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MINISTRY OF INFRASTRUCTURE



Japan International Cooperation Agency



CONTRACTOR

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IMPROVEMENT OF SUBSTATIONS AND DISTRIBUTION NETWORK, PHASE 2, IN THE REPUBLIC OF RWANDA

SOIL INVESTIGATIONS FOR :

. 110 / 15 kV NDERA SUBSTATION

. 110 kV & 15 kV POWER LINES

FILE 1 / 2



KIGALI, May 2015

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I. METHODOLOGY

For this project, the soil investigations were done on 27 points defined on the drawing in the survey report :

- page no.5 : General overview project for 15 kV & 110 kV lines.
- page no.31 : Ndera substation layout.

These points, for soil investigations, are :

- SIP1-SIP2-SIP3-SIP4-SIP5-SIP6-SIP7-SIP8-SIP9-SIP10-SIP11-SIP12-SIP13-SIP14-SIP15-SIP16-SIP17-SIP18-SIP19-SIP20-SIP21-SIP22-SIP23-SIP24-SIP25-SIP26-SIP27.

In the immediate vicinity of each point, approximately 3m around, the soil was examined in situ and the levy of samples was performed at required depth.

After having dug a 4m deep hole for a section of 1.30 m x 1.30 m ; had followed the following operations that are the essential phases of these geotechnical studies.

1) Field tests and levy of samples (on each point)

This phase comprises :

- Observations and analysis of soils texture on the walls of the test pits ;
- Levy of undisturbed samples ;
- Levy of samples overhauled ;
- Backfilling of the test pits ;
- Penetration test in natural ground, performed with a static penetrometer 50 kN, up to more than 10 m deep.

2) Laboratory tests (for each point)

On the selected samples from test pits, physical, mechanical and chemical tests analysis were performed by the following tests :

- Physical tests : Natural water content, Specific gravity, Sieve analysis, Liquid limit, Plastic limit.
- Mechanical tests : Modified proctor, Shear test, unconfined compression test.
- Chemical tests : the degree of alkalinity in soil expressed as a pH, the concentration of sulphate (as SO_4^{2-}) and chlorides (as Cl^-)

3) Results and recommendations for foundation

Bringing together the results of field tests and laboratory tests, soil represented by each point is identified, in its form and in its quality.

This identification, facilitating the rational use of these soils, allows the expert to give recommendations for better land use, such as materials and support.

All the work of geotechnical studies, as described above, is presented in two volumes :

- volume 1/2 : own report of the expert ;
- volume 2/2 : test report.

For reasons of speed and ease, separate laboratories were used simultaneously :

- Rincent BTP Rwanda Ltd,
- Geotechnical laboratory and laboratory of agronomy, University of Rwanda, Huye campus.

II. STANDARDS REFERENCES

In large part, we use the French standardization (NF) and, in lesser extent, British Standards (BSCS) and American Standards (AASHTO) & ASTM.

Sampling - Standard NF P94-202

Moisture content - Standard NF P94-050

Specific gravity - Standard NF P94-053

Sieve analysis - Standard NF P94-056

Atterberg limits- Standard NF P94-051

Modified proctor- Standard NF P94-093

Direct shear box- Standard NF P94-071-2

Unconfined compression strength- Standard AASHTO T134

British Soil Classification System- BSCS

Chemical analysis (sulfate & chloride) - Standard : ASTM D 4327

Chemical analysis (pH) - Standard : ASTM D 4972

In-Situ static penetration tests performed using a GeoMIL 50 kN SPT.

III. ILLUSTRATION OF THESE STUDIES ON DIFFERENT PHASES

1) Excavation of test pit



2) Levy of undisturbed sample



3) Levy of sample overhauled



4) Penetration tests:



Setting ink needles for the base of the penetrometer



Installation of the base



Loading sounding tubes



Penetrometer in action



Penetrometer in action : measuring applied forces

5) Laboratory work

a. Liquid limit



b. Sieve analysis



c. Modified Proctor



Drying oven



d. Shear frame



e. Unconfined compression test



Molded specimens,
immersed in a
treatment basin

f. Chemical analysis



IV. EXPOSED OBSERVATIONS ON EACH TEST PIT

Legend :

- ALT : height above sea level for the natural ground - V_s : depth of vegetable soil
- G_w : presence of groundwater - S_E : the extraction depth of the sample

SIP 1



Excavation



Extraction of sample



Earth excavation encountered scattered pebbles from 3.40 m deep



Backfilling of the borehole

Designation	Value
ALT	1 613.04 m
V_s	0.80 m
S_E	1.00 - 2.00 m
W_G	Not
After 0.80 m of vegetable earth, a reddish silt occupies practically all the depth and the background becomes stony.	

SIP 2



Excavations



Excavated soils

Designation	Value
ALT	1 596.04 m
Vs	0.50 m
SE	0.80 - 1.20 m
WG	Not
It is a pure lateritic area, extends 50.0 m radius.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- SE : the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
ALT	1 595.12 m
Vs	1.00 m
SE	3.30 - 4.00 m
WG	Not
Beyond the topsoil, this soil consists of lateritic silt	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- Gw : presence of groundwater - SE : the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
A_{LT}	1 597.70 m
V_S	1.00 m
S_E	2.50 - 3.00 m
W_G	Not
Beyond the topsoil, this soil consists of lateritic silt	

Legend :

- A_{LT} : height above sea level for the natural ground - V_S : depth of vegetable soil
- G_w : presence of groundwater - S_E : the extraction depth of the sample



Excavated soils

Designation	Value
ALT	1 603.40 m
Vs	0.50 m
SE	2.00 - 2.40 m
WG	Not
Completely lateritic hill, with a very hard laterite from 1.00 m deep.	



Excavations



Excavated soils

Designation	Value
ALT	1 597.90 m
Vs	0.60 m
SE	2.00 - 2.50 m
WG	Not
After earth vegetable, soil consists of silty clay.	

Legend :

- ALT: height above sea level for the natural ground - Vs: depth of vegetable soil
- Gw: presence of groundwater - SE: the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
ALT	1 585.73 m
Vs	0.50 m
SE	2.00 - 2.50 m
WG	Not
After earth vegetable, soil consists of silty clay.	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- Gw : presence of groundwater - SE : the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
A_{LT}	1 567.48 m
V_s	0.50 m
S_E	3.50 - 3.70 m
W_G	Not
Full deph, the topsoil is based on a layer of silt soil laterite.	

Legend :

- A_{LT} : height above sea level for the natural ground
- V_s : depth of vegetable soil
- W_G : presence of groundwater
- S_E : the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
ALT	1 557.91 m
V _s	0.70 m
S _E	3.60 - 3.90 m
W _G	Not
The layer of soil vegetable overlooks a lateritic soil silt.	

Legend :

- ALT : height above sea level for the natural ground
- V_s : depth of vegetable soil
- G_w : presence of groundwater
- S_E : the extraction depth of the sample

SIP 10



Excavations



Excavated soils

Designation	Value
ALT	1 506.00 m
Vs	0.70 m
SE	1.60 - 2.00 m
WG	Not
This soil is totally lateritic	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- GW : presence of groundwater - SE : the extraction depth of the sample

SIP 11



Excavation



Excavated soils

Designation	Value
ALT	1 485.50 m
Vs	0.70 m
SE	2.00 - 2.50 m
WG	Not
A layer of silty clay (1.50 m) on lateritic silt comes just after the topsoil.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- GW : presence of groundwater
- SE : the extraction depth of the sample



Excavations



Excavated soils

Designation	Value
ALT	1 484.53 m
Vs	0.30 m
Se	1.00 - 3.00 m
Wg	Not
Under the topsoil, comes a layer of soil laterite (3.00 m) on silt.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- Se : the extraction depth of the sample

SIP 13



Excavation



Earth excavation

Designation	Value
ALT	1 450.00 m
Vs	0.70 m
SE	3.00 - 3.30 m
WG	Not
The topsoil rests on stony ground semi hard sedimentary formation.	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- GW : presence of groundwater - SE : the extraction depth of the sample

SIP 14



Excavations



Excavated soils

Designation	Value
ALT	1 459.67 m
Vs	0.70 m
Se	3.00 - 3.40 m
Wg	Not
Soil consists of silty land based on sedimentary rocks loose.	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- Wg : presence of groundwater - Se : the extraction depth of the sample

SIP 15



Excavations



Excavated soils

Designation	Value
ALT	1 500.00 m
VS	0.70 m
SE	2.20 - 2.50 m
WG	Not
Lateritic soil under topsoil	

Legend :

- ALT : height above sea level for the natural ground
- VS : depth of vegetable soil
- GW : presence of groundwater
- SE : the extraction depth of the sample

SIP 16



Excavation



Excavated soils

Designation	Value
ALT.....	1 457.71 m
Vs.....	1.40 m
Se.....	1.20 - 1.50 m
Wg.....	Not
Under a large vegetable layer, brown and whitish soil is rocky.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- Se : the extraction depth of the sample

SIP 17



Excavation



The immediate vicinity of the point

Designation	Value
ALT	1 451.87 m
Vs	0.70 m
Se	0.70 - 1.00 m
Wg	Not
Silty soil whitish and hard sedimentary rocks.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- Se : the extraction depth of the sample

SIP 18



Excavation



Excavated soils

Designation	Value
ALT.....	1 308.32 m
Vs.....	0.20 m
SE.....	2.00 - 2.30 m
WG.....	Not
Hard ground made of quartz gravel	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- GW : presence of groundwater
- SE : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
A_{LT}	1 249.46 m
V_s	1.00 m
S_E	1.00 - 1.50 m
W_G	Not
After earth vegetable, a silty clay layer (0.50 m) rests on a rocky ground	

Legend :

- A_{LT} : height above sea level for the natural ground
- V_s : depth of vegetable soil
- W_G : presence of groundwater
- S_E : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
ALT	1 337.36 m
Vs	1.30 m
SE	1.60 - 2.00 m
WG	Not
Under a thick layer of topsoil, the soil is lateritic silt	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- SE : the extraction depth of the sample

SIP 21



Excavation



Excavated soils

Designation	Value
ALT	1 548.52 m
Vs	0.50 m
SE	3.50 - 3.80 m
WG	Not
A layer of pure clay (2.30 m) draws on hard lateritic soil.	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- Gw : presence of groundwater - SE : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
ALT	1 543.00 m
Vs	0.50 m
SE	2.00 - 2.50 m
WG	Not
A silty clay layer (3.00 m) on whitish sedimentary rocks.	

Legend :

- ALT : height above sea level for the natural ground - Vs : depth of vegetable soil
- GW : presence of groundwater - SE : the extraction depth of the sample



Excavations



Designation	Value
ALT	1 542.70 m
Vs	0.50 m
SE	2.00 - 2.60 m
WG	Not
Land of hard stones with lateritic ground.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- SE : the extraction depth of the sample

SIP 24



Excavation



Excavated soils

Designation	Value
ALT	1 548.25 m
Vs	0.50 m
SE	3.60 - 4.00 m
WG	Not
The ground is entirely composed of silty clay, the color changes from black to brown.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- SE : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
ALT	1 545.00 m
Vs	0.60 m
SE	3.50 - 3.90 m
WG	Not
The soil is red clay full depth.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- Gw : presence of groundwater
- SE : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
ALT	1 543.00 m
VS	0.55 m
SE	3.00 - 3.20 m
WG	Not
The soil is red clay full depth.	

Legend :

- ALT : height above sea level for the natural ground
- VS : depth of vegetable soil
- GW : presence of groundwater
- SE : the extraction depth of the sample



Excavation



Excavated soils

Designation	Value
ALT	1 542.68 m
Vs	0.70 m
SE	2.20 - 2.50 m
WG	Not
The soil is rocky mid hard sediment.	

Legend :

- ALT : height above sea level for the natural ground
- Vs : depth of vegetable soil
- GW : presence of groundwater
- SE : the extraction depth of the sample

V. GENERAL CONCLUSION

The geotechnical studies of this project show soils in the following manner :

1) Soil as support structure.

From 2.40 m deep, all the soils encountered are of good quality and present no risk of destabilization by groundwater or flooding; although, we are at the end of the rainy season.

Indeed, the bearing capacity, consistency and density of these soils can allow no punching, no shifting, no swelling, under load.

- The plasticity is intermediat : $12 \% \leq IP \leq 18 \%$;
- The cohesion is also intermediat because the internal friction angle varies from 20° to 30° .
- The minimum bearing capacity is greater than 0.2 Mpa.

(Nota / penetration test sheet :

Rt : total resistance, Rp : resistance to the tip and Qadm : bearing capacity).

2) Soil as building material.

Set up by backfill, soils must protect the works of all lifting and overturn.

The characteristics data from these studies attribute those qualities to examined soils ; indeed :

- The dry density $\gamma_{d\text{ opm}} \geq 1.60 \text{ t/m}^3$
- The internal friction angle is greater than 20° for the majority of points (the shear strength is proportional to soil consolidation).
- The unconfined compressive strength gives good resistances ($\geq 0.2 \text{ Mpa}$) to the compression pressure.
- No soil presents no aggression against cement ($SO_4^{2-} \leq 0.06 \%$; $pH = \pm 7.0$ and $Cl \leq 61$ parts per million).

General observation of all the results of the tests imposed on soils allows us to classify them into two categories :

1) Good soil, including :

- the Clay of Intermediate plasticity (CI),
- very Silty Sand (SF),
- very Clayey Sand (SCI).

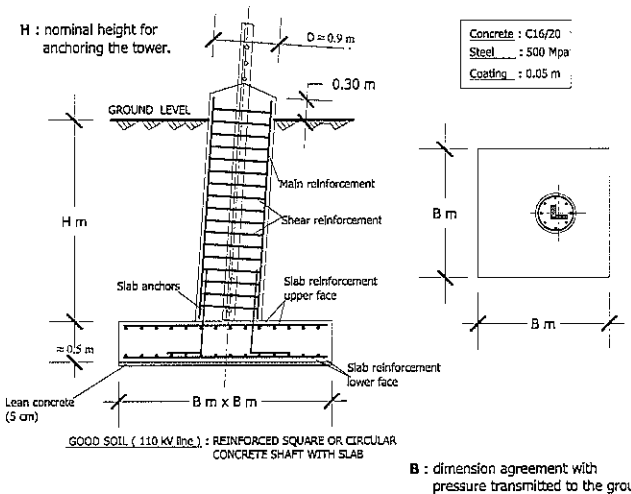
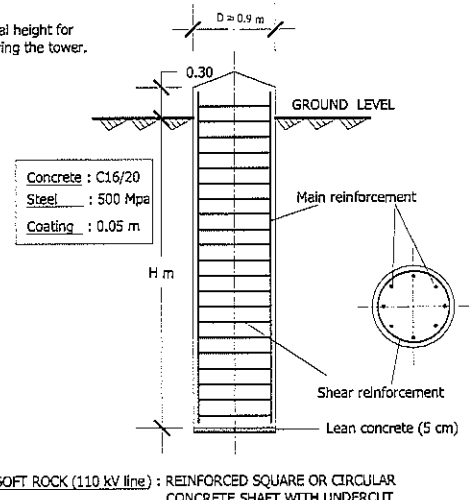
2) Soft rock including : - weathered rock, - well-graded silty gravel, - well-graded clayey gravel (G C)

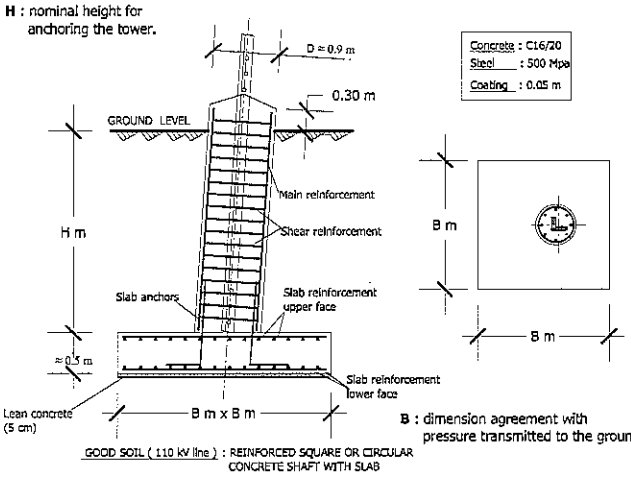
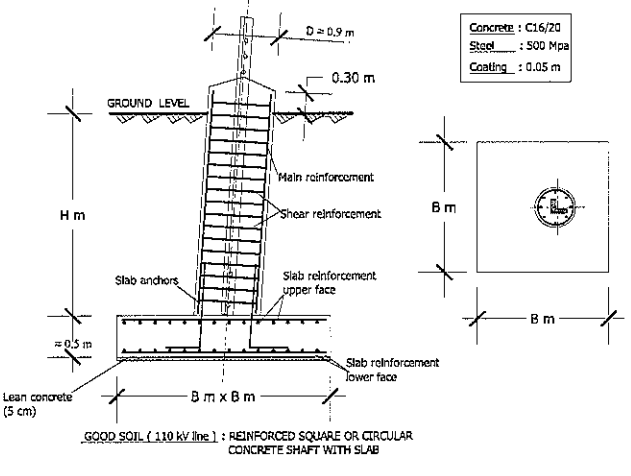
VI. TABLE OF TEST RESULTS & RECOMMENDATIONS FOR FOUNDATION SYSTEM

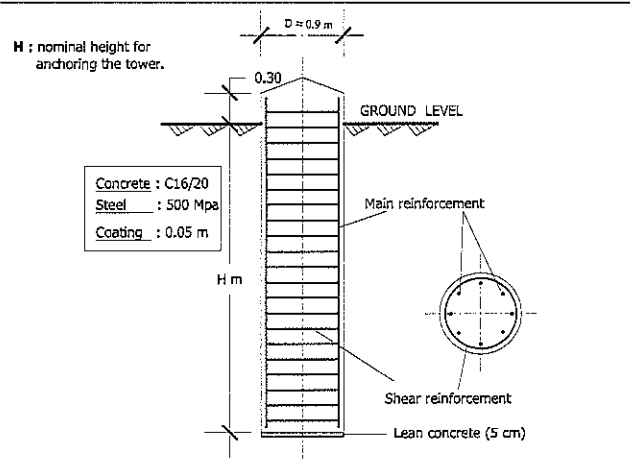
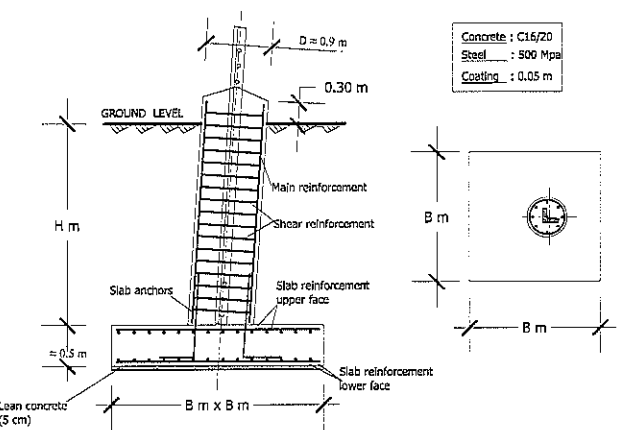
TO REFER TO COMPLEMENTARY ELUCIDATIONS, FROM PAGE 49 TO PAGE 74

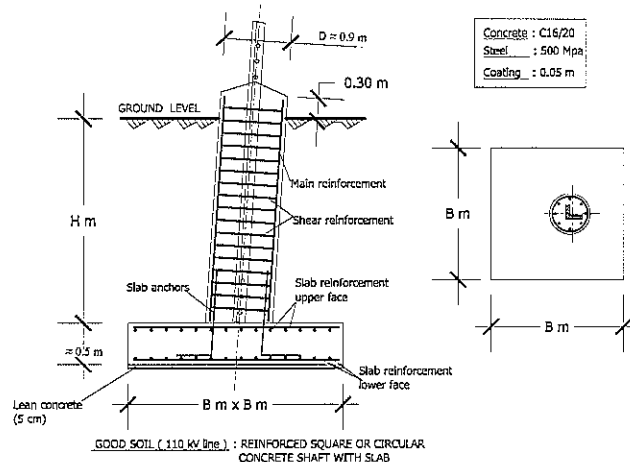
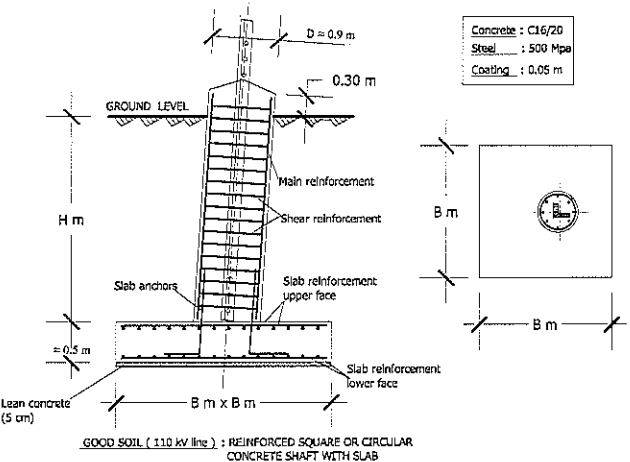
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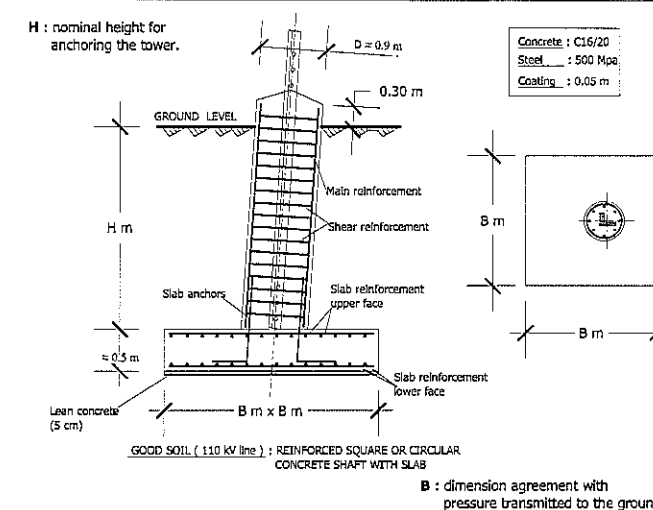
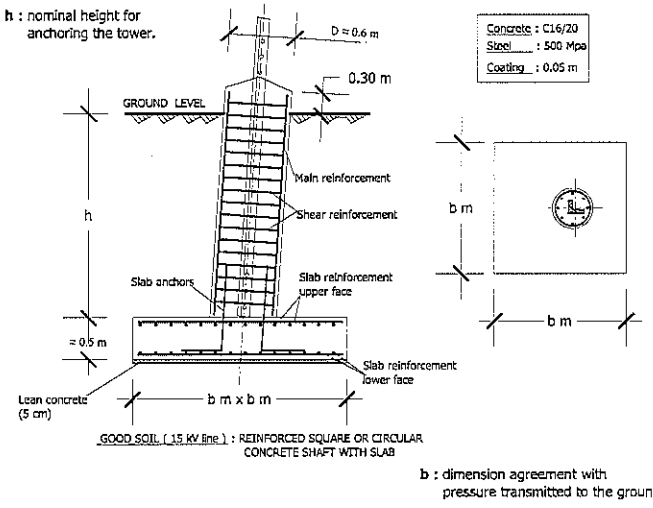
- I_P : Plasticity Index - I_c : Consistency Index - $W_{opm} (\%)$: Optimum water content
- $\gamma_{d\text{ opm}}$: Optimum dry specific gravity - γ_h : Natural specific gravity - $w(N)$: Natural Moisture content
- C_{uu} : Cohesion unconsolidated - undrained - ψ_{uu} : Angle of internal friction

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 1 (ON 110 kV line)	CI (clay of intermediate plasticity)	- IP : 16.8 % - Consistency $I_c = 1.39 > 1$: very consistent ground - Compaction Backfill : $\gamma_{OPM} = 1.92 \text{ t/m}^3$ $W_{OPM} = 13.28 \%$ - Natural soil : $\gamma_h = 1.61 \text{ t/m}$ $W_{(N)} = 14.90 \%$ $\gamma_s = 2.68 \text{ t/m}$	- Permissible bearing pressure (from 2.40 m deep) = 2167 kPa - Shear test : $C_{uu} = 35 \text{ kN/m}^2$ $\psi_{uu} = 25.41^\circ$ - Chemical analysis : - pH = 6.03 $SO_4^{2-} = 0.021 \%$ $Cl^- = 22 \text{ ppm}$	Picks and shovels can be used.	
SIP 2 (ON 110 kV line)	SF (very silty sand)	- IP : 13.8 % - Consistency $I_c = 1.42 > 1$: very consistent ground - Compaction Backfill : $\gamma_{OPM} = 1.92 \text{ t/m}^3$ $W_{OPM} = 12.42 \%$ - Natural soil : $\gamma_h = 1.60 \text{ t/m}$ $W_{(N)} = 15.10 \%$ $\gamma_s = 2.68 \text{ t/m}$	- Permissible bearing pressure (from 2.40 m deep) = 9167 kPa - Shear test : $C_{uu} = 1 \text{ kN/m}^2$ $\psi_{uu} = 39.18^\circ$ - Chemical analysis : - pH = 5.99 $SO_4^{2-} = 0.02 \%$ $Cl^- = 26 \text{ ppm}$	pneumatic hammer	

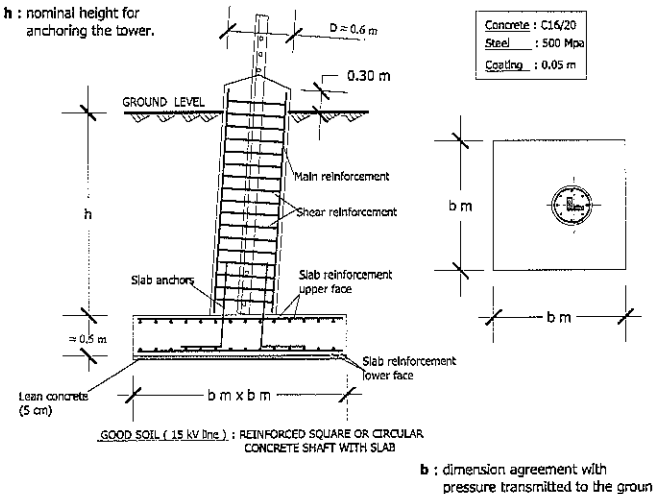
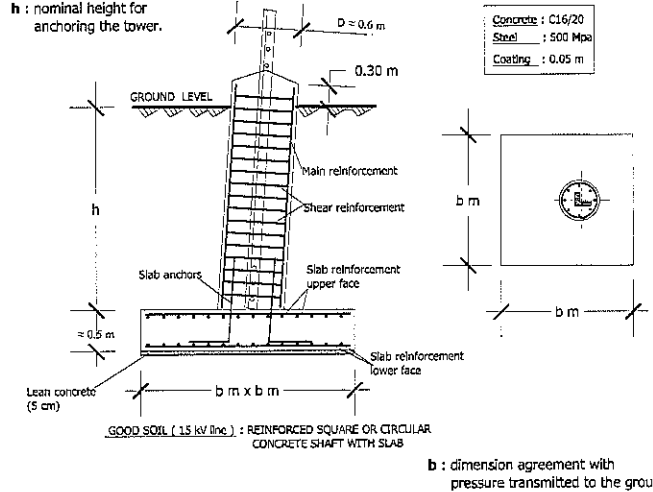
SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a log)
SIP 3 (ON 110 kV line)	SCI (very clayey sand)	- IP : 18.3 % - Consistency $I_c = 1.77 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 2.00 \text{ t/m}^3$. $W_{OPM} = 11.25 \%$ - Natural soil : . $\gamma_h = 1.81 \text{ t/m}^3$. $W_{(N)} = 8.7 \%$. $\gamma_s = 2.68 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9333 kPa - Shear test : . $C_{uu} = 25 \text{ kN/m}^2$. $\psi_{un} = 31.38^\circ$ - Chemical analysis : . pH = 5.84 . $SO_4^2 = 0.018 \%$. $Cl^- = 23 \text{ ppm}$	Picks and shovels can be used.	
SIP 4 (ON 110 kV line)	SF (very silty sand)	- IP : 21.0 % - Consistency $I_c = 1.30 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.81 \text{ t/m}^3$. $W_{OPM} = 16.21 \%$ - Natural soil : . $\gamma_h = 1.58 \text{ t/m}^3$. $W_{(N)} = 16.0 \%$. $\gamma_s = 2.66 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9333 kPa - Shear test : . $C_{uu} = 25 \text{ kN/m}^2$. $\psi_{un} = 31.38^\circ$ - Chemical analysis : . pH = 5.85 . $SO_4^2 = 0.018 \%$. $Cl^- = 23 \text{ ppm}$	Picks and shovels can be used.	

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 5 (ON 110 kV line)	S F	- IP : 12.4 % - Consistency $I_c = 1.95 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dPM} = 2.02 \text{ t/m}^3$. $W_{OPM} = 11.87 \%$ - Natural soil : . $\gamma_h = 1.64 \text{ t/m}^3$. $W(n) = 10 \%$. $\gamma_s = 2.75 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 8000 kPa - Shear test : . $C_{uu} = 5 \text{ kN/m}^2$. $\psi_{uu} = 30.54^\circ$ - Chemical analysis : . pH = 6.40 . $SO_4^2 = 0.017 \%$. $Cl^- = 37 \text{ ppm}$	Pneumatique hammer	 SOFT ROCK (110 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH UNDERCUT
SIP 6 (ON 110 kV line)	C I	- IP : 21.9 % - Consistency $I_c = 1.22 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dPM} = 1.72 \text{ t/m}^3$. $W_{OPM} = 17.20 \%$ - Natural soil : . $\gamma_h = 1.62 \text{ t/m}^3$. $W(n) = 18.9 \%$. $\gamma_s = 2.63 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 2000 kPa - Shear test : . $C_{uu} = 62 \text{ kN/m}^2$. $\psi_{uu} = 10.48^\circ$ - Chemical analysis : . pH = 5.71 . $SO_4^2 = 0.015 \%$. $Cl^- = 11 \text{ ppm}$	Picks and shovels can be used.	 GOOD SOIL (110 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB

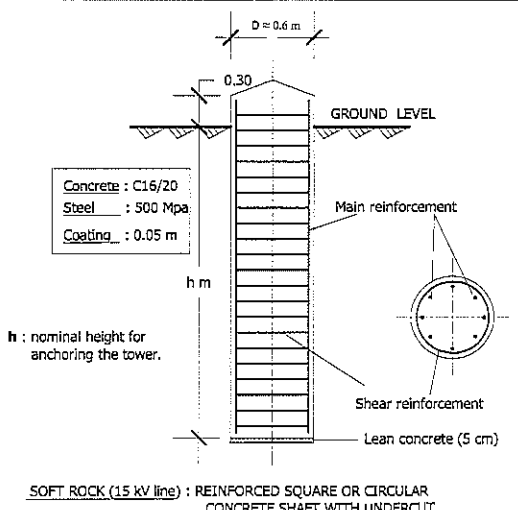
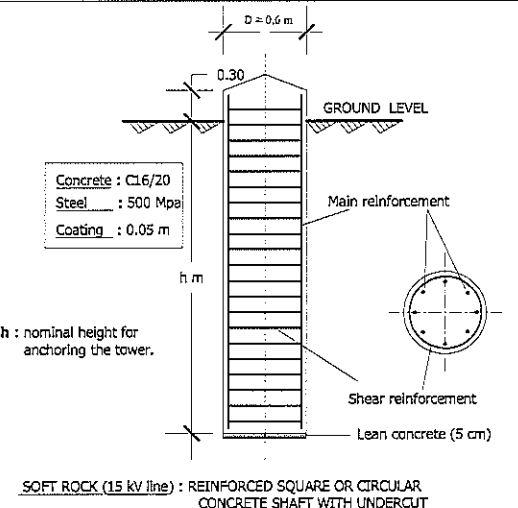
SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 7 (ON 110 kV line)	C I	- IP : 21.1 % - Consistency $I_c = 1.20 > 1$: very consistent ground - Compaction Backfill : $\gamma_{dOPM} = 1.71 \text{ t/m}^3$ $W_{OPM} = 19.48 \%$ - Natural soil : $\gamma_h = 1.59 \text{ t/m}^3$ $W_{(N)} = 19.0 \%$ $\gamma_s = 2.63 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 1333 kPa - Shear test : $C_{uu} = 55 \text{ kN/m}^2$ $\psi_{uu} = 28.37^\circ$ - Chemical analysis : - pH = 6.56 $SO_4^2 = 0.021 \%$ $Cl^- = 16 \text{ ppm}$	Picks and shovels can be used.	
SIP 8 (ON 110 kV line)	C I	- IP : 18.8 % - Consistency $I_c = 1.04 > 1$: very consistent ground - Compaction Backfill : $\gamma_{dOPM} = 1.76 \text{ t/m}^3$ $W_{OPM} = 17.32 \%$ - Natural soil : $\gamma_h = 1.65 \text{ t/m}^3$ $W_{(N)} = 19.6 \%$ $\gamma_s = 2.63 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 2500 kPa - Shear test : $C_{uu} = 27 \text{ kN/m}^2$ $\psi_{uu} = 26.57^\circ$ - Chemical analysis : - pH = 7.31 $SO_4^2 = 0.023 \%$ $Cl^- = 23 \text{ ppm}$	Picks and shovels can be used.	

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 9 (ON 110 kV line)	C I	- IP : 17.4 % - Consistency $I_c = 1.28 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.68 \text{ t/m}^3$. $W_{OPM} = 20.90 \%$ - Natural soil : . $\gamma_h = 1.53 \text{ t/m}^3$. $W_{(N)} = 18.0 \%$. $\gamma_s = 2.67 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 2000 kPa - Shear test : . $C_{uu} = 44 \text{ kN/m}^2$. $\psi_{uu} = 25.87^\circ$ - Chemical analysis : . pH = 5.67 . $SO_4^2 = 0.010 \%$. $Cl^- = 9 \text{ ppm}$	Picks and shovels can be used.	 H : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m B : dimension agreement with pressure transmitted to the ground .
SIP 10 (ON 15 kV line)	S F	- IP : 14.1 % - Consistency $I_c = 1.39 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 2.04 \text{ t/m}^3$. $W_{OPM} = 11.20 \%$ - Natural soil : . $\gamma_h = 1.94 \text{ t/m}^3$. $W_{(N)} = 13.0 \%$. $\gamma_s = 2.79 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 7000 kPa - Shear test : . $C_{uu} = 1.0 \text{ kN/m}^2$. $\psi_{uu} = 33.42^\circ$ - Chemical analysis : . pH = 7.00 . $SO_4^2 = 0.037 \%$. $Cl^- = 46 \text{ ppm}$	Picks and shovels can be used.	 h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m b : dimension agreement with pressure transmitted to the ground .

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 11 (ON 15 kV line)	C I	- IP : 18.3 % - Consistency $I_c = 1.29 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.83 \text{ t/m}^3$. $W_{OPM} = 15.6 \%$ - Natural soil : . $\gamma_h = 1.76 \text{ t/m}^3$. $W_{(N)} = 12.3 \%$. $\gamma_s = 2.66 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 8833 kPa - Shear test : . $C_{uu} = 39 \text{ kN/m}^2$. $\psi_{uu} = 11.31^\circ$ - Chemical analysis : . $pH = 7.35$. $SO_4^2 = 0.014 \%$. $Cl^- = 14 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. GROUND LEVEL $D \approx 0.6 \text{ m}$ 0.30 m Main reinforcement Shear reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) $b \text{ m} \times b \text{ m}$ GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground .
SIP 12 (ON 15 kV line)	C G	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.91 \text{ t/m}^3$. $W_{OPM} = 13.21 \%$ - Natural soil : . $\gamma_h = 1.82 \text{ t/m}^3$. $W_{(N)} = 10.2 \%$. $\gamma_s = 2.66 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 800 kPa - Shear test : . $C_{uu} = /$. $\psi_{uu} = /$ - Chemical analysis : . $pH = 7.68$. $SO_4^2 = 0.034 \%$. $Cl^- = 46 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. GROUND LEVEL $D \approx 0.6 \text{ m}$ 0.30 m Main reinforcement Shear reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) $b \text{ m} \times b \text{ m}$ GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground .

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 13 (ON 15 kV line)	C G	- IP : / - Consistency $I_c = > 1$: very consistent ground - Compaction Backfill : $\gamma_{dOPM} = 1.82 \text{ t/m}^3$ $W_{OPM} = 12.4 \%$ - Natural soil : $\gamma_h = 1.78 \text{ t/m}^3$ $W_{(N)} = 9.9 \%$ $\gamma_s = 2.45 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : $C_{uu} = /$ $\psi_{uu} = /$ - Chemical analysis : $pH = 5.81$ $SO_4^2 = 0.021 \%$ $Cl^- = 26 \text{ ppm}$	Picks and shovels can be used.	 h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GROUND LEVEL h 0.30 m Main reinforcement Shear reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) b m x b m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground.
SIP 14 (ON 15 kV line)	S F	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : $\gamma_{dOPM} = 2.07 \text{ t/m}^3$ $W_{OPM} = 7.90 \%$ - Natural soil : $\gamma_h = 1.98 \text{ t/m}^3$ $W_{(N)} = 10.0 \%$ $\gamma_s = 2.61 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : $C_{uu} = /$ $\psi_{uu} = /$ - Chemical analysis : $pH = 5.81$ $SO_4^2 = 0.021 \%$ $Cl^- = 26 \text{ ppm}$	Picks and shovels can be used.	 h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GROUND LEVEL h 0.30 m Main reinforcement Shear reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) b m x b m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground.

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 15 (ON 15 kV line)	C I	- IP : 15 % - Consistency $I_c = 1.61 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.97 \text{ t/m}^3$. $W_{OPM} = 11.48 \%$ - Natural soil : . $\gamma_h = 1.82 \text{ t/m}^3$. $W_{(N)} = 7.0 \%$. $\gamma_s = 2.62 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : . $C_{uu} = 44 \text{ kN/m}^2$. $\psi_{uu} = 25.87^\circ$ - Chemical analysis : . pH = 5.81 . $SO_4^2 = 0.030 \%$. $Cl^- = 28 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GROUND LEVEL h D = 0.6 m 0.30 m Main reinforcement Slab reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) b m x b m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground .
SIP 16 (ON 15 kV line)	S F	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 2.00 \text{ t/m}^3$. $W_{OPM} = 11.5 \%$ - Natural soil : . $\gamma_h = 1.71 \text{ t/m}^3$. $W_{(N)} = 2.6 \%$. $\gamma_s = 2.7 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : . $C_{uu} = /$. $\psi_{uu} = /$ - Chemical analysis : . pH = 5.82 . $SO_4^2 = 0.060 \%$. $Cl^- = 55 \text{ ppm}$	Pneumatique hammer	h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GROUND LEVEL h D = 0.6 m 0.30 m Main reinforcement Slab reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) b m x b m SOFT ROCK (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH UNDERCUT

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 17 (ON 15 kV line)	S F	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : $\gamma_{OPM} = 2.02 \text{ t/m}^3$ $W_{OPM} = 6.82 \%$ - Natural soil : $\gamma_h = 1.88 \text{ t/m}^3$ $W_{(N)} = 5.4 \%$ $\gamma_s = 2.43 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : $C_{uu} = /$ $\psi_{uu} = /$ - Chemical analysis : $pH = 6.02$ $SO_4^2 = 0.010 \%$ $Cl^- = 10 \text{ ppm}$	Pneumatique hammer	 Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m h : nominal height for anchoring the tower. SOFT ROCK (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH UNDERCUT
SIP 18 (ON 15 kV line)	C G	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : $\gamma_{OPM} = 2.09 \text{ t/m}^3$ $W_{OPM} = 6.0 \%$ - Natural soil : $\gamma_h = 1.97 \text{ t/m}^3$ $W_{(N)} = 6.0 \%$ $\gamma_s = 2.45 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 9000 kPa - Shear test : $C_{uu} = /$ $\psi_{uu} = /$ - Chemical analysis : $pH = 5.88$ $SO_4^2 = 0.038 \%$ $Cl^- = 61 \text{ ppm}$	Pneumatique hammer	 Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m h : nominal height for anchoring the tower. SOFT ROCK (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH UNDERCUT

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a log)
SIP 19 (ON 15 kV line)	S F	- IP : 17.5 % - Consistency $I_c = 1.54 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 2.06 \text{ t/m}^3$. $W_{OPM} = 5.1 \%$ - Natural soil : . $\gamma_h = 1.92 \text{ t/m}^3$. $W_{(N)} = 7.0 \%$. $\gamma_s = 2.60 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 1000 kPa - Shear test : . $C_{uu} = 60 \text{ kN/m}^2$. $\psi_{uu} = 26.79^\circ$ - Chemical analysis : . pH = 6.18 . $SO_4^2 = 0.022 \%$. $Cl^- = 36 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground.
SIP 20 (ON 15 kV line)	C I	- IP : 17.9 % - Consistency $I_c = 1.31 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.80 \text{ t/m}^3$. $W_{OPM} = 18.42 \%$ - Natural soil : . $\gamma_h = 1.68 \text{ t/m}^3$. $W_{(N)} = 13.6 \%$. $\gamma_s = 2.77 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 6000 kPa - Shear test : . $C_{uu} = 51 \text{ kN/m}^2$. $\psi_{uu} = 29.25^\circ$ - Chemical analysis : . pH = 7.36 . $SO_4^2 = 0.025 \%$. $Cl^- = 45 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b : dimension agreement with pressure transmitted to the ground.

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 21 (gantry in REG Plot)	CI	- IP : 15.1 % - Consistency $I_c = 1.06 > 1$: very consistent ground - Compaction Backfill : $\gamma_{d,OPM} = 1.97 \text{ t/m}^3$ $W_{OPM} = 10.0 \%$ - Natural soil : $\gamma_h = 1.58 \text{ t/m}^3$ $W_{(N)} = 16.8 \%$ $\gamma_s = 2.61 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 3000 kPa - Shear test : $C_{uu} = 33 \text{ kN/m}^2$ $\psi_{uu} = 25.64^\circ$ - Chemical analysis : - pH = 7.34 $SO_4^2 = 0.013 \%$ $Cl^- = 12 \text{ ppm}$	Picks and shovels can be used.	h : nominal height for anchoring the tower. GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB
SIP 22 (in REG Plot)	CI (loose sedimentary rocks)	- IP : 19.0 % - Consistency $I_c = 1.27 > 1$: very consistent ground - Compaction Backfill : $\gamma_{d,OPM} = 1.77 \text{ t/m}^3$ $W_{OPM} = 17.91 \%$ - Natural soil : $\gamma_h = 1.66 \text{ t/m}^3$ $W_{(N)} = 17.2 \%$ $\gamma_s = 2.66 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 2333 kPa - Shear test : $C_{uu} = 44 \text{ kN/m}^2$ $\psi_{uu} = 25.87^\circ$ - Chemical analysis : - pH = 6.75 $SO_4^2 = 0.015 \%$ $Cl^- = 19 \text{ ppm}$	Picks and shovels can be used.	IMPORTANT NOTES The area marked by the points SIP22, SIP23, SIP24, SIP25 and SIP26 is a land with a surface silty clay layer ($\pm 3.80 \text{ m}$) whose depth decreases towards the east and west, while it increases to the north. Below this layer, it generally falls on a hard sedimentary metamorphic layer. For any foundation constructed within 2.50 m of depth; the bearing capacity of the soil must be limited to 0.2 Mpa for current civil engineering works (buildings, various works), whereas for foundations going beyond this depth; the case of towers, take one of the types of foundation proposed above.

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 23 (in REG Plot)	S F (metamorphic sedimentary rocks)	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 2.0 \text{ t/m}^3$. $W_{OPM} = 10.02 \%$ - Natural soil : . $\gamma_h = 1.86 \text{ t/m}^3$. $W_{(N)} = 8.0 \%$. $\gamma_s = 2.62 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 8333 kPa - Shear test : . $C_{uu} = /$. $\psi_{uu} = /$ - Chemical analysis : . pH = 6.89 . $SO_4^2 = 0.017 \%$. $Cl^- = 18 \text{ ppm}$	Picks and shovels can be used; preferably use pneumatic hammer.	See " IMPORTANT NOTES " (SIP 22)
SIP 24 (in REG Plot)	C I (clay hard)	- IP : 19.3 % - Consistency $I_c = 0.69$ and $0.5 < I_c < 0.75$: semi - consistence ground. - Compaction Backfill : . $\gamma_{dOPM} = 1.76 \text{ t/m}^3$. $W_{OPM} = 19.60 \%$ - Natural soil : . $\gamma_h = 1.65 \text{ t/m}^3$. $W_{(N)} = 18.0 \%$. $\gamma_s = 2.75 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 1333 kPa - Shear test : . $C_{uu} = 45 \text{ kN/m}^2$. $\psi_{uu} = 18.78^\circ$ - Chemical analysis : . pH = 6.88 . $SO_4^2 = 0.016 \%$. $Cl^- = 13 \text{ ppm}$	Picks and shovels can be used.	See " IMPORTANT NOTES " (SIP 22)

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 25 (in REG Plot)	C I (clay hard)	- IP : 19.1 % - Consistency $I_c = 1.20 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.73 \text{ t/m}^3$. $W_{OPM} = 18.4 \%$ - Natural soil : . $\gamma_h = 1.64 \text{ t/m}^3$. $W_{(N)} = 17.9 \%$. $\gamma_s = 2.65 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 1500 kPa - Shear test : . $C_{uu} = 44 \text{ kN/m}^2$. $\psi_{uu} = 25.87^\circ$ - Chemical analysis : . pH = 5.52 . $SO_4^2 = 0.013 \%$. $Cl^- = 6 \text{ ppm}$	Picks and shovels can be used .	See " IMPORTANT NOTES " (SIP 22)
SIP 26 (in REG Plot)	C I (clay hard)	- IP : 18.5 % - Consistency $I_c = 1.15 > 1$: very consistent ground - Compaction Backfill : . $\gamma_{dOPM} = 1.78 \text{ t/m}^3$. $W_{OPM} = 17.75 \%$ - Natural soil : . $\gamma_h = 1.62 \text{ t/m}^3$. $W_{(N)} = 16.3 \%$. $\gamma_s = 2.65 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 1500 kPa - Shear test : . $C_{uu} = 50 \text{ kN/m}^2$. $\psi_{uu} = 29.25^\circ$ - Chemical analysis : . pH = 5.56 . $SO_4^2 = 0.009 \%$. $Cl^- = 7 \text{ ppm}$	Picks and shovels can be used.	See " IMPORTANT NOTES " (SIP 22)

SOIL INVESTIGATION POINTS	CLASSIFICATION ACCORDING BSCS	ENGINEERING PROPERTIES		EXCAVATION CONDITION	FOUNDATION TYPE (a leg)
SIP 27 (on 15 kV line in REG Plot)	S F	- IP : / - Consistency $I_c > 1$: very consistent ground - Compaction Backfill : $\gamma_{d\text{opt}} = 2.09 \text{ t/m}^3$ $W_{\text{opt}} = 8.20 \%$ - Natural soil : $\gamma_h = 1.98 \text{ t/m}^3$ $W_{(N)} = 6.0 \%$ $\gamma_s = 2.65 \text{ t/m}^3$	- Permissible bearing pressure (from 2.40 m deep) = 8667 kPa - Shear test : $C_{uu} = /$ $\psi_{uu} = /$ - Chemical analysis : - pH = 5.94 $\text{SO}_4^{2-} = 0.020 \%$ $\text{Cl}^- = 16 \text{ ppm}$	Picks and shovels can be used ; preferably, use pneumatic hammer.	h : nominal height for anchoring the tower. Concrete : C16/20 Steel : 500 Mpa Coating : 0.05 m GROUND LEVEL h 0.30 m Main reinforcement Slab anchors Slab reinforcement upper face Slab reinforcement lower face Lean concrete (5 cm) b m x b m GOOD SOIL (15 kV line) : REINFORCED SQUARE OR CIRCULAR CONCRETE SHAFT WITH SLAB b m b m b : dimension agreement with pressure transmitted to the ground .

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GEOLOGICAL UNIT SIP 1

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Organic Clay with rootlets, dark brownish, soft, moist, low plasticity. 0.00 - 0.80 m	0		0	0	0
	20		167	500	600
	40		333	1000	1600
	60		400	1200	2800
	80		333	1000	4300
Clay, yellowish beige, consistent & hard, intermediate plasticity. 0.80 - 3.40 m	100		400	1200	6300
	120		267	800	7500
	140		467	1400	8000
	160		1400	4200	9000
	180		3167	9500	13500
	200		3500	10500	16500
	220		2167	6500	20000
	240		4000	12000	24500
	260		4667	14000	31500
	280		3333	10000	31000
	300		3167	9500	30500
	320		2667	8000	29500
	340		2167	6500	27000
	360		3667	11000	29500
	380		8667	26000	50000
Clay with pebbels, yellowish beige, consistent & hard, low plasticity.	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				
* ULS : Ultimate Limit State					

GEOLOGICAL UNIT SIP 2

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Lateritic soil with rootlets, dark red, hard, dry, without plasticity. 0.00 - 0.50 m	0		0	0	0
	20		233	700	800
	40		1167	3500	4000
	60		2333	7000	7500
	80		2500	7500	8000
Lateritic soil, dark red, very hard, dry, without plasticity. 0.50 - 4.00 m	100		2667	8000	8500
	120		4333	13000	13500
	140		7500	22500	34500
	160		8667	26000	46500
	180		9167	27500	50000
	200				
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
	440				
	460				
	480				
	500				
* ULS : Ultimate Limit State	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 3

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Organic Clay with rootlets, dark brownish, soft, moist, low plasticity. 0.00 - 1.00 m	0		0	0	0
	20		567	1700	1800
	40		700	2100	3000
	60		533	1600	4000
	80		467	1400	4500
	100		833	2500	6000
Lateritic Clay, yellowish beige, consistent & hard, low plasticity. 1.00 - 4.00 m	120		1833	5500	7500
	140		4000	12000	13000
	160		8500	25500	34000
	180		8667	26000	43000
	200		9333	28000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
* ULS : Ultimate Limit State	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 4 (identical to SIP 3)

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Organic Clay with rootlets, dark brownish, soft, moist, low plasticity. 0.00 - 1.00 m	0		0	0	0
	20		567	1700	1800
	40		700	2100	3000
	60		533	1600	4000
	80		467	1400	4500
	100		833	2500	6000
Lateritic Clay, yellowish beige, consistent & hard, low plasticity. 1.00 - 4.00 m	120		1833	5500	7500
	140		4000	12000	13000
	160		8500	25500	34000
	180		8667	26000	43000
	200		9333	28000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
* ULS : Ultimate Limit State	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 5

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Lateritic soil with rootlets, dark red, hard, dry, without plasticity. 0.00 - 0.50 m	0		0	0	0
	20		1167	3500	4000
	40		2167	6500	7000
	60		2333	7000	8000
	80		2167	6500	7500
Lateritic soil, dark red, very hard, dry, without plasticity. 0.50 - 4.00 m	100		2833	8500	9000
	120		4000	12000	13500
	140		4667	14000	14500
	160		5167	15500	18500
	180		6167	18500	24500
	200		6833	20500	27000
	220		7333	22000	36000
	240		8000	24000	44500
	260		9000	27000	50000
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
* ULS : Ultimate Limit State	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 6

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, yellowish red, soft, moist, intermediat plasticity. 0.00 - 0.50 m	0		0	0	0
	20		133	400	600
	40		367	1100	1300
	60		800	2400	2700
	80		667	2000	4500
Clay soil, yellowish red,consistent hard, dry, intermediat plasticity. 0.50 - 4.00 m	100		767	2300	6500
	120		600	1800	7000
	140		2000	6000	11500
	160		2167	6500	14000
	180		1833	5500	13500
	200		2333	7000	15000
	220		2167	6500	17000
	240		2500	7500	19500
	260		3167	9500	23500
	280		3333	10000	27500
	300		3500	10500	28500
	320		3000	9000	27000
	340		2833	8500	26500
	360		2500	7500	27000
	380		2333	7000	24500
	400		2167	6500	24000
	420		2000	6000	23500
	440		3000	9000	26500
	460		2333	7000	24500
	480		2167	6500	24000
	500		6333	19000	36000
	520		7000	21000	50000
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
* ULS : Ultimate Limit State	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 7

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, dark brown, soft, moist, intermediat plasticity. 0.00 - 0.50 m	0		0	0	0
	20		100	300	400
	40		267	800	1000
	60		667	2000	2400
	80		833	2500	4500
Clay soil, brown,consistent hard, dry, intermediat plasticity. 0.50 - 4.00 m	100		933	2800	6000
	120		767	2300	7000
	140		867	2600	7500
	160		933	2800	8000
	180		1000	3000	10000
	200		1167	3500	12500
	220		1500	4500	15500
	240		1400	4200	14500
	260		1333	4000	14000
	280		1400	4200	15000
	300		1600	4800	15500
	320		1667	5000	14000
	340		2000	6000	14500
	360		2167	6500	15500
	380		2267	6800	17000
	400		2333	7000	19500
	420		2167	6500	16500
	440		1733	5200	14500
	460		1667	5000	13000
	480		1833	5500	13500
	500		1667	5000	13000
* ULS : Ultimate Limit State	520		1733	5200	13500
	540		1333	4000	13000
	560		1833	5500	11500
	580		1667	5000	13500
	620		2000	6000	14500
	640		1833	5500	15500
	660		2000	6000	15000
	680		1733	5200	16000
	700		1833	5500	17000
	720		2167	6500	20000
	740		1833	5500	19000
	760		2167	6500	18500
	780		1833	5500	19500
	800		2000	6000	18500
	820		1833	5500	19500
	840		1833	5500	19000
	860		2000	6000	20500
	880		2167	6500	20000
	900		1833	5500	20500
	920		3000	9000	26500
	940		4833	14500	34500
	960		5667	17000	41500
	980		6833	20500	50000
	1000				

GEOLOGICAL UNIT SIP 8

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Clay soil with rootlets, ligh brown, soft, moist, intermediat plasticity. 0.00 - 0.50 m	20		667	2000	2200
	40		1167	3500	3600
	60		1667	5000	5500
	80		2167	6500	7000
	100		2067	6200	6500
Clay soil, dark brown,consistent hard, dry, intermediat plasticity. 0.50 - 4.00 m	120		2333	7000	7500
	140		2500	7500	8000
	160		2333	7000	8500
	180		3500	10500	11000
	200		3667	11000	11500
	220		4333	13000	13500
	240		5167	15500	16500
	260		5333	16000	19500
	280		5000	15000	22500
	300		3667	11000	26500
	320		3833	11500	24500
	340		3500	10500	23500
	360		3667	11000	22500
	380		2667	8000	20500
	400		2500	7500	20000
	420		2667	8000	17500
	440		2500	7500	16500
	460		2333	7000	17000
* ULS : Ultimate Limit State	480		3500	10500	18000
	500		3167	9500	19500
	520		2667	8000	22500
	540		3000	9000	22000
	560		3500	10500	24500
	580		5167	15500	28000
	620		6667	20000	40500
	640		6833	20500	45500
	660		7500	22500	50000
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 9

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, reddish brown, soft, moist, intermediat plasticity. 0.00 - 0.70 m	0		0	0	0
	20		133	400	600
	40		533	1600	2000
	60		867	2600	2800
	80		1567	4700	5000
Clay soil, reddish brown,consistent hard, dry, intermediat plasticity. 0.70 - 4.00 m	100		1800	5400	5700
	120		1333	4000	7500
	140		2333	7000	8000
	160		2500	7500	9500
	180		2000	6000	11500
	200		2167	6500	14500
	220		2333	7000	18500
	240		2167	6500	19000
	260		2333	7000	19500
	280		2167	6500	20500
	300		2333	7000	21000
	320		2000	6000	22500
	340		2167	6500	24000
	360		2333	7000	26000
	380		2500	7500	26500
	400		2167	6500	25500
	420		2000	6000	24500
	440		1833	5500	22500
	460		1667	5000	21500
	480		2167	6500	21000
	500		2333	7000	20500
	520		2167	6500	16500
	540		2333	7000	15500
	560		2500	7500	19000
	580		2667	8000	18000
	620		2833	8500	20500
	640		3167	9500	22500
	660		3000	9000	24000
	680		3167	9500	24500
	700		2833	8500	22500
	720		2333	7000	23500
	740		2167	6500	21500
	760		2667	8000	20500
	780		2500	7500	19500
	800		2833	8500	21500
	820		3000	9000	20500
	840		3167	9500	21000
	860		3500	10500	23500
	880		6833	20500	44500
	900		8667	26000	50000
	920				
	940				
	960				
	980				
	1000				
* ULS : Ultimate Limit State					

GEOLOGICAL UNIT SIP 10

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, reddish brown, soft, moist, intermediat plasticity. 0.00 - 0.70 m	0		0	0	0
	20		400	1200	1500
	40		1167	3500	3700
	60		1067	3200	4200
	80		733	2200	5500
Clay soil, reddish brown,consistent hard, dry, intermediat plasticity. 0.70 - 4.00 m	100		1333	4000	7500
	120		1567	4700	9000
	140		1667	5000	14500
	160		4833	14500	25000
	180		5500	16500	34000
	200		6333	19000	42000
	220		7000	21000	50000
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				
* ULS : Ultimate Limit State					

GEOLOGICAL UNIT SIP 11

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Blackish gray clay, soft, dry, intermediat plasticity. 0.00 - 1.50 m	0		0	0	0
	20		233	700	800
	40		500	1500	1700
	60		633	1900	2200
	80		500	1500	2800
	100		533	1600	3700
	120		733	2200	6700
	140		5500	16500	23500
	160		6500	19500	44500
	180		8833	26500	50000
Blackish brown lateritic soil, consistent hard, dry, intermediat plasticity. 1.50 - 4.00 m	200				
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
	440				
	460				
* ULS : Ultimate Limit State	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 13

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Silt with rootlets, dark brownish, soft, dry, low plasticity. 0.00 - 0.70 m	0		0	0	0
	20				
	40				
	60				
	80				
Friable sedimentary rock, consistent hard, dry. 0.70 - 4.00 m	100		Metamorphic rock from 20 cm not allowing penetration We consider the minimum value under 2.40 m from SIP 15 area.		
	120				
	140				
	160				
	180				
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
	400				
	420				
	440				
	460				
* ULS : Ultimate Limit State	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 14

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Silt with rootlets, dark brownish, soft, dry, low plasticity. 0.00 - 0.70 m	0		0	0	0
	20		Metamorphic rock from 20 cm not allowing penetration We consider the minimum value under 2.40 m from SIP 15 area.		
	40				
	60				
	80				
Friable sedimentary rock, consistent hard, dry. 0.70 - 4.00 m	100				
	120				
	140				
	160				
	180				
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
	400				
	420				
	440				
	460				
	480				
* ULS : Ultimate Limit State	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 15

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Reddish clay with rootlets, soft, dry, low plasticity. 0.00 - 0.70 m	0		0	0	0
	20		333	1000	1400
	40		267	800	1000
	60		333	1000	1600
	80		400	1200	2000
Reddish clay with very hard gravel, hard, dry, low plasticity. 0.70 - 4.00 m	100		1500	4500	5000
	120		5167	15500	16000
	140		6833	20500	26000
	160		8500	25500	30500
	180		8667	26000	41500
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
	400				
	420				
	440				
	460				
	480				
* ULS : Ultimate Limit State	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 16

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Rocky ground, whitish brown, moyenement hard sedimentary rock	0		0	0	0
	20		Metamorphhic rock from 20 cm not allowing penetration We consider the minimum value under 2.40 m from SIP 15 area.		
	40				
	60				
	80				
	100				
	120				
	140				
	160				
	180				
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
	400				
* ULS : Ultimate Limit State	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 17

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Rocky ground, whitish brown, moyenement hard sedimentary rock	0		0	0	0
	20		Metamorphhic rock from 20 cm not allowing penetration We consider the minimum value under 2.40 m from SIP 15 area.		
	40				
	60				
	80				
	100				
	120				
	140				
	160				
	180				
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
* ULS : Ultimate Limit State	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 18

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Rocky ground, whitish brown, moyenement hard sedimentary rock and quartz gravel.	0		0	0	0
	20		Metamorphic rock from 20 cm not allowing penetration We consider the minimum value under 2.40 m from SIP 15 area.		
	40				
	60				
	80				
	100				
	120				
	140				
	160				
	180				
	200		9000	27000	50000
	220				
	240				
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	390				
* ULS : Ultimate Limit State	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 19

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, reddish brown, soft, moist, intermediat plasticity. 0.00 - 1.50 m	0		0	0	0
	20		500	1500	1800
	40		533	1600	2700
	60		900	2700	4500
	80		2000	6000	7000
	100		2333	7000	8500
	120		1500	4500	9500
	140		1333	4000	13500
	160		1667	5000	16500
	180		1500	4500	19000
Sedimentary rock soil, reddish brown, consistent but friable and dry. 1.50 - 4.00 m	200		2000	6000	23000
	220		1500	4500	29500
	240		1333	4000	25500
	260		1500	4500	26500
	280		2333	7000	30500
	300		3333	10000	34500
	320		3500	10500	36500
	340		3333	10000	39500
	360		2000	6000	40500
	380		1500	4500	38000
	400		1000	3000	37500
	420		3667	11000	36500
* ULS : Ultimate Limit State	440		5000	15000	44000
	460		5500	16500	50000
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 20

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, reddish brown, soft, moist, intermediat plasticity. 0.00 - 1.30 m	0		0	0	0
	20		400	1200	1500
	40		333	1000	1600
	60		267	800	2800
	80		600	1800	3200
	100		1667	5000	6500
	120		3667	11000	14000
	140		4167	12500	18500
Lateritic soil, reddish brown, consistent ,hard, dry. 1.30 - 4.00 m	160		4667	14000	23000
	180		4833	14500	29500
	200		5167	15500	33500
	220		5833	17500	41500
	240		6000	18000	46500
	260		6167	18500	50000
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
	440				
	460				
* ULS : Ultimate Limit State	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 21

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
Clay soil with rootlets, reddish brown, soft, moist, intermediat plasticity. 0.00 - 2.30 m	0		0	0	0
	20		500	1500	2100
	40		1533	4600	5000
	60		2233	6700	7000
	80		2167	6500	6500
	100		2167	6500	7000
	120		2233	6700	7500
	140		2500	7500	8000
	160		2000	6000	10500
	180		1667	5000	13500
	200		1833	5500	19500
	220		2000	6000	18000
	240		1833	5500	17500
Lateritic soil, reddish brown, consistent ,hard, dry. 2.30 - 4.00 m	260		3000	9000	22500
	280		4667	14000	30500
	300		6833	20500	43500
	320		8667	26000	50000
	340				
	360				
	380				
	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
* ULS : Ultimate Limit State	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 22

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Clay soil with rootlets in topsoil (0.50 cm thick), reddish brown, hard, intermediat plasticity. 0.00 - 3.60 m	20		100	300	400
	40		167	500	500
	60		567	1700	2000
	80		600	1800	2200
	100		1167	3500	3700
	120		900	2700	5000
	140		833	2500	7500
	160		2000	6000	10500
	180		2167	6500	12500
	200		333	1000	9500
	220		1667	5000	12000
	240		2333	7000	15500
	260		6667	20000	30500
	280		7333	22000	40500
	300		5667	17000	42000
	320		8667	26000	46500
	340		8833	26500	50000
	360				
Lateritic soil, reddish brown,consistent, hard, dry. 3.6 - 4.00 m	380				
	400				
	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				
* ULS : Ultimate Limit State					

GEOLOGICAL UNIT SIP 23

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Lateritic soil with pebbles over the height, reddish brown, consistent, hard, dry.	20		67	200	500
	40		333	1000	1200
	60		600	1800	2200
	80		900	2700	3000
	100		1167	3500	5500
	120		2000	6000	7000
	140		3167	9500	14500
	160		2667	8000	16500
	180		5333	16000	25500
	200		8333	25000	31500
	220		8500	25500	40500
	240		8333	25000	46000
	260		8833	26500	50000
	280				
	300				
	320				
	340				
	360				
	380				
	400				
* ULS : Ultimate Limit State	420				
	440				
	460				
	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 24

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Lateritic soil, reddish gray, consistent, hard. 0.00 - 3.20 m	20		133	400	1700
	40		500	1500	2200
	60		667	2000	4000
	80		1200	3600	5600
	100		1667	5000	7500
	120		2000	6000	8500
	140		1500	4500	11000
	160		1667	5000	14500
	180		2000	6000	16500
	200		2167	6500	18500
	220		2333	7000	19500
	240		2500	7500	22000
	260		2667	8000	20500
	280		2333	7000	19500
	300		2167	6500	18500
Lateritic soil, reddish brown, consistent, hard. 3.20 - 4.00 m	320		2000	6000	18000
	340		1867	5600	18500
	360		2000	6000	17000
	380		1833	5500	15500
	400		1500	4500	13500
	420		1333	4000	20500
	440		3167	9500	26500
	460		3667	11000	39500
	480		4833	14500	32500
	500		4000	12000	42500
	520		5500	16500	44500
	540		5667	17000	50000
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				
* ULS : Ultimate Limit State					

GEOLOGICAL UNIT SIP 25

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Lateritic soil, reddish gray, consistent, hard. 0.00 - 3.20 m	20		167	500	800
	40		400	1200	1400
	60		733	2200	2500
	80		1333	4000	4500
	100		1833	5500	6000
	120		2167	6500	7500
	140		2333	7000	10500
	160		2167	6500	16500
	180		2500	7500	24000
	200		2667	8000	26500
	220		2333	7000	25500
	240		2000	6000	24000
	260		1833	5500	25500
	280		2000	6000	25000
	300		1833	5500	27500
	320		1667	5000	26000
Lateritic soil, reddish brown, consistent, hard. 3.20 - 4.00 m	340		1500	4500	24500
	360		1667	5000	25500
	380		2000	6000	26500
	400		2167	6500	24500
* ULS : Ultimate Limit State	420		1833	5500	21000
	440		2167	6500	21500
	460		2000	6000	24500
	480		2167	6500	27500
	500		2333	7000	38000
	520		4833	14500	41500
	540		5333	16000	44500
	560		5833	17500	50000
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 26

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Clay soil, dark red, consistent, hard.	20		33	100	200
	40		400	1200	1500
	60		667	2000	2500
	80		567	1700	4500
	100		933	2800	6500
	120		2333	7000	10500
	140		2500	7500	17000
	160		2167	6500	21000
	180		2333	7000	24500
	200		2167	6500	28500
	220		3000	9000	31500
	240		3333	10000	32500
	260		3500	10500	36500
	280		3167	9500	38000
	300		3667	11000	39500
	320		3833	11500	41500
	340		4000	12000	42500
	360		2167	6500	44500
	380		2000	6000	43000
	400		1833	5500	42000
* ULS : Ultimate Limit State	420		1667	5000	41500
	440		1500	4500	39500
	460		1667	5000	37500
	480		1333	4000	36500
	500		1667	5000	37000
	520		2167	6500	39500
	540		4833	14500	42000
	560		6833	20500	50000
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

GEOLOGICAL UNIT SIP 27

Light penetrometer (GeoMIL 50 kN SPT) test without soil coring for sample taking

DESCRIPTION OF THE PIT	Depth (below existing ground level) cm	Soil Stratigraphy (observed in the well)	GEOTECHNICAL BEARING CAPACITIES		
			Allowable (kPa)	ULS * (kPa)	Ultimate (kPa)
	0		0	0	0
Organic Clay with rootlets, dark brownish, soft, moist, low plasticity. 0.00 - 0.70 m	20		267	800	1000
	40		500	1500	1700
	60		533	1600	2800
	80		400	1200	3500
	100		667	2000	6000
Brownish gray stony soil, hard, low plasticity. 0.70 - 4.0 m	120		2333	7000	9500
	140		5333	16000	25500
	160		6833	20500	31500
	180		6500	19500	36500
	200		6833	20500	46000
	220		7333	22000	47500
	240		8667	26000	50000
	260				
	280				
	300				
	320				
	340				
	360				
	380				
	400				
	420				
	440				
	460				
* ULS : Ultimate Limit State	480				
	500				
	520				
	540				
	560				
	580				
	620				
	640				
	660				
	680				
	700				
	720				
	740				
	760				
	780				
	800				
	820				
	840				
	860				
	880				
	900				
	920				
	940				
	960				
	980				
	1000				

