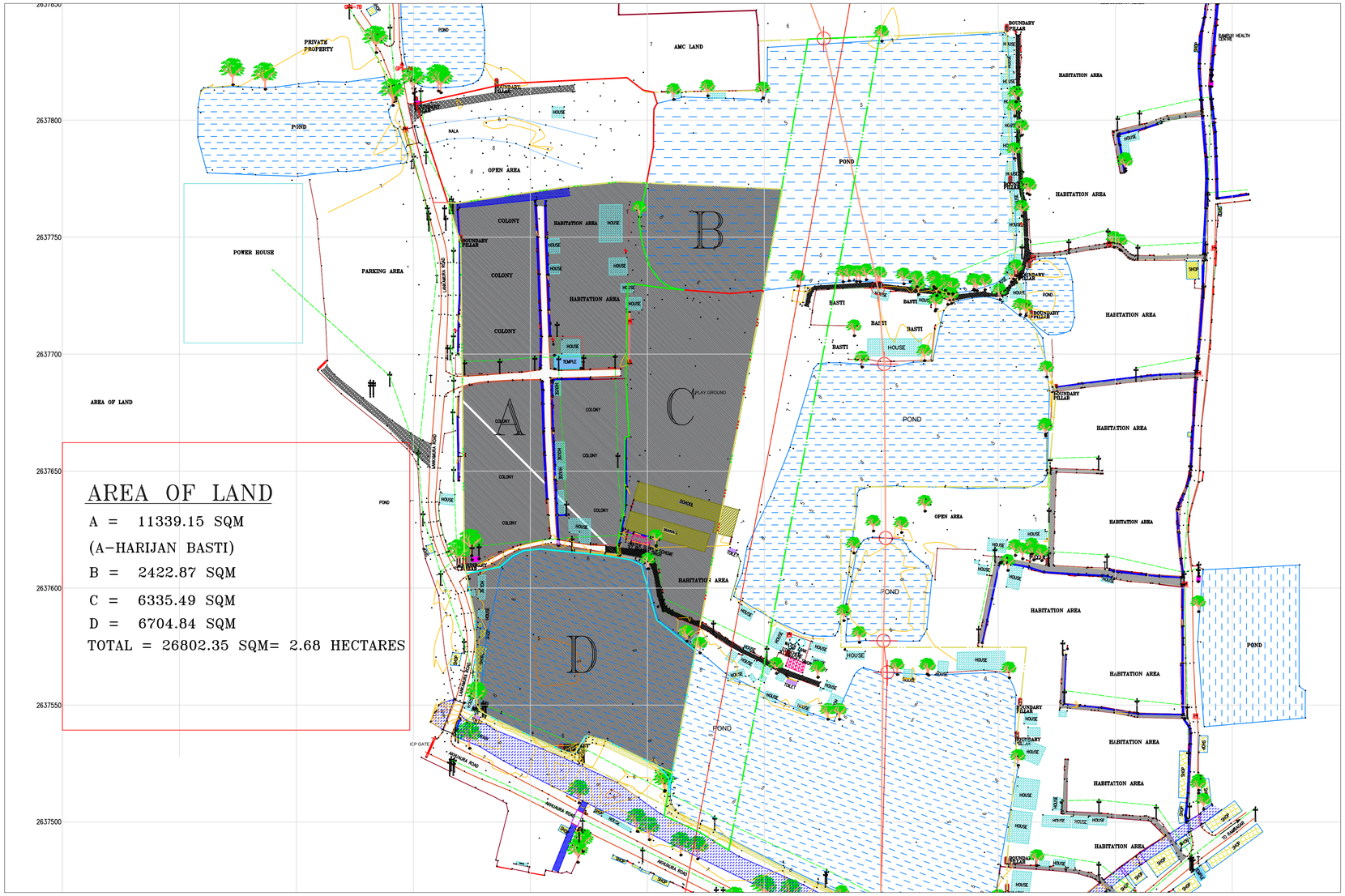
DWG NO

TITLE: PROPOSED SITE DETAILS



AREA OF LAND

A = 11339.15 SQM
(A–HARIJAN BASTI)
B = 2422.87 SQM
C = 6335.49 SQM
D = 6704.84 SQM
TOTAL = 26802.35 SQM= 2.68 HECTARES

	SIGN.										
	INITIALS										
	REVISIONS										
	SIGN.										
	INITIALS										
	REVISIONS										
P0	SIGN.										
	INITIALS										
ISSUE		DRN	DSN	CHD	CV	EL	IC	ME	PE/PM	APPD	DATE (dd–mm–yyyy)
					CLEARED						

FOR APPROVAL

DO NOT SCALE

'P' (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK ABOVE THIS BLOCK.

CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'.

FILE NAME :

LIGHT HOUSE PROJECT, UNDER THE GLOBAL HOUSING TECHNOLOGY CHALLENGE, INDIA
AGARTALA–TRIPURA

PROPOSED SITE DETAILS

TATA CONSULTING ENGINEERS LIMITED

SCALE : 1:1000
DC & DISC : NCR
DWG NO.
ISSUE P0

SIZE–A1

FILE NAME: F–091–Rev–R0.dwg

TCE FORM NO. 091 R0

2.6.3 Soil Testing Report

Job No: 421202

REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
AGARTALA SMART CITY PROJECT, TRIPURA

(Highrise Building for Slum Dwellers, Akhaura)

Client:

M/S. TATA Consulting Engineers Limited,
Unit No.- NB 1502 & SB 1501, 15th Floor,
Empire Tower, Cloud City Campus, Village E
Kalwa Industrial Est, Thane Belapur Road, Airoli
Navi Mumbai – 400708
Maharashtra, India.

Foundation Consultants:

C. E. Testing Company Pvt. Limited
An ISO 9001, 14001 & OHSAS 18001 Cerified Company
NABL Accredited Laboratory
124A, N. S. C. Bose Road : Kolkata - 700 092
Phones : 2428-6221/6222/6223 Fax : (033) 2428-6220
Email : cetest@cetestindia.com

October – 2018

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REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
AGARTALA SMART CITY PROJECT, TRIPURA

1. INTRODUCTION

Government of India plans to implement Smart City Programme to transform 100 Indian Cities to Smart Cities. **TATA Consulting Engineers Limited** have been appointed as Project Management Consultant to design, develop certain parts of Agartala, the capital city of Tripura under **Area based Development.** For layout plan and designing various foundation structures coming under this project, it was necessary to conduct a detailed Geotechnical Investigation work to obtain engineering properties of the underlying soil and **M/s. Tata Consulting Engineers Limited** appointed **M/s. C. E. Testing Company Pvt. Ltd.,** Kolkata as their Geotechnical Consultant.

This is a part of the whole project and deals with soil investigation for **Highrise Building for Slum Dwellers at Akhaura.**

The scope of the work comprises of sinking 02 nos. Boreholes.The bore holes were of 150 mm in diameter. It included advancing the boreholes by Shell and Auger equipment. The scope also included conducting Standard Penetration Tests, collecting disturbed samples at regular intervals for identification and logging purposes, collecting undisturbed tube samples at suitable intervals or at change of strata whichever is earlier and testing these in the laboratory.

Based on the above, this report presents the Bore Logs, Soil Profile, laboratory and field Test Results. On the basis of field tests and laboratory test results and their analysis thereof, the most suitable type of foundation is suggested. The field profile is sometimes changed in the light of laboratory test results.

The subsoil is of very poor to medium quality. It is characterized by filled up soil followed by a very soft to soft, clayey silt / silty clay layer. Below that, a medium, silty clay / clayey silt followed by a medium dense to dense silty sand layer was observed. A stiff to very stiff clayey silt layer appears afterwards. Underlying the above, a very dense, silty sand layer is encountered and that continued up to the termination depth of both the bore holes.

Considering the nature of the subsoil, field tests and laboratory tests, suitable foundation system is suggested. However this is discussed in details later.

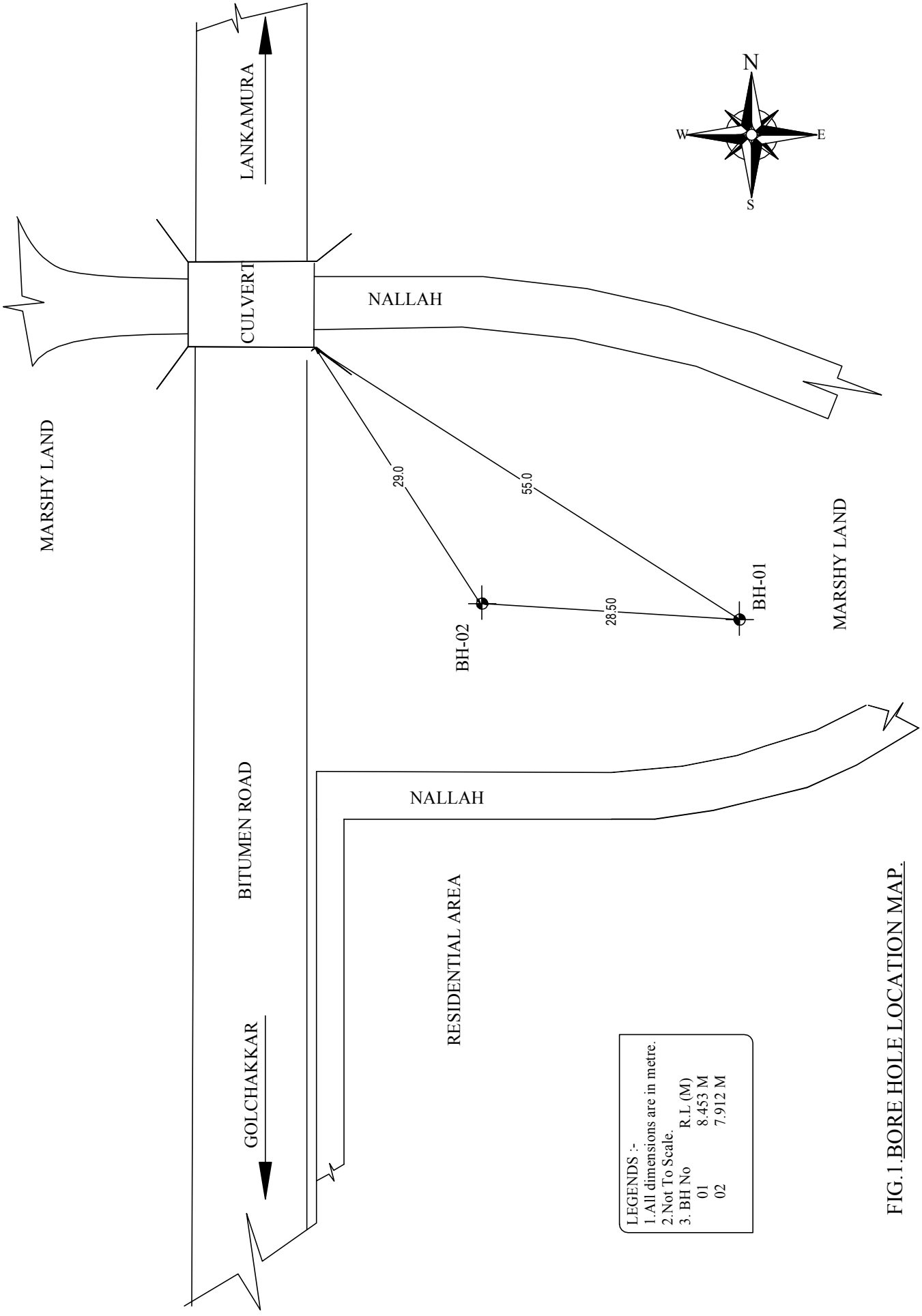

FIG.1.BORE HOLE LOCATION MAP.

2. FIELD INVESTIGATION

2.1. GENERAL:

In an attempt for optimization in the design of foundation for these proposed structures to be constructed at this site, Geotechnical Investigation was envisaged. The entire Investigation programme had been divided mainly into two parts, I) Field works & II) Laboratory tests.

I) Field works unfold the sub-surface deposit types and their characteristics and

II) Laboratory tests part would help determining the relevant physical and geotechnical properties of the sub-surface deposits leading to finalization of foundation depths of the structures and the bearing capacity with particular reference to the sub-surface types and their strength parameters and settlement potentials at the site.

A list of the bore holes with the Co-ordinates, R.L., terminating depth and standing water level below EGL are presented in a tabular form below:-

Bore Hole No.	Co-ordinate, (M)		R.L. (M)	Terminating Depth (m)	Standing Water Level (m)
	Easting	Northing			
BH-01	322352.444	2637779.793	8.453	31.63	2.30
BH-02	322323.929	2637777.575	7.912	30.00	1.80

2.2. BORING:

Boring was carried out by Shell and Auger method to sink nominal 150mm diameter bore holes to depths envisaged by using a mechanical winch. Undisturbed soil samples were collected at suitable intervals or at change of strata whichever is earlier by open drive sampling method since it was intended to ascertain the sub-soil characteristics.

2.3. SAMPLING:

Nominal 100 mm diameter undisturbed samples were recovered. The sampling equipment used consists of a two-tier assembly of sample tubes 450 mm in length fitted at its lower end. The sampling assembly was driven by means of a jarring link to its full length or as far downs as was found practicable. After withdrawal the ends of the tubes were sealed with wax and capped before onward transmission to the laboratory. At close intervals in depth disturbed samples were collected for identification and logging purpose. These were tagged and packed in polythene packets and transported to the laboratory.

2.4. STANDARD PENETRATION TESTS:

Standard Penetration Tests were conducted in the bore holes at intervals of 1.50M / 3.0M or at change of strata whichever is earlier in depth using a split spoon sampler. The split spoon sampler used is of a Standard design having an outer diameter of 50.8 mm and inner diameter of 35 mm, driving with a monkey weighing 63.5 kgs, falling freely through 75cms advances the spoon. A record of the number of blows required to penetrate every 7.5cms to a maximum depth of 45cms was made. The first 15cm of drive are considered to be seating drive and are neglected. The total blows required for third, fourth, fifth & sixth 7.50cm of penetration is counted and termed as penetration resistance "N". On completion of a test, the split spoon sampler was opened and soil specimens were preserved in polythene bags for logging purpose.

The borehole was sunk with winch. However, raising of hammer for SP Tests was done manually. Hence there will not be any inertia loss and the efficiency of hammer blows should be considered as 100%.

2.5. MEASUREMENT OF WATER TABLE:

Standing water level after 24 hours of removal of casing was noted and shown in the profile.

3. LABORATORY TESTING

For proper identification and classification of the sub-soil deposits and for deriving adequate information regarding its relevant physical and geotechnical properties at the site under investigation, the following laboratory tests were conducted on the soil samples collected from the exploratory bore holes:

1. ***Grain size analysis (Sieve as well as Hydrometer).***
2. ***Determination of Liquid Limit, Plastic Limit & Shrinkage Limit.***
3. ***Determination of Natural Moisture Content.***
4. ***Determination of Specific Gravity.***
5. ***Determination of Bulk & Dry Unit Weight.***
6. ***Strength determination by Triaxial Unconsolidated Undrained Test (UU).***
7. ***Strength determination by Vane Shear Test.***
8. ***Strength Determination of Unconfined Compression Test on "UDS" (UNCONFD).***
9. ***Strength Determination of Unconfined Compression Test on REMOULDED samples.***
10. ***One-dimensional Consolidation Test for determining settlement potentiality.***
11. ***Determination of Free Swell Index & Swelling Pressure.***
12. ***Chemical tests on soil samples to determine pH value, Sulphate, Chloride content, organic matter etc.***

Laboratory test results are presented in a tabular form in the Appendix. The results are self explanatory except that of consolidation tests. The compressibility for a pressure range has been separated into 2 components through the compression ratio. As a first step dial gauge reading is plotted against square root of time and by extrapolation dial reading at zero time, is obtained. The compression ratio is given as

$r = (d_i - d_s)/(d_i - d_f)$, where

d_i = Initial reading of dial before load application

d_s =Dial reading corresponding to theoretical zero time

d_f = Final dial reading after 24 hrs.

Now we write $m_{vc} = (1- r) \times m_v$

All the tests were conducted as per relevant Indian Standard Specifications.

4. SUBSOIL CONDITION, PROPERTIES AND STRATIFICATION

4.1. SUB-SOIL CONDITIONS:

The boring records showing the various soils met with are enclosed in the Appendix. These are prepared from field logs after proper modifications in the light of the laboratory test results and observation of disturbed and penetrometer soil samples. The results of the Standard Penetration Tests are given as 'N' values in these boring records. The sub-soil profiles (as obtained from field and Laboratory test results) across the bore holes are shown under Fig. 2 giving description, consistency and colour of each stratum. The "N" values are shown in the profile. The laboratory test results and the backup sheets are presented in the Appendix.

4.2. SUB-SOIL STRATIFICATIONS:

The subsoil is of very poor to medium quality. It is characterized by filled up soil followed by a very soft to soft, clayey silt / silty clay layer. Below that, a medium, silty clay / clayey silt followed by a medium dense to dense silty sand layer was observed. A stiff to very stiff clayey silt layer appears afterwards. Underlying the above, a very dense, silty sand layer is encountered and that continued up to the termination depth of both the bore holes. The layer wise description of each layer is presented below.

4.2.1. FILL:

Filled up soil consists of deep grey, silty clay with debris, garbage & brick bats. The average properties of this layer (which may not be truly representative of this layer) are presented below.

Bulk Density, gms/cc	1.74	Specific gravity	2.58
Dry Density, gms/cc	1.24		
Natural Water Content, %	40	**GRAIN SIZE**	
TRSH-UU:		Sand %	13
Cohesion kg/sqcm	0.20	Silt %	73
Friction angle °	0	Clay %	14

4.2.2. STRATUM - I:

The soil in this layer consists of very soft to soft, steel grey, clayey silt / silty clay with decomposed wood & organic matter. Average “N” value of this layer is 02. The “UDS” that could be collected from this layer show the following average properties.

Bulk Density, gms/cc	1.50	Specific gravity	2.53
Dry Density, gms/cc	0.80	Void ratio	1.157
Natural Water Content, %	87	Liquid Limit %	47
		Plastic Limit %	27
TRSH-UU:		Plasticity Index %	20
Cohesion kg/sqcm	0.13	Shrinkage Limit %	26
Friction angle °	0	**GRAIN SIZE**	
UNCONFINED "C"	0.08	Sand %	15
REMOULDED "C"	0.03	Silt %	70
SENSITIVITY	2.67	Clay %	15

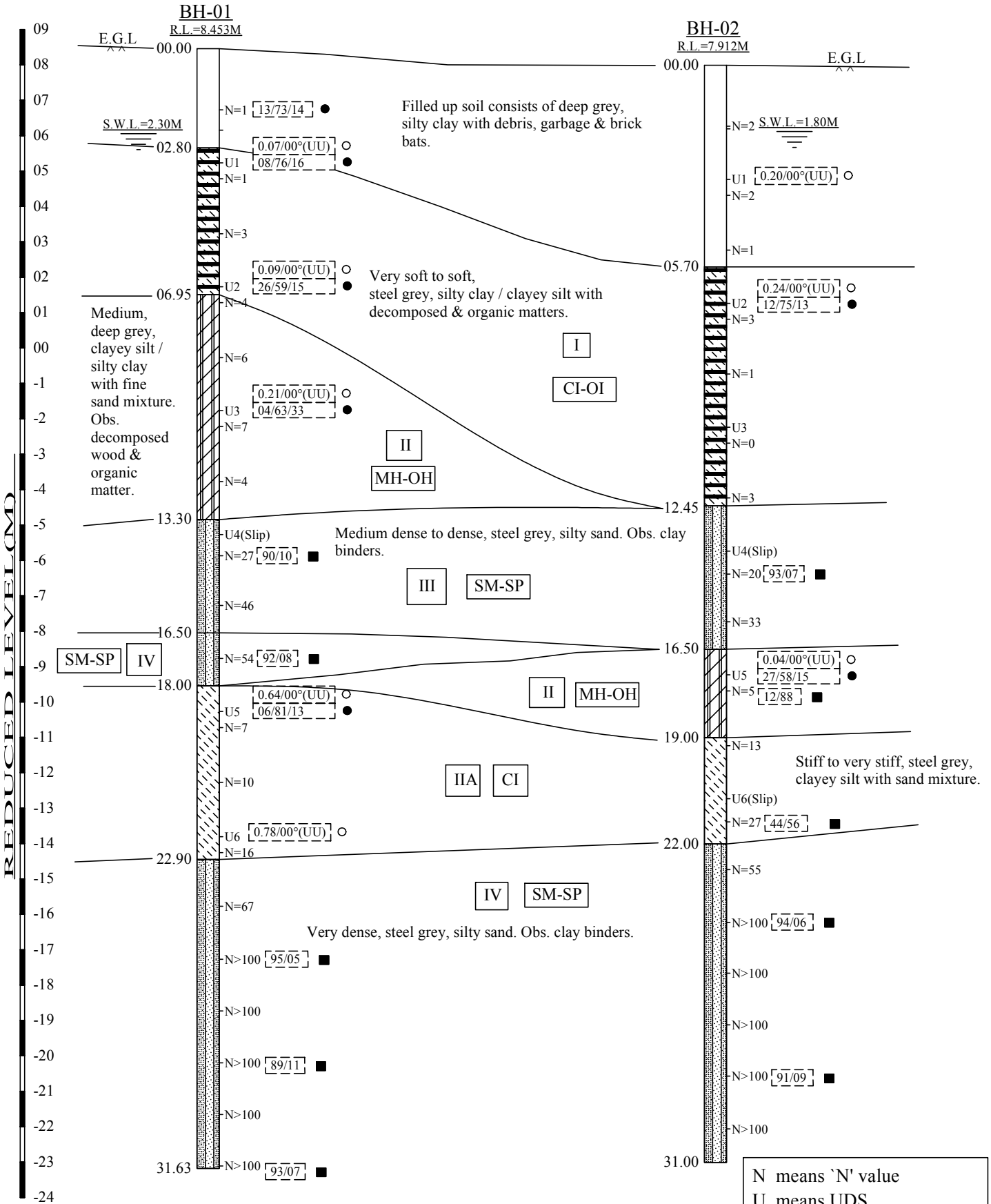

FIG.2.GENERALISED SOIL PROFILE.