct shear tests has been conducted on disturbed and undisturbed soil sample taken at various depth and values of 'c' and phi has been evaluated from the curve. The bearing capacity of soil has been evaluated both from shear criteria and settlement criteria and is given in recommendation section. Water table was encountered in the bore hole at the depth of 10.4m to 10.7m depth as per bore log data. The modulus of subgrade reaction according to Bowle's equation is 3533.33 kN/m^3.

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

9.1 Bearing Capacity

9.1.1 Isolated Foundation

FROM SHEAR CRITERIA

Depth of Foundation below EGL (m)	Footing Size(m)	Net Allowable Bearing Capacity (T/sq. m)
2.0	2.0 X 2.0	7.03
	2.5 X 2.5	7.34

9.1.2 Raft Foundation

FROM SHEAR CRITERIA (BASEMENT AREA)

Depth of Foundation below EGL (m)	Embedment Depth of Raft Foundation (m)	Net Allowable Bearing Capacity of Foundation (T/sq.. m)	Gross Bearing Capacity Of Foundation (T/sq. m)
5.0	1.2	26.50	32.35

FROM SETTLEMENT CRITERIA (BASEMENT AREA)

Founding Level of Raft Foundation From EGL (m)	Embedment Depth of Raft Foundation (m)	Net Allowable Bearing Capacity of Foundation (T/sq. m)	Gross Bearing Capacity Of Foundation (T/sq. m)
5.0	1.2	28.40	34.25

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

10.0 RECOMMENDATIONS

ISOLATED FOUNDATION

Depth of Foundation below EGL (m)	Footing Size(m)	Net Allowable Bearing Capacity (T/sq. M)
2.0	2.0 X 2.0	7.03
	2.5 X 2.5	7.34

RAFT FOUNDATION (BASEMENT AREA)

Founding Level of Raft Foundation From EGL (m)	Embedment Depth of Raft Foundation (m)	Net Allowable Bearing Capacity of Foundation (T/sq. m)	Gross Bearing Capacity Of Foundation (T/sq. m)
5.0	1.2	26.50	32.35

NOTE:-

1) If any loose pockets are observed during excavation for foundation, the same shall be filled with PCC 1:5:10. Foundation can subsequently be placed over this prepared surface.
2) If the profile of soil at any location defers from what is shown, the same shall be brought in notice of soil consultant before laying any foundation.

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

11.0 CLOSURE

We appreciate the opportunity to perform this investigation for you and have pleasure in submitting this report. Please contact us when we can be of further service to you.

For Swati Structure Solutions Pvt. Ltd.

Dr. Sadanand Ojha

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.					S.P.T. PLOT Observed / Corrected	PROJECT: CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW												SHEET NO. 16	
						BOREHOLE NO				TERMINAL DEPTH (m)				Water Table					
						BH-1				25.0 meter				10.50 meter					
N Value	N Corrected Value	DEPTH (m) from E.G.L	Type of Sample	Soil Classification		GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY	BULK DENSITY	MOIST. CONT.	SHEAR PARAMETER			Sp. Gr.	VOID RATIO 'e'	COMPRESSION INDEX 'Cc'
						GRAVEL	SAND	SILT	CLAY						TEST TYPE	C	f			
						%	%	%	%	%	%	gm/cc	gm/cc	%		kN/m²	deg.			
		0.50	DS-1	SANDY SILT WITH																
8	8	1.95	SPT-1			0.0	75.4	12.1	12.5	28	15									
		2.80	UDS-1									1.34	1.58	18	UU	0.001	22	2.66	0.99	0.162
10	10	3.45	SPT-2																	
11	11	4.95	SPT-3			0.0	86.7	10.9	2.4	20	NP									
		5.80	UDS-2									1.43	1.56	9	UU	0.001	22	2.65	0.85	0.09
12	12	6.45	SPT-4																	
13	13	7.95	SPT-5																	
		8.80	UDS-3																	
16	16	9.45	SPT-6			0.0	90.2	6.8	3.0	25	NP									
19	17	10.95	SPT-7																	
		11.80	UDS-4	UNIFORM FINE SAND								1.29	1.60	24	UU	0.002	23	2.67	1.07	0.135
22	19	12.45	SPT-8																	
24	20	13.95	SPT-9																	
		14.80	UDS-5																	
25	20	15.45	SPT-10			0.0	81.8	16.8	1.4	25	NP									
28	22	16.95	SPT-11																	
		17.80	UDS-6									1.35	1.58	17	UU	0.002	22	2.66	0.97	0.135
29	22	18.45	SPT-12																	
30	23	19.95	SPT-13																	
		20.80	UDS-7																	
34	25	21.45	SPT-14																	
37	26	22.95	SPT-15			0.0	88.4	8.5	3.1	23	NP									
		23.80	UDS-8									1.42	1.60	13	UU	0.001	23	2.65	0.87	0.117
40	28	25.00	SPT 16																	

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

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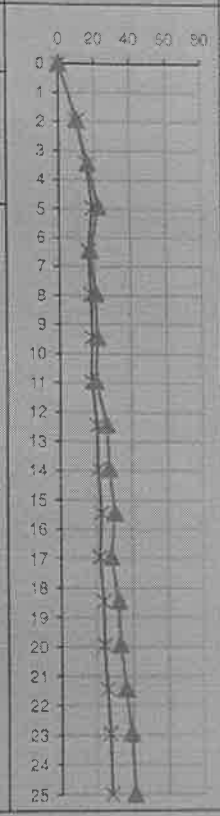
SWATI STRUCTURE SOLUTIONS PVT. LTD.					S.P.T. PLOT Observed Corrected	PROJECT: CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW													SHEET NO. 17
						BOREHOLE NO BH-2					TERMINAL DEPTH (m) 25.0 meter			Water Table 10.40 meter					
N Values	N Corrected Values	DEPTH (m) from E.G.L.	Type of Sample	Soil Classification	0 20 40 60 80 100	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY	BULK DENSITY	MOIST. CONT.	SHEAR PARAMETER			Sp. Gr.	VOID RATIO 'e'	COMPRESSION INDEX 'Cc'
						GRAVEL %	SAND %	SILT %	CLAY %	%	%	gm/cc	gm/cc	%	TEST TYPE	C kg/cm²	ϕ deg.			
		0.50	DS-1	SANDY SILT WITH CLAY	0															
9	9	1.95	SPT-1		1	0.0	79.1	12.7	8.2	27	13									
		2.80	UDS-1		2							1.33	1.58	19	UU	0.001	22	2.65	1.0	0.153
10	10	3.45	SPT-2		3															
12	12	4.95	SPT-3		4	0.0	86.5	9.4	4.1	22	NP									
		5.80	UDS-2		5							1.46	1.58	8	UU	0.001	23	2.65	0.81	0.108
11	11	6.45	SPT-4		6															
14	14	7.95	SPT-5		7															
		8.80	UDS-3		8															
16	16	9.45	SPT-6		9	0.0	86.5	9.3	4.1	24	NP									
19	17	10.95	SPT-7		10															
		11.80	UDS-4		11							1.31	1.59	21	UU	0.002	23	2.66	1.02	0.126
24	20	12.45	SPT-8	UNIFORM FINE SAND	12															
27	21	13.95	SPT-9		13															
		14.80	UDS-5		14															
29	22	15.45	SPT-10		15	0.0	84.4	13.0	2.6	25	NP									
31	23	16.95	SPT-11		16															
		17.80	UDS-6		17							1.36	1.60	18	UU	0.002	24	2.65	0.95	0.135
34	25	18.45	SPT-12		18															
35	25	19.95	SPT-13		19															
		20.80	UDS-7		20															
36	26	21.45	SPT-14		21															
36	26	22.95	SPT-15		22	0.0	80.0	8.4	2.6	24	NP									
		23.80	UDS-8		23							1.39	1.60	15	UU	0.001	23	2.66	0.91	0.126
38	27	25.00	SPT-16		24															
					25															

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.					S.P.T. PLOT Observed / Corrected	PROJECT: CONSTRUCTION OF SIDRI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW												SHEET NO. 19	
						BOREHOLE NO					TERMINAL DEPTH (m)			Water Table					
						BH-3					25.0 meter								
N Values	N Corrected Values	DEPTH (m) from E.G.L.	Type of Sample	Soil Classification		GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY	BULK DENSITY	MOIST CONT	SHEAR PARAMETER				
						GRAVEL	SAND	SILT	CLAY						TEST TYPE	C	Φ		
						%	%	%	%	%	%	gm/cc	gm/cc	%		kg/cm²	deg.		
		0.50	DS-1	SANDY SILT WITH CLAY															
10	10	1.95	SPT-1			2.4	72.9	12.8	11.8	25	12								
		2.80	UDS-1									1.26	1.53	21	UU	0.001	22	2.65	1.1
16	16	3.45	SPT-2																
22	19	4.95	SPT-3	UNIFORM FINE SAND		0.0	93.8	4.3	1.9	21	NP								
		5.80	UDS-2									1.39	1.51	9	UU	0.001	24	2.65	0.91
17	16	6.45	SPT-4																
20	18	7.95	SPT-5																
		8.80	UDS-3																
21	18	9.45	SPT-6			0.0	91.1	6.8	2.1	20	NP								
20	18	10.95	SPT-7																
		11.80	UDS-4									1.42	1.55	9	UU	0.001	24	2.67	0.93
26	21	12.45	SPT-8																
27	21	13.95	SPT-9																
		14.80	UDS-5																
30	23	15.45	SPT-10			0.0	86.7	11.1	2.2	22	NP								
28	22	16.95	SPT-11																
		17.80	UDS-6									1.31	1.54	18	UU	0.001	22	2.65	1.04
32	24	18.45	SPT-12																
33	24	19.95	SPT-13																
		20.80	UDS-7																
36	26	21.45	SPT-14																
39	27	22.95	SPT-15			0.0	86.1	10.9	3.1	23	NP								
		23.80	UDS-8									1.29	1.50	15	UU	0.002	23	2.66	0.91
41	28	25.00	SPT 16																



Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.					S.P.T. PLOT Observed Corrected	PROJECT: CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW												SHEET NO. 19	
						BOREHOLE NO					TERMINAL DEPTH (m)			Water Table					
						BH-4					25.0 meter			10.50 meter					
N Value	N Corrected Value	DEPTH (m. from E.G.L.	Type of Sample	Soil Classification	0 20 40 60 80	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY	BULK DENSITY	MOIST. CONT.	SHEAR PARAMETER			Sp. Gr.	VOID RATIO e	COMPRESSION INDEX Cc
					0	GRAVEL %	SAND %	SILT %	CLAY %	%	%	gm/cc	gm/cc	%	TEST TYPE	C N/mm²	f deg.			
		0.50	DS-1	SANDY SILT WITH CLAY	1															
8	8	1.95	SPT-1		2	1.3	78.0	9.9	10.8	26	13									
		2.80	UDS-1		3							1.30	1.60	23	UU	0.002	22	2.65	1.04	0.144
10	10	3.45	SPT-2		4															
11	11	4.95	SPT-3		5	0.0	89.2	8.7	2.0	22	NP									
		5.80	UDS-2		6							1.39	1.50	8	UU	0.001	23	2.65	0.91	0.108
12	12	6.45	SPT-4		7															
13	13	7.95	SPT-5		8															
		8.80	UDS-3		9															
16	16	9.45	SPT-6		10	0.0	89.3	9.3	1.3	23	NP									
19	17	10.95	SPT-7		11															
		11.80	UDS-4		12							1.27	1.55	22	UU	0.001	23	2.66	1.09	0.117
22	19	12.45	SPT-8	UNIFORM FINE SAND	13															
24	20	13.95	SPT-9		14															
		14.80	UDS-5		15															
25	20	15.45	SPT-10		16	0.0	83.8	14.9	1.2	25	NP									
28	22	16.95	SPT-11		17															
		17.80	UDS-6		18							1.34	1.58	18	UU	0.002	24	2.65	0.98	0.135
29	22	18.45	SPT-12		19															
30	23	19.95	SPT-13		20															
		20.80	UDS-7		21															
34	25	21.45	SPT-14		22															
37	26	22.95	SPT-15		23	0.0	84.4	13.5	2.1	25	NP									
		23.80	UDS-8		24							1.37	1.60	17	UU	0.002	24	2.66	0.95	0.135
40	28	25.00	SPT 16		25															

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.

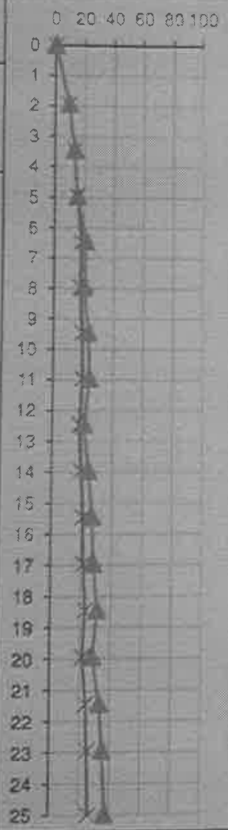
PROJECT: CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.- 7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW

SHEET NO. 20

BOREHOLE NO: BH-5 | TERMINAL DEPTH (m): 25.0 meter | Water Table: 10.60 meter

S.P.T. PLOT

Observed / Corrected



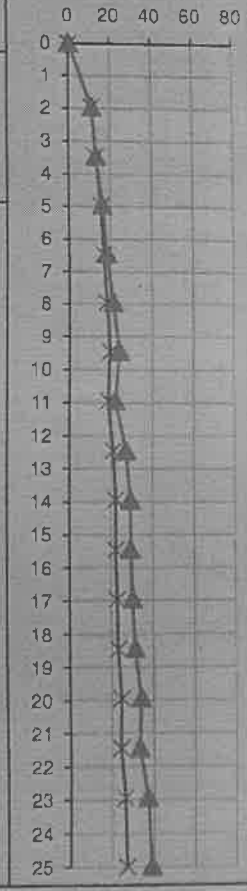
N Values	N Corrected Values	DEPTH (m) from E.G.L.	Type of Sample	Soil Classification	GRAVEL %	SAND %	SILT %	CLAY %	LIQUID LIMIT %	PLASTIC LIMIT %	DRY DENSITY g/cc	BULK DENSITY g/cc	MOIST. CONT. %	TEST TYPE	C N/mm²	φ deg.	Sp. Gr.	VOID RATIO e_0	COMPRESSION INDEX 'Cc'
		0.50	DS-1	SANDY SILT WITH CLAY															
9	9	1.95	SPT-1		1.1	74.8	11.2	12.9	25	14									
		2.80	UDS-1								1.35	1.58	17	UU	0.001	22	2.65	0.96	0.135
10	10	3.45	SPT-2	UNIFORM FINE SAND															
12	12	4.95	SPT-3		0.0	88.6	10.0	1.3	21	NP									
		5.80	UDS-2								1.39	1.52	9	UU	0.001	23	2.65	0.90	0.099
11	11	6.45	SPT-4																
14	14	7.95	SPT-5																
		8.80	UDS-3																
16	16	9.45	SPT-6		0.0	88.6	10.2	1.2	21	NP									
19	17	10.95	SPT-7																
		11.80	UDS-4								1.31	1.58	21	UU	0.001	24	2.67	1.04	0.099
24	20	12.45	SPT-8																
27	21	13.95	SPT-9																
		14.80	UDS-5																
29	22	15.45	SPT-10		0.0	85.2	13.5	1.3	23	NP									
31	23	16.95	SPT-11																
		17.80	UDS-6								1.34	1.54	15	UU	0.001	22	2.66	0.99	0.117
34	25	18.45	SPT-12																
35	25	19.95	SPT-13																
		20.80	UDS-7																
36	26	21.45	SPT-14																
36	26	22.95	SPT-15		0.0	90.2	7.6	2.2	22	NP									
		23.80	UDS-8								1.36	1.59	17	UU	0.002	23	2.66	0.96	0.108
38	27	25.00	SPT-16																

Addition......Nil........
Deletion.......Nil.........
Correction.....Nil.........
Overwriting.....Nil.........

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.

S.P.T. PLOT
Observed
Corrected



PROJECT: CONSTRUCTION OF SIDBI HEAD OFFICE BUILDING AT PLOT NO.-7/8, SECTOR-7, GOMTI NAGAR EXTENSION, LUCKNOW

SHEET NO. 21

BOREHOLE NO	TERMINAL DEPTH (m)	Water Table
BH-6	25.0 meter	10.70 meter

N Values	N Corrected Values	DEPTH (m) from E.G.L.	Type of Sample	Soil Classification	GRAIN SIZE ANALYSIS				LIQUID LIMIT	PLASTIC LIMIT	DRY DENSITY	BULK DENSITY	MOIST. CONT.	SHEAR PARAMETER			fg. Gr.	SWELLING %	COMPRESSION INDEX Cc
					GRAVEL %	SAND %	SILT %	CLAY %	%	%	gm/c	gm/c	%	TEST TYPE	C kN/m²	f deg.			
		0.50	DS-1	SANDY SILT WITH CLAY															
10	10	1.95	SPT-1		1.7	73.5	12.9	11.9	23	12									
		2.80	UDS-1								1.36	1.62	19	UU	0.001	23	2.65	0.95	0.117
16	16	3.45	SPT-2																
22	19	4.95	SPT-3	UNIFORM FINE SAND	0.0	93.8	4.3	1.9	20	NP									
		5.80	UDS-2								1.38	1.50	9	UU	0.001	24	2.65	0.93	0.09
17	16	6.45	SPT-4																
20	18	7.95	SPT-5																
		8.80	UDS-3																
21	18	9.45	SPT-6		0.0	91.1	6.8	2.1	22	NP									
20	18	10.95	SPT-7																
		11.80	UDS-4								1.42	1.55	9	UU	0.002	24	2.66	0.87	0.105
26	21	12.45	SPT-8																
27	21	13.95	SPT-9																
		14.80	UDS-5																
30	23	15.45	SPT-10		0.0	87.1	11.1	1.8	23	NP									
28	22	16.95	SPT-11																
		17.80	UDS-6								1.32	1.58	20	UU	0.001	23	2.65	1.01	0.117
32	24	18.45	SPT-12																
33	24	19.95	SPT-13																
		20.80	UDS-7																
36	26	21.45	SPT-14																
39	27	22.95	SPT-15		0.0	86.1	10.9	3.1	22	NP									
		23.80	UDS-8								1.40	1.62	16	UU	0.001	23	2.67	0.91	0.108
41	28	25.00	SPT 16																

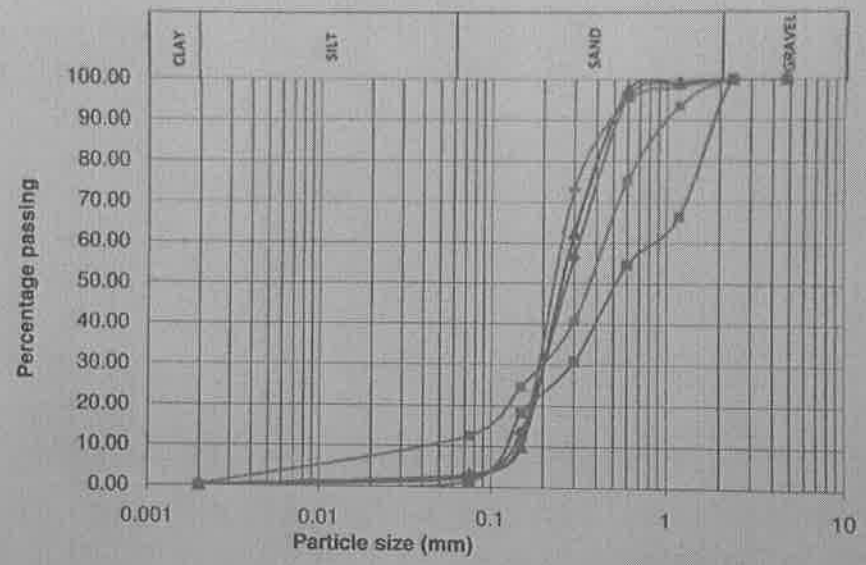
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD. SHEET NO. 22

GRAIN SIZE ANALYSIS

Bore Hole No. 1



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	0.0	75.4	12.1	12.5
	Uniform fine Sand	4.50	0.0	86.7	10.9	2.4
	Uniform fine Sand	9.00	0.0	90.2	6.8	3.0
	Uniform fine Sand	15.00	0.0	81.8	16.8	1.4
	Uniform fine Sand	22.00	0.0	88.4	6.5	3.1

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

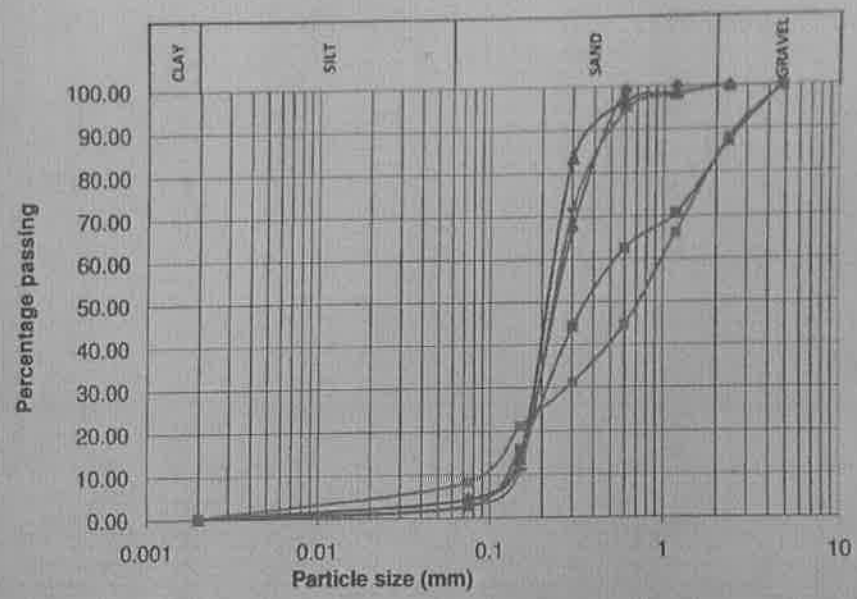
A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.

SHEET NO. 23

GRAIN SIZE ANALYSIS

Bore Hole No. 2



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	0.0	79.1	12.7	8.2
	Uniform fine Sand	4.50	0.0	86.5	9.4	4.1
	Uniform fine Sand	9.00	0.0	86.5	9.3	4.1
	Uniform fine Sand	15.00	0.0	84.4	13.0	2.6
	Uniform fine Sand	22.00	0.0	89.0	8.4	2.6

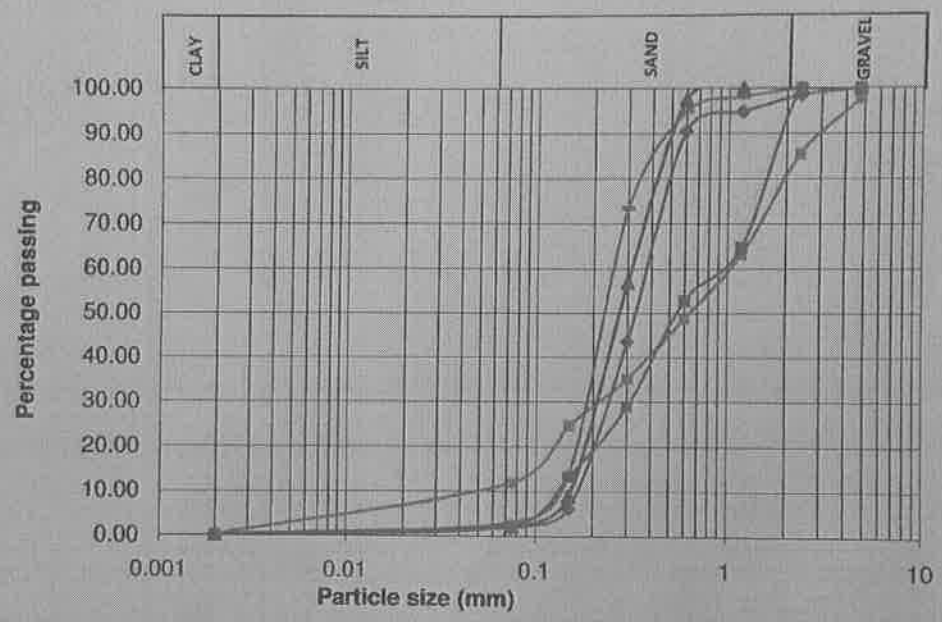
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD. SHEET NO. 24

GRAIN SIZE ANALYSIS

Bore Hole No. 3



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	2.4	72.9	12.8	11.6
	Uniform fine Sand	4.50	0.0	93.8	4.3	1.9
	Uniform fine Sand	9.00	0.0	91.1	6.8	2.1
	Uniform fine Sand	15.00	0.0	86.7	11.1	2.2
	Uniform fine Sand	22.00	0.0	86.1	10.9	3.1

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

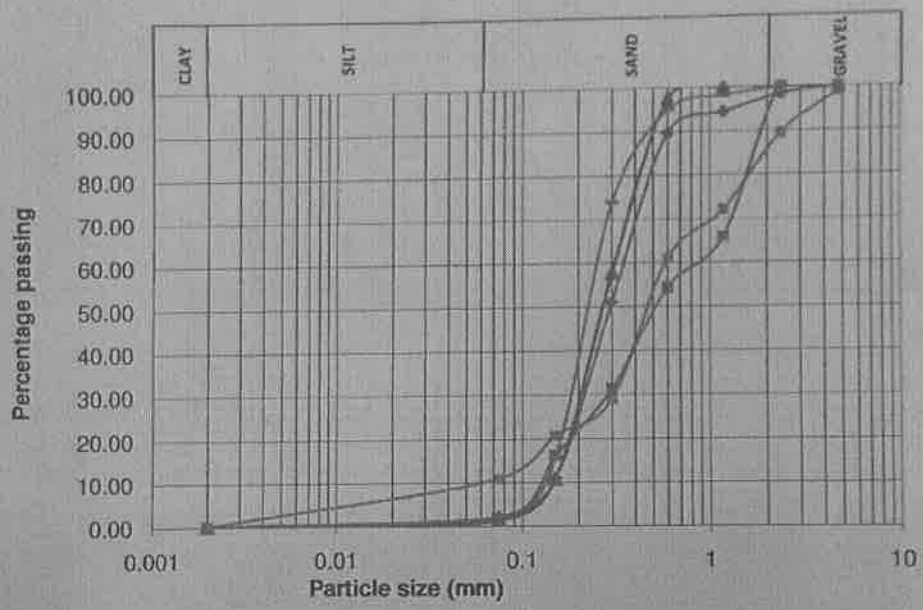
A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD.

SHEET NO. 25

GRAIN SIZE ANALYSIS

Bore Hole No. 4



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	1.3	78.0	9.9	10.8
	Uniform fine Sand	4.50	0.0	89.2	8.7	2.0
	Uniform fine Sand	9.00	0.0	89.3	9.3	1.3
	Uniform fine Sand	15.00	0.0	83.8	14.9	1.2
	Uniform fine Sand	22.00	0.0	84.4	13.5	2.1

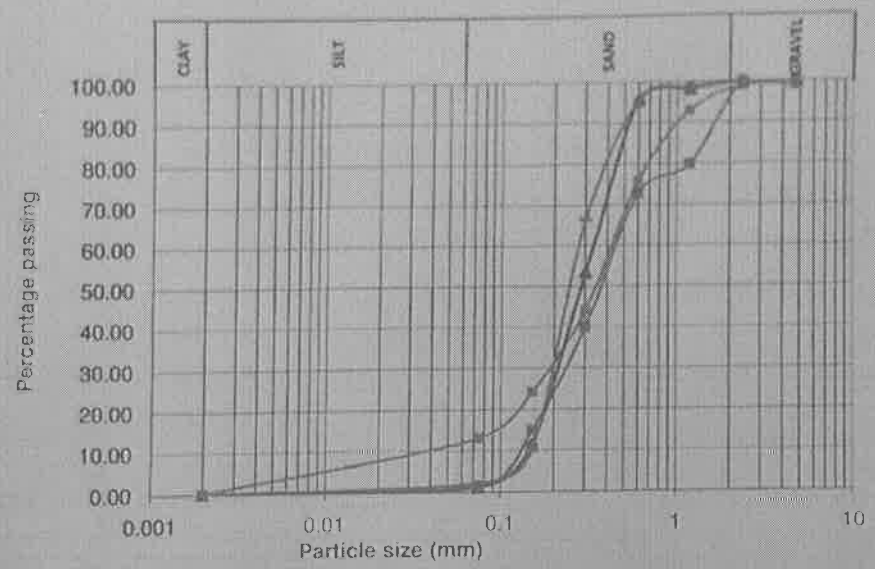
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD. SHEET NO. 25

GRAIN SIZE ANALYSIS

Bore Hole No. 5



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	1.1	74.8	11.2	12.9
	Uniform fine Sand	4.50	0.0	88.6	10.0	1.3
	Uniform fine Sand	9.00	0.0	88.6	10.2	1.2
	Uniform fine Sand	15.00	0.0	85.2	13.5	1.3
	Uniform fine Sand	22.00	0.0	90.2	7.6	2.2

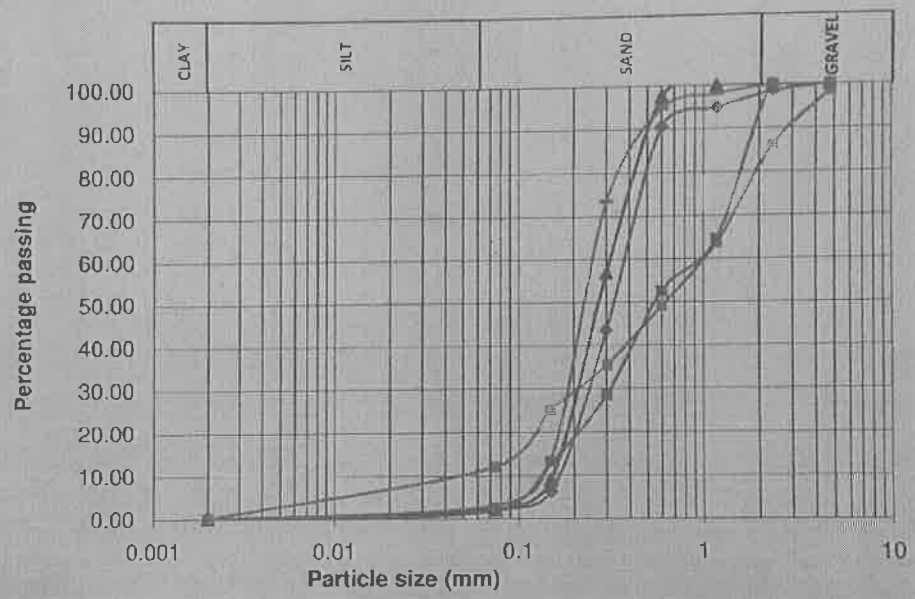
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

SWATI STRUCTURE SOLUTIONS PVT. LTD. SHEET NO. 27

GRAIN SIZE ANALYSIS

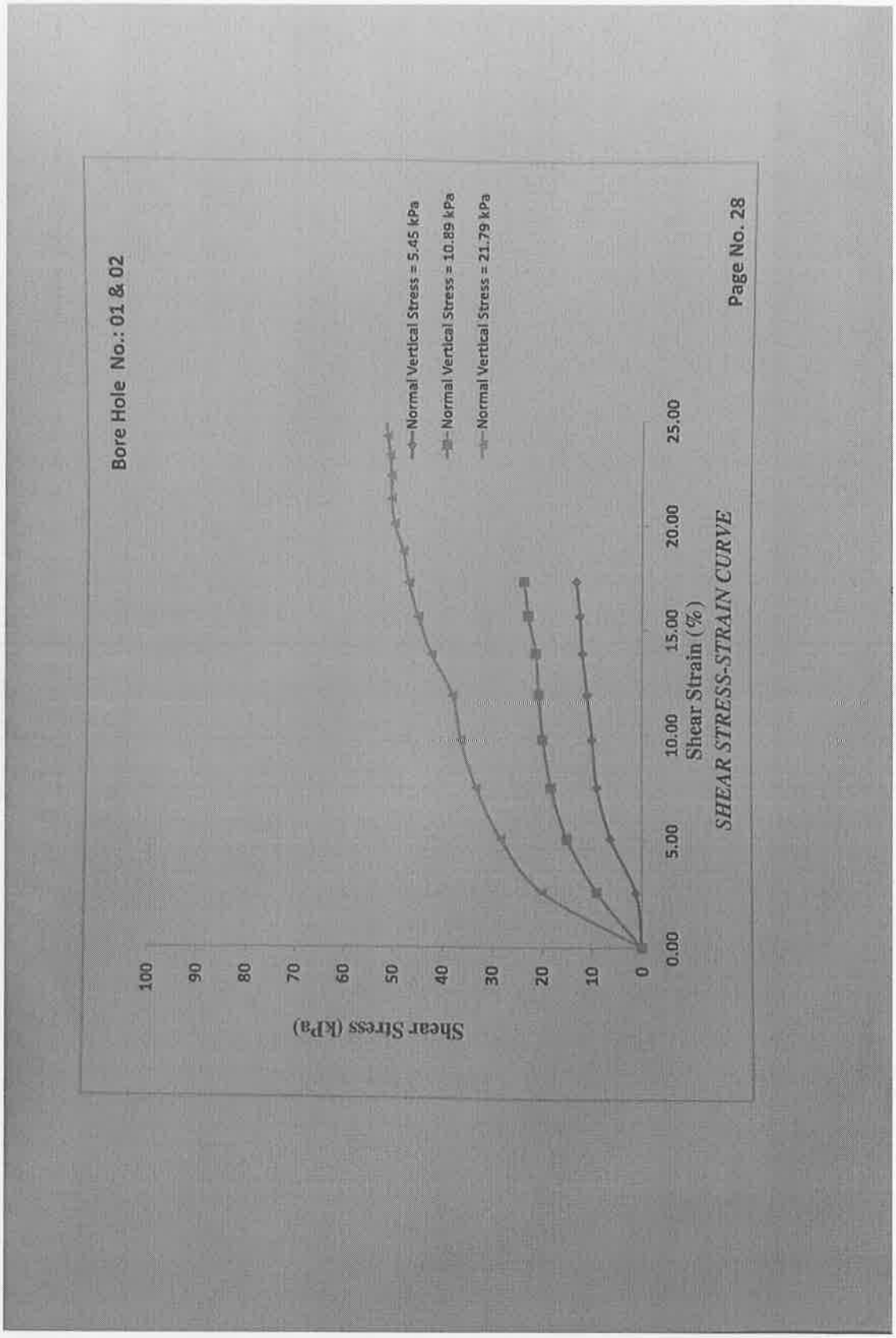
Bore Hole No. 6



Symbol	Description	Depth (m) from E.G.L.	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	Sandy Silt With Clay	1.50	1.7	73.5	12.9	11.9
	Uniform fine Sand	4.50	0.0	93.8	4.3	1.9
	Uniform fine Sand	9.00	0.0	91.1	6.8	2.1
	Uniform fine Sand	15.00	0.0	87.1	11.1	1.8
	Uniform fine Sand	22.00	0.0	86.1	10.9	3.1

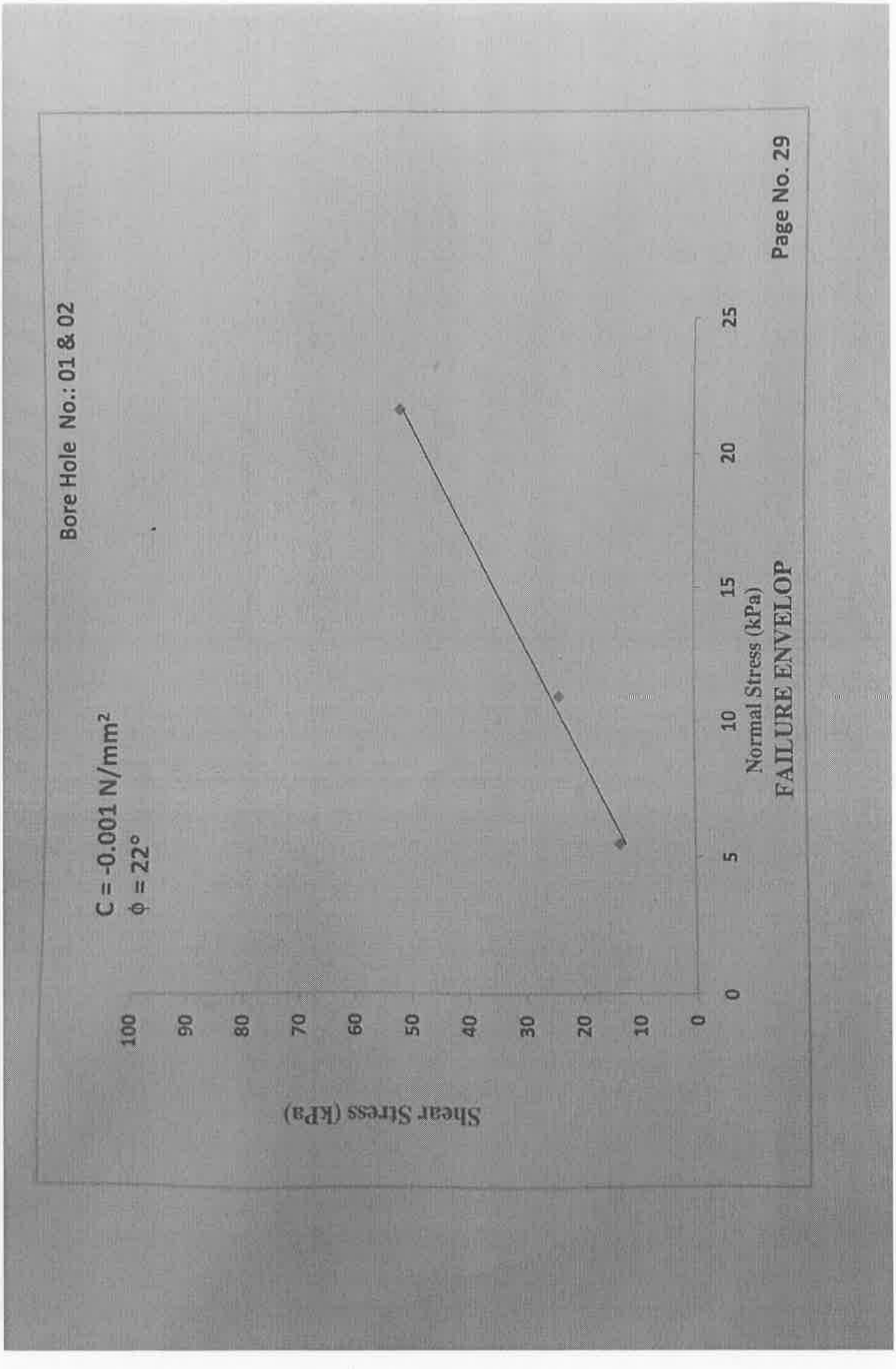
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)



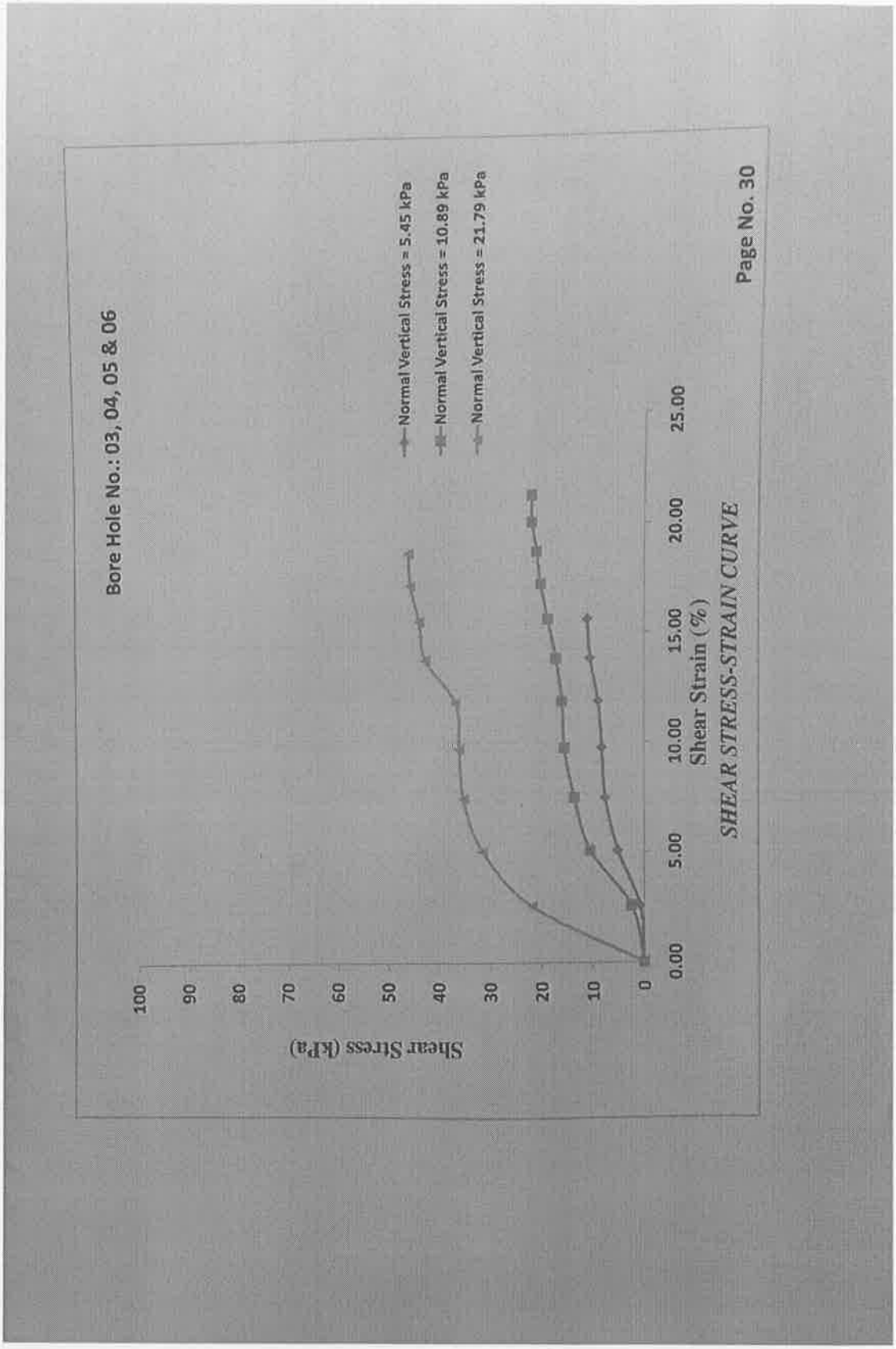
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)



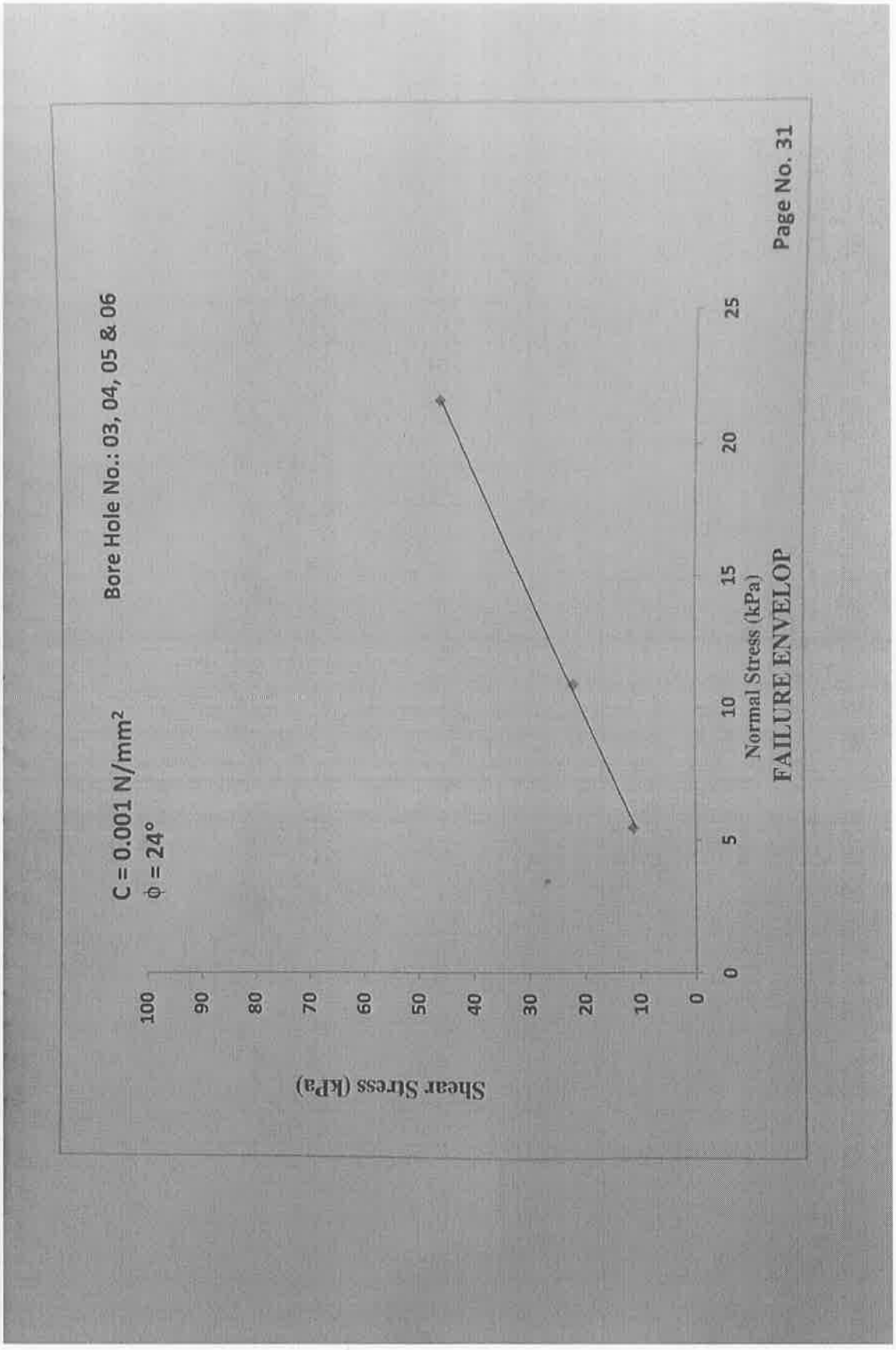
Addition..........Nil....,,,........
Deletion.... .. ....Nil........ ....
Correction......Nil...,.... ....
Overwriting.....Nil............

A.E. (P)



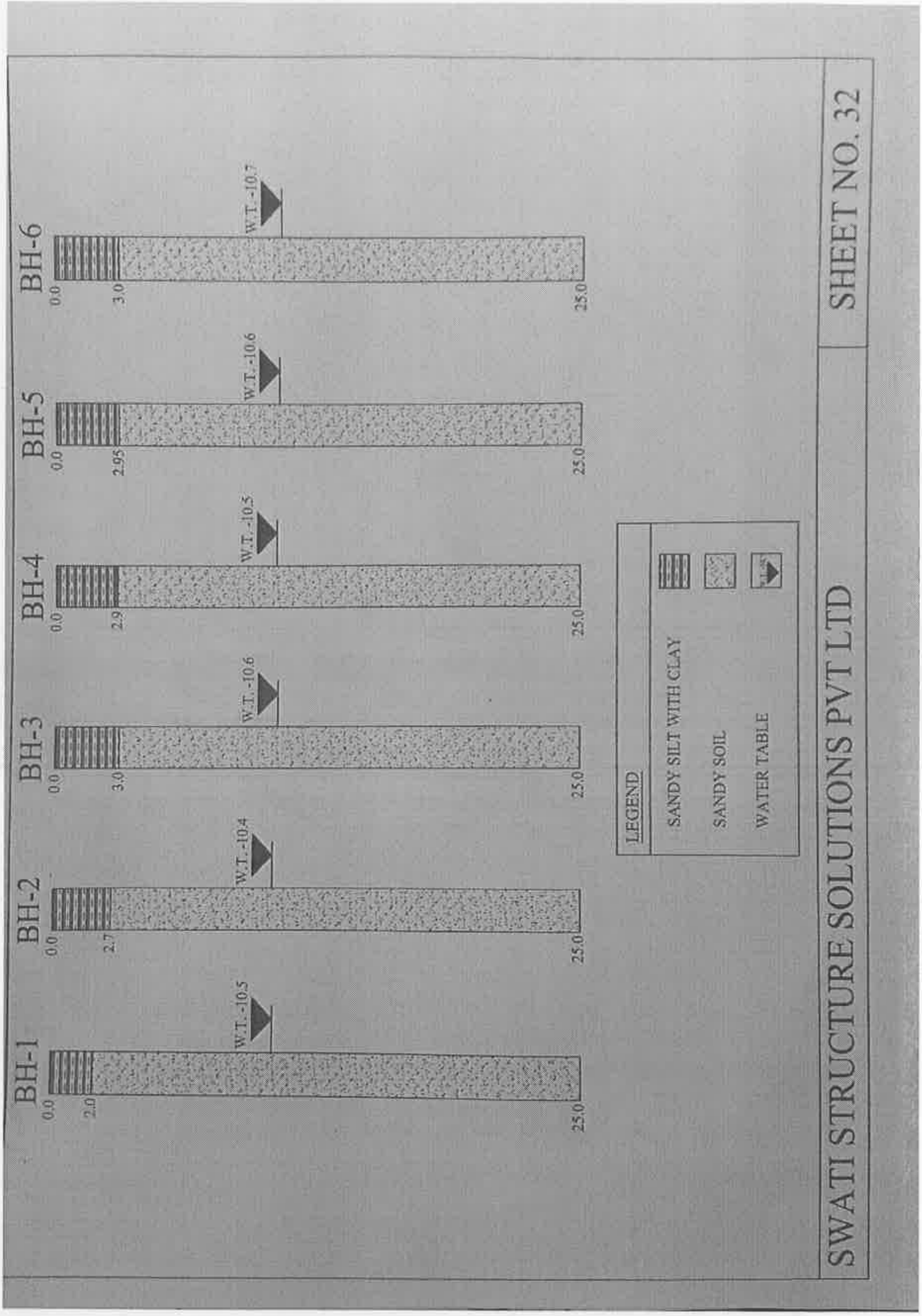
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)



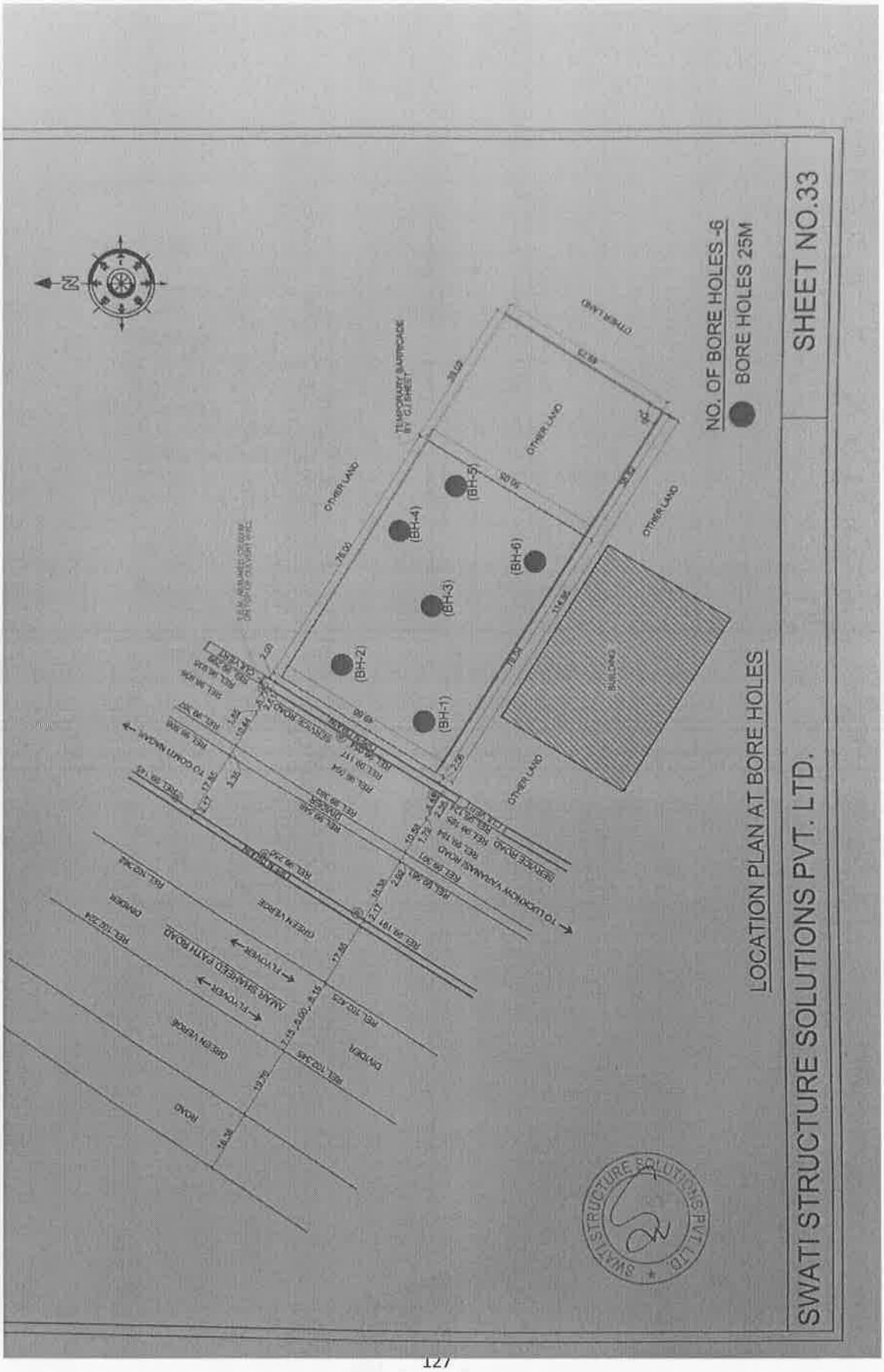
Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)



Addition.........Nil..........
Deletion..........Nil..........
Correction......Nil..........
Overwriting.....Nil..........

A.E. (P)



Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)

APPENDIX – 'A'

LIST OF REFERRED IS CODES

Field Investigation

1. IS: 1948-1970 Classification and identification of soils for general engineering purposes (first revision) Amendment 2
2. IS: 1892-1979 Code of practice for sub surface investigations for foundations
3. IS: 2131-1981 Method of standard penetration tests for soils
4. IS: 2132-1986 Code of practice for thin walled tube sampling of soils

Laboratory tests

1. IS: 2720-1983 (Part 1) Methods of tests for soils: Preparation of dry soil samples for various tests (second revision)
2. IS: 2720-1980 (Part-2) Methods of test for soils: Determination of water content (second revision) Amendment 1
3. IS: 2720-1980 (Part-3/Sec 1) Method of test for soil : Determination ofspecific gravity : Fine grained soils
4. IS: 2720-1980 (Part-3/Sec 2) Method of test for soil : Determination ofspecific gravity : Fine , medium & coarse grained soils.(First revision)
5. IS: 2720-1985 (Part-4) Methods of test for soils: Grain size analysis (Second revision)
6. IS: 2720-1985 (Part-5) Methods of test for soils: Determination of liquid and plastic limit (Second revision)
7. IS: 2720 (Part-8) Determination of water contant – dry density relation using heavy compaction. (First revision)
8. IS: 2720 (Part-10) Methods of test for soils: Determination of Shear strength parameter using Tri-axial apparatus.

Foundation Construction

1. IS:1080-1986Code of Practice for design and construction of shallow foundation on soils (other than raft, ring and shall) (Second revision)
2. IS: 1904-1986Code of Practice for design and construction of foundation in soils: First Revision (Amendment 1)
3. IS: 6403-1981 Code of Practice for determination of bearing capacity of shallow foundation: First revision (Amendment 1)
4. IS: 8009-1976 (part-1)Code of Practice for Calculation of settlement of foundation : Shallow foundation subject to symmetrical static vertical loads (Amendment 2)

Addition.....Nil.....
Deletion.....Nil.....
Correction.....Nil.....
Overwriting.....Nil.....

A.E. (P)