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Annex D4-3

Preliminary Geotechnical Investigation

A REPORT

ON

GEO-TECHNICAL INVESTIGATION

OF

PROPOSED SITES OF

LEKHNATH & DAMAULI

SUBSTATIONS AND TRANSMISSION LINES

AT

KASKI AND TANAHUN DISTRICT

Prepared For: Hydro-Consult Engineering Limited

Chaitra-2078

Submitted By;
R.R.P. Survey Consults Pvt Ltd.
Kathmandu

Project : Geotechnical Investigation of Lekhnath and Damauli Substations and Transmission		
Revision	Date	Details of Revision
0	8/12/2021	First Release
1	26/12/2021	Figure `1 : Location Plan of Boreholes in Google Earth
		Geological Description of Substation and TL differently
		Geological Map of Nepal in A3 Size
		Change in name of Code in chapter 5.2 under sampling
		Changes in Literatures under heading Dynamic Cone Penetration Test
		Figure 7 and 8 in A3 size
		Inclusion of Liquefaction Analysis for Borehole 3 for field condition
		Literature for Pile Foundation in Chapter 10
		Table of Bearing capacity for Isolated footing for 20 mm permissible Settlement for Different boreholes
		Table of Allowable Pile Capacity
		Recommendations for Embankment fillings
		Additional Phoographs for Boreholes 2 and 6
		Correction in Depth name in Sieve Analysis calculation sheets of Borehole 9
2	1/4/2021	New google map of four new boreholes
		Table for name of additional boreholes with coordinates
		Geological description of new boreholes
		Coorection for diameter of boreholes
		Code mentioned under heading Dynamic Cone Penetration Test
		New chapter for Insitu Permeability Test included
		New chapter for Mechanical Tests included
		Change in liquefaction analysis of Borehole 3 as revision of field test was done
		New calculation sheets of liquefaction analysis of new boreholes
		Changes in table of liquefaction analysis with new boreoholes results
		Change in allowable bearing capacity of Borehole 3 location
		Change in allowable pile capacity considering all the boreholes
		Table related to angle of friction for ew boreholes
		Literature related to location for filling materials
		Inclusion of New Borehole Logs and repeated Borehole 3 in Annex - I
		Inclusion of laboratory test results of New Boreholes and repeated Borehole 3 in Annex - II
		Inclusion of photographs of New Boreholes and repeated Borehole 3 in Annex - III

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1. Background

This geotechnical investigation report (research) is prepared based on the site explorations and laboratory test results carried out by **R.R.P. Survey Consults Pvt. Ltd., Kathmandu** at the proposed sites of **Substations and Transmission Lines** in Kaski and Tanahun Districts, Gandaki Province. The investigation characterizes the subsurface conditions and develops the necessary requirement for the proposed safe bearing capacity of the proposed substation and transmission tower foundation. The boreholes are located at various locations of Kaski and Tanahun districts. The google map of location of the boreholes is shown in figure 1.

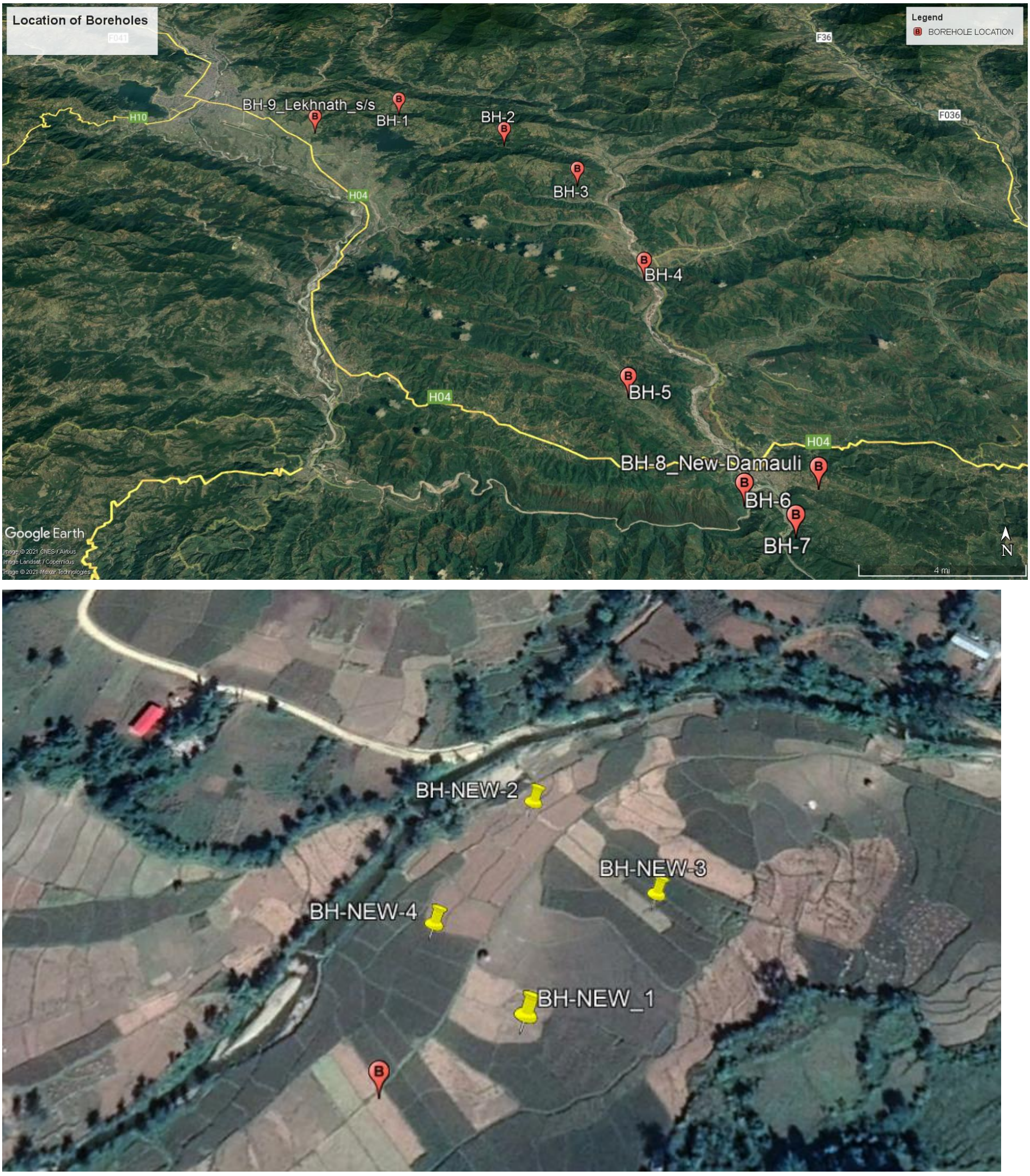


Fig 1: Location Plan of Boreholes in Google Earth

Table: List of Borehole with their coordinates

S.N.	BOREHOLE	COORDINATES
1	1	28°11'38.21"N 84°6'8.79"E
2	2	28°10'6.84"N 84°9'48.6"E
3	3	28°8'14.65"N 84°12'10.47"E
4	4	28°4'30.66"N 84°13'54.39"E
5	5	28°0'38.13"N 84°13'3.56"E
6	6	27°57'38.51"N 84°15'35.55"E
7	7	27°56'48.77"N 84°16'41.71"E
8	8	27°58'3.43"N 84°17'40.63"E
9	9	28°10'47.96"N 84° 3'22.89"E
10	1 – NEW-Damauli	27°58'3.14"N 84°17'33.52"E
11	2– NEW-Damauli	27°58'6.38"N 84°17'33.67"E
12	3 – NEW-Damauli	27°58'4.92"N 84°17'35.53"E
13	4 – NEW-Damauli	27°58'4.47"N 84°17'32.16"E

The soil investigation work for nine boreholes and additional four boreholes in Damauli Substation was carried out on month of Karthik and Mangsir, 2078 (October, 2021) and Falgun and Chaitra (February and March, 2022) respectively. The total quantity of soil investigation included six boreholes of fifteen meters depth in substations and seven boreholes up to depth of 6m wherever applicable as per the understanding. Standard Penetration Tests (SPT) and Dynamic Cone Penetration Tests (DCPT) were conducted at 1.5 m depth interval to furnish the compactness of the soil strata in the field.

The scope of work of present contract includes the following:

- Exploration of the subsurface soil formation and properties of soil at the site and conduct requisite in-situ tests like Standard Penetration Tests and Dynamic Cone Penetration Tests whichever is applicable depending upon the strata at site.
- Laboratory testing of representative samples obtained during the field investigation to evaluate relevant engineering parameters of the subsurface soils.
- Analysis of test results from in-situ and laboratory tests.

This report includes:

- Borehole logs
- Results of in situ and laboratory tests
- Assessment of Liquefaction susceptibility
- Perform Geotechnical Analysis and assessment of bearing capacity
- Recommendations of different suitable foundation types at different depths

2. Collection and review of available data

Site conditions, topographical and geological characteristic of the project area was grasped sufficiently through collecting and reviewing previously conducted soil investigation reports of nearby corridors, topographical map and geological map. Information stored in the form of maps, tables and published papers are collected from various sources.

3. Planning of works

Work schedule, location of these boreholes and other project specific issues were identified

based upon the KMZ file with location of the boreholes was provided to the drilling consultant. Immediately after finalization of foundations at site, drilling team finalized drilling methodology and revised methodology depending upon the changes on environment, geological and local conditions.

Table 1: Proposed Laboratory investigation of Soil

SPT samples (as per change in strata or if single strata at least 3 in each hole)	U/D samples (at least 1 in each hole if cohesive strata)
Natural Moisture test Specific Gravity test Liquid limit / Plastic Limit test Grain Size Distribution test Unit weight Direct shear test	Natural Moisture test Specific Gravity test Liquid limit / Plastic Limit test Grain Size Distribution test Unit weight/ Bulk density Uni-axial compression test Consolidation test

4. General Geology and Geomorphology

From the exploration record of the boreholes at different borehole locations can be acquired from borehole logs.

As per Geological map of Nepal, the project site of Lekhnath Substation, lies in **Lesser Himalaya** of Plio – Pleistocene to Quaternary age composed of fluvial/fluvioglacial gravels, conglomerates and lacustrine clay deposit. Borehole 1, 2, 3, 4 and 5 lies in lesser Himalaya under **Kuncha Group** of Precambrian age composed of mainly flyschoid sequence (bedded schists, phyllites and metasandstones), locally shallow water quartzite beds and basic sills and dykes present. Whereas, Damauli Substation, Borehole 6 and 7 lies in lesser Himalaya; under **Nawakot Group** of Precambrian to Lower Paleozoic consisting mainly shallow marine sediments, lower part dominantly clastic (phyllites, sandstones, quartzites and calcareous sandstones). Stromtolitic limestones and black slates occur in the upper part. Basic sills and dykes present.

Geological map of the project area is shown in Fig. 2. The map is an extract from Geological map of Nepal published by the Department of Mines and Geology of Government of Nepal.

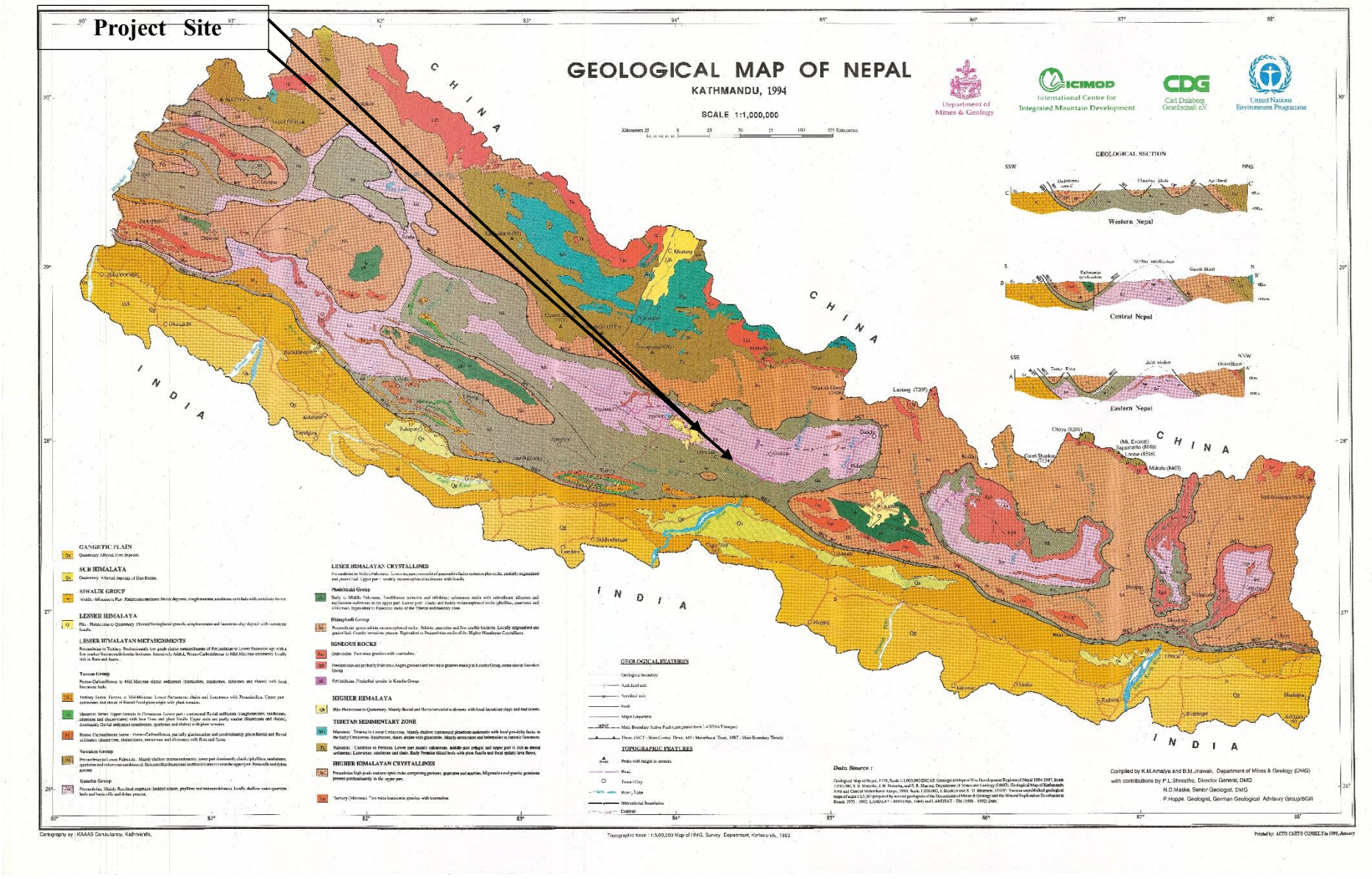
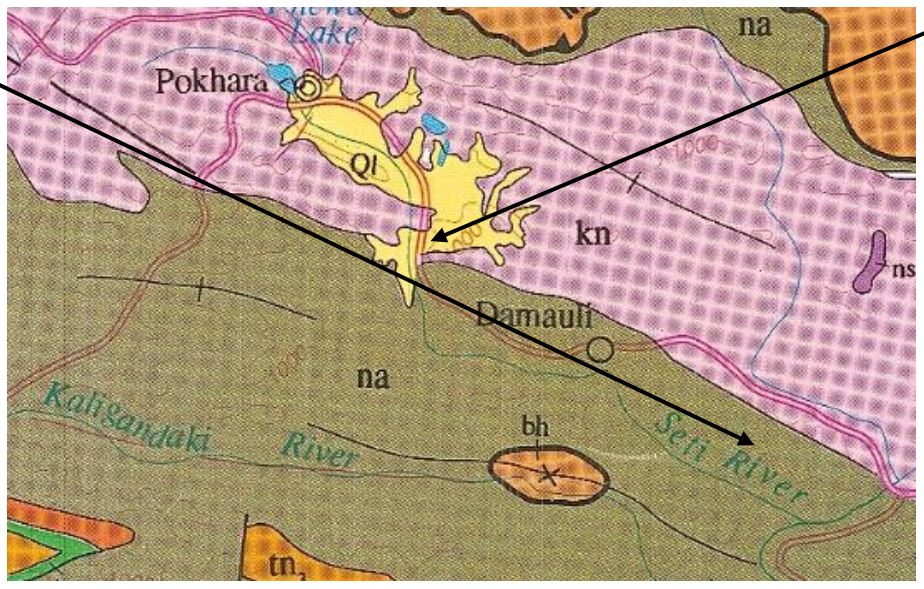


Fig 2: Geological map of Nepal including project area

Damauli Substation- Borehole 8, Borehole 1, 2, 3 and 4 (NEW)

Lekhnath Substation- Borehole 9



LESSER HIMALAYA

Q — Plio - Pleistocene to Quaternary. Fluvial/fluvioglacial gravels, conglomerates and lacustrine clay deposit with vertebrate fossils.

Kuncha Group

kn — Precambrian. Mainly flyschoid sequence (bedded schists, phyllites and metasandstones), locally shallow water quartzite beds and basic sills and dykes present.

5. Geo-technical Exploration

Geological condition/stratum at the test site is important aspect to determine the depth, size and types of foundation. Drilling can define the characteristic and strength of soil and rock in both unstable and stable zones. Standard Penetration Tests and Dynamic Cone Penetration Tests carried out in different depths can give appropriateness of the densification of the soil strata.

On the basis of substation location and transmission tower locations, the drilling team was mobilized by Rotary Drilling Rig and Auger Set. Safety mechanisms were developed for technical team and workers with safety helmets and safety gloves while working.

5.1 Boring

Boring investigation was performed in the subsoil to abstract information of soil state, thickness and depth of layers etc. The subsoil distribution, fractured zone and soft ground shall be grasped for the foundation design of structures depending on boring test results. In addition, in-situ tests, sounding, and underground water level measurement were performed using bore-holes.

The drilling works were carried out by Rotary drilling Rig and Auger Set. The diameter of borehole at borehole locations were of 96 mm and 100 mm. The boreholes were logged continuously in the field. The borehole logs included visual classification of soil, records of SPT for penetration of 450mm, DCPT for penetration of 300mm and position of ground water table. The borehole logs for site are presented in Annex-I including general ground water table.

5.2 Sampling

Before any disturbed samples were taken, the boreholes were washed clean to flush any loose disturbed soil particles deposited during the boring operation. The samples obtained in the split spoon barrel of SPT tube during Standard Penetration Tests were preserved as representative disturbed samples. The disturbed samples recovered in SPT tube were placed in air-tight double 0.5 mm thick transparent plastic bags, labeled properly for identification and finally sealed to avoid any loss of moisture. Only then, the samples were transportation to the laboratory for further investigations.

The test was conducted and samples were obtained as per **IS 2131: 1981 Method for Standard Penetration Test for soils**.

5.3 Field Test

The field test conducted at the site consists of Standard Penetration Test (SPT) and Dynamic Cone Penetration Tests (DCPT). They are the method for measuring soil characteristics of relative density and strength simply and quickly by penetrating resistance into the ground and pulling out it onto the ground. Penetration tests were executed through all strata.

Standard Penetration Test (SPT)

A standard split barrel sampler was used in the test. The tests were conducted in the boreholes of the site at a depth interval of every 1.5 m where sample can be extracted. The driving of split-spoon barrel was recorded at first 150 mm and then after at every 150 mm of penetration till the total penetration was 450 mm. The number of blows recorded for the first 150 mm of penetration is disregarded. The number of blows recorded for the last two 150 mm intervals are added and expressed as SPT N-value. The records of the SPT values obtained are presented in borehole logs in Annex-I.

Dynamic Cone Penetration Test (DCPT)

It consists of driving a cone by blows of hammers. The number of blows for driving the cone through a specified distance is a measure of the dynamic cone resistance. Dynamic Cone Penetration tests are performed by a 50-mm solid cone. (IS 4968: Part I). The driving energy is given by a 63.5 kg monkey hammer falling freely through a height of 750 mm onto the drive head. First of all, the cone is driven 100 mm into the soil at the bottom of the bore hole. It is then driven further 200 mm and the number of blows (Ncbr values) required to drive this distance is recorded.

The result i.e., Nc values first corrected to the Standard Penetration Test (SPT) value (N) and that provides and estimation of degree of compaction of soil strata, values of angles of internal friction (Φ) and allowable bearing capacity. The dynamic cone resistance is correlated with the SPT (N) as given below.

N_c= 1.5 N for depth up to 3 m

= 1 .75 N for depth 3 to 6 m

= 2 N for depth greater than 6 m

The records of the DCPT values obtained are also presented in borehole logs in Annex-I.

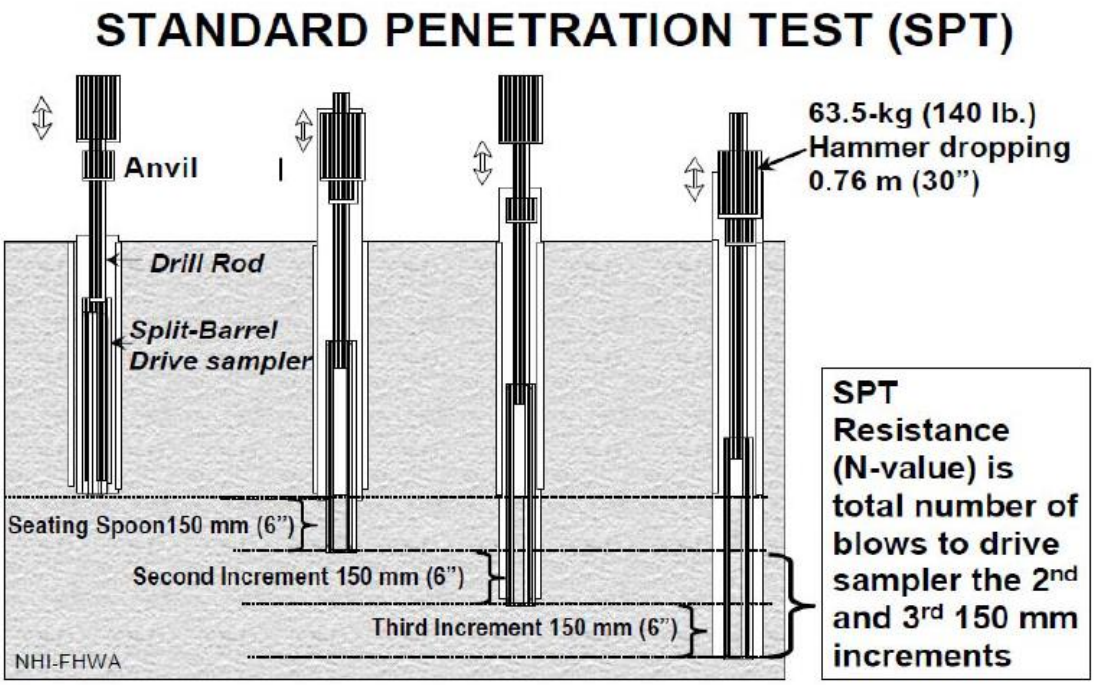


Fig 3: Test Procedure of Standard Penetration Test

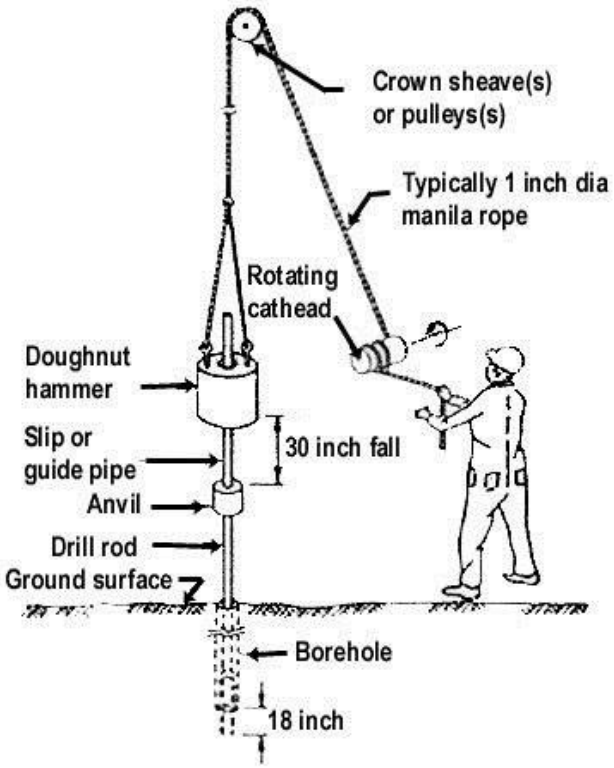


Fig 4: Schematic Description of Standard Penetration Test/Dynamic Cone Penetration Test

Table 2: Correlation between N-values and Internal Friction Angles in Granular Soils

N Value	Relative Density	Relative Density, D_r (%)	Internal friction angle, Φ	
			Peck (1974)	Meyerhof (1956)
< 4	Very loose	0.0 ~ 15	< 28.5	< 30
4 ~ 10	Loose	15 ~ 35	28.5 ~ 30.0	30 ~ 35
10 ~ 30	Medium	35 ~ 65	30.0 ~ 36.0	35 ~ 40
30 ~ 50	Dense	65 ~ 85	36.0 ~ 41.0	40 ~ 45
> 50	Very dense	85 ~ 100	> 41.0	> 45

In our analysis, Internal angle of friction was adopted as;

$\phi = 15+\sqrt{(12 * N\ corr.)}$ for sandy soils given by Dunham (1954)

Table 3: Correlation between N-values to Consistency and Unconfined Compression Strength in Cohesive Soils

N Value	Consistency	Unconfined Compression Test, q_u in kN/m^2
< 4	Very soft	< 25
2 ~ 4	Soft	25 ~ 50
4 ~ 8	Medium Stiff	50.0 ~ 100
8 ~ 15	Stiff	100 ~ 200
15 ~ 30	Very Stiff	200 ~ 400
> 30	Hard	400 ~ 800

5.4 Ground water table monitoring

Water Table is defined as underground border between the grounds in which all spaces are filled with water and the ground above in which the spaces contain some air. The level of the water table tends to follow the shape of the overlying ground surface, rising under hills and dipping in valleys, but with a gentler slope than the ground. The level of the water table also varies with the climate, rising during rainy periods and falling during dry season.

The position of ground water table was measured at each borehole from the ground surface. The water level observed in the boreholes at the end of a 24 hours long period after completion

of boring work was taken as the position of ground water table. The depth to ground water table if observed are recorded in the borehole logs presented.

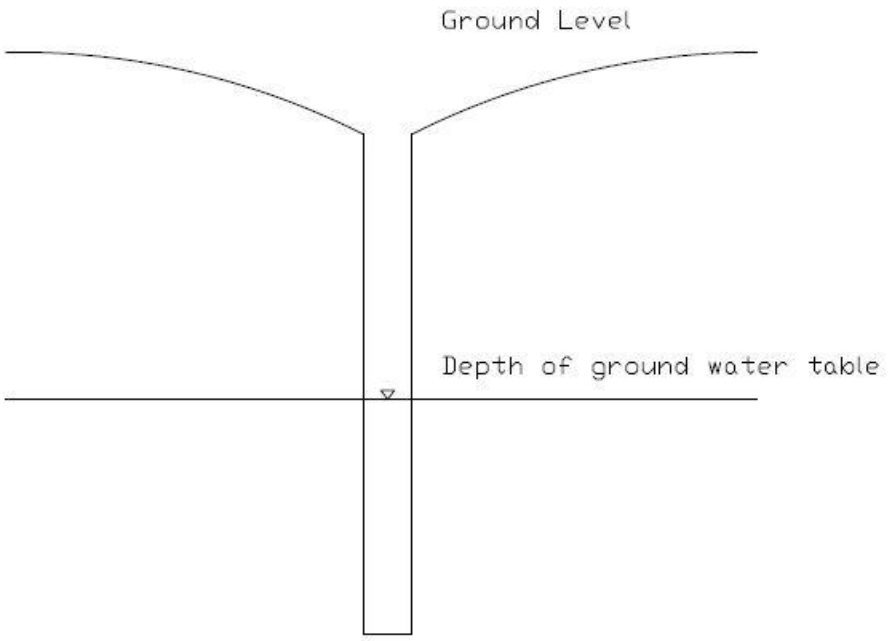


Fig 5: Reference point for measuring water level in borehole

5.5 In-situ Permeability Test

In-situ permeability tests were conducted to determine the water percolation capacity of the overburden soil. This test was performed inside the bore holes at an interval of two meters in all boreholes. The type of test was pump-in test.

Pump-in test (Constant Head Method)

The test was conducted in the bore holes by allowing water to percolate into the soil. Only clear water was used for conducting the test. Before conducting the test, the borehole was cleaned. Water was allowed to percolate through the test section for a sufficient period of time to saturate the soil before starting the observation.

Water was allowed into the borehole through a metering system ensuring gravity flow at the constant head to maintain a steady water level in the borehole. A reference mark was made at a convenient level which can be easily seen in the casing pipe to note down the fluctuations of water level. The fluctuations were counteracted by varying the quantity of water flowing into bore hole. The elevation of water was observed. The necessary observations such as flow rate, elevation of water surface above test depth, diameter of casing pipe etc. was made and recorded in proforma. The permeability by constant head method (open-end test) was obtained

from the following relation:

K=C1*Q/H

Where,

K = coefficient of permeability, cm/sec;

q = constant rate of flow into the hole, litre/min;

r = internal radius of casing; and

H = differential head of water in m = H1 (gravity head) – Hf (head loss due to friction)

Values of C1, which vary with the size of casing and rods obtained from Table 1 of IS 5529 (Part 1): 2013.

The value of H, for gravity test made below water table is the difference between the level of water in the casing and the ground water level. For test above water table, H1 is the depth of water in the hole and Hf is neglected being a small value.

Note: The depths where the constant head couldn't be maintained in the boreholes and water falls down abruptly no falling head method was feasible, so litres of water flowing inside the borehole at the proposed depths for a given time was recorded to have idea of permeability values of the soil at that depth.

As the field permeability test couldn't be conducted due to rise of water up to the surface in all the boreholes 1,3 and 4 from depth 10 to 15 m. As the soil is silty sandy gravels with boulders; the permeability value of such deposits from various literatures is suggested in range of **0.0005 to 0.05 m/s.** (Reference: https://www.geotechdata.info/parameter/permeability)

The permeability values of soil at various depths at different borehole locations of Damauli Substation is tabulated below:

Table 4: Field Permeability Test Results at different borehole locations at various depths

BOREHOLE 1 - NEW							
Depths	2	4	6	8	10	12	14
Permeability,k,cm/s	0.1048	0.0804	0.0678	0.0657	No tests could be performed due to water level rise to the ground level		
BOREHOLE 2 - NEW							
Depths	2	4	6	8	10	12	14
Permeability,k,cm/s	0.2958	0.2530	0.0608	0.4051	0.4098	0.3397	0.2901
BOREHOLE 3 - NEW							
Depths	2	4	6	8	10	12	14
Permeability,k,cm/s	0.1060	0.1111	0.1418	0.2643	No tests could be performed due to water level rise to the ground level		
BOREHOLE 4 - NEW							
Depths	2	4	6	8	10	12	14
Permeability,k,cm/s	0.1388	0.1583	0.1442	0.0604	No tests could be performed due to water level rise to the ground level		

6. Laboratory Testing, Interpretations and Determination of Design Parameters

Disturbed and undisturbed samples are tested to get the physical characteristics and mechanical properties. To identify the properties, laboratory soil tests were performed.

6.1 Tests for determination of index properties

Standard laboratory tests were carried out to characterize the soil strata. The laboratory tests included the following: Grain Size Analysis, Natural Moisture Content, and Specific Gravity. Depending upon the type of soil and the scope of works, type and number of the laboratory tests were determined in consultation with the Geotechnical Engineer. All the requisite laboratory tests were carried out in accordance with IS standard specifications mentioned as follows:

Moisture Content-IS 2720: Part 2: 1973: Part 2; Grain Size Analysis-IS 2720: Part 4: 1985: Part I; Specific Gravity-IS 2720: Part 3: Sec 1: 1980: Part 3.

Grain Size Analysis

Grain size distribution was determined by dry and wet mechanical process. Sieve analysis was carried out by sieving a soil sample through a set of sieves kept one over the other, the largest size being kept at the top and the smallest size at the bottom. The soil retained on each sieve

was weighed and expressed as a percentage of the weight of sample. Finally, the gradation curve was found with % finer and corresponding particle size (D), dia. Further Uniformity Coefficient (C_U), Coefficient of Curvature (C_C) along with D_{10} (Ten percent of the soil particles are finer than this size), D_{30} (Thirty percent of the soil particles are finer than this size), D_{50} (Fifty percent of the soil particles are finer than this size) and D_{60} (Sixty percent of the soil particles are finer than this size).

Natural Moisture Content

The natural moisture content was determined from samples recovered through the split spoon sampler and disturbed samples.

Atterberg's Limit

Liquid Limit and Plastic Limit Tests were conducted in soil with cohesive nature as per Indian standards.

Specific Gravity Test

The specific gravity test was conducted of the soil samples which passes the No. 200 mm sieve. The pycnometer method is widely used in the laboratory test for finding out Specific Gravity (G) value.

6.2 Mechanical Tests

Generally, some sets of soil samples were selected assuming similar in situ layers and conducted laboratory tests from each borehole in order to discern the shear related strengths and stress-strain responses of soils. All the laboratory tests were numbered sequentially. The test number and the prefix were used as test and specimen identifiers.

Direct Shear Test

Direct shear tests were conducted on disturbed samples collected from the borehole. Some of the samples obtained from the borehole was used to carry out direct shear test. The samples were carefully extruded from the sampling tubes and molded using standard moulds of 6.0 x 6.0 cm² cross-sectional areas and trimmed to 2.5 cm high. Solid metal plates were placed on both surfaces of the samples to prevent the dissipation of pore water during shearing. The direct shear equipment is mechanically-operated, and shearing applied at constant strain rate. If the samples are cohesive they will be sheared at a relatively fast rate (duration of tests less than 10 minutes) to maintain un-drained condition. The samples were sheared at three

different normal stresses. The direct shear test results are presented in terms of the failure envelops to give the angle of internal frictions (Ø) and the cohesion intercepts(c). Here, in our analysis the strata are cohesionless sand, so cohesion intercept in neglected.

Note for other lab tests: Trials for undisturbed sampling were carried out but samples weren't collected in the undisturbed sampling tubes. So, an assessment of the consolidation characteristics of the soil at the substation site cannot be carried out due to presence of sandy strata.

7. Seismicity

Many earth scientists believe that longitudinally the entire 2,400 km long Himalayan arc can be segmented into different individual parts (200-300 km) which periodically break and move separately and produce mega earthquake (catastrophic earthquake) in the Himalayan region. From east to west, the great earthquake of Assam, India (1950), Shilong, India (1897), Nepal-Bihar, India (1934) and Kangra, India (1905) are the mega-earthquakes of the last century produced by the movements in different parts of the Himalayan arc, all with magnitude around 8.0. When a sector of the Himalaya moves and produces earthquakes, it will take some time (from decades to century) to repeat the event at the same place. Nepal is prone to an earthquake of minor or major magnitude. Records of earthquakes since 1253 indicate that Nepal was hit by 16 major earthquakes - the 1833 (magnitude 7.9) and 1934(magnitude 8.3) are two of these which have occurred at an interval of 100 years. Statically, the earthquake occurrence data of the last century shows that in average Nepal was hit by a big earthquake in every 12 years (Nakarmi, 1997).

Statistics shows that 1934 earthquake was the severest for Kathmandu valley where significant damages to the lives and properties were observed. Recently devastating earthquake in April 25th, 2015 causing significant damages to life and properties of the people. The frequency and intensity of earthquakes are found at the weakness of the crust such as major faults and major bends. Location of Nepal in the Himalaya along with major tectonic boundary and various longitudinal zones of the Himalaya is shown in Fig.7.

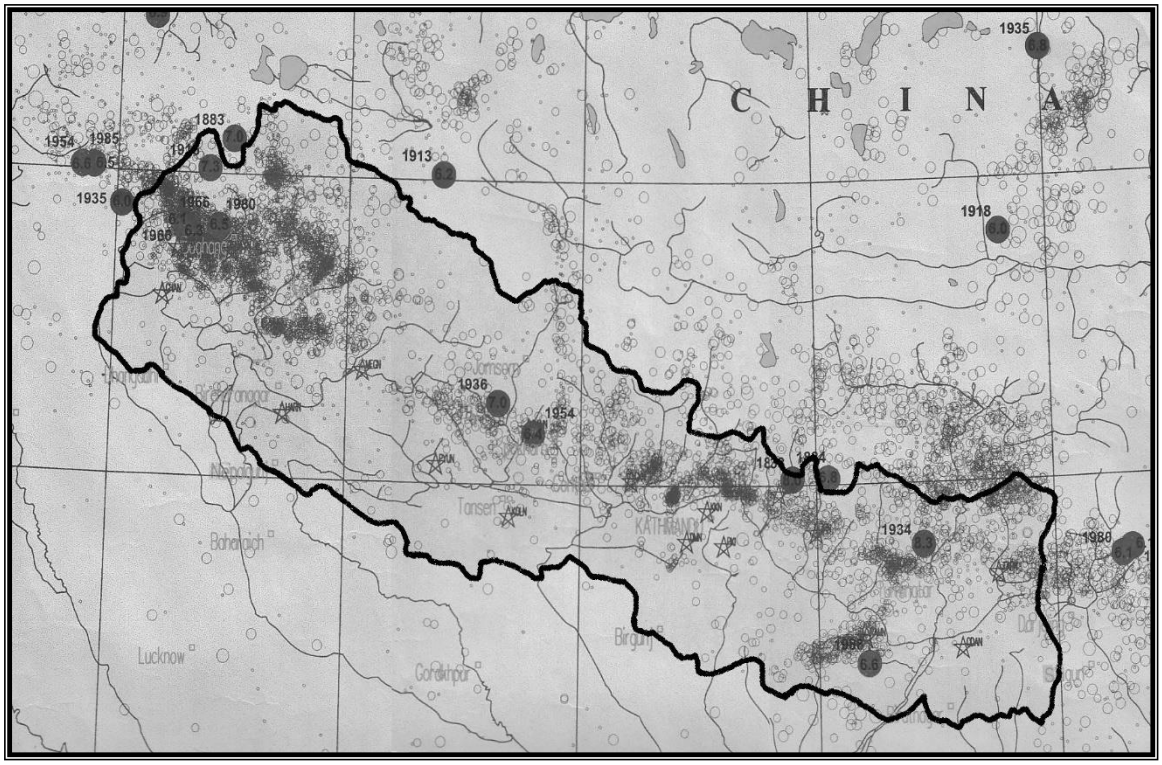


Fig. 6: Historical events of Earthquakes (Source: Microseismic epicenter map of Nepal Himalaya and adjoining region, 1997 published by DoMG, GON).

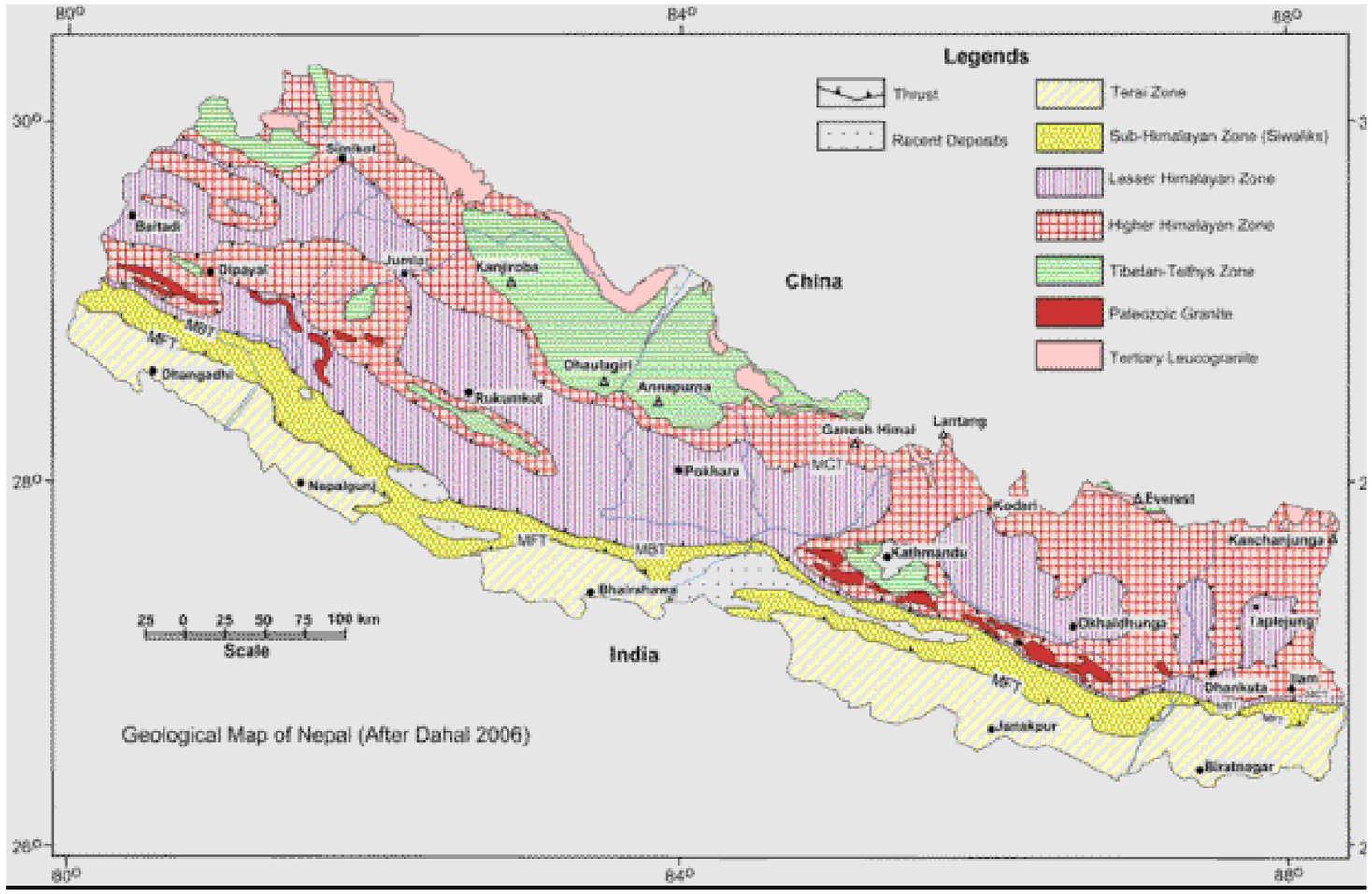


Fig. 7: Geological map of Nepal (Dahal 2006)

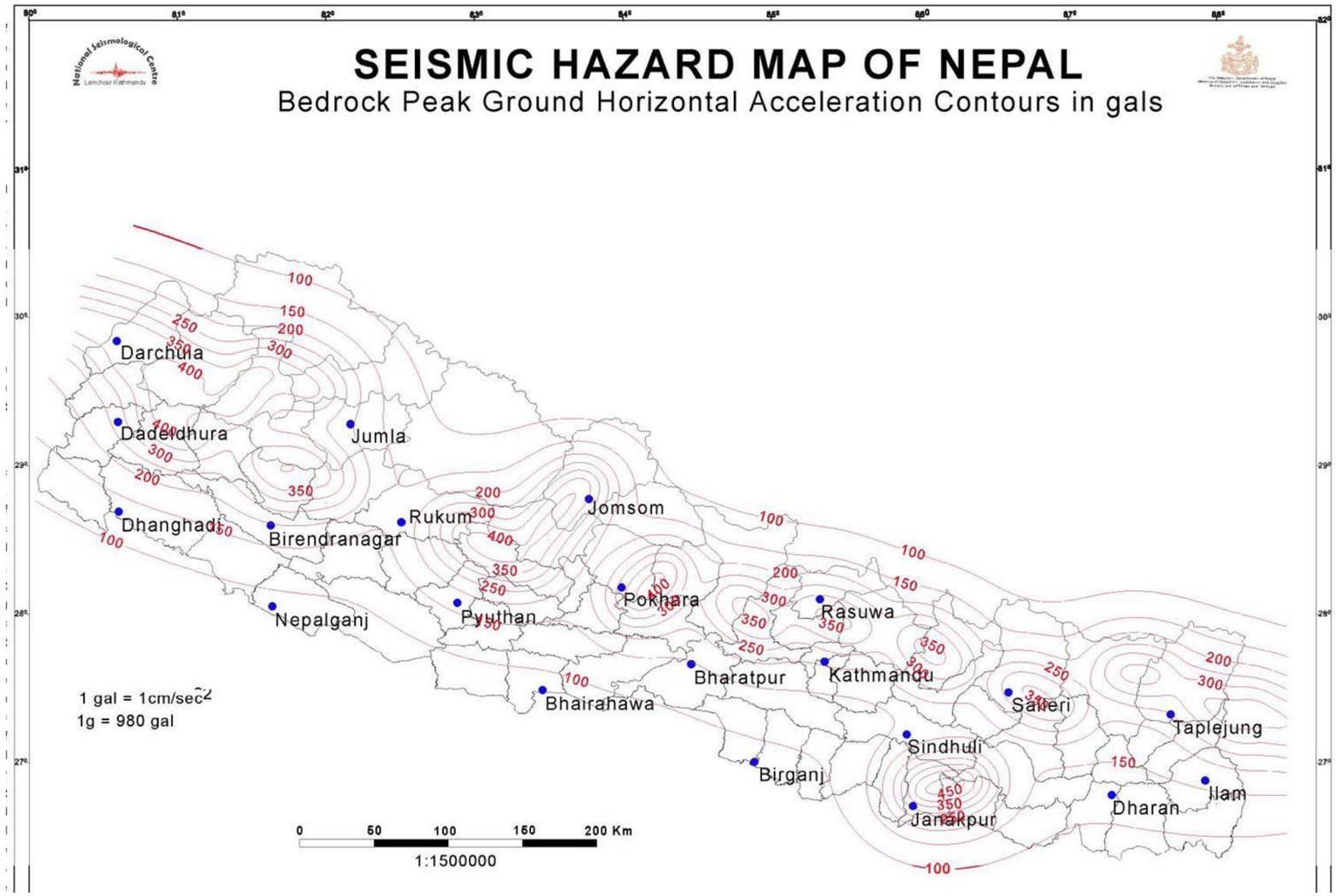


Fig. 8: Probabilistic Seismic Hazard Assessment Map of the Nepal Himalaya

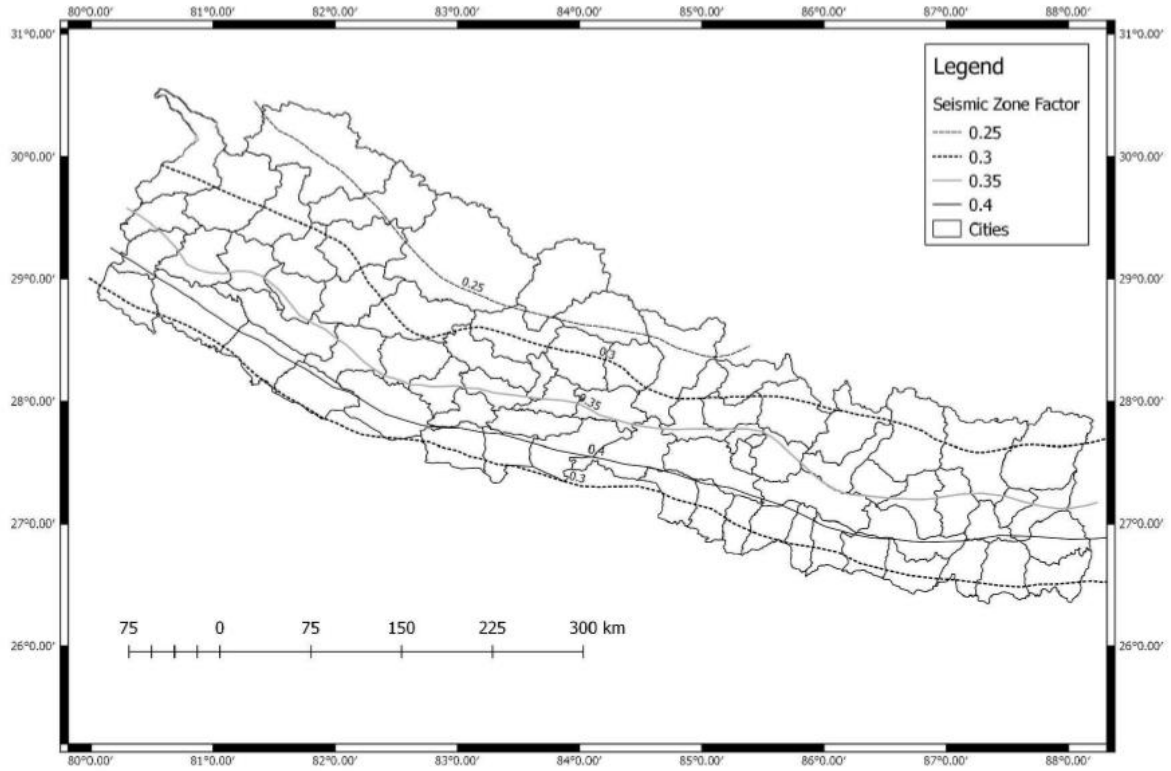


Fig 9: Seismic Zone Factor, Z (From Seismic Zoning Map of Nepal)

To counteract earthquake effect, due consideration has to be taken in the structural design of structures as per seismic design as provided by Building Code of Nepal. The project area is located in the area having Seismic Zone Factor, Z, equal to 0.3 (Pokhara area) and 0.35 (Damauli area) according to Seismic Zoning Map of Nepal in Nepal National Building Code NBC: 105: 2020.

8. Liquefaction

Saturated loose to medium dense cohesion less soils and low plastic silts tend to densify and consolidate when subjected to cyclic shear deformations inherent with large seismic ground motions. Pore-water pressures within such layers increase as the soils are cyclically loaded, resulting in a decrease in vertical effective stress and shear strength. If the shear strength drops below the applied cyclic shear loadings, the layer is expected to transition to a semi fluid state until the excess pore-water pressure dissipates.

8.1 Identification of liquefaction area

The present site consists of various soil types as mentioned in borehole logs and water table

depth encountered in them. All the borehole is assumed to have water table at surface and some of major soil type is adopted to be medium sand to depict the worst-case scenario for liquefaction analysis.

8.2 Analysis of Liquefaction

In general, for clean sand, if the SPT value is less than 30, the soil is prone to liquefaction. The increase in fines content, however, increases the liquefaction resistance of soil. Here, in our analysis, increase in fine content from 35% and greater is considered to be no liquefaction strata. In this report, the soil liquefaction analysis has been done based on SPT N value.

The factor of safety (FS) against liquefaction in terms of CSR (Cyclic stress ratio) and CRR (cyclic resistance ratio) is defined by

$$FS = \frac{CRR_{7.5}}{CSR_{7.5,\sigma}}$$

Where, $CRR_{7.5}$ is the cyclic stress ratio (CRR) for earthquakes of magnitude 7.5 and $CSR_{7.5,\sigma}$ is the normalized cyclic stress ratio (CSR) for earthquakes of magnitude 7.5 and effective overburden pressure of 100 kPa.

$CSR_{7.5,\sigma}$ Is given by (Idriss and Boulanger, 2006)

$$CSR_{7.5,\sigma} = 0.65 \frac{\sigma_v}{\sigma'_v} \frac{a_{\max}}{g} \frac{\gamma_d}{MSF} \frac{1}{K_\sigma}$$

σ_v is the total vertical stress; σ'_v is the effective vertical stress; $a_{\max}$ is the peak horizontal ground surface acceleration; g is the acceleration of gravity; γ_d is the nonlinear shear stress mass participation factor (or stress reduction factor), MSF is the magnitude scaling factor; K_σ is the correction factor for effective overburden. The consideration of factors K_σ and Kα (for sloping ground) is beyond routine practice and can be precisely estimated using the method of Youd et al. (2001) if necessary.

The term γ_d provides an approximate correction for flexibility in the soil profile given by:

$$\gamma_d = \frac{(1 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5})}{(1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.00121z^2)}$$

Where, z = depth below ground surface in meters.

Cyclic resistance ratio (CRR), the capacity of soil to resist liquefaction, can be obtained from the corrected blow count $(N_1)_{60}$ using empirical correlations proposed by Seed et al. (1985).

The CRR curves for a fines content of < 5% (clean sands) can be approximated by Youd et al. (2001)

$$CRR_{7.5} = \frac{1}{34-(N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10.(N_1)_{60}+45]^2} - \frac{1}{200}$$

For $(N_1)_{60} < 30$. For $(N_1)_{60} \geq 30$, clean granular soils are classified as non-liquefiable. The CRR increases with increasing fines content and thus $(N_1)_{60}$ should be corrected to an equivalent clean sand value, $(N_1)_{60CS}$ (Youd et al. 2001)

$(N_1)_{60CS} = (N_1)_{60}; \text{FC} \leq 5\%$

$(N_1)_{60CS} = \exp[1.76 - (190/FC^2)] + [0.99 + (\text{FC}^{1.5}/1000](\text{N}_1)_{60}; \quad 5\% \leq \text{FC} \leq 35\%$

$(N_1)_{60CS} = 5 + 1.2(N_1)_{60}; \text{FC} \geq 35\%$

Where $(N_1)_{60}$ is the SPT blow count normalized to an overburden pressure of approximately 100 kPa and a hammer energy ratio of 60% expressed as (Youd et al. 2001)

$(N_1)_{60} = NC_N C_E C_B C_R C_S$

Where N = measured standard penetration resistance; C_N =factor to normalize N to a common reference effective overburden stress (1 atm.); C_E = correction for hammer energy ratio; C_B = correction factor for borehole diameter; C_R =correction factor for rod length; C_S =correction for samplers with or without liners. The factor C_N is given by

$$C_N = \frac{2.2}{1.2 + \sigma'_v / P_a}$$

Following the recommendation of NCEER 1996 (Youd et al. 2001), the lower and upper bounds for MSF values can be defined by $MSF = 10^{2.24}/M_w^{2.56}$ and $MSF = (M_w/7.5)^{-3.3}$, respectively (M_w is the moment magnitude). Similarly, K_σ is given by (Youd et al., 2001)

$K_\sigma = (\sigma'_v / p_a)^{(f-1)}$

Where p_a is the atmospheric pressure (100 kPa) and f is assumed to be 0.75 (a value of 0.6-0.8 is recommended in Youd et al., 2001).

Iwasaki (1982) was used to calculate Liquefaction Potential Index (L.P.I) and to calculate the severity of site towards liquefaction.

According to Iwasaki;

Iwasaki et. Al. (1982)	
Liquefaction Potential Index, (LPI)	**Severity**
0	Very Low
0 < LPI < 5	Low
5 <LPI < 15	High
15 < LPI	Very High

Literatures Reviewed:

After recent review of various research papers from various country and various soil condition. The following assumption is taken in consideration either the Soil is Susceptible to liquefaction or not:

- Clayey layer with fines greater than 35% with Liquid Limit greater than 35, having Plasticity Index greater than 12 and moisture content lower than 85% of Liquid limit isn't susceptible towards liquefaction.
- Soil having natural moisture nearly equal to Liquid Limit may experience behavior similar to liquefaction so proper mechanism should be designed to encounter the situation.
- If the Plasticity Index (PI) of the soil is equal or greater than 7 than such soil layer isn't susceptible to liquefaction. (Boulanger and Idriss, 2006)
- Soil with PI < 12 and ratio of Water Content to Liquid Limit (Wc/LL) > 0.85 will be susceptible to liquefaction. (Bray and Sancio, 2006)

Table 5: Sample Procedures for Analysis and Result Interpretations of Liquefaction

Deterministic Approach For Liquefaction Analysis- NCEER- 1996/1998
Geotechnical Investigation of Proposed sites of Substations and Tranmission Lines

BORE HOLE NO: **1**
LOCATION : Kaski
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	23	Medium Sand	53.36		17	26	11	1.68	38.69	51.43	30.00	0.990	1.745	0.468	0.294	1.59	No	0	9.25	1.5	0.00		
3	3.0	28	Medium Sand	32.41		17	51	22	1.55	43.51	55.96	30.00	0.979	1.467	0.468	0.345	1.35	No	0	8.5	1.5	0.00	**0.00**	**Very Low**
4	4.5	31	Medium Sand	34.12		17	77	32	1.44	44.76	58.17	30.00	0.969	1.326	0.468	0.378	1.24	No	0	7.75	1.5	0.00		
5	6.0	41	Medium Sand	17.47		17	102	43	1.35	55.29	61.89	30.00	0.958	1.234	0.468	0.401	1.16	No	0	7	1.5	0.00		

BORE HOLE NO: **2**
LOCATION : Kaski
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00	**0.00**	**Very Low**
2	1.5	35	Medium Sand	5.00		17	26	11	1.68	58.88	58.88	30.00	0.990	1.745	0.468	0.294	1.59	No	0	9.25	1.5	0.00		

BORE HOLE NO: **3**
LOCATION : Tanahun
G.W.L (Z_w) : 20.00 Not available
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1
Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	7	Medium Sand	53.24		17	26	26	1.51	10.58	17.70	17.70	0.990	1.407	0.188	0.154	-	No	0	9.25	1.5	0.00		
3	3.0	8	Medium Sand	57.90		17	51	51	1.29	10.29	17.35	17.35	0.979	1.183	0.185	0.181	-	No	0	8.5	1.5	0.00	**0.00**	**Very Low**
4	4.5	9	Medium Sand	57.90		17	77	77	1.12	10.08	17.09	17.09	0.969	1.069	0.182	0.198	-	No	0	7.75	1.5	0.00		
5	6.0	44	Medium Sand	63.70		17	102	102	0.99	43.60	57.32	30.00	0.958	0.995	0.468	0.211	-	No	0	7	1.5	0.00		

BORE HOLE NO: **4**
LOCATION : Sishaghat
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1
Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	32	Medium Sand	29.15		17	26	11	1.68	53.83	66.41	30.00	0.990	1.745	0.468	0.294	1.59	No	0	9.25	1.5	0.00		
3	3.0	39	Medium Sand	14.24		17	51	22	1.55	60.61	65.53	30.00	0.979	1.467	0.468	0.345	1.35	No	0	8.5	1.5	0.00	**0.00**	**Very Low**
4	4.5	39	Medium Sand	27.25		17	77	32	1.44	56.32	68.26	30.00	0.969	1.326	0.468	0.378	1.24	No	0	7.75	1.5	0.00		
5	6.0	44	Medium Sand	32.82		17	102	43	1.35	59.34	74.77	30.00	0.958	1.234	0.468	0.401	1.16	No	0	7	1.5	0.00		

BORE HOLE NO: **5**
LOCATION : Ranibari, Tanahun
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	13	Medium Sand	81.50		17	26	11	1.68	21.87	31.24	30.00	0.990	1.745	0.468	0.294	1.59	No	0	9.25	1.5	0.00		
3	3.0	17	Medium Sand	86.32		17	51	22	1.55	26.42	36.70	30.00	0.979	1.467	0.468	0.345	1.35	No	0	8.5	1.5	0.00	**0.00**	**Very Low**
4	4.5	20	Medium Sand	84.16		17	77	32	1.44	28.88	39.66	30.00	0.969	1.326	0.468	0.378	1.24	No	0	7.75	1.5	0.00		
5	6.0	24	Medium Sand	78.58		17	102	43	1.35	32.36	43.84	30.00	0.958	1.234	0.468	0.401	1.16	No	0	7	1.5	0.00		

BORE HOLE NO: **6**
LOCATION : Damauli
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00	**0.00**	**Very Low**
2	1.5	50	Medium Sand	5.00		19.05	29	14	1.64	82.18	82.18	30.00	0.990	1.639	0.468	0.273	1.72	No	0	9.25	1.5	0.00		

BORE HOLE NO: **7**
LOCATION : Damauli
G.W.L (Z_w) : 0.00 Atmospheric Pressure(P_a) = 100 Kpa
a_{max}/g : **0.3** f= 0.75
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000											
2	1.5	12	Medium Sand	69.91		17	26	11	1.68	20.19	29.22	29.22	0.990	1.745	0.421	0.294	1.43	No	0	9.25	1.5	0.00		
3	3.0	28	Medium Sand	63.00		17	51	22	1.55	43.51	57.21	30.00	0.979	1.467	0.468	0.345	1.35	No	0	8.5	1.5	0.00	**0.00**	**Very Low**
4	4.5	28	Medium Sand	53.64		17	77	32	1.44	40.43	53.52	30.00	0.969	1.326	0.468	0.378	1.24	No	0	7.75	1.5	0.00		
5	6.0	31	Medium Sand	45.35		17	102	43	1.35	41.80	55.17	30.00	0.958	1.234	0.468	0.401	1.16	No	0	7	1.5	0.00		

BORE HOLE NO: **8**
LOCATION : DAMAULI SUBSTATION
G.W.L (Z_w) : 0.00 Atmospheric Pressure(P_a) = 100 Kpa
a_{max}/g : **0.3** f= 0.75
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	11	Medium Sand	35.31		17	26	11	1.68	18.50	27.20	27.20	0.990	1.745	0.344	0.294	1.17	No	0	9.25	1.5	0.00		
3	3.0	15	Medium Sand	3.39		17	51	22	1.55	23.31	23.31	23.31	0.979	1.467	0.262	0.345	0.76	Yes	0.24	8.5	1.5	3.06		
4	4.5	13	Medium Sand	49.81		17	77	32	1.44	18.77	27.53	27.53	0.969	1.326	0.354	0.378	0.94	Yes	0.06	7.75	1.5	0.70		
0	6.0	15	Medium Sand	12.50		17	102	43	1.35	20.23	22.64	22.64	0.958	1.234	0.251	0.401	0.63	Yes	0.37	7	1.5	3.89		
0	7.5	21	Medium Sand	26.27		17	128	54	1.26	26.56	34.29	30.00	0.943	1.167	0.468	0.418	1.12	No	0	6.25	1.5	0.00	**7.64**	**High**
0	9.0	31	Medium Sand	18.54		17	153	65	1.19	36.92	42.85	30.00	0.923	1.115	0.468	0.428	1.09	No	0	5.5	1.5	0.00		
0	10.5	30	Medium Sand	7.43		17	179	75	1.13	33.76	34.29	30.00	0.894	1.073	0.468	0.431	1.08	No	0	4.75	1.5	0.00		
9	12.0	32	Medium Sand	31.89		17	204	86	1.07	34.13	44.76	30.00	0.857	1.038	0.468	0.427	1.10	No	0	4	1.5	0.00		
10	13.5	46	Medium Sand	5.00		17	230	97	1.01	46.62	46.62	30.00	0.811	1.007	0.468	0.416	1.12	No	0	3.25	1.5	0.00		
11	15.0	46	Medium Sand	5.00		17	255	108	0.97	44.42	44.42	30.00	0.761	0.981	0.468	0.401	1.17	No	0	2.5	1.5	0.00		

BORE HOLE NO: **9**
LOCATION : Lekhnath Substation
G.W.L (Z_w) : 0.00
a_{max}/g : **0.3**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	35	Medium Sand	11.22		17	26	11	1.68	58.88	61.78	30.00	0.990	1.745	0.468	0.294	1.59	No	0	9.25	1.5	0.00		
3	3.0	39	Medium Sand	11.22		17	51	22	1.55	60.61	63.56	30.00	0.979	1.467	0.468	0.345	1.35	No	0	8.5	1.5	0.00		
4	4.5	39	Medium Sand	1.91		17	77	32	1.44	56.32	56.32	30.00	0.969	1.326	0.468	0.378	1.24	No	0	7.75	1.5	0.00		
5	6.0	44	Medium Sand	1.91		17	102	43	1.35	59.34	59.34	30.00	0.958	1.234	0.468	0.401	1.16	No	0	7	1.5	0.00		
6	7.5	44	Medium Sand	5.51		17	128	54	1.26	55.66	55.83	30.00	0.943	1.167	0.468	0.418	1.12	No	0	6.25	1.5	0.00	**0.00**	**Very Low**
7	9.0	46	Medium Sand	5.51		17	153	65	1.19	54.79	54.96	30.00	0.923	1.115	0.468	0.428	1.09	No	0	5.5	1.5	0.00		
8	10.5	46	Medium Sand	5.51		17	179	75	1.13	51.77	51.93	30.00	0.894	1.073	0.468	0.431	1.08	No	0	4.75	1.5	0.00		
9	12.0	46	Medium Sand	6.10		17	204	86	1.07	49.06	49.34	30.00	0.857	1.038	0.468	0.427	1.10	No	0	4	1.5	0.00		
10	13.5	46	Medium Sand	6.10		17	230	97	1.01	46.62	46.89	30.00	0.811	1.007	0.468	0.416	1.12	No	0	3.25	1.5	0.00		
11	15.0	46	Medium Sand	6.10		17	255	108	0.97	44.42	44.68	30.00	0.761	0.981	0.468	0.401	1.17	No	0	2.5	1.5	0.00		

BORE HOLE NO: **1 - NEW**
LOCATION : DAMAULI SUBSTATION
G.W.L (Z_w) : 0.00 Atmospheric Pressure(P_a) = 100 Kpa
a_{max}/g : **0.35** f= 0.75
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki ,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	15	Medium Sand	5.85		17	26	11	1.68	25.23	25.36	25.36	0.990	1.745	0.299	0.343	0.87	Yes	0.13	9.25	1.5	1.80		
3	3.0	11	Medium Sand	5.28		17	51	22	1.55	17.09	17.14	17.14	0.979	1.467	0.182	0.403	0.45	Yes	0.55	8.5	1.5	7.01		
4	4.5	17	Medium Sand	9.20		17	77	32	1.44	24.55	25.60	25.60	0.969	1.326	0.304	0.441	0.69	Yes	0.31	7.75	1.5	3.60		
5	6.0	10	Medium Sand	28.69		17	102	43	1.35	13.49	20.04	20.04	0.958	1.234	0.216	0.468	0.46	Yes	0.54	7	1.5	5.67		
6	7.5	7	Medium Sand	28.69		17	128	54	1.26	8.85	14.74	14.74	0.943	1.167	0.157	0.488	0.32	Yes	0.68	6.25	1.5	6.38	**24.47**	**Very High**
7	9.0	34	Gravel	3.69		17	153	65	1.19	40.50	40.50	30.00	0.923	1.115	0.468	0.500	0.94	No	0	5.5	1.5	0.00		
8	10.5	46	Gravel	23.04		17	179	75	1.13	51.77	61.04	30.00	0.894	1.073	0.468	0.503	0.93	No	0	4.75	1.5	0.00		
9	12.0	46	Gravel	27.78		17	204	86	1.07	49.06	60.30	30.00	0.857	1.038	0.468	0.498	0.94	No	0	4	1.5	0.00		
10	13.5	46	Gravel	30.22		17	230	97	1.01	46.62	58.62	30.00	0.811	1.007	0.468	0.486	0.96	No	0	3.25	1.5	0.00		
11	15.0	46	Gravel	46.69		17	255	108	0.97	44.42	58.30	30.00	0.761	0.981	0.468	0.468	1.00	No	0	2.5	1.5	0.00		

BORE HOLE NO: **2 - NEW**
LOCATION : Lekhnath Substation
G.W.L (Z_w) : 0.00 Atmospheric Pressure(P_a) = 100 Kpa
a_{max}/g : **0.35** f= 0.75
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki ,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	35	Medium Sand	27.25		17	26	11	1.68	58.88	71.16	30.00	0.990	1.745	0.468	0.343	1.37	No	0	9.25	1.5	0.00		
3	3.0	17	Medium Sand	35.07		17	51	22	1.55	26.42	36.70	30.00	0.979	1.467	0.468	0.403	1.16	No	0	8.5	1.5	0.00		
4	4.5	39	Medium Sand	19.19		17	77	32	1.44	56.32	63.96	30.00	0.969	1.326	0.468	0.441	1.06	No	0	7.75	1.5	0.00		
5	6.0	23	Medium Sand	25.49		17	102	43	1.35	31.02	39.04	30.00	0.958	1.234	0.468	0.468	1.00	Yes	0	7	1.5	0.00		
6	7.5	16	Medium Sand	35.77		17	128	54	1.26	20.24	29.29	29.29	0.943	1.167	0.425	0.488	0.87	Yes	0.13	6.25	1.5	1.22	**6.58**	**High**
7	9.0	9	Medium Sand	27.46		17	153	65	1.19	10.72	16.67	16.67	0.923	1.115	0.177	0.500	0.35	Yes	0.65	5.5	1.5	5.36		
8	10.5	46	Gravel	11.44		17	179	75	1.13	51.77	54.61	30.00	0.894	1.073	0.468	0.503	0.93	No	0	4.75	1.5	0.00		
9	12.0	46	Gravel	11.44		17	204	86	1.07	49.06	51.83	30.00	0.857	1.038	0.468	0.498	0.94	No	0	4	1.5	0.00		
10	13.5	46	Gravel	11.44		17	230	97	1.01	46.62	49.32	30.00	0.811	1.007	0.468	0.486	0.96	No	0	3.25	1.5	0.00		
11	15.0	46	Gravel	11.44		17	255	108	0.97	44.42	47.05	30.00	0.761	0.981	0.468	0.468	1.00	No	0	2.5	1.5	0.00		

BORE HOLE NO: **3 - NEW**
LOCATION : Lekhnath Substation
G.W.L (Z_w) : 0.00
a_{max}/g : **0.35**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki ,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	12	Medium Sand	35.90		17	26	11	1.68	20.19	29.22	29.22	0.990	1.745	0.421	0.343	1.23	No	0	9.25	1.5	0.00		
3	3.0	19	Medium Sand	4.13		17	51	22	1.55	29.53	29.53	29.53	0.979	1.467	0.438	0.403	1.09	No	0	8.5	1.5	0.00		
4	4.5	16	Medium Sand	11.91		17	77	32	1.44	23.10	25.35	25.35	0.969	1.326	0.299	0.441	0.68	Yes	0.32	7.75	1.5	3.72		
5	6.0	9	Medium Sand	25.10		17	102	43	1.35	12.14	17.84	17.84	0.958	1.234	0.190	0.468	0.41	Yes	0.59	7	1.5	6.20		
6	7.5	5	Silt	55.98		17	128	54	1.26	6.32	12.59	12.59	0.943	1.167	0.137	0.488	0.28	Yes	0.72	6.25	1.5	6.75	**17.16**	**Very High**
7	9.0	45	Medium Sand	2.07		17	153	65	1.19	53.60	53.60	30.00	0.923	1.115	0.468	0.500	0.94	Yes	0.06	5.5	1.5	0.50		
8	10.5	46	Gravel	13.68		17	179	75	1.13	51.77	55.97	30.00	0.894	1.073	0.468	0.503	0.93	No	0	4.75	1.5	0.00		
9	12.0	46	Gravel	13.68		17	204	86	1.07	49.06	53.16	30.00	0.857	1.038	0.468	0.498	0.94	No	0	4	1.5	0.00		
10	13.5	46	Gravel	13.68		17	230	97	1.01	46.62	50.62	30.00	0.811	1.007	0.468	0.486	0.96	No	0	3.25	1.5	0.00		
11	15.0	46	Gravel	13.68		17	255	108	0.97	44.42	48.32	30.00	0.761	0.981	0.468	0.468	1.00	No	0	2.5	1.5	0.00		

BORE HOLE NO: **4 - NEW**
LOCATION : Lekhnath Substation
G.W.L (Z_w) : 0.00
a_{max}/g : **0.35**
Moment magnitude (M): **7.80**
MSF: 0.89
FoS against Liquefaction : 1

Atmospheric Pressure(P_a) = 100 Kpa
f= 0.75

S.N.	Depth (m)	Corrected SPT (N_{60})	Major Soil type	Fine contents %	PI	Unit wt (KN/m^3)	Total Stress (KN/m^2)	Eff stress (KN/m^2)	C_N	$(N_1)_{60}$	$(N_1)_{60cs}$	$(N_1)_{60cs}$	γ_d	Kσ	CRR	$CSR_{M,\sigma}$	FS	Liquefaction	F(z)	w(z)	H	F(z).w(z).H	Liquefaction Potential Index	Severity (Iwasaki ,1982)
1	0.0						0		1.70				1.000						0	10	1.5	0.00		
2	1.5	35	Medium Sand	8.38		17	26	11	1.68	58.88	60.10	30.00	0.990	1.745	0.468	0.343	1.37	No	0	9.25	1.5	0.00		
3	3.0	9	Medium Sand	49.92		17	51	22	1.55	13.99	21.78	21.78	0.979	1.467	0.239	0.403	0.59	Yes	0.41	8.5	1.5	5.23		
4	4.5	13	Medium Sand	30.04		17	77	32	1.44	18.77	26.38	26.38	0.969	1.326	0.322	0.441	0.73	Yes	0.27	7.75	1.5	3.14		
5	6.0	18	Medium Sand	35.92		17	102	43	1.35	24.27	34.13	30.00	0.958	1.234	0.468	0.468	1.00	Yes	0	7	1.5	0.00		
6	7.5	16	Medium Sand	18.90		17	128	54	1.26	20.24	25.11	25.11	0.943	1.167	0.294	0.488	0.60	Yes	0.4	6.25	1.5	3.75	**12.61**	**High**
7	9.0	46	Medium Sand	13.12		17	153	65	1.19	54.79	58.77	30.00	0.923	1.115	0.468	0.500	0.94	Yes	0.06	5.5	1.5	0.50		
8	10.5	46	Gravel	9.70		17	179	75	1.13	51.77	53.58	30.00	0.894	1.073	0.468	0.503	0.93	No	0	4.75	1.5	0.00		
9	12.0	46	Gravel	14.94		17	204	86	1.07	49.06	53.88	30.00	0.857	1.038	0.468	0.498	0.94	No	0	4	1.5	0.00		
10	13.5	46	Gravel	9.70		17	230	97	1.01	46.62	48.34	30.00	0.811	1.007	0.468	0.486	0.96	No	0	3.25	1.5	0.00		
11	15.0	46	Gravel	9.70		17	255	108	0.97	44.42	46.08	30.00	0.761	0.981	0.468	0.468	1.00	No	0	2.5	1.5	0.00		

8.3 Conclusion and Recommendation

- The liquefiable depths with liquefaction potential index and their severity at different borehole locations for considered parameters according to our analysis is tabulated below.

Summary of Liquefaction Analysis for PGA/g=0.3 for Kaski and Tanahun Districts from NBC 105:2020 and Mw=7.8 (Gorkha Earthquake)			
Borehole No.	Depths (m) Having Factor of Safety < 1	Liquefaction Potential Index	Severity
BOREHOLE 1	-	0.00	Very Low
BOREHOLE 2	-	0.00	Very Low
BOREHOLE 3	-	0.00	Very Low
BOREHOLE 4	-	0.00	Very Low
BOREHOLE 5	-	0.00	Very Low
BOREHOLE 6	-	0.00	Very Low
BOREHOLE 7	-	0.00	Very Low
BOREHOLE 8	3-6	7.64	High
BOREHOLE 9	-	0.00	Very Low

Summary of Liquefaction Analysis for PGA/g=0.35 for Damauli Area from NBC 105:2020 and Mw=7.8 (Gorkha Earthquake)				
NEW BOREHOLES OF DAMAULI SUBSTATION				
Borehole No.	Depths (m) Having Factor of Safety < 1	Liquefaction Potential Index	Severity	Proposed Foundation Type
BOREHOLE 1 - NEW	1.5-7.5	24.47	Very High	Pile Foundation
BOREHOLE 2 - NEW	6-9	6.58	High	Pile Foundation
BOREHOLE 3 - NEW	4.5-9	17.16	Very High	Pile Foundation
BOREHOLE 4 - NEW	3-9	12.61	High	Pile Foundation

- The site is susceptible to liquefaction in Borehole 1-4 (New) and Borehole 8 at the time of worst-case scenario.
- Considering possibility of liquefaction under adopted parameters in New boreholes 1 to 4 and Borehole 8 i.e. at location of Damauli Substation, it is recommended to place either raft foundation or extend cast in-situ bored pile significantly below liquefiable

depth from generalized ground level.

- It is recommended to place the pile foundation in the i.e. in the bearing stratum i.e. depth around 10 m of the project site so as to get the maximum tip resistance.
- Modern techniques like sand compaction piles, densification, and water-replacement, deep mixing can prevent area from liquefaction as per availability in the market.

9. Analysis of Allowable Bearing Pressure

The allowable bearing pressure (q_a) is the maximum pressure that can be imposed on the foundation soil taking into consideration the ultimate bearing capacity of the soil and the tolerable settlement of the structure. Analysis to determine the ultimate bearing capacity and the pressure corresponding to a specified maximum settlement were performed and the minimum pressure obtained from the two analyses were adopted as the allowable bearing pressure. Here, isolated, raft and pile foundations for different depths and dimensions are analyzed for the case of static condition considering the worst condition i.e., submerged condition.

9.1 SPT correction

The so obtained SPT values have been corrected in accordance with the proposal of Skempton, (1986) and Liao and Whitman (1987) as outlined below with consideration of field procedure, hammer efficiency, borehole diameter, and sample and rod length.

Correction of SPT N-value using the relation after Skempton, 1986

$N_{60} = E_m\ C_B\ C_S\ C_R\ N/0.60$

Where: N_{60} = SPT N value corrected for field procedure

E_m = Hammer Efficiency, C_B = borehole diameter correction, C_S = Sample Correction, C_R = rod length correction, N = SPT N value recorded in the field,

The correction factors taken are:

E_m =0.55 for hand drop hammer, due to lack of true verticalness and proper speed of SPT blow

C_B =1.0 for 65 mm to 115 mm dia. Borehole,

C_s =1.0 for standard sampler,

C_R =0.7 for rod length 0.00 - 2.99,

=0.75 for rod length 3.00 - 3.99 m,

=0.85 for rod length 4.00 - 5.99 m,

=0.95 for rod length 6.00 - 9.99 m,

=1 for rod length beyond 10.00 m,

Correction for overburden

The correction for values of N should be made for the field SPT values for depths. Modified correction in 1974, peck, Hanson and Thornburn suggested standard pressure of 100 kN/m^2 corresponding to a depth of 5 m of soil with bulk density $20kN/m^2$ can be represented by the following equation:

$(N_1)_{60} = N_{60} C_n$

$C_n = 0.77 \log (2000/p_0)$

Where, p_0 is effective overburden pressure in kN/m^2.

Dilatancy Correction (for fine sand and silts below water table)

Terzaghi and Peak (1976) give correction for water pressure.

If, Nrec≤ 15, then Ncorr= Nrec

If Nrec≥ 15, then Ncorr= 15+1/2(Nrec – 15)

Then for bearing capacity analysis Ncorr is used as the N in the Correlation provided by different Researchers.

9.2 Allowable Bearing Capacity from Shear Failure Criteria

The bearing capacity analysis has been carried out for foundation soil. The bearing capacity analysis was carried out based on the results of SPT N-value. The so adopted N-value is the average value beneath each point between level of the base of the footing and the depth equal to 2 times the width of the foundation. In computing the average any individual value more than 50 percent greater than the average was neglected, but the values for all loose seams if encountered was included. (IS 6403:1981)

The well-known Indian Standard (IS 6403:1981) has been used to compute bearing capacity of soil on the basis of shear failure criteria. Different depths and widths of foundation are used in the analysis.

Indian Standard IS 6403:1981

qna= (c Nc sc dc ic+q (Nq-1) sq dq iq+0.5*B ɣ Nɣ sɣ dɣ iɣ)/FOS

Where,

Df = Depth of foundation

FOS = Factor of safety

C = cohesion in KN/m2

Nc, Nq, Nɣ= Bearing capacity factors

Nq = eπItanø tan2 $(45 + \frac{\Phi}{2})$

Nc = (Nq-1) CotØ

Ny= 2 (Nq+1) tanØ

sc, sq, sɣ= Shape factors

dc, dq, dɣ= Depths factors

ic, iq, iɣ = Inclination factors

q = Effective surcharge at the base level of foundation in KN/m^2

B = Width of footing in, m

ɣ= Bulk unit weight of soil sample in KN/m^3

Rw = Correction factor for location of water table

9.3 Allowable Bearing Pressure from Settlement Criteria in Granular soils

The following equation is used to determine bearing capacity from settlement criteria for S mm sett lement by Bowle's equation.

$$q_{np}=12.2N(\frac{B+0.3}{B})^2 R_d W_\gamma (S/25)$$

Where,

B = Width of foundation

Wγ and W_q are water table correction factor

D_f = Depth of foundation

N_c = SPT Value corrected for overburden pressure

q_{np} = safe settlement pressure

9.4 Allowable Bearing Pressure based on Tolerable Settlement in Cohesive Soils

If the clay layer is encountered, the settlement was calculated by:

S_f=Ht/ (1+e0) *Cc log10 ((p0+Δp) /p0)

Where: S_f = Consolidation or settlement in m

Ht = Thickness of soil layer in m

e^0 = Initial void ratio

P0 = Effective stress at mid height of layer in kN/m^2

Δp = Pressure increment kN/m^2

The minimum of allowable bearing capacity value obtained from the shear failure criteria and settlement criteria is adopted as the allowable bearing capacity for the given foundation size at that depth.

10.Pile Foundation

The bearing capacity of pile foundation is based on Indian Standard code. The following methodologies were used.

Q_{u1} = $$A_p\left(\frac{1}{2}D_r N_r + P_D N_q\right) + \sum_{i=l}^{n} KP_{Di}\tan\delta.A_{si}$$

Q_{u2} = $$A_p CNc + \alpha c.A_{si}$$

Q_u = $Q_{u1} + Q_{u2}$

Where

A_p = Cross sectional area of pile toe

D = Stem diameter

γ = effective unit weight of soil at pile toe

P_D = effective over burden pressure at pile toe

N_r & Nq = bearing capacity factor depending upon the angle of internal friction at toe.

$\sum_{i=l}^{n}$ = summation of n layers in which pile is installed.

Ø = angle of internal friction

K = coefficient of earth pressure $\left(=\frac{1-\sin\phi}{1+\sin\phi}\right)$

P_{di} = effective over burden pressure for the i^{th} layer where i varies from 1 to n.

δ = angle of wall friction between the pile

A_{si} = surface area of pile stem in the i^{th} layer

C = Cohesion of Soil

N_c = Skempton factor

α = Adhesion Factor

The minimum factor of safety for arriving at the safe pile capacity from the ultimate load

capacity obtained by using static formulae shall be 2.5.

The bearing capacity of a single pile is to be determined from **Pile Load Test**. The purpose of the test is one or more of the following:

- to establish criteria for installation of working piles
- to establish settlement of working load
- to get an idea of the suitability of the pile for a purpose
- to determine the safe load capacity

Some Assumptions for Analysis

- Due to limitation of drilled depth, it is assumed that the soil strata are similar underneath as like the preceding last drilled depth for settlement analysis of foundation of sizes where 2B exceeds the borehole depth.
- In between two tested samples, properties of soil in middle sections were interpolated as relevancy of data. And design data were interpolated between semi empirical data form field test and lab test results.

11.Recommendation of Foundation Type and Depth

Based on the analysis, the following recommendations are made.

- Isolated and Raf/Mat footing are analyzed for allowable bearing capacity (static condition) for permissible settlement of 25 mm and 40 mm respectively. The details with different depths and different dimensions of Isolated and Raft/Mat footing of the project site at different borehole locations is summarized below:

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 1																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	201	216	216	207	194	186	179	256	243	229	219	204	193	186	270	248	240	235	217	205	196	275	252	245	239	231	217	207		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 1																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	201	216	225	234	243	232	224	256	268	275	273	255	242	232	324	309	301	293	271	256	245	344	316	306	299	289	271	259		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 2																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	286	295	280	268	252	240	232	342	314	297	283	264	250	240	342	314	305	298	276	260	249	336	308	299	292	282	265	253		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 2																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	286	310	322	335	315	300	290	364	382	371	354	330	313	301	428	393	381	372	344	325	311	420	385	374	366	353	331	316		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 3																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	89	96	96	92	86	82	79	115	108	102	97	90	86	82	117	107	104	102	94	89	85	116	107	104	101	98	92	87		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 3																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	89	96	99	103	108	103	99	115	119	122	121	113	107	103	141	134	130	127	117	111	106	145	133	129	126	122	115	109		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 4																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	283	292	278	266	250	238	230	339	312	294	281	262	248	239	342	314	305	298	276	260	249	336	308	299	292	282	265	253		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 4																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	283	306	319	332	312	298	288	360	378	368	351	327	310	298	428	393	381	372	344	325	311	420	385	374	366	353	331	316		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 5																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	131	141	146	142	133	127	122	168	166	157	149	139	132	127	188	172	168	164	151	143	137	195	179	174	170	164	154	147		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 5																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	131	141	146	152	163	159	153	168	175	179	184	174	165	159	215	216	209	205	189	179	171	244	224	218	212	205	193	184		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 6																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	286	295	280	268	252	240	232	342	314	297	283	264	250	240	342	314	305	298	276	260	249	336	308	299	292	282	265	253		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 6																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	286	310	322	335	315	300	290	364	382	371	354	330	313	301	428	393	381	372	344	325	311	420	385	374	366	353	331	316		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 7																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	119	128	133	129	121	115	111	153	150	142	136	126	120	115	167	154	149	146	135	127	122	161	148	143	140	135	127	121		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 7																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	119	128	133	138	148	144	139	153	159	163	168	158	150	144	193	192	187	182	169	159	152	201	185	179	175	169	159	151		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 8 (DAMAULI SUBSTATION)																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	119	128	133	129	121	115	111	153	150	142	136	126	120	115	172	158	154	150	139	131	125	172	158	153	150	144	136	129		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 8 (DAMAULI SUBSTATION)																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	119	128	133	138	148	144	139	153	159	163	168	158	150	144	198	198	192	188	173	164	157	215	197	191	187	180	169	162		

RAFT FOOTING (SQUARE)																								
BOREHOLE 8 (DAMAULI SUBSTATION)																								
Depth of footing, D_f,m	1.50							2.00							2.50									
Width of footing B,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16			
Length of footing L,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16			
Allowable Bearing Capacity in KN/m^2 for 40 mm Permissible Settlement	170	204	196	190	187	185	183	197	209	199	193	190	187	185	237	226	214	207	202	199	196			

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RAFT FOOTING (SQUARE)																														
BOREHOLE 8 (DAMAULI SUBSTATION)																														
Depth of footing, D_f,m	3.00							3.50							4.00							4.50								
Width of footing B,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16		
Length of footing L,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16		
Allowable Bearing Capacity in KN/m^2 for 40 mm Permissible Settlement	272	242	228	220	215	211	208	281	248	232	223	217	213	210	271	238	221	212	206	202	198	253	226	210	201	194	190	187		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 9 (LEKHNATH SUBSTATION)																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 20 mm Permissible Settlement	274	286	271	260	244	233	225	332	305	288	275	256	243	233	328	301	292	285	264	249	238	323	297	288	281	272	255	243		

ISOLATED FOOTING (SQUARE)																														
BOREHOLE 9 (LEKHNATH SUBSTATION)																														
Depth of footing, D_f,m	1.50							2.00							2.50							3.00								
Width of footing B,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Length of footing L,m	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00	1.50	2.00	2.25	2.50	3.00	3.50	4.00		
Allowable Bearing Capacity in KN/m^2 for 25 mm Permissible Settlement	274	296	308	321	305	291	281	348	365	360	343	320	303	291	410	376	365	357	330	311	298	404	371	360	352	339	319	304		

RAFT FOOTING (SQUARE)																									
BOREHOLE 9 (LEKHNATH SUBSTATION)																									
Depth of footing, D_f,m	1.50							2.00							2.50										
Width of footing B,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16				
Length of footing L,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16				
Allowable Bearing Capacity in KN/m^2 for 40 mm Permissible Settlement	379	398	381	371	365	360	357	428	403	383	372	365	359	356	459	413	391	378	369	363	359				

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RAFT FOOTING (SQUARE)																									
BOREHOLE 9 (LEKHNATH SUBSTATION)																									
Depth of footing, D_f,m	3.00							3.50							4.00							4.50			
Width of footing B,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Length of footing L,m	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Allowable Bearing Capacity in KN/m^2 for 40 mm Permissible Settlement	474	423	398	384	374	368	363	490	433	405	389	379	372	366	506	443	413	395	384	376	370	502	450	417	398	386	377	371

- Pile foundation is strictly proposed for Damauli substation due to presence of liquefiable sandy layers below the foundation. Considering soil liquefiable depths from 1.5 m to 9 m, it is analyzed to calculate the allowable pile capacity for various lengths and dimensions of pile taking pile cap at a depth of **1.5 m** from natural ground level for New Boreholes 1, 2, 3, 4 and Borehole 8 (Damauli Substation) which is summarized below:

ALLOWABLE LOAD CARRYING CAPACITY OF CAST-INSITU BORED PILE (IS 2911-1-2)				
BOREHOLE NO:	**NEW BH 1, 2,3,4 & BH 8**			
Depth of Pile Top	1.5 m below ground level			
Size of Pile, mm	500			
Length of pile, m	9	10.5	12	13.5
ALLOWABLE BEARING CAPACITY, TONNES	18.62	19.56	20.50	21.43

BOREHOLE NO:	**NEW BH 1, 2,3,4 & BH 8**			
Depth of Pile Top	1.5 m below ground level			
Size of Pile, mm	600			
Length of pile, m	9	10.5	12	13.5
ALLOWABLE BEARING CAPACITY, TONNES	31.91	33.26	34.61	35.95

ALLOWABLE LOAD CARRYING CAPACITY OF CAST-INSITU BORED PILE (IS 2911-1-2)				
BOREHOLE NO:	**NEW BH 1, 2,3,4 & BH 8**			
Depth of Pile Top	1.5 m below ground level			
Size of Pile, mm	700			
Length of pile, m	9	10.5	12	13.5
ALLOWABLE BEARING CAPACITY, TONNES	50.37	52.21	54.04	55.87

BOREHOLE NO:	**NEW BH 1, 2,3,4 & BH 8**			
Depth of Pile Top	1.5 m below ground level			
Size of Pile, mm	800			
Length of pile, m	9	10.5	12	13.5
ALLOWABLE BEARING CAPACITY, TONNES	74.78	77.18	79.57	81.96

- Pile Integrity Tests based on IS 14893:2001 or ASTM D 5882-16 or equivalent standards should be followed. Pile Integrity Test on 5 % of working piles and the Ultimate Load Test on pile should be carried out as per equivalent standards.

- If karst/caverns are seen during the construction phase, they should be treated with grouting under the supervision of Geotechnical Engineer after verification from Electrical Resistivity Tomography Test. (ERT).
- IS 2911 and its parts can be referred for quality and workmanship for the bores cast in-situ piles construction.
- The cohesion of the soil can be neglected as being sandy strata. The angle of friction obtained by corelating from SPT N-values is tabulated below:.

BOREHOLE 1 - NEW										
Depth	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
N-value, Ncorr	21	16	19	13	8	27	33	32	31	30
Angle of Friction in Degrees	31	29	30	27	25	33	35	34	34	34
BOREHOLE 2 - NEW										
Depth	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
N-value, Ncorr	38	20	34	22	17	10	33	32	31	30
Angle of Friction in Degrees	36	31	35	31	29	26	35	34	34	34
BOREHOLE 3 - NEW										
Depth	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
N-value, Ncorr	18	22	19	12	6	33	33	32	31	30
Angle of Friction in Degrees	30	31	30	27	24	35	35	34	34	34
BOREHOLE 4 - NEW										
Depth	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
N-value, Ncorr	38	14	16	19	17	34	33	32	31	30
Angle of Friction in Degrees	36	28	29	30	29	35	35	34	34	34
Note: 1. Above calculations for Angle of Friction is calculated from, $\phi = 15+\sqrt{(12*N\ corr.)}$ for sandy soils given by Dunham (1954)										

- If filling ground is observed during the construction, the foundation should be placed below the filling ground to reduce the uneven settlements.
- If there is rise in platform for the proposed foundation the embankment filling should be guided as:

  The maximum size of the coarse material in the mixture of filling materials shall not exceed 75 mm for general earth fill. The soil with less than 15 percent passing 0.075 mm sieve should be used. The fill materials shall also be free from organic or other deleterious materials so as not to cause corrosion of the soil reinforcement and the facia panels. The CBR value of any embankment fill materials should be greater than 5%. The fill material

shall have liquid limit not exceeding 35 plasticity index value should not be greater than 6. Embankment foundations shall be excavated/furrowed and brought under Optimum Moisture Content and re-compacted in layers of 150 mm each in order to achieve the required level of compaction. Layers of material other than rock fill shall not exceed 150 mm compacted depth. The filling materials can be acquired from the hills (reddish brown silty clayey gravels) in the vicinity or can be acquired from river bed materials of Madi river or Marshyangdi river.

- The slope of the excavation should be maintained at about 45° to prevent the slope from collapsing during excavation or construction period.
- Because of presence of seepage water and consideration of probable rise in water table in monsoon, side fall (collapse) is eminent. So, at the time of construction of foundation, it is strongly recommended to design the appropriate site protection measures based on the soil properties shown in this report.
- The above recommendation is based on the mentioned methodology of our analysis. It is worth mentioning that the allowable bearing capacity depends on many variables such as allowable settlement, type of foundation, size and depth of foundation, importance of structure, cost of project etc. Therefore, based on soil index properties data and engineering properties data provided in this report, the foundation designer is free to refine the calculations wherever he feels necessary.

12.References

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Nepal Building Codes

IS: 1498 Classification and identification of soils for general engineering purposes

IS: 1892 Code of practice for subsurface Investigation for foundation

IS: 2131 Method of standard penetration test for soils

IS: 2132 Code of practice for thin walled tube sampling of soils

IS: 2720 Method of test for soils (Relevant parts)

Prepared By:
Ritesh Baral
Geotechnical Engineer
Council Number –9537 Civil "A"

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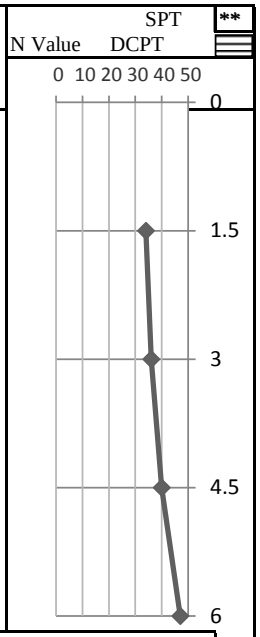
ANNEX-I
LOG OF BOREHOLES

BOREHOLE NO:- 1

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Kaski — Total Depth, m : **6.0**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 28°11'38.21"N 84°6'8.79"E

Soil Description	Symbol	Depth, m	Test Type		No. of blows 15 cm	15 cm	15 cm	N-Value
Dense reddish brownish sandy SILT with low plastic clay and gravels		1						
			**	SPT	10	15	19	34
		2						
		3	**	SPT	12	16	20	36
		4						
			**	SPT	13	18	22	40
		5						
		6	**	SPT	13	20	27	47

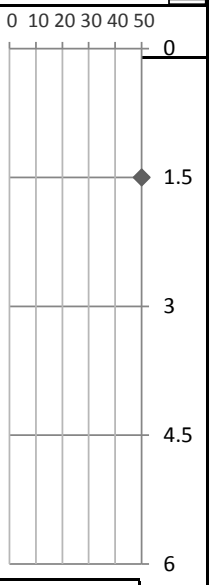


Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 2

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Kaski — Total Depth, m : **1.5**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 28°10'6.84"N 84°9'48.6"E

Soil Description	Symbol	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Very dense brownish higly fractured and weathered rock of Phyllite		1	** SPT	50/3			> 50
		2					
		3					
		4					
		5					
		6					



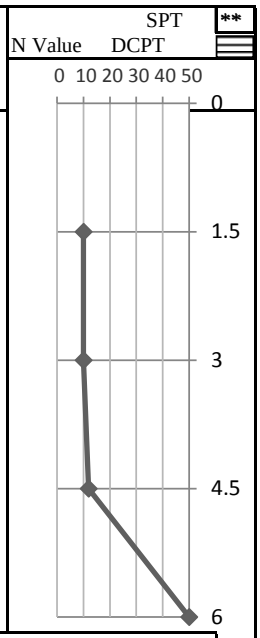
Note: Drilling could be carried out up to depth of 1.5 m due to presence of Bed rock from Auger method of drilling.

Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 3

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli — Total Depth, m : **6.0**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 28°8'14.65"N 84°12'10.47"E

Soil Description	Symbol	Depth, m	Test Type		No. of blows 15 cm	15 cm	15 cm	N-Value
Loose to medium dense reddish brown clayey SILT with small gravels and sand		1						
			**	SPT	2	5	5	10
		2						
		3	**	SPT	3	3	7	10
		4						
			**	SPT	2	6	6	12
Very dense reddish brown clayey GRAVELS with traces of sand		5						
		6	**	SPT	42	50/3		> 50

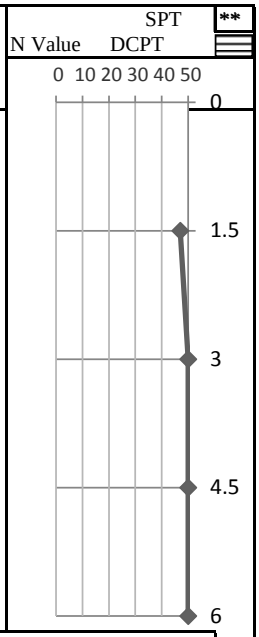


Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 4

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Sishaghat — Total Depth, m : **6.0**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 28°4'30.66"N 84°13'54.39"E

Soil Description	Symbol	Depth, m	Test Type		No. of blows 15 cm	15 cm	15 cm	N-Value
Very dense brownish very silty sandy GRAVELS and BOULDERS		1						
			**	SPT	13	20	27	47
		2						
		3	**	SPT	21	33	40	> 50
		4						
			**	SPT	40	50/3		> 50
		5						
		6	**	SPT	50/5			> 50

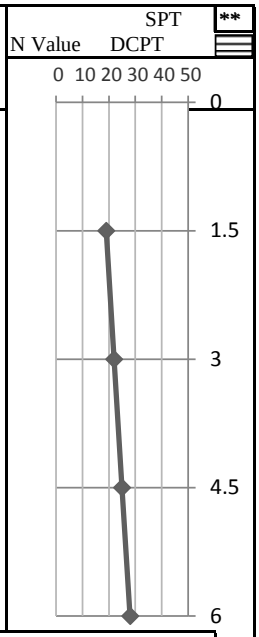


Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 5

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Ranitari, Tanahun — Total Depth, m : **6.0**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 28°0'38.13"N 84°13'3.56"E

Soil Description	Symbol	Depth, m	Test Type		No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense to dense brownish sandy SILT with low plastic clay		1	**	SPT	7	8	11	19
		2						
		3	**	SPT	11	10	12	22
		4						
		5	**	SPT	10	12	13	25
		6	**	SPT	11	13	15	28

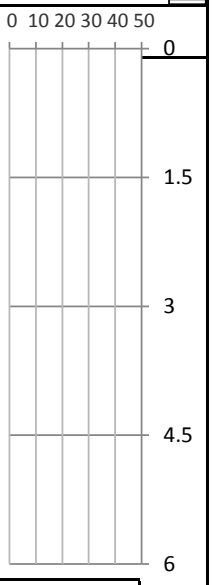


Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 6

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli — Total Depth, m : **1.5**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 27°57'38.51"N 84°15'35.55"E

Soil Description	Symbol	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Very dense brownish higly fractured and weathered rock of Phyllite		1					
		2	**	SPT	19	29	42	71
		3					
		4					
		5					
		6					



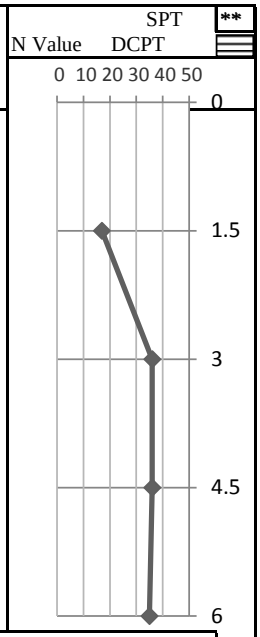
Note: Drilling could be carried out up to depth of 1.5 m due to presence of Bed rock from Auger method of drilling.

Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 7

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Bahungaun, Damauli — Total Depth, m : **6.0**
Drilling Method : Auger — Depth to Ground Water: NA
Inclination of Hole:Vertical
Borehole Coordinates: 27°56'48.77"N 84°16'41.71"E

Soil Description	Symbol	Depth, m	Test Type		No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense to dense brownish sandy SILT with small gravels and clay		1						
			**	SPT	7	8	9	17
		2						
		3	**	SPT	10	18	18	36
		4						
			**	SPT	11	16	20	36
		5						
		6	**	SPT	13	18	17	35

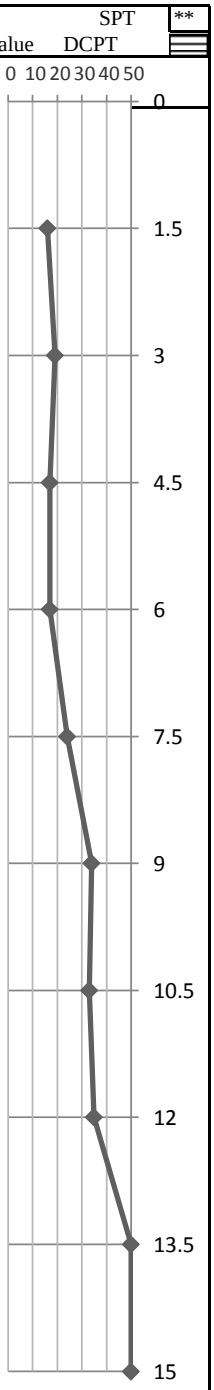


Types of Soil		N Value					
Granular Soil	Compactness	**0 to 4** Very Loose	**4 to 10** Loose	**10 to 30** Med. Dense	**30 to 50** Dense	**> 50** Very Dense	
Cohesive Soil	Consistency	**0 to 2** Very Soft	**2 to 4** Soft	**4 to 8** Med. Soft	**8 to 16** Stiff	**16 to 32** Very Stiff	**> 32** Hard

BOREHOLE NO:- 8 (DAMAULI SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Substation Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli, Tanahun — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 3.5 m
Inclination of Hole:Vertical
Borehole Coordinates: 27°58'5.53"N 84°17'35.95"E

Soil Description	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense greyish very silty fine SAND with gravels or sandy SILT with gravels	1					
	1.5	** SPT	4	7	9	16
	2					
	3	** SPT	19	10	9	19
	4					
	4.5	** SPT	12	7	10	17
Medium dense to dense greyish and whitish mix very silty gravelly SAND with traces of clay	5					
	6	** SPT	14	8	9	17
	7					
	7.5	** SPT	17	11	13	24
	8					
	9	** SPT	19	16	18	34
	10					
	10.5	** SPT	12	14	19	33
	11					
	12	** SPT	21	18	17	35
Very dense greyish and whitish mix very silty sandy GRAVELS with BOULDERS	13					
	13.5	DCPT	43	50/5		> 50
	14					
	15	DCPT	50/5			> 50

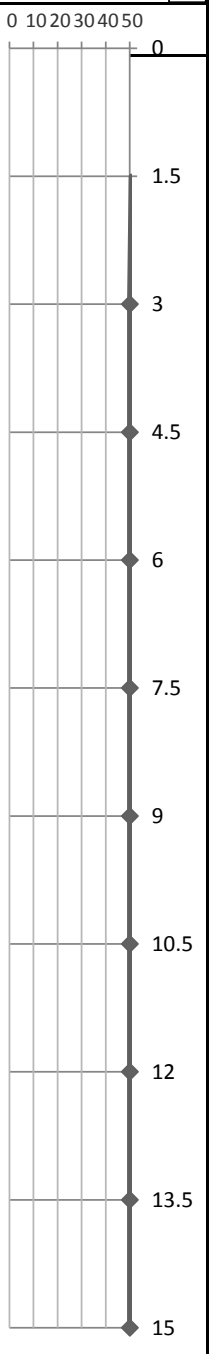


Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

BOREHOLE NO:- 9 (LEKHNATH SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Site
CLIENT : Nepal Electricity Authority
LOCATION : Pokhara Metropolitan City, Argau, Lekhnath — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 3.4 m
Inclination of Hole:Vertical
Borehole Coordinates: 28°10'47.96"N 84° 3'22.89"E

Soil Description	Symbol	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Very dense light greyish sandy silty GRAVELS with BOULDERS with few traces of clay		1	DCPT	18	34	42	51
		2					
		3	DCPT	17	48	50/6	> 50
		4	DCPT	29	50/7		> 50
		5					
		6	DCPT	37	42	50/9	> 50
		7	DCPT	32	50/2		> 50
		8					
		9	DCPT	19	50/6		> 50
		10	DCPT	46	50/7		> 50
		11					
		12	DCPT	27	40	50/3	> 50
		13	DCPT	80	37	50/7	> 50
		14					
		15	DCPT	27	50/11		> 50

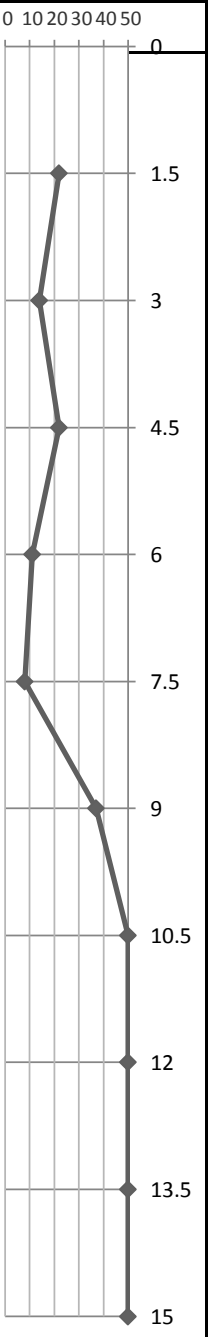


Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

BOREHOLE : 1 (NEW) (DAMAULI SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Substation Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli, Tanahun — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 2.5 m
Inclination of Hole:Vertical
Borehole Coordinates: 27°58'3.14"N 84°17'33.52"E

Soil Description	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense greyish very silty fine SAND with gravels or sandy GRAVELS	1	** SPT	9	10	12	22
	2					
	3	** SPT	8	8	6	14
	4					
		** SPT	12	10	12	22
Loose to dense to dense greyish and whitish mix very silty gravelly SAND with traces of clay	5					
	6	** SPT	5	5	6	11
	7	No SPT sample retrieved				
		** SPT	5	4	4	8
	8	No SPT sample retrieved				
	9	** SPT	25	18	19	37
Very dense greyish and whitish mix very silty sandy GRAVELS with few BOULDERS	10	DCPT	50/3			> 50
	11					
	12	DCPT	49	50/5		> 50
	13					
		DCPT	43	50/5		> 50
	14					
	15	DCPT	50/5			> 50

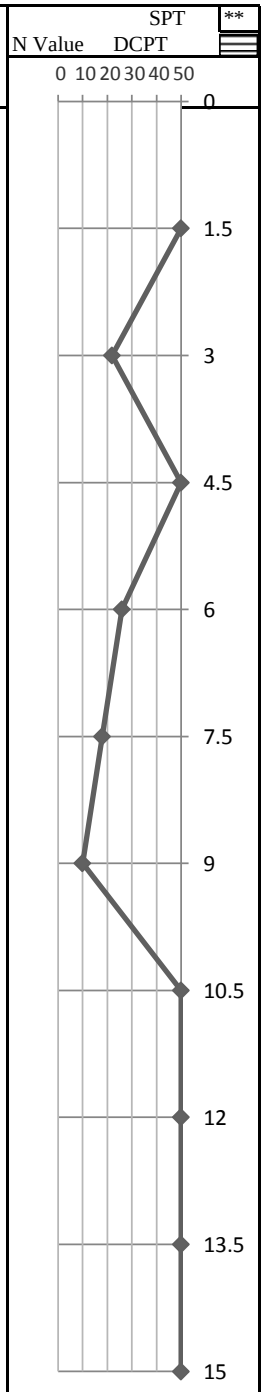


Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

BOREHOLE : 2 (NEW) (DAMAULI SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Substation Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli, Tanahun — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 4 m
Inclination of Hole:Vertical
Borehole Coordinates: 27°58'6.38"N 84°17'33.67"E

Soil Description	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense to very dense greyish very silty fine SAND with gravels	1					
	1.5	** SPT	27	39	50/3	> 50
	2					
	3	** SPT	6	9	13	22
Very dense brownish silty sandy GRAVELS with BOULDERS	4					
	4.5	** SPT	22	50/2		> 50
	5					
	6	** SPT	11	12	14	26
Medium dense greyish and whitish mix silty gravelly medium to fine SAND or gravelly sandy SILT with traces of clay	7					
	7.5	** SPT	5	9	9	18
	8					
	9	** SPT	7	7	3	10
	10					
	10.5	DCPT	50/5			> 50
Very dense greyish very silty sandy GRAVELS with BOULDERS	11					
	12	DCPT	43	50/7		> 50
	13					
	13.5	DCPT	50/7			> 50
	14					
	15	DCPT	50/3			> 50

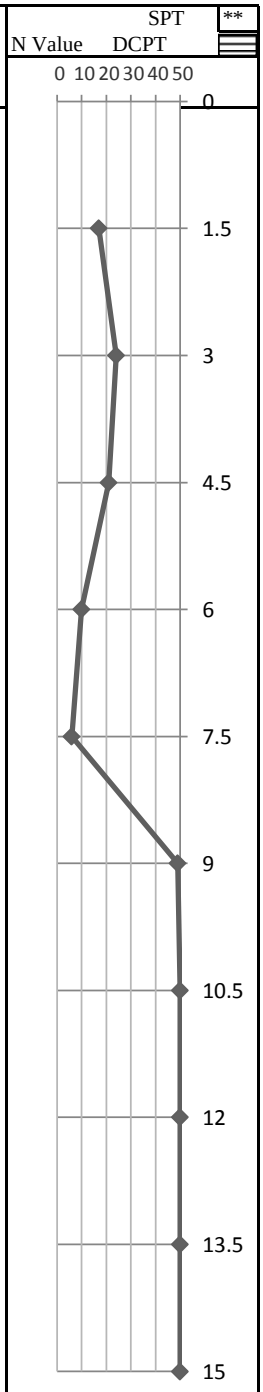


Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

BOREHOLE : 3 (NEW) (DAMAULI SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Substation Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli, Tanahun — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 2 m
Inclination of Hole:Vertical
Borehole Coordinates: 27°58'4.92"N 84°17'35.53"E

Soil Description	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Medium dense greyish very silty medium to fine SAND with small gravels	1					
	1.5	** SPT	7	8	9	17
	2					
	3	** SPT	6	10	14	24
Loose to medium dense greyish silty sandy GRAVELS	4					
	4.5	** SPT	19	11	10	21
	5					
	6	** SPT	6	4	6	10
Loose greyish and whitish mix sandy SILT with traces of clay	7					
	7.5	** SPT	5	3	3	6
	8					
Dense greyish silty sandy GRAVELS	9	** SPT	23	31	18	49
	10					
	10.5	** SPT	49	50/2		> 50
	11					
	12	DCPT	50/5			> 50
Very dense greyish very silty sandy GRAVELS with BOULDERS	13					
	13.5	DCPT	50/3			> 50
	14					
	15	DCPT	50/7			> 50

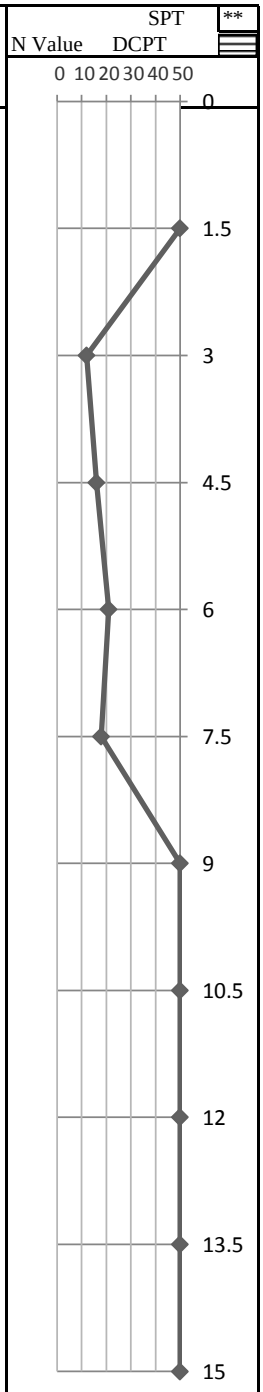


Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

BOREHOLE : 4 (NEW) (DAMAULI SUBSTATION)

PROJECT : Geotechnical Investigation of Proposed Substation Site
CLIENT : Nepal Electricity Authority
LOCATION : Damauli, Tanahun — Total Depth, m : **15.0**
Drilling Method : Rotary — Depth to Ground Water: 2.5 m
Inclination of Hole:Vertical
Borehole Coordinates: 27°58'4.47"N 84°17'32.16"E

Soil Description	Depth, m	Test Type	No. of blows 15 cm	15 cm	15 cm	N-Value
Top brownish medium dense sandy SILT with traces of clay	1					
Very dnese brownish silty sandy GRAVELS with BOULDERS	2	DCPT	29	50/3		> 50
	3	** SPT	19	6	6	12
	4					
	4	** SPT	6	9	7	16
Medium dense greyish and whitish mix very silty SAND and GRAVELS or gravelly sandy SILT with traces of clay	5					
	6	** SPT	10	14	7	21
	7					
	7	** SPT	13	10	8	18
	8					
	9	** SPT	14	16	50/7	> 50
	10					
	10	DCPT	50/1			> 50
	11					
Very dense greyish very silty sandy GRAVELS with BOULDERS	12	DCPT	43	50/2		> 50
	13					
	13	DCPT	50/5			> 50
	14					
	15	DCPT	50/10			> 50



Types of Soil		N Value					
Granular Soil	Compactness	0 to 4 Very Loose	4 to 10 Loose	10 to 30 Med. Dense	30 to 50 Dense	> 50 Very Dense	
Cohesive Soil	Consistency	0 to 2 Very Soft	2 to 4 Soft	4 to 8 Med. Soft	8 to 16 Stiff	16 to 32 Very Stiff	> 32 Hard

ANNEX-II

LABORATORY TEST RESULTS

Moisture Content

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Test Method		IS: 2720 Part II						
S.N	**Sample**	**Depth m**	**Mass (gm) of**					**Moisture Content %**
			Wet Soil + Container	**Dry Soil + Container**	**Container**	**Moisture**	**Dry Soil**	
Bore Hole 1								
1	SPT	1.50	129.00	110.00	4.00	19.00	106.00	17.92
2	SPT	3.00	182.50	147.50	4.00	35.00	143.50	24.39
3	SPT	4.50	208.50	177.00	4.00	31.50	173.00	18.21
4	SPT	6.00	202.00	159.00	4.00	43.00	155.00	27.74
Bore Hole 3								
1	Disturbed	1.00	1090.00	850.00	147.68	240.00	702.32	34.17
2	SPT	1.50	790.00	600.00	108.00	190.00	492.00	38.62
3	Disturbed	2.00	830.00	650.00	156.00	180.00	494.00	36.44
4	SPT	3.00	870.00	640.00	97.09	230.00	542.91	42.36
5	SPT	4.50	750.00	560.00	155.00	190.00	405.00	46.91
6	Disturbed	5.00	665.00	521.00	102.30	144.00	418.70	34.39

Moisture Content

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Test Method		IS: 2720 Part II						
S.N	**Sample**	**Depth m**	**Mass (gm) of**					**Moisture Content %**
			Wet Soil + Container	**Dry Soil + Container**	**Container**	**Moisture**	**Dry Soil**	
Bore Hole 4								
1	SPT	1.50	165.50	146.50	4.00	19.00	142.50	13.33
2	SPT	3.00	180.50	168.50	4.00	12.00	164.50	7.29
3	SPT	4.50	200.00	178.00	4.00	22.00	174.00	12.64
4	SPT	6.00	145.00	124.00	4.00	21.00	120.00	17.50
Bore Hole 5								
1	SPT	1.50	145.50	120.00	4.00	25.50	116.00	21.98
2	SPT	3.00	177.50	142.50	4.00	35.00	138.50	25.27
3	SPT	4.50	166.00	137.00	4.00	29.00	133.00	21.80
4	SPT	6.00	180.00	146.50	4.00	33.50	142.50	23.51

Moisture Content

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Test Method		IS: 2720 Part II						
S.N	**Sample**	**Depth m**	**Mass (gm) of**					**Moisture Content %**
			Wet Soil + Container	**Dry Soil + Container**	**Container**	**Moisture**	**Dry Soil**	
Bore Hole 7								
1	SPT	1.50	149.50	117.00	4.00	32.50	113.00	28.76
2	SPT	3.00	208.50	183.50	4.00	25.00	179.50	13.93
3	SPT	4.50	185.50	162.00	4.00	23.50	158.00	14.87
4	SPT	6.00	221.50	191.50	4.00	30.00	187.50	16.00
Bore Hole 8 - DAMAULI SUBSTATION								
1	SPT	1.50	206.50	184.00	4.00	22.50	180.00	12.50
2	SPT	3.00	186.00	177.00	4.00	9.00	173.00	5.20
3	SPT	4.50	160.00	131.50	4.00	28.50	127.50	22.35
4	SPT	6.00	141.00	132.00	4.00	9.00	128.00	7.03
5	SPT	7.50	170.00	159.50	4.00	10.50	155.50	6.75
6	SPT	9.00	181.50	171.50	4.00	10.00	167.50	5.97
7	SPT	10.50	175.50	167.50	4.00	8.00	163.50	4.89
8	SPT	12.00	204.00	196.00	4.00	8.00	192.00	4.17
Bore Hole 9 - LEKHNATH SUBSTATION								
1	Disturbed	1.50	133.50	110.00	4.00	23.50	106.00	22.17
2	Disturbed	3.00	200.00	171.00	4.00	29.00	167.00	17.37
3	Disturbed	7.50	212.00	180.00	4.00	32.00	176.00	18.18
4	Disturbed	9.00	221.50	188.00	4.00	33.50	184.00	18.21

SPECIFIC GRAVITY TEST OF SOIL SOLIDS

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Testing Method **IS : 2720 Part 3**

Bore Hole No.		**1**				**3**		
Depth	m	1.5	3.0	4.5	6.0	1.5	3.0	4.5
Sample		SPT	SPT	SPT	SPT	SPT	SPT	SPT
Wt. Pycnometer + Water + Soil	gm	176.28	180.80	176.22	180.65	176.33	180.96	176.85
Temperature	°C	30	30	30	29	30	29	30
Wt. Pycnometer + Water	gm	157.70	161.80	157.72	162.01	157.92	162.62	158.33
Wt. Soil	gm	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Specific Gravity of Water		0.9957	0.9957	0.9957	0.9960	0.9957	0.9960	0.9957
Specific Gravity of Soil Solids		2.62	2.72	2.60	2.63	2.58	2.56	2.60

SPECIFIC GRAVITY TEST OF SOIL SOLIDS

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Testing Method **IS : 2720 Part 3**

Bore Hole No.		**4**			**5**	
Depth	m	1.5	3.0	4.5	1.5	4.5
Sample		SPT	SPT	SPT	SPT	SPT
Wt. Pycnometer + Water + Soil	gm	180.84	176.24	180.65	180.75	176.20
Temperature	°C	29	30	29	29	30
Wt. Pycnometer + Water	gm	162.20	157.50	162.10	162.30	157.89
Wt. Soil	gm	30.0	30.0	30.0	30.0	30.0
Specific Gravity of Water		0.9957	0.9957	0.9960	0.9960	0.9957
Specific Gravity of Soil Solids		2.63	2.65	2.61	2.59	2.56

SPECIFIC GRAVITY TEST OF SOIL SOLIDS

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Testing Method **IS : 2720 Part 3**

Bore Hole No.		7		
Depth	m	1.5	3.0	4.5
Sample		SPT	SPT	SPT
Wt. Pycnometer + Water + Soil	gm	180.84	176.24	180.65
Temperature	°C	29	30	29
Wt. Pycnometer + Water	gm	162.32	157.66	162.10
Wt. Soil	gm	30.0	30.0	30.0
Specific Gravity of Water		0.9957	0.9957	0.9960
Specific Gravity of Soil Solids		2.60	2.62	2.61

SPECIFIC GRAVITY TEST OF SOIL SOLIDS

Project : Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines

Location : Kaski and Tanahun Districts

Testing Method **IS : 2720 Part 3**

Bore Hole No.		**8 - DAMAULI SUBSTATION**				**9 - LEKHNATH SS**	
Depth	m	1.5	4.5	7.5	10.5	4.5	9.0
Sample		SPT	SPT	SPT-1	SPT-2	Disturbed	Disturbed
Wt. Pycnometer + Water + Soil	gm	180.75	176.20	181.14	184.59	180.72	176.18
Temperature	°C	29	30	28	30	29	30
Wt. Pycnometer + Water	gm	162.22	157.56	162.70	166.10	162.10	157.59
Wt. Soil	gm	30.0	30.0	30.0	30.0	30.0	30.0
Specific Gravity of Water		0.9960	0.9957	0.9963	0.9958	0.9960	0.9957
Specific Gravity of Soil Solids		2.61	2.63	2.59	2.60	2.63	2.62

Moisture Content

Project : Geotechnical Investigation of Proposed Substation Site

Client : Nepal Electricity Authority

Location : Damauli, Tanahun

Test Method			IS: 2720 Part II					
S.N	**Sample**	**Depth m**	**Mass (gm) of**					**Moisture Content %**
			Wet Soil + Container	**Dry Soil + Container**	**Container**	**Moisture**	**Dry Soil**	
Borehole 1 - NEW								
1	SPT	1.50	445.00	430.00	90.01	15.00	339.99	4.41
2	SPT	3.00	445.00	405.00	108.00	40.00	297.00	13.47
3	SPT	4.50	525.00	490.00	89.52	35.00	400.48	8.74
4	Disturbed	6.00	580.00	520.00	128.23	60.00	391.77	15.32
5	Disturbed	7.50	720.00	620.00	87.56	100.00	532.44	18.78
6	SPT	9.00	340.00	325.00	91.23	15.00	233.77	6.42
7	Disturbed	10.50	810.00	710.00	91.29	100.00	618.71	16.16
8	Disturbed	12.00	940.00	840.00	156.74	100.00	683.26	14.64
9	Disturbed	13.50	610.00	540.00	88.40	70.00	451.60	15.50
10	Disturbed	15.00	555.00	495.00	93.46	60.00	401.54	14.94
Borehole 2 - NEW								
1	SPT	1.50	200.00	195.00	17.75	5.00	177.25	2.82
1	SPT	3.00	175.00	170.00	20.45	5.00	149.55	3.34
1	SPT	4.50	710.00	620.00	156.00	90.00	464.00	19.40
1	SPT	6.00	650.00	630.00	155.00	20.00	475.00	4.21
1	SPT	7.50	1525.00	1270.00	162.85	255.00	1107.15	23.03
1	SPT	7.50	330.00	320.00	108.00	10.00	212.00	4.72
1	SPT	9.00	395.00	370.00	155.67	25.00	214.33	11.66
1	Disturbed	10.50	745.00	740.00	91.23	5.00	648.77	0.77

Borehole 3 - NEW								
1	SPT	1.50	380.00	351.23	89.52	28.77	261.71	10.99
2	SPT	3.00	1010.00	925.00	156.00	85.00	769.00	11.05
3	SPT	4.50	750.00	720.00	97.09	30.00	622.91	4.82
4	Disturbed	6.00	865.00	830.00	138.45	35.00	691.55	5.06
5	SPT	7.50	635.00	515.00	88.40	120.00	426.60	28.13
6	SPT	9.00	945.00	885.00	162.85	60.00	722.15	8.31
7	Disturbed	9.00	840.00	820.00	91.23	20.00	728.77	2.74
8	Disturbed	10.00	425.00	380.00	89.52	45.00	290.48	15.49
9	Disturbed	10.50	345.00	305.00	90.01	40.00	214.99	18.61
10	Disturbed	10.50	735.00	720.00	95.15	15.00	624.85	2.40
11	Disturbed	12.00	320.00	280.00	93.46	40.00	186.54	21.44
12	Disturbed	13.50	470.00	395.00	155.00	75.00	240.00	31.25
13	Disturbed	15.00	155.00	130.00	17.25	25.00	112.75	22.17
Borehole 4 - NEW								
1	SPT	3.00	370.00	360.00	140.00	10.00	220.00	4.55
2	SPT	4.50	510.00	480.00	86.33	30.00	393.67	7.62
3	SPT	6.00	755.00	715.00	128.23	40.00	586.77	6.82
4	SPT	7.50	395.00	375.00	147.68	20.00	227.32	8.80
5	SPT	9.00	680.00	620.00	156.74	60.00	463.26	12.95
6	Disturbed	10.50	930.00	925.00	88.40	5.00	836.60	0.60
7	Disturbed	12.00	570.00	565.00	156.00	5.00	409.00	1.22
8	Disturbed	13.50	495.00	490.00	95.15	5.00	394.85	1.27
9	Disturbed	15.00	565.00	560.00	89.52	5.00	470.48	1.06

SPECIFIC GRAVITY TEST OF SOIL SOLIDS

Project : Geotechnical Investigation of Proposed Substation Site

Client : Nepal Electricity Authority

Location : Damauli, Tanahun

Testing Method **IS : 2720 Part 3**

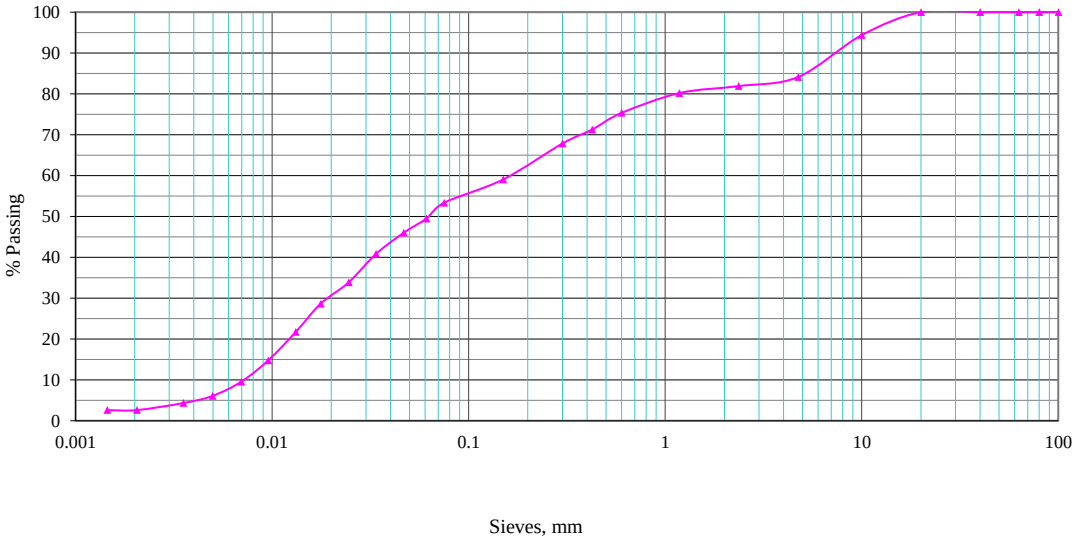
Bore Hole No.		**1**				**2**			**3**			**4**		
Depth	m	1.5	3.0	4.5	9.0	3.0	6.0	7.5	1.5	3.0	7.5	3.0	4.5	6.0
Sample		SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT
Wt. Pycnometer + Water + Soil	gm	181.60	181.00	176.20	180.80	178.40	174.90	185.40	178.50	174.60	178.39	181.14	184.59	188.56
Temperature	°C	29	24	26	24	26	28	29	26	24	26	28	30	32
Wt. Pycnometer + Water	gm	163.10	162.59	157.62	162.32	159.90	156.40	166.89	159.96	156.10	159.90	162.70	166.01	169.92
Wt. Soil	gm	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Specific Gravity of Water		0.9960	0.9973	0.9968	0.9973	0.9968	0.9963	0.9960	0.9968	0.9973	0.9968	0.9963	0.9958	0.9953
Specific Gravity of Soil Solids		2.60	2.58	2.62	2.60	2.60	2.60	2.60	2.61	2.60	2.60	2.59	2.62	2.63

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Kaski

Bore Hole : 1
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 152.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	8.560	8.560	5.617	94.38
4.750	15.620	24.180	15.866	84.13
2.360	3.400	27.580	18.097	81.90
1.180	2.600	30.180	19.803	80.20
0.600	7.400	37.580	24.659	75.34
0.425	6.200	43.780	28.727	71.27
0.300	5.200	48.980	32.139	67.86
0.150	13.400	62.380	40.932	59.07
0.075	8.700	71.080	46.640	53.36
0.061				49.50
0.047				46.02
0.034				40.81
0.025				33.87
0.018				28.66
0.013				21.71
0.010				14.76
0.007				9.55
0.005				6.08
0.004				4.34
0.002				2.61
0.001				2.61



CLAY	SILT	SAND	GRAVEL
2.61 %	50.75 %	30.77 %	15.87 %

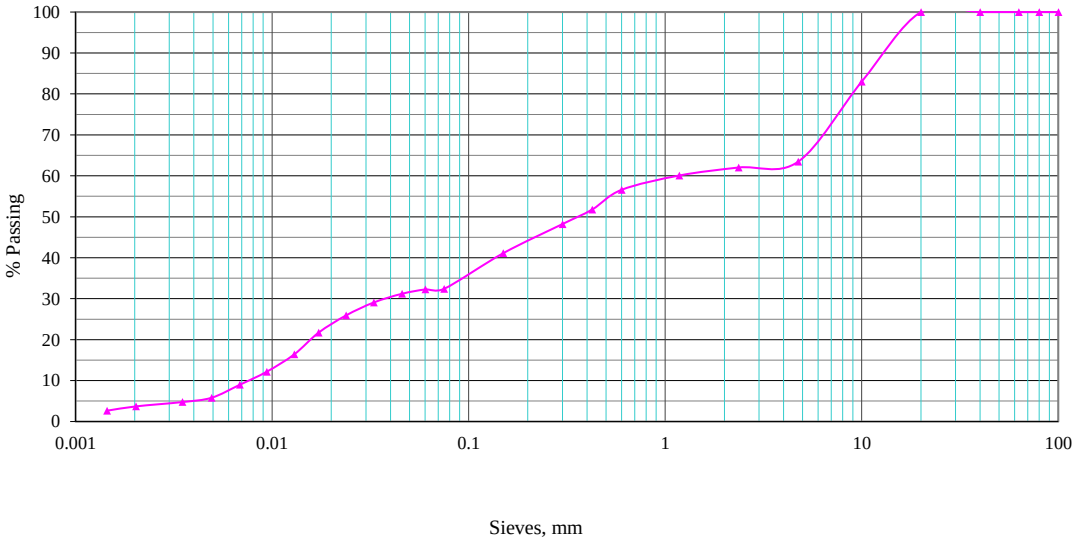
D_{10}	D_{30}	D_{50}	D_{60}
0.0072	0.02	0.06	0.17
C_U	23.61	C_C	0.33

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Kaski

Bore Hole : 1
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 174.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	29.630	29.630	16.980	83.02
4.750	34.120	63.750	36.533	63.47
2.360	2.500	66.250	37.966	62.03
1.180	3.400	69.650	39.914	60.09
0.600	6.100	75.750	43.410	56.59
0.425	8.400	84.150	48.223	51.78
0.300	6.200	90.350	51.777	48.22
0.150	12.400	102.750	58.883	41.12
0.075	15.200	117.950	67.593	32.41
0.060				32.26
0.046				31.20
0.033				29.08
0.024				25.91
0.017				21.68
0.013				16.39
0.009				12.16
0.007				8.99
0.005				5.82
0.003				4.76
0.002				3.70
0.001				2.64



CLAY	SILT	SAND	GRAVEL
3.70 %	28.71 %	31.06 %	36.53 %

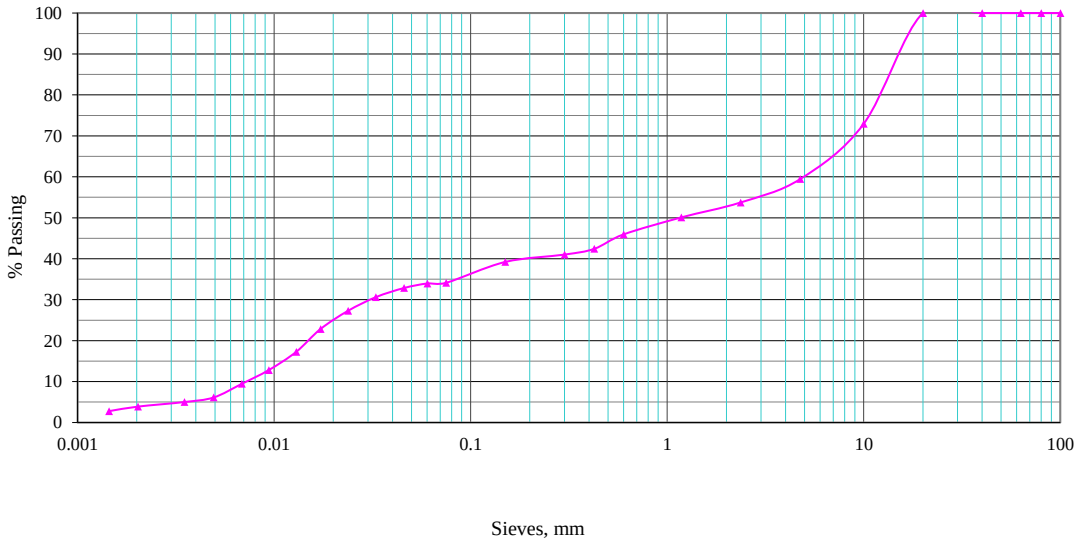
D_{10}	D_{30}	D_{50}	D_{60}
0.0077	0.04	0.36	1.17
C_U	151.95	C_C	0.18

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Kaski

Bore Hole : 1
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 178.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	48.230	48.230	27.035	72.97
4.750	24.100	72.330	40.544	59.46
2.360	10.200	82.530	46.261	53.74
1.180	6.500	89.030	49.905	50.10
0.600	7.400	96.430	54.053	45.95
0.425	6.300	102.730	57.584	42.42
0.300	2.500	105.230	58.985	41.01
0.150	3.200	108.430	60.779	39.22
0.075	9.100	117.530	65.880	34.12
0.060				33.96
0.046				32.85
0.033				30.62
0.024				27.28
0.017				22.83
0.013				17.26
0.009				12.81
0.007				9.46
0.005				6.12
0.003				5.01
0.002				3.90
0.001				2.78



CLAY	SILT	SAND	GRAVEL
3.90 %	30.22 %	25.34 %	40.54 %

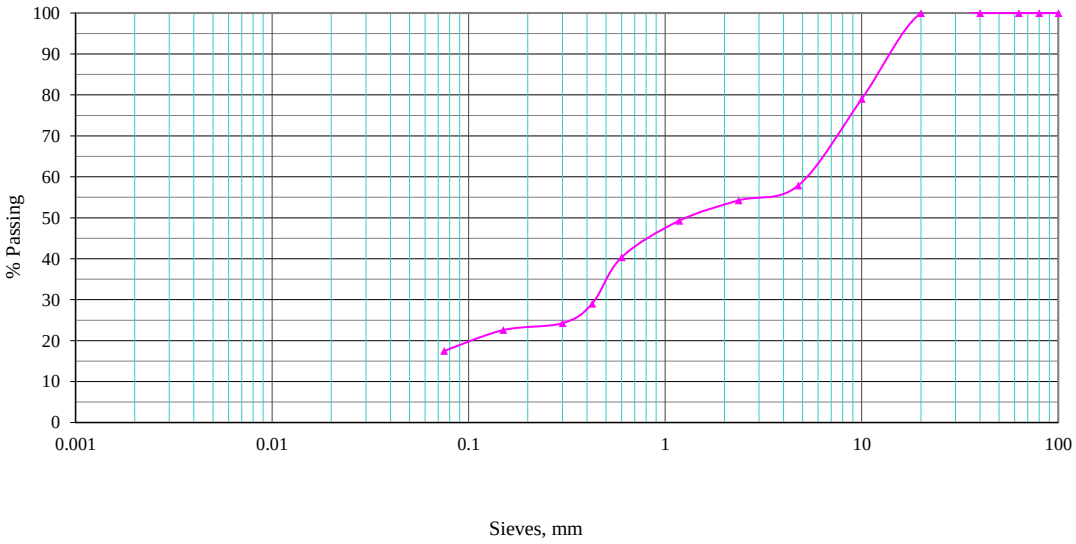
D_{10}	D_{30}	D_{50}	D_{60}
0.0073	0.03	1.17	4.96
C_U	679.45	C_C	0.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Kaski

Bore Hole : 1
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 125.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	26.300	26.300	20.973	79.03
4.750	26.530	52.830	42.129	57.87
2.360	4.560	57.390	45.766	54.23
1.180	6.200	63.590	50.710	49.29
0.600	11.200	74.790	59.641	40.36
0.425	14.200	88.990	70.965	29.04
0.300	6.000	94.990	75.750	24.25
0.150	2.100	97.090	77.424	22.58
0.075	6.400	103.490	82.528	17.47



CLAY	SILT	SAND	GRAVEL
0.00 %	17.47 %	40.40 %	42.13 %

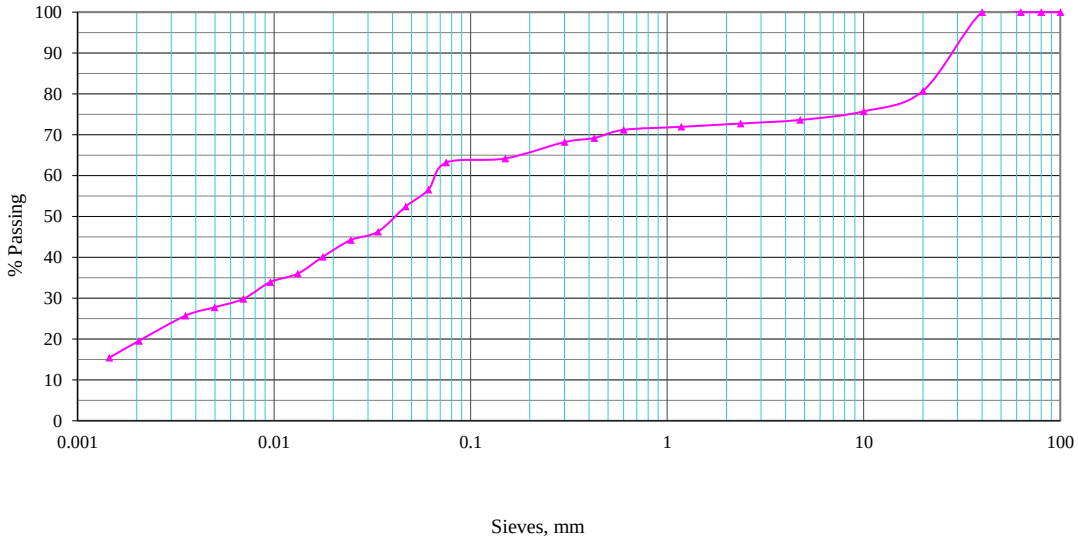
D_{10}	D_{30}	D_{50}	D_{60}
0.0429	0.44	1.35	5.28
C_U	123.08	C_C	0.85

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : Disturbed **Depth (m):** 1
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	38.560	38.560	19.280	80.72
10.000	10.000	48.560	24.280	75.72
4.750	4.200	52.760	26.380	73.62
2.360	1.750	54.510	27.255	72.75
1.180	1.600	56.110	28.055	71.95
0.600	1.500	57.610	28.805	71.20
0.425	4.000	61.610	30.805	69.20
0.300	2.000	63.610	31.805	68.20
0.150	8.000	71.610	35.805	64.20
0.075	2.000	73.610	36.805	63.20
0.061				56.56
0.047				52.45
0.034				46.28
0.025				44.22
0.018				40.11
0.013				35.99
0.010				33.94
0.007				29.82
0.005				27.77
0.004				25.71
0.002				19.54
0.001				15.43



CLAY	SILT	SAND	GRAVEL
19.54 %	43.66 %	10.43 %	26.38 %

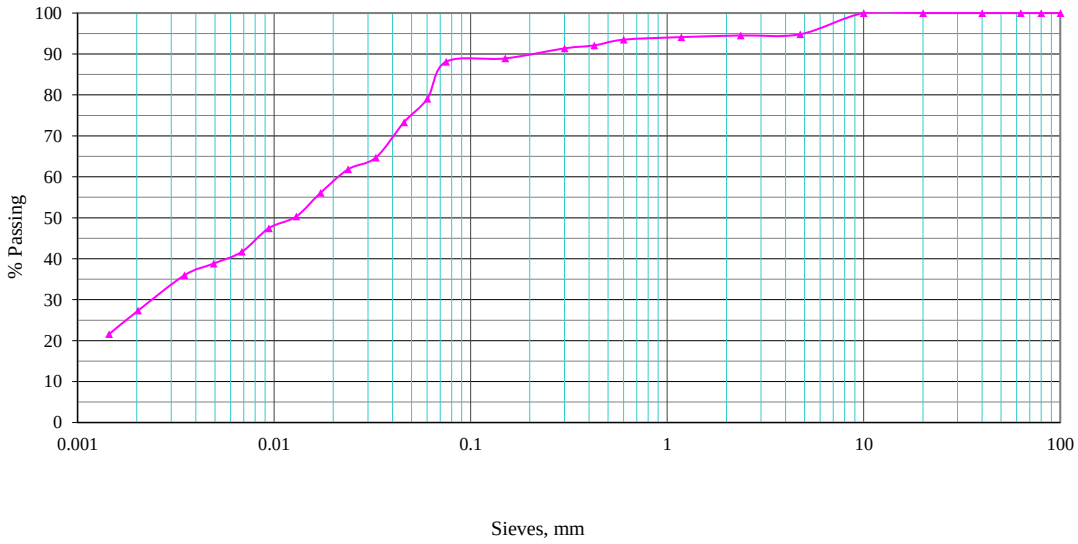
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0.01	0.04	0.07
C_U	50	C_C	1.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	10.360	10.360	5.180	94.82
2.360	0.600	10.960	5.480	94.52
1.180	0.800	11.760	5.880	94.12
0.600	1.250	13.010	6.505	93.50
0.425	2.800	15.810	7.905	92.10
0.300	1.450	17.260	8.630	91.37
0.150	4.900	22.160	11.080	88.92
0.075	1.600	23.760	11.880	88.12
0.060				79.08
0.046				73.33
0.033				64.70
0.024				61.83
0.017				56.08
0.013				50.33
0.009				47.45
0.007				41.70
0.005				38.82
0.003				35.95
0.002				27.32
0.001				21.57



CLAY	SILT	SAND	GRAVEL
27.32 %	60.80 %	6.70 %	5.18 %

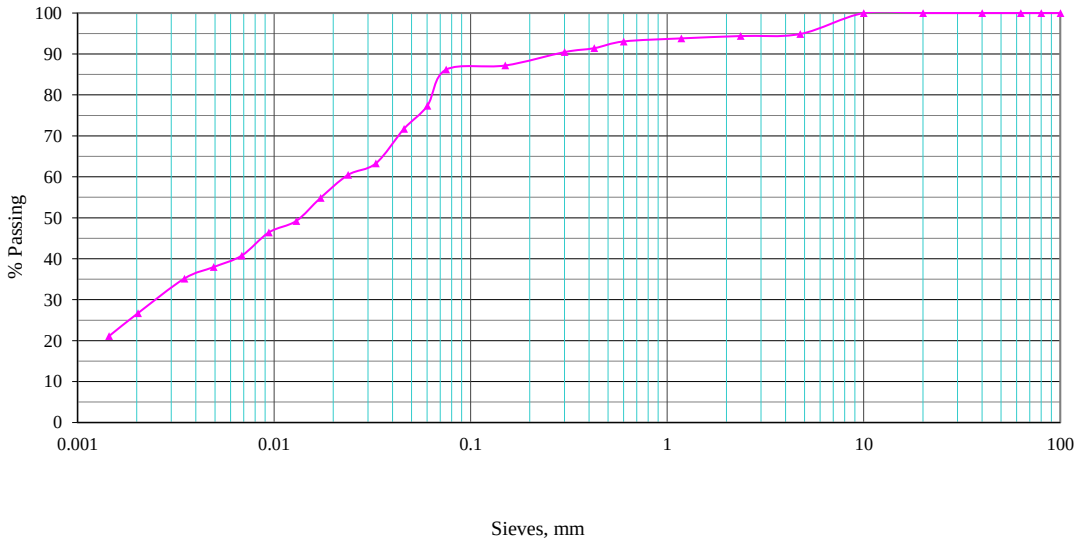
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0	0.01	0.02
C_U	14.29	C_C	0

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : Disturbed **Depth (m):** 2.0
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	10.230	10.230	5.115	94.89
2.360	1.000	11.230	5.615	94.39
1.180	1.150	12.380	6.190	93.81
0.600	1.500	13.880	6.940	93.06
0.425	3.300	17.180	8.590	91.41
0.300	1.900	19.080	9.540	90.46
0.150	6.550	25.630	12.815	87.19
0.075	2.000	27.630	13.815	86.19
0.060				77.35
0.046				71.72
0.033				63.28
0.024				60.47
0.017				54.85
0.013				49.22
0.009				46.41
0.007				40.78
0.005				37.97
0.003				35.16
0.002				26.72
0.001				21.09



CLAY	SILT	SAND	GRAVEL
26.72 %	59.47 %	8.70 %	5.11 %

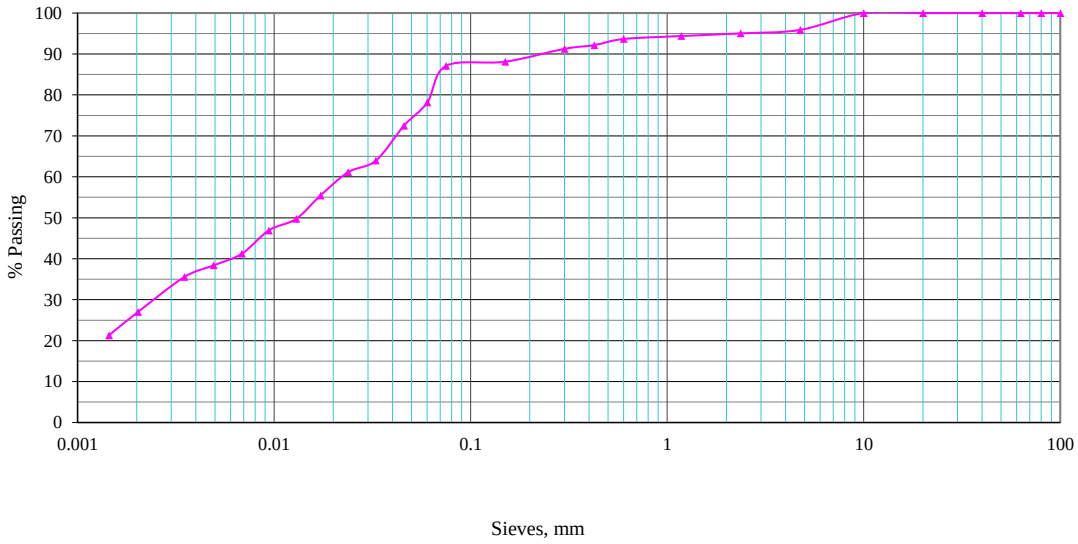
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0	0.01	0.02
C_U	14.29	C_C	0

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	8.230	8.230	4.115	95.89
2.360	1.700	9.930	4.965	95.04
1.180	1.300	11.230	5.615	94.39
0.600	1.450	12.680	6.340	93.66
0.425	3.000	15.680	7.840	92.16
0.300	1.800	17.480	8.740	91.26
0.150	6.300	23.780	11.890	88.11
0.075	2.000	25.780	12.890	87.11
0.060				78.18
0.046				72.49
0.033				63.96
0.024				61.12
0.017				55.43
0.013				49.75
0.009				46.91
0.007				41.22
0.005				38.38
0.003				35.53
0.002				27.01
0.001				21.32



CLAY	SILT	SAND	GRAVEL
27.01 %	60.10 %	8.78 %	4.11 %

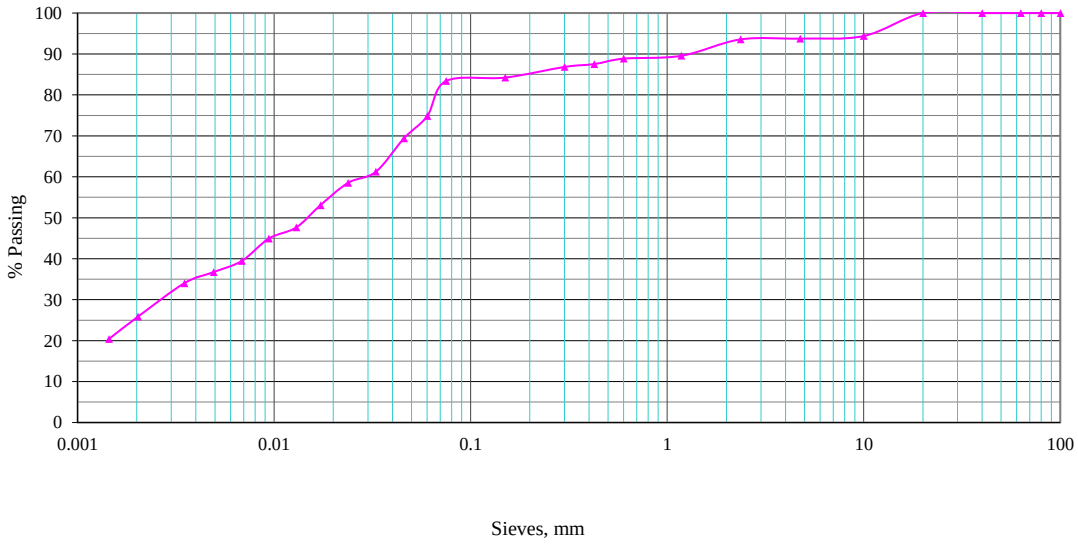
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0	0.01	0.02
C_U	14.29	C_C	0

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	11.230	11.230	5.615	94.39
4.750	1.250	12.480	6.240	93.76
2.360	0.400	12.880	6.440	93.56
1.180	8.000	20.880	10.440	89.56
0.600	1.400	22.280	11.140	88.86
0.425	2.650	24.930	12.465	87.54
0.300	1.400	26.330	13.165	86.84
0.150	5.200	31.530	15.765	84.24
0.075	1.650	33.180	16.590	83.41
0.060				74.86
0.046				69.41
0.033				61.25
0.024				58.52
0.017				53.08
0.013				47.64
0.009				44.91
0.007				39.47
0.005				36.75
0.003				34.03
0.002				25.86
0.001				20.42



CLAY	SILT	SAND	GRAVEL
25.86 %	57.55 %	10.35 %	6.24 %

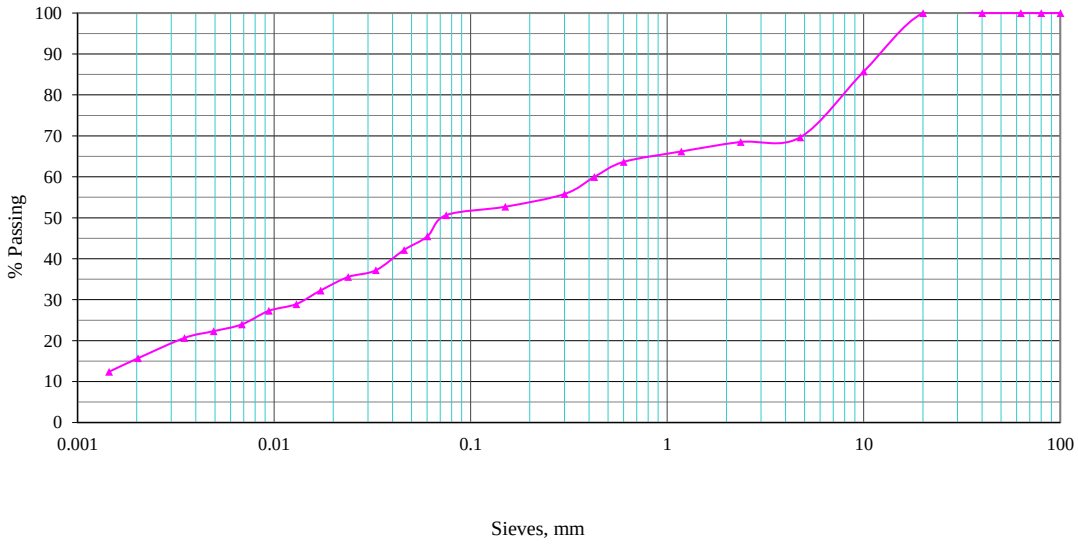
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0	0.01	0.03
C_U	21.43	C_C	0

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 3
Sample : Disturbed **Depth (m):** 6.0
Total Wt. (gm) 200.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	28.560	28.560	14.280	85.72
4.750	32.120	60.680	30.340	69.66
2.360	2.300	62.980	31.490	68.51
1.180	4.620	67.600	33.800	66.20
0.600	5.100	72.700	36.350	63.65
0.425	7.400	80.100	40.050	59.95
0.300	8.300	88.400	44.200	55.80
0.150	6.200	94.600	47.300	52.70
0.075	4.120	98.720	49.360	50.64
0.060				45.45
0.046				42.14
0.033				37.18
0.024				35.53
0.017				32.23
0.013				28.92
0.009				27.27
0.007				23.96
0.005				22.31
0.003				20.66
0.002				15.70
0.001				12.39



CLAY	SILT	SAND	GRAVEL
15.70 %	34.94 %	19.02 %	30.34 %

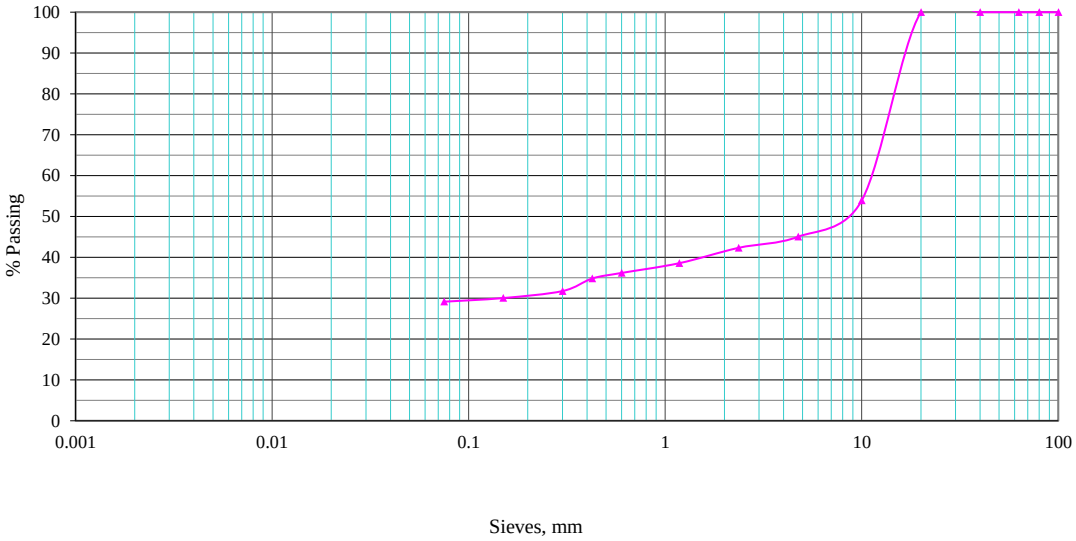
D_{10}	D_{30}	D_{50}	D_{60}
0.0014	0.01	0.07	0.43
C_U	307.14	C_C	0.17

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Sishaghat

Bore Hole : 4
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 146.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	67.500	67.500	46.075	53.92
4.750	13.000	80.500	54.949	45.05
2.360	4.000	84.500	57.679	42.32
1.180	5.500	90.000	61.433	38.57
0.600	3.500	93.500	63.823	36.18
0.425	2.000	95.500	65.188	34.81
0.300	4.500	100.000	68.259	31.74
0.150	2.500	102.500	69.966	30.03
0.075	1.300	103.800	70.853	29.15



CLAY	SILT	SAND	GRAVEL
0.00 %	29.15 %	15.90 %	54.95 %

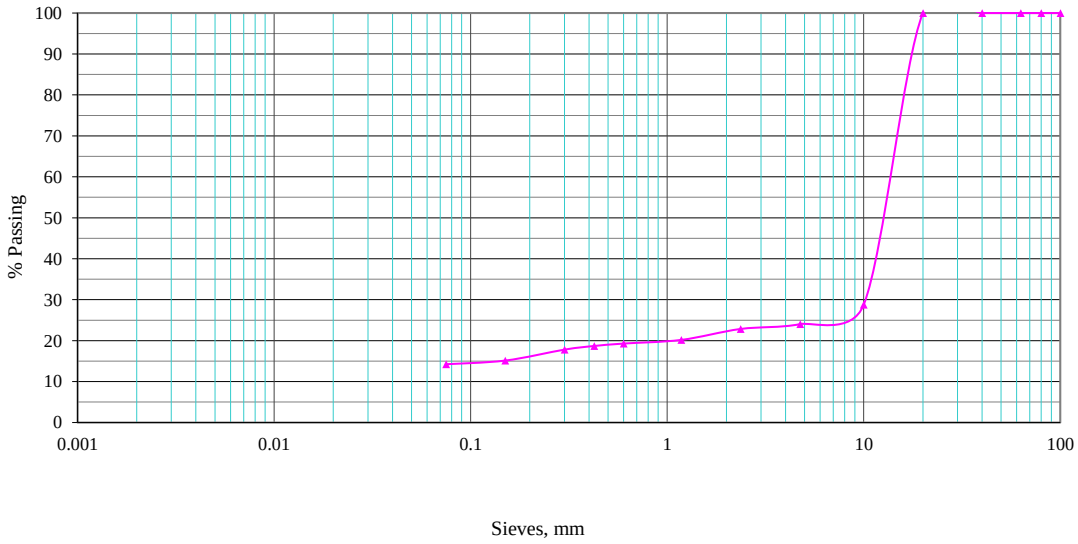
D_{10}	D_{30}	D_{50}	D_{60}
0.0257	0.15	7.68	21.87
C_U	850.97	C_C	0.04

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Sishaghat

Bore Hole : 4
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 168.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	120.000	120.000	71.217	28.78
4.750	8.000	128.000	75.964	24.04
2.360	2.000	130.000	77.151	22.85
1.180	4.500	134.500	79.822	20.18
0.600	1.500	136.000	80.712	19.29
0.425	1.000	137.000	81.306	18.69
0.300	1.500	138.500	82.196	17.80
0.150	4.500	143.000	84.866	15.13
0.075	1.500	144.500	85.757	14.24



CLAY	SILT	SAND	GRAVEL
0.00 %	14.24 %	9.79 %	75.96 %

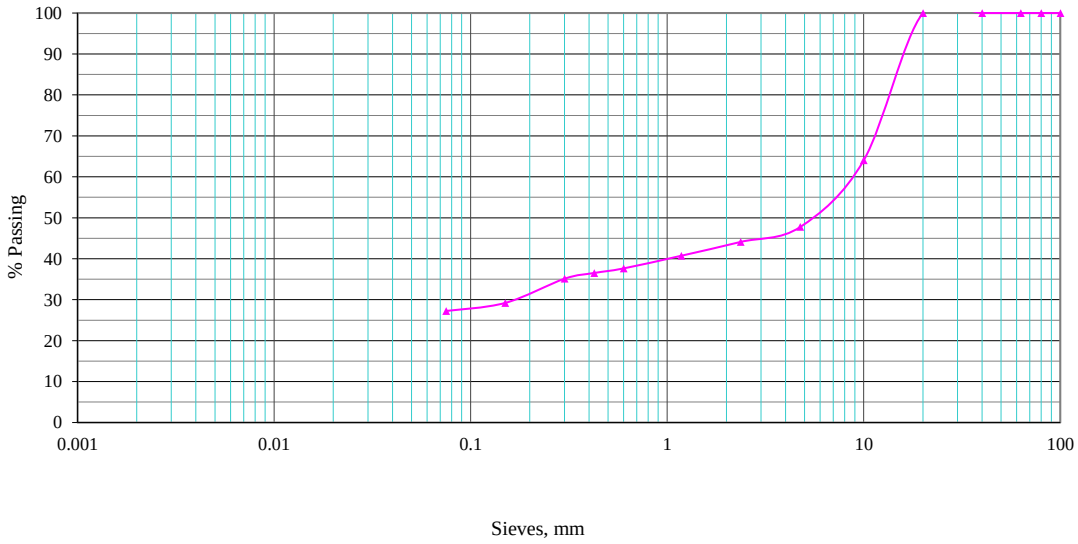
D_{10}	D_{30}	D_{50}	D_{60}
0.0527	11.54	36.81	49.45
C_U	938.33	C_C	51.1

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Sishaghat

Bore Hole : 4
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 178.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	64.000	64.000	35.955	64.04
4.750	29.000	93.000	52.247	47.75
2.360	6.500	99.500	55.899	44.10
1.180	6.000	105.500	59.270	40.73
0.600	5.500	111.000	62.360	37.64
0.425	2.000	113.000	63.483	36.52
0.300	2.500	115.500	64.888	35.11
0.150	10.500	126.000	70.787	29.21
0.075	3.500	129.500	72.753	27.25



CLAY	SILT	SAND	GRAVEL
0.00 %	27.25 %	20.51 %	52.25 %

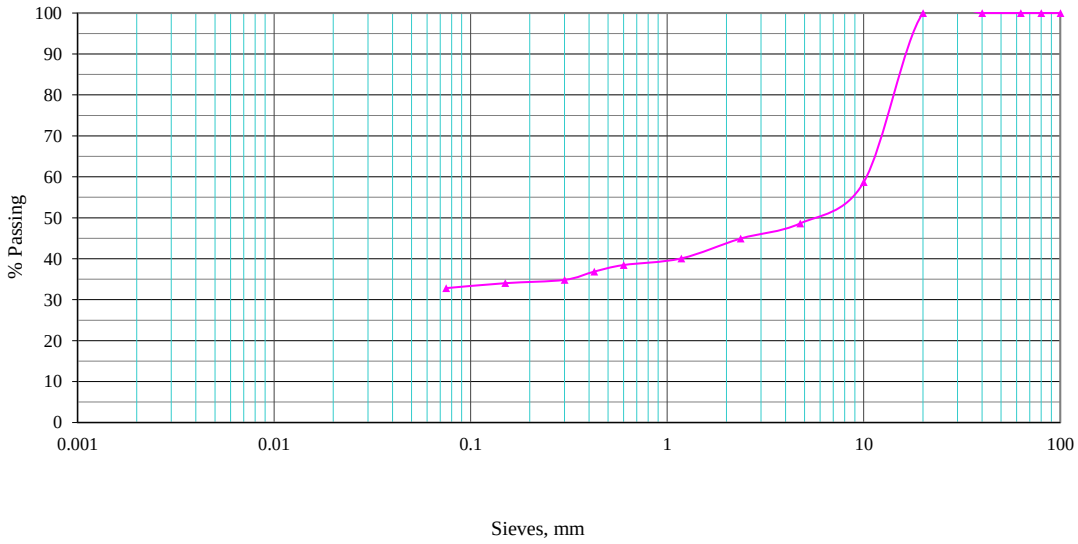
D_{10}	D_{30}	D_{50}	D_{60}
0.0275	0.17	5.47	8.7
C_U	316.36	C_C	0.12

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Sishaghat

Bore Hole : 4
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 124.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	51.200	51.200	41.290	58.71
4.750	12.500	63.700	51.371	48.63
2.360	4.600	68.300	55.081	44.92
1.180	6.000	74.300	59.919	40.08
0.600	2.000	76.300	61.532	38.47
0.425	2.000	78.300	63.145	36.85
0.300	2.500	80.800	65.161	34.84
0.150	1.000	81.800	65.968	34.03
0.075	1.500	83.300	67.177	32.82



CLAY	SILT	SAND	GRAVEL
0.00 %	32.82 %	15.81 %	51.37 %

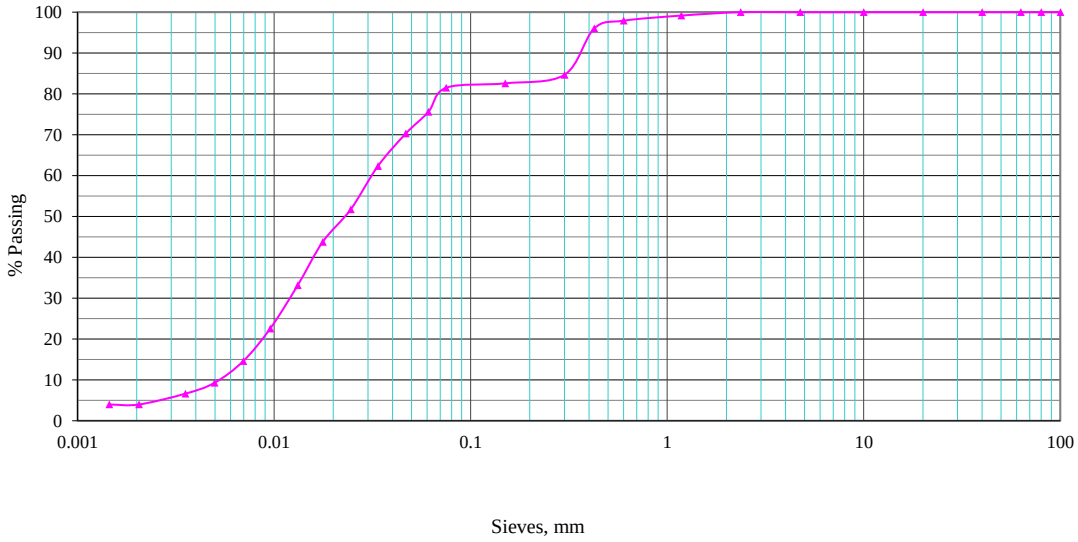
D_{10}	D_{30}	D_{50}	D_{60}
0.0229	0.07	5.46	12.81
C_U	559.39	C_C	0.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Ranibari, Damauli, Tanahun

Bore Hole : 5
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 120.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.000	0.000	0.000	100.00
1.180	1.000	1.000	0.833	99.17
0.600	1.500	2.500	2.083	97.92
0.425	2.300	4.800	4.000	96.00
0.300	13.600	18.400	15.333	84.67
0.150	2.500	20.900	17.417	82.58
0.075	1.300	22.200	18.500	81.50
0.061				75.60
0.047				70.29
0.034				62.34
0.025				51.73
0.018				43.77
0.013				33.16
0.010				22.55
0.007				14.59
0.005				9.28
0.004				6.63
0.002				3.98
0.001				3.98



CLAY	SILT	SAND	GRAVEL
3.98 %	77.52 %	18.50 %	0.00 %

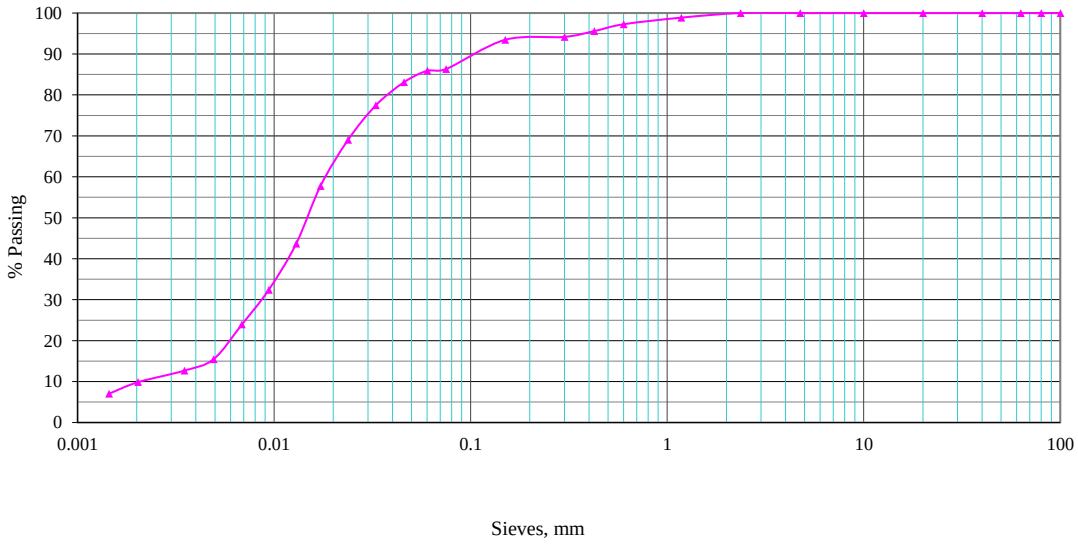
D_{10}	D_{30}	D_{50}	D_{60}
0.0052	0.01	0.02	0.03
C_U	5.77	C_C	0.64

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 5
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 142.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.000	0.000	0.000	100.00
1.180	1.600	1.600	1.123	98.88
0.600	2.300	3.900	2.737	97.26
0.425	2.400	6.300	4.421	95.58
0.300	2.000	8.300	5.825	94.18
0.150	1.000	9.300	6.526	93.47
0.075	10.200	19.500	13.684	86.32
0.060				85.91
0.046				83.10
0.033				77.46
0.024				69.01
0.017				57.75
0.013				43.66
0.009				32.39
0.007				23.94
0.005				15.49
0.003				12.68
0.002				9.86
0.001				7.04



CLAY	SILT	SAND	GRAVEL
9.86 %	76.46 %	13.68 %	0.00 %

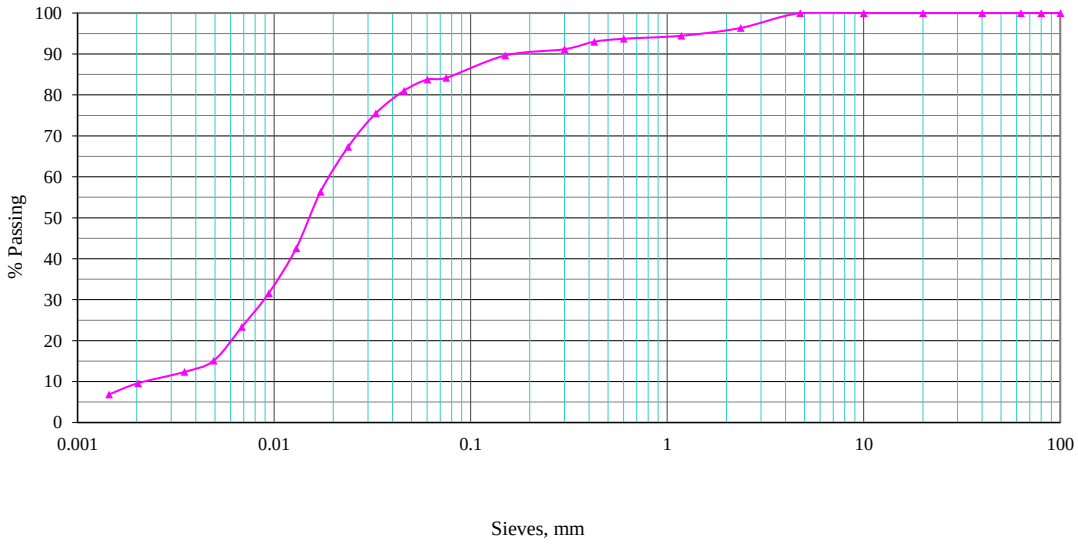
D_{10}	D_{30}	D_{50}	D_{60}
0.0021	0.01	0.01	0.02
C_U	9.52	C_C	2.38

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 5
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 137.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	5.000	5.000	3.650	96.35
1.180	2.600	7.600	5.547	94.45
0.600	1.000	8.600	6.277	93.72
0.425	1.000	9.600	7.007	92.99
0.300	2.500	12.100	8.832	91.17
0.150	2.100	14.200	10.365	89.64
0.075	7.500	21.700	15.839	84.16
0.060				83.77
0.046				81.02
0.033				75.53
0.024				67.29
0.017				56.30
0.013				42.57
0.009				31.58
0.007				23.35
0.005				15.11
0.003				12.36
0.002				9.61
0.001				6.87



CLAY	SILT	SAND	GRAVEL
9.61 %	74.55 %	15.84 %	0.00 %

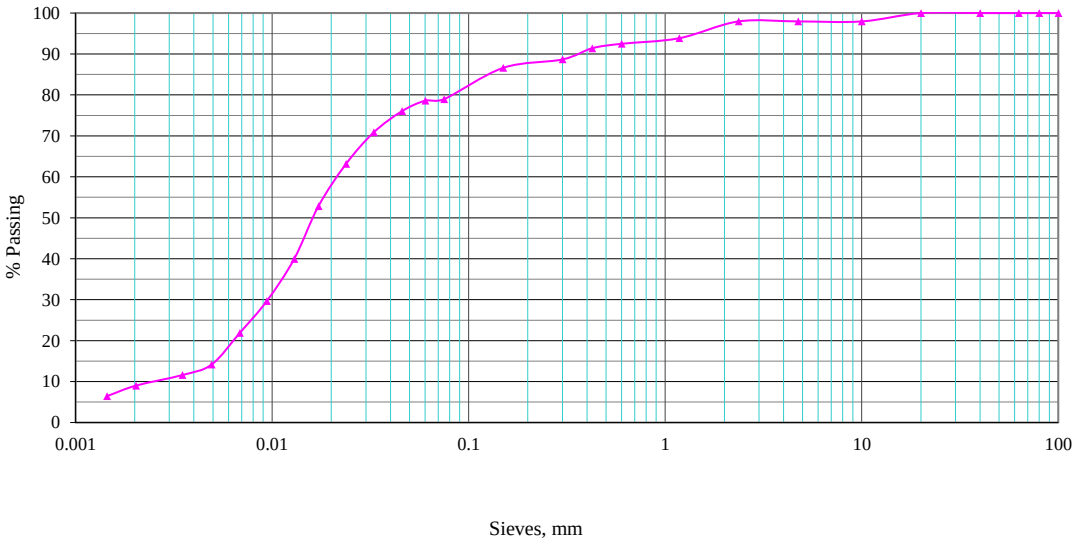
D_{10}	D_{30}	D_{50}	D_{60}
0.0022	0.01	0.02	0.02
C_U	9.09	C_C	2.27

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 5
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 146.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	3.000	3.000	2.048	97.95
4.750	0.000	3.000	2.048	97.95
2.360	0.000	3.000	2.048	97.95
1.180	6.000	9.000	6.143	93.86
0.600	2.000	11.000	7.509	92.49
0.425	1.600	12.600	8.601	91.40
0.300	4.000	16.600	11.331	88.67
0.150	3.000	19.600	13.379	86.62
0.075	11.200	30.800	21.024	78.98
0.060				78.61
0.046				76.03
0.033				70.88
0.024				63.14
0.017				52.84
0.013				39.95
0.009				29.64
0.007				21.91
0.005				14.18
0.003				11.60
0.002				9.02
0.001				6.44



CLAY	SILT	SAND	GRAVEL
9.02 %	69.96 %	18.98 %	2.05 %

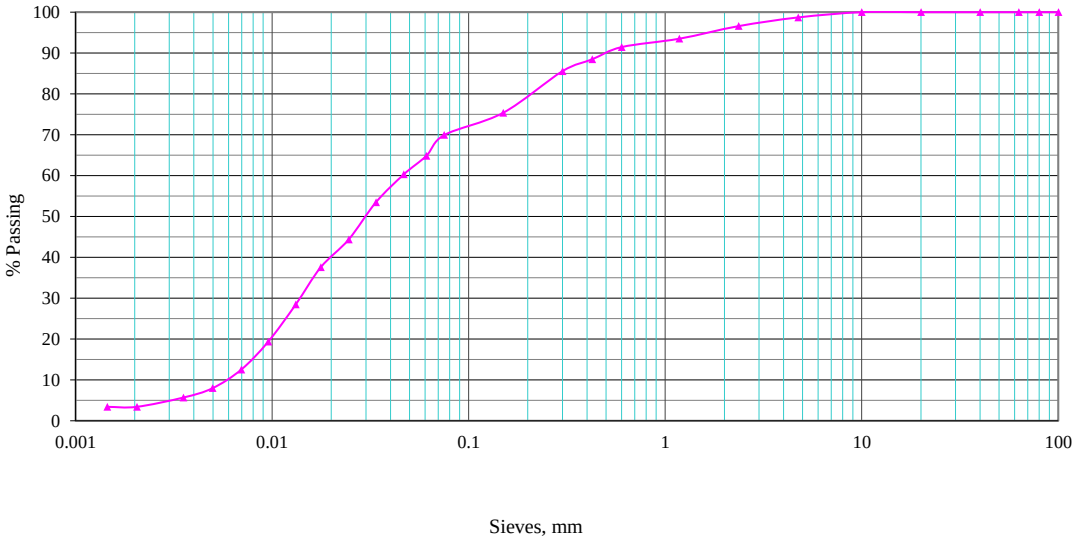
D_{10}	D_{30}	D_{50}	D_{60}
0.0026	0.01	0.02	0.02
C_U	7.69	C_C	1.92

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 7
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 117.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	1.500	1.500	1.282	98.72
2.360	2.500	4.000	3.419	96.58
1.180	3.600	7.600	6.496	93.50
0.600	2.400	10.000	8.547	91.45
0.425	3.500	13.500	11.538	88.46
0.300	3.400	16.900	14.444	85.56
0.150	11.900	28.800	24.615	75.38
0.075	6.400	35.200	30.085	69.91
0.061				64.85
0.047				60.30
0.034				53.47
0.025				44.37
0.018				37.55
0.013				28.44
0.010				19.34
0.007				12.52
0.005				7.96
0.004				5.69
0.002				3.41
0.001				3.41



CLAY	SILT	SAND	GRAVEL
3.41 %	66.50 %	28.80 %	1.28 %

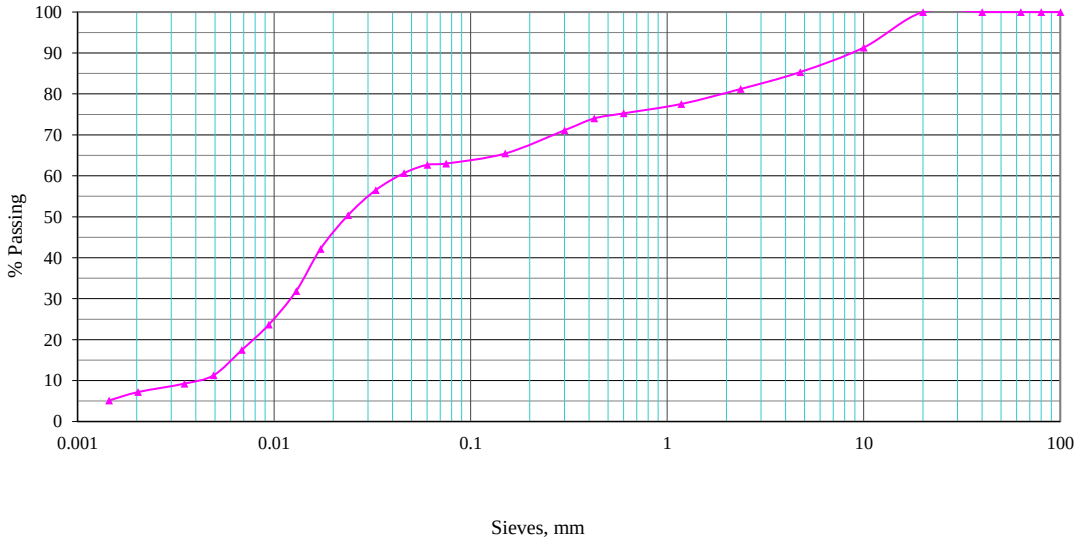
D_{10}	D_{30}	D_{50}	D_{60}
0.0059	0.01	0.03	0.05
C_U	8.47	C_C	0.34

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 7
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 183.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	15.900	15.900	8.665	91.34
4.750	11.000	26.900	14.659	85.34
2.360	7.600	34.500	18.801	81.20
1.180	6.700	41.200	22.452	77.55
0.600	4.200	45.400	24.741	75.26
0.425	2.300	47.700	25.995	74.01
0.300	5.300	53.000	28.883	71.12
0.150	10.400	63.400	34.550	65.45
0.075	4.500	67.900	37.003	63.00
0.060				62.70
0.046				60.65
0.033				56.54
0.024				50.37
0.017				42.15
0.013				31.87
0.009				23.64
0.007				17.47
0.005				11.31
0.003				9.25
0.002				7.20
0.001				5.14



CLAY	SILT	SAND	GRAVEL
7.20 %	55.80 %	22.34 %	14.66 %

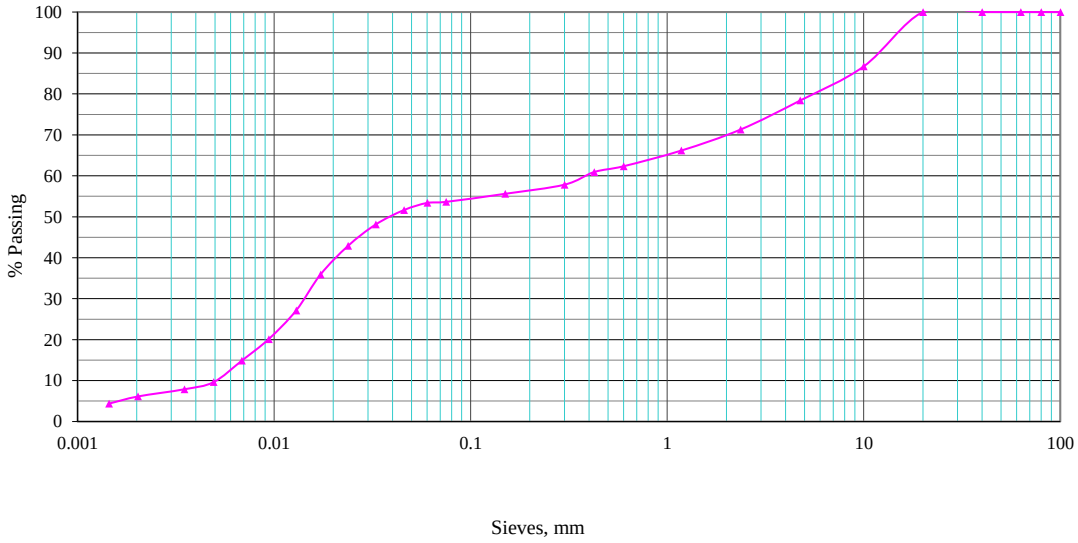
D_{10}	D_{30}	D_{50}	D_{60}
0.004	0.01	0.02	0.04
C_U	10	C_C	0.63

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 7
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 162.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	21.500	21.500	13.272	86.73
4.750	13.500	35.000	21.605	78.40
2.360	11.500	46.500	28.704	71.30
1.180	8.300	54.800	33.827	66.17
0.600	6.200	61.000	37.654	62.35
0.425	2.300	63.300	39.074	60.93
0.300	5.000	68.300	42.160	57.84
0.150	3.600	71.900	44.383	55.62
0.075	3.200	75.100	46.358	53.64
0.060				53.39
0.046				51.64
0.033				48.14
0.024				42.89
0.017				35.89
0.013				27.13
0.009				20.13
0.007				14.88
0.005				9.63
0.003				7.88
0.002				6.13
0.001				4.38



CLAY	SILT	SAND	GRAVEL
6.13 %	47.51 %	24.75 %	21.60 %

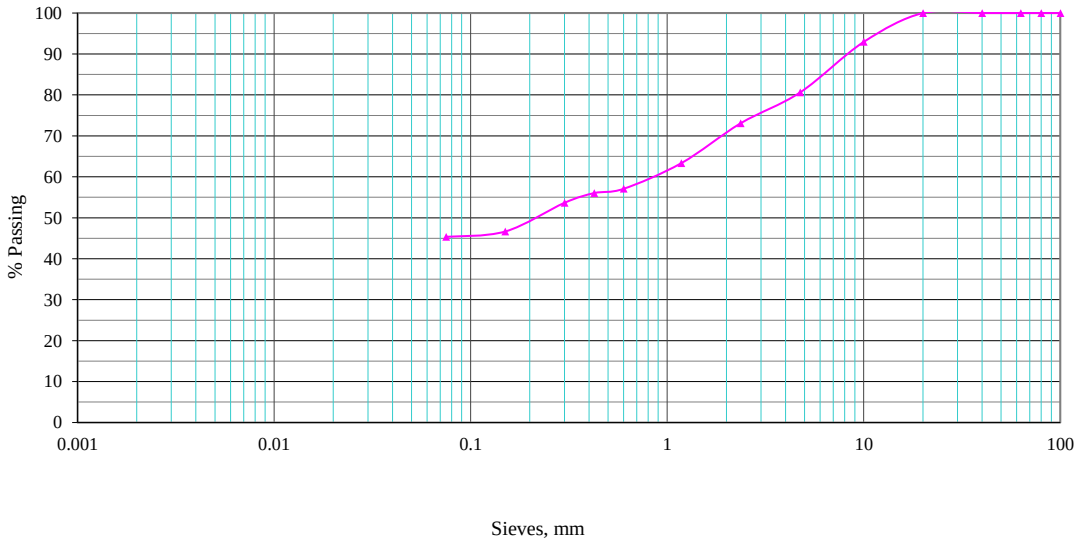
D_{10}	D_{30}	D_{50}	D_{60}
0.0051	0.01	0.04	0.39
C_U	76.47	C_C	0.05

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 7
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 191.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	13.500	13.500	7.050	92.95
4.750	23.600	37.100	19.373	80.63
2.360	14.500	51.600	26.945	73.05
1.180	18.600	70.200	36.658	63.34
0.600	12.000	82.200	42.924	57.08
0.425	2.000	84.200	43.969	56.03
0.300	4.560	88.760	46.350	53.65
0.150	13.400	102.160	53.347	46.65
0.075	2.500	104.660	54.653	45.35



CLAY	SILT	SAND	GRAVEL
0.00 %	45.35 %	35.28 %	19.37 %

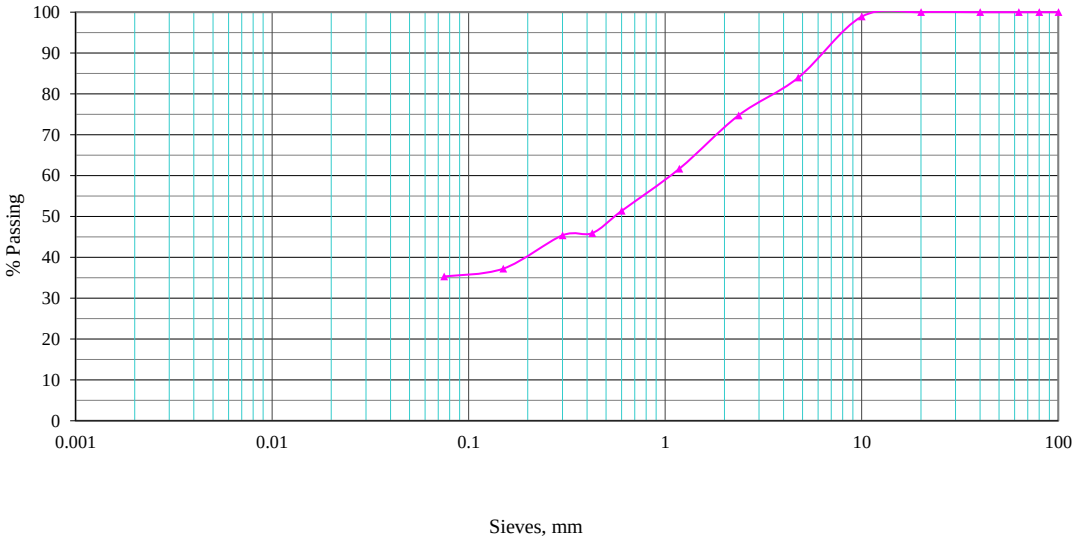
D_{10}	D_{30}	D_{50}	D_{60}
0.0165	0.05	0.22	0.87
C_U	52.73	C_C	0.17

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 184.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	2.000	2.000	1.087	98.91
4.750	27.500	29.500	16.033	83.97
2.360	17.000	46.500	25.272	74.73
1.180	24.000	70.500	38.315	61.68
0.600	19.000	89.500	48.641	51.36
0.425	10.000	99.500	54.076	45.92
0.300	1.000	100.500	54.620	45.38
0.150	15.000	115.500	62.772	37.23
0.075	3.500	119.000	64.674	35.33



CLAY	SILT	SAND	GRAVEL
0.00 %	35.33 %	48.64 %	16.03 %

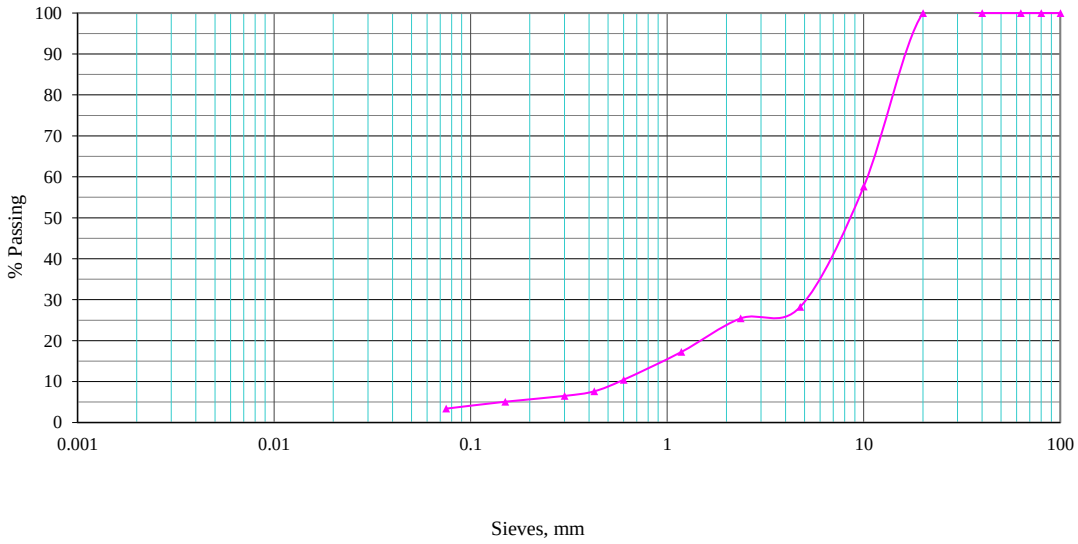
D_{10}	D_{30}	D_{50}	D_{60}
0.0212	0.06	0.56	1.09
C_U	51.42	C_C	0.16

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 177.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	75.000	75.000	42.373	57.63
4.750	52.000	127.000	71.751	28.25
2.360	5.000	132.000	74.576	25.42
1.180	14.500	146.500	82.768	17.23
0.600	12.000	158.500	89.548	10.45
0.425	5.000	163.500	92.373	7.63
0.300	2.000	165.500	93.503	6.50
0.150	2.500	168.000	94.915	5.08
0.075	3.000	171.000	96.610	3.39



CLAY	SILT	SAND	GRAVEL
0.00 %	3.39 %	24.86 %	71.75 %

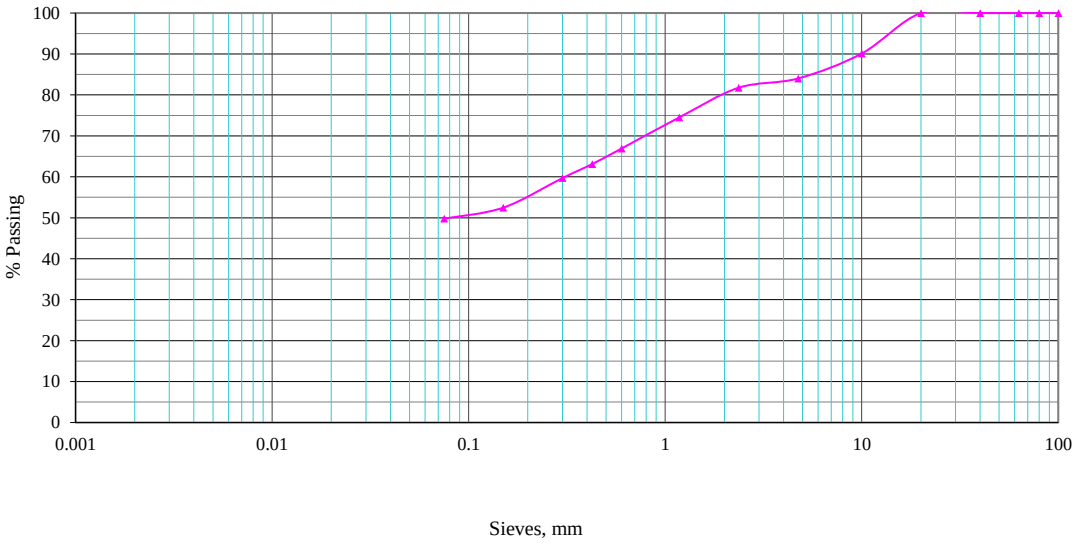
D_{10}	D_{30}	D_{50}	D_{60}
0.572	5.06	8.64	15.04
C_U	26.29	C_C	2.98

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 131.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	13.000	13.000	9.886	90.11
4.750	8.000	21.000	15.970	84.03
2.360	3.000	24.000	18.251	81.75
1.180	9.500	33.500	25.475	74.52
0.600	10.000	43.500	33.080	66.92
0.425	5.000	48.500	36.882	63.12
0.300	4.500	53.000	40.304	59.70
0.150	9.500	62.500	47.529	52.47
0.075	3.500	66.000	50.190	49.81



CLAY	SILT	SAND	GRAVEL
0.00 %	49.81 %	34.22 %	15.97 %

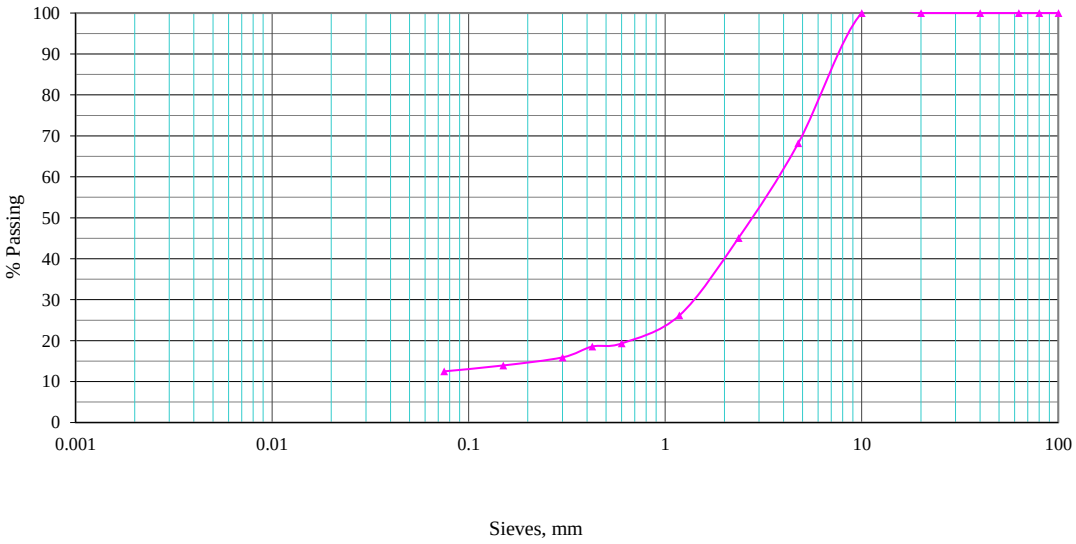
D_{10}	D_{30}	D_{50}	D_{60}
0.0151	0.05	0.08	0.31
C_U	20.53	C_C	0.53

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 132.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	42.000	42.000	31.818	68.18
2.360	30.500	72.500	54.924	45.08
1.180	25.000	97.500	73.864	26.14
0.600	9.000	106.500	80.682	19.32
0.425	1.000	107.500	81.439	18.56
0.300	3.500	111.000	84.091	15.91
0.150	2.600	113.600	86.061	13.94
0.075	1.900	115.500	87.500	12.50



CLAY	SILT	SAND	GRAVEL
0.00 %	12.50 %	55.68 %	31.82 %

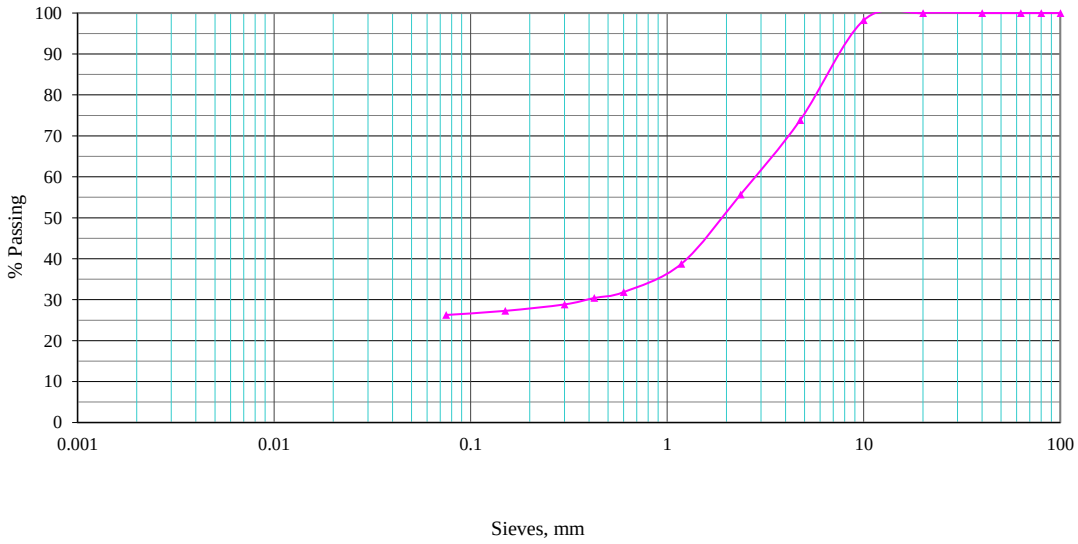
D_{10}	D_{30}	D_{50}	D_{60}
0.06	1.42	2.87	3.9
C_U	65	C_C	8.62

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 7.5
Total Wt. (gm) 159.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	2.800	2.800	1.755	98.24
4.750	38.900	41.700	26.144	73.86
2.360	29.000	70.700	44.326	55.67
1.180	27.000	97.700	61.254	38.75
0.600	11.000	108.700	68.150	31.85
0.425	2.300	111.000	69.592	30.41
0.300	2.500	113.500	71.160	28.84
0.150	2.500	116.000	72.727	27.27
0.075	1.600	117.600	73.730	26.27



CLAY	SILT	SAND	GRAVEL
0.00 %	26.27 %	47.59 %	26.14 %

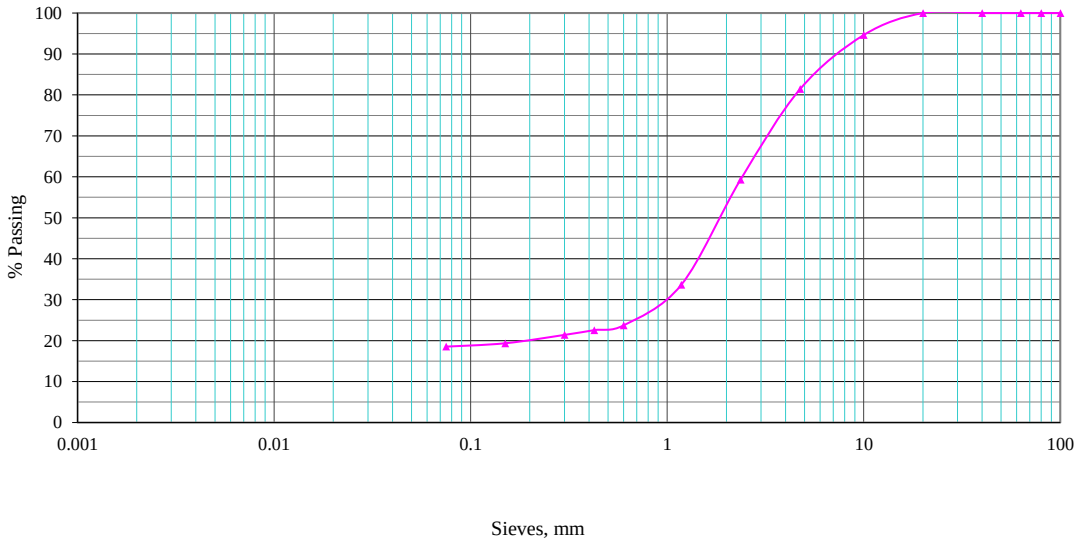
D_{10}	D_{30}	D_{50}	D_{60}
0.0286	0.39	1.96	2.93
C_U	102.45	C_C	1.82

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 9.0
Total Wt. (gm) 171.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	9.200	9.200	5.364	94.64
4.750	22.600	31.800	18.542	81.46
2.360	38.000	69.800	40.700	59.30
1.180	44.000	113.800	66.356	33.64
0.600	17.000	130.800	76.268	23.73
0.425	2.000	132.800	77.434	22.57
0.300	2.000	134.800	78.601	21.40
0.150	3.500	138.300	80.641	19.36
0.075	1.400	139.700	81.458	18.54



CLAY	SILT	SAND	GRAVEL
0.00 %	18.54 %	62.92 %	18.54 %

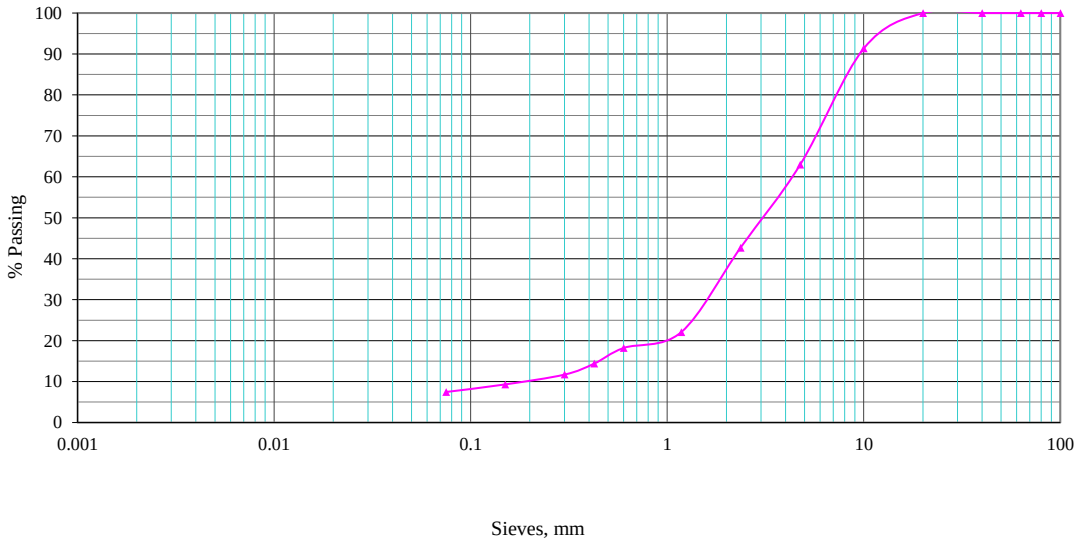
D_{10}	D_{30}	D_{50}	D_{60}
0.0404	0.97	1.93	2.44
C_U	60.4	C_C	9.54

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 10.5
Total Wt. (gm) 167.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	14.500	14.500	8.657	91.34
4.750	47.500	62.000	37.015	62.99
2.360	34.000	96.000	57.313	42.69
1.180	34.500	130.500	77.910	22.09
0.600	6.500	137.000	81.791	18.21
0.425	6.400	143.400	85.612	14.39
0.300	4.500	147.900	88.299	11.70
0.150	4.000	151.900	90.687	9.31
0.075	3.100	155.000	92.537	7.46



CLAY	SILT	SAND	GRAVEL
0.00 %	7.46 %	55.52 %	37.01 %

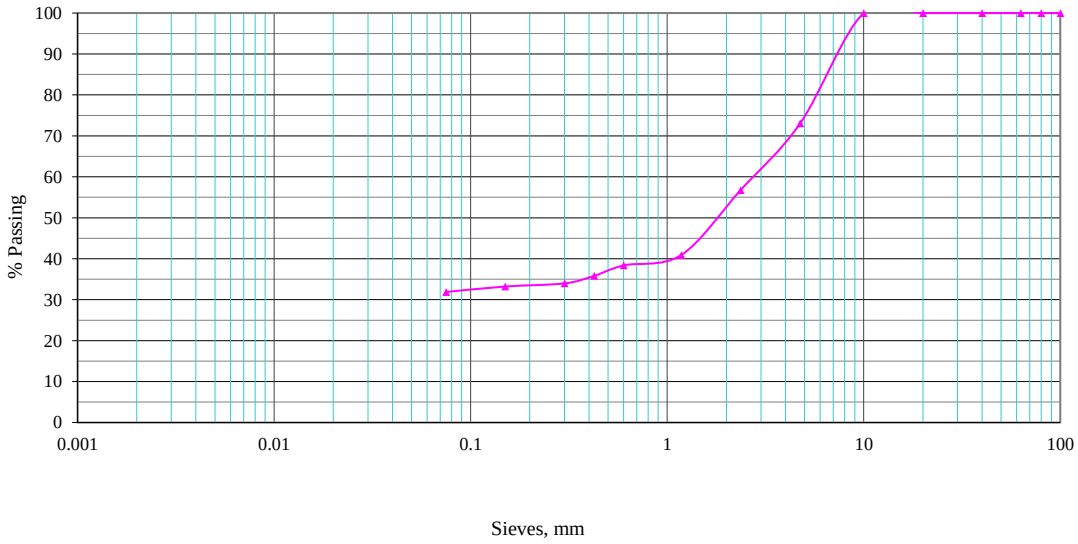
D_{10}	D_{30}	D_{50}	D_{60}
0.1931	1.63	3.22	4.4
C_U	22.79	C_C	3.13

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Damauli, Tanahun

Bore Hole : 8 - DAMAULI SUBSTATION
Sample : SPT **Depth (m):** 12.0
Total Wt. (gm) 196.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	52.800	52.800	26.939	73.06
2.360	32.000	84.800	43.265	56.73
1.180	31.000	115.800	59.082	40.92
0.600	5.000	120.800	61.633	38.37
0.425	5.000	125.800	64.184	35.82
0.300	3.600	129.400	66.020	33.98
0.150	1.500	130.900	66.786	33.21
0.075	2.600	133.500	68.112	31.89



CLAY	SILT	SAND	GRAVEL
0.00 %	31.89 %	41.17 %	26.94 %

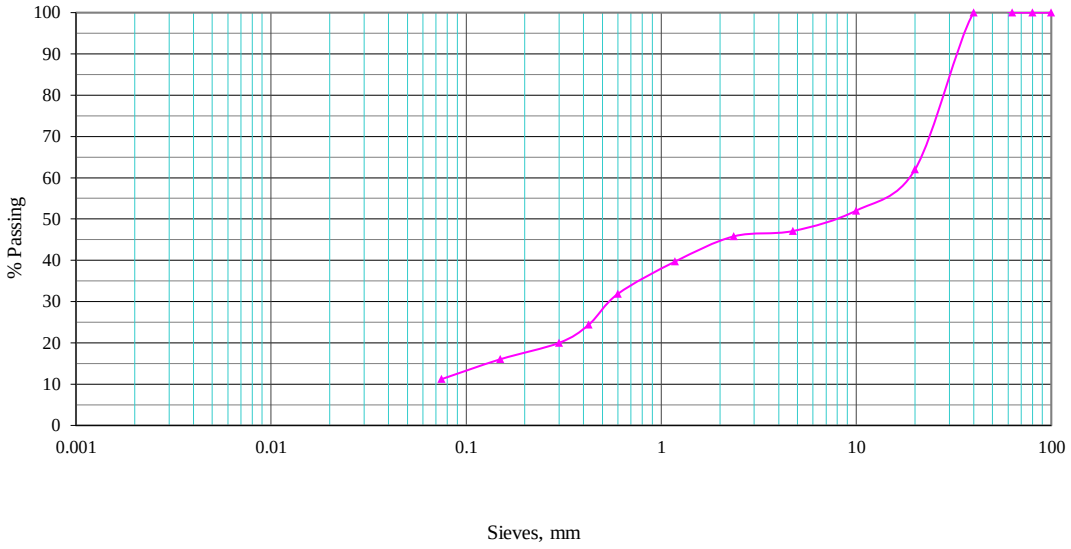
D_{10}	D_{30}	D_{50}	D_{60}
0.0235	0.07	1.86	2.84
C_U	120.85	C_C	0.07

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Pokhara Metropolitan City, Argau, Lekhnath

Bore Hole : 9 - LEKHNATH SUBSTATION
Sample : Disturbed **Depth (m):** 1.5
Total Wt. (gm) 232.55

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	88.420	88.420	38.022	61.98
10.000	23.100	111.520	47.955	52.04
4.750	11.500	123.020	52.900	47.10
2.360	3.000	126.020	54.190	45.81
1.180	14.200	140.220	60.297	39.70
0.600	18.200	158.420	68.123	31.88
0.425	17.400	175.820	75.605	24.39
0.300	10.200	186.020	79.991	20.01
0.150	9.230	195.250	83.960	16.04
0.075	11.200	206.450	88.777	11.22



CLAY	SILT	SAND	GRAVEL
0.00 %	11.22 %	35.88 %	52.90 %

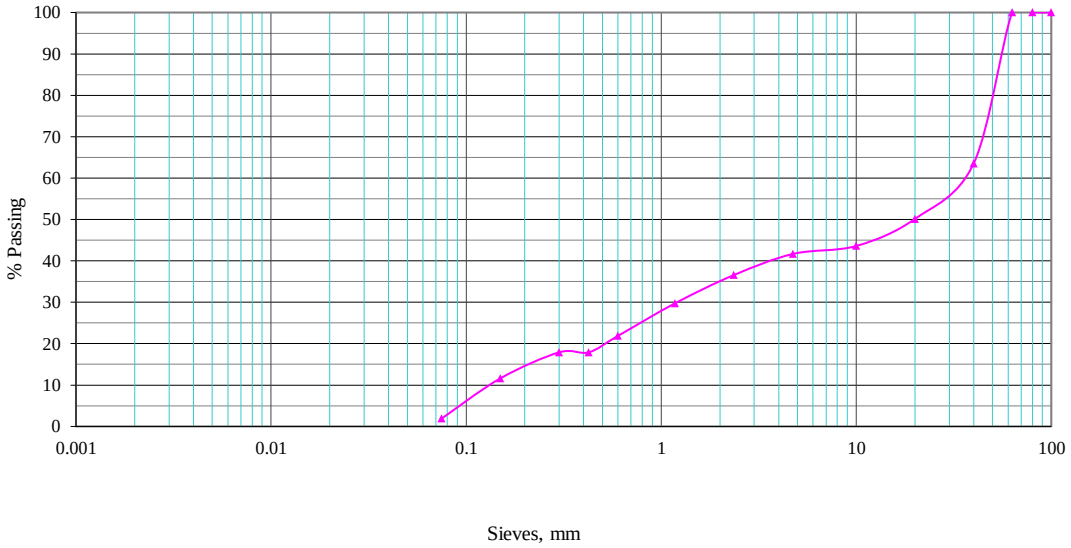
D_{10}	D_{30}	D_{50}	D_{60}
0.0668	0.56	7.83	18.01
C_U	269.61	C_C	0.26

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Pokhara Metropolitan City, Argau, Lekhnath

Bore Hole : 9 - LEKHNATH SUBSTATION
Sample : Disturbed **Depth (m):** 4.5
Total Wt. (gm) 340.63

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	124.230	124.230	36.471	63.53
20.000	45.600	169.830	49.858	50.14
10.000	22.300	192.130	56.404	43.60
4.750	6.500	198.630	58.313	41.69
2.360	17.400	216.030	63.421	36.58
1.180	23.200	239.230	70.232	29.77
0.600	26.900	266.130	78.129	21.87
0.425	13.500	279.630	82.092	17.91
0.300	0.000	279.630	82.092	17.91
0.150	21.400	301.030	88.374	11.63
0.075	33.100	334.130	98.092	1.91



CLAY	SILT	SAND	GRAVEL
0.00 %	1.91 %	39.78 %	58.31 %

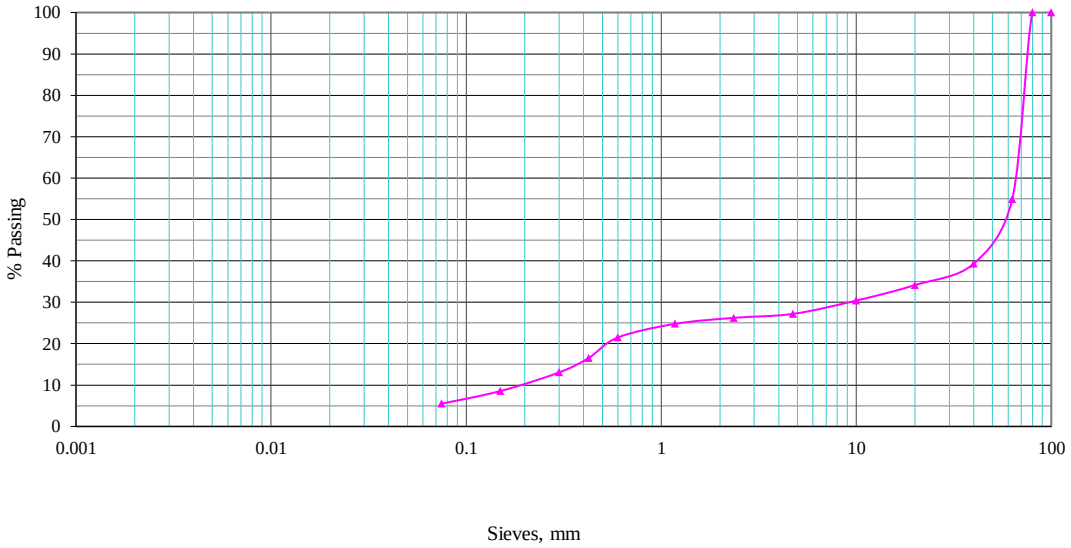
D_{10}	D_{30}	D_{50}	D_{60}
0.1375	1.22	19.78	34.73
C_U	252.58	C_C	0.31

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Pokhara Metropolitan City, Argau, Lekhnath

Bore Hole : 9 - LEKHNATH SUBSTATION
Sample : Disturbed **Depth (m):** 7.5
Total Wt. (gm) 477.22

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	215.400	215.400	45.136	54.86
40.000	74.230	289.630	60.691	39.31
20.000	24.600	314.230	65.846	34.15
10.000	17.860	332.090	69.588	30.41
4.750	15.330	347.420	72.801	27.20
2.360	4.600	352.020	73.765	26.24
1.180	6.900	358.920	75.211	24.79
0.600	15.700	374.620	78.500	21.50
0.425	23.600	398.220	83.446	16.55
0.300	16.700	414.920	86.945	13.05
0.150	21.500	436.420	91.450	8.55
0.075	14.500	450.920	94.489	5.51



CLAY	SILT	SAND	GRAVEL
0.00 %	5.51 %	21.69 %	72.80 %

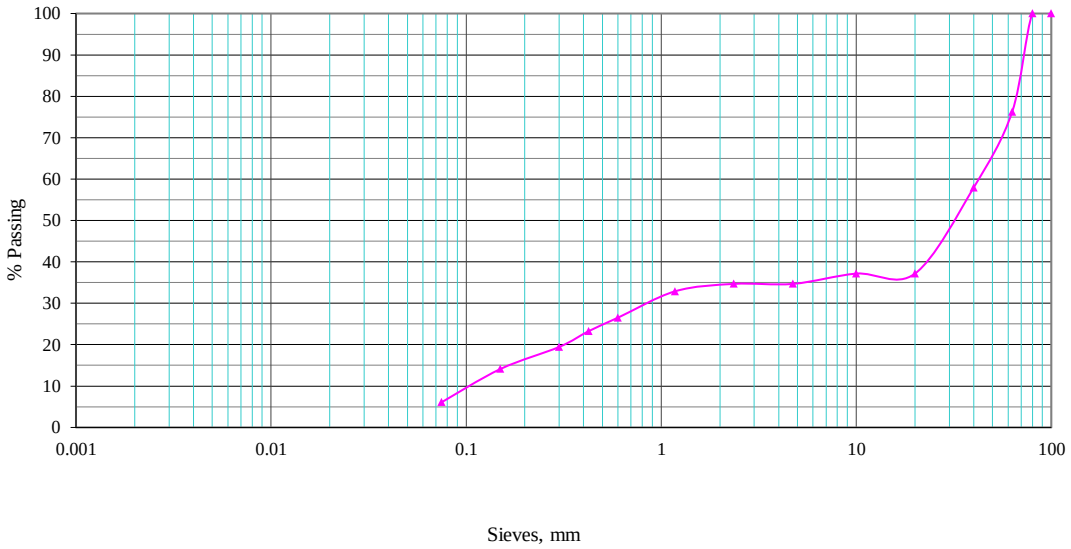
D_{10}	D_{30}	D_{50}	D_{60}
0.1983	9.33	55.81	67.21
C_U	338.93	C_C	6.53

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Sites of Substations and Tranmission Lines
Location : Pokhara Metropolitan City, Argau, Lekhnath

Bore Hole : 9 - LEKHNATH SUBSTATION
Sample : Disturbed **Depth (m):** 12.0
Total Wt. (gm) 693.70

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	164.740	164.740	23.748	76.25
40.000	126.960	291.700	42.050	57.95
20.000	144.200	435.900	62.837	37.16
10.000	0.000	435.900	62.837	37.16
4.750	17.200	453.100	65.316	34.68
2.360	0.000	453.100	65.316	34.68
1.180	12.400	465.500	67.104	32.90
0.600	44.300	509.800	73.490	26.51
0.425	22.500	532.300	76.733	23.27
0.300	26.500	558.800	80.554	19.45
0.150	36.900	595.700	85.873	14.13
0.075	55.700	651.400	93.902	6.10



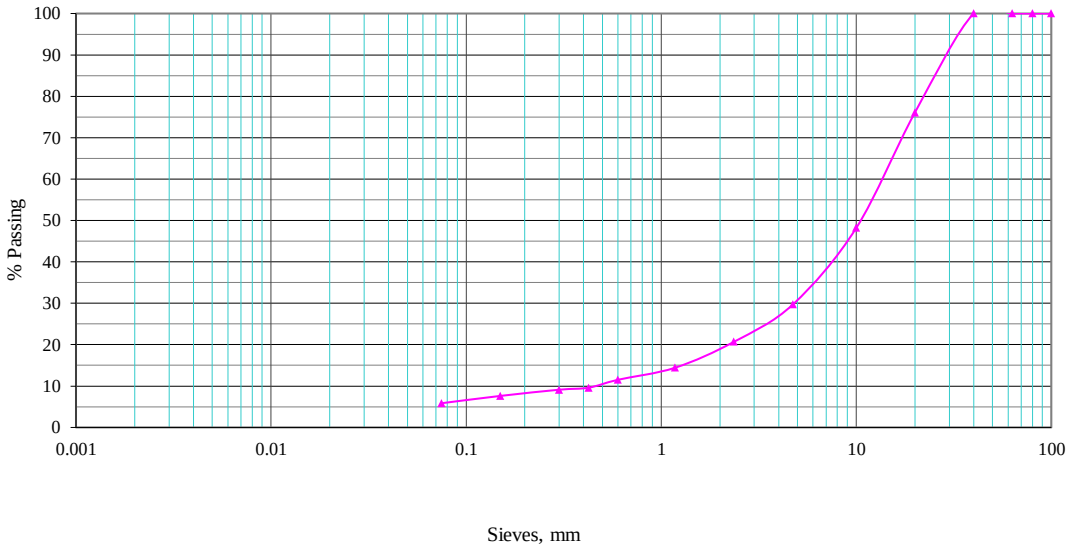
CLAY	SILT	SAND	GRAVEL
0.00 %	6.10 %	28.59 %	65.32 %

D_{10}	D_{30}	D_{50}	D_{60}
0.1114	0.92	32.35	42.58
C_U	382.23	C_C	0.18

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 341.85

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	81.700	81.700	23.899	76.10
10.000	95.400	177.100	51.806	48.19
4.750	62.950	240.050	70.221	29.78
2.360	31.100	271.150	79.318	20.68
1.180	21.350	292.500	85.564	14.44
0.600	10.000	302.500	88.489	11.51
0.425	6.500	309.000	90.391	9.61
0.300	1.700	310.700	90.888	9.11
0.150	5.100	315.800	92.380	7.62
0.075	6.050	321.850	94.149	5.85



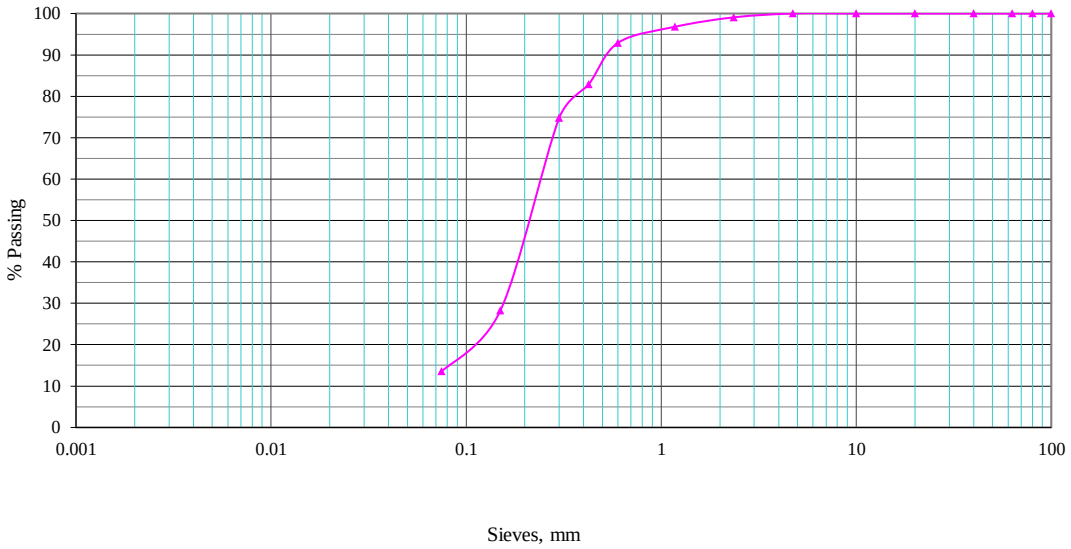
CLAY	SILT	SAND	GRAVEL
0.00 %	5.85 %	23.93 %	70.22 %

D_{10}	D_{30}	D_{50}	D_{60}
0.4609	4.81	10.65	14.23
C_U	30.87	C_C	3.53

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 1.5
Total Wt. (gm) 231.70

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	2.150	2.150	0.928	99.07
1.180	5.250	7.400	3.194	96.81
0.600	9.050	16.450	7.100	92.90
0.425	23.200	39.650	17.113	82.89
0.300	18.850	58.500	25.248	74.75
0.150	107.700	166.200	71.731	28.27
0.075	34.100	200.300	86.448	13.55



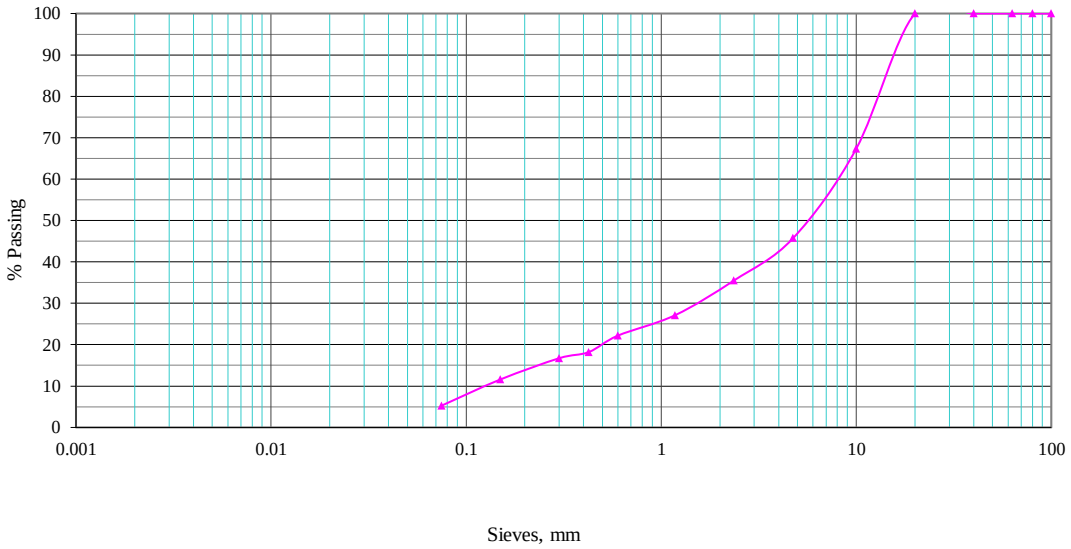
CLAY	SILT	SAND	GRAVEL
0.00 %	13.55 %	86.45 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0553	0.16	0.22	0.25
C_U	4.52	C_C	1.85

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 297.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	97.150	97.150	32.655	67.34
4.750	64.250	161.400	54.252	45.75
2.360	30.500	191.900	64.504	35.50
1.180	24.900	216.800	72.874	27.13
0.600	14.700	231.500	77.815	22.18
0.425	11.850	243.350	81.798	18.20
0.300	4.400	247.750	83.277	16.72
0.150	15.250	263.000	88.403	11.60
0.075	18.800	281.800	94.723	5.28



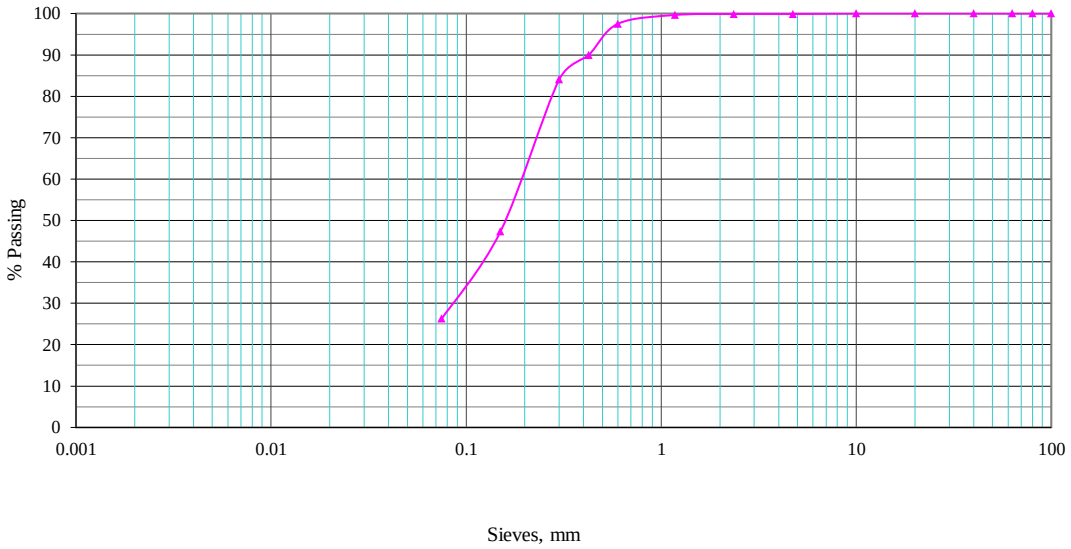
CLAY	SILT	SAND	GRAVEL
0.00 %	5.28 %	40.47 %	54.25 %

D_{10}	D_{30}	D_{50}	D_{60}
0.1311	1.59	5.78	8.21
C_U	62.62	C_C	2.35

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 3.0
Total Wt. (gm) 435.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.500	0.500	0.115	99.89
2.360	0.000	0.500	0.115	99.89
1.180	1.050	1.550	0.356	99.64
0.600	9.250	10.800	2.478	97.52
0.425	32.850	43.650	10.017	89.98
0.300	25.850	69.500	15.950	84.05
0.150	160.000	229.500	52.668	47.33
0.075	91.750	321.250	73.723	26.28



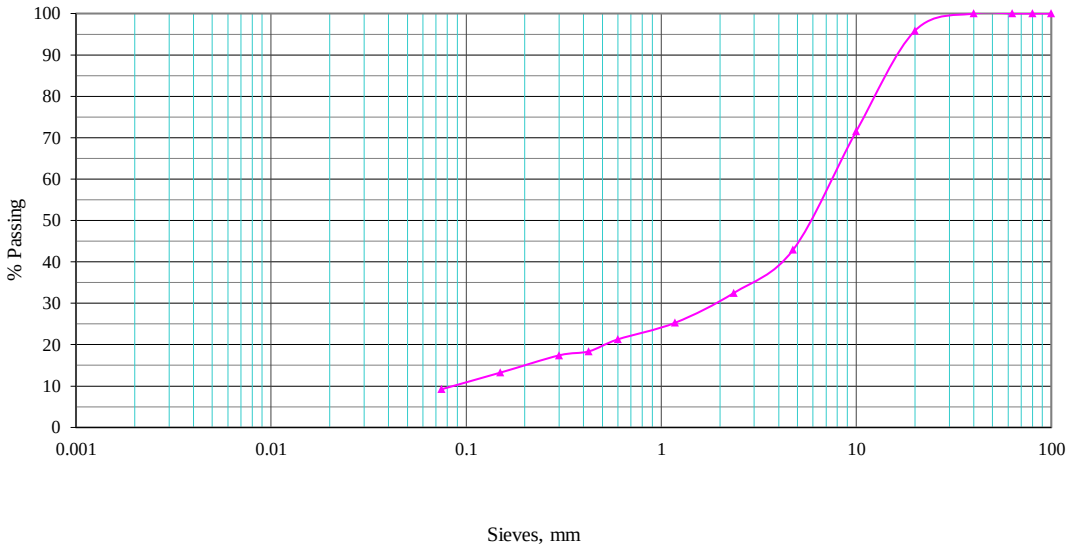
CLAY	SILT	SAND	GRAVEL
0.00 %	26.28 %	73.61 %	0.11 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0285	0.09	0.16	0.2
C_U	7.02	C_C	1.42

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 398.45

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	16.550	16.550	4.154	95.85
10.000	96.800	113.350	28.448	71.55
4.750	114.000	227.350	57.059	42.94
2.360	41.600	268.950	67.499	32.50
1.180	28.700	297.650	74.702	25.30
0.600	16.000	313.650	78.718	21.28
0.425	11.600	325.250	81.629	18.37
0.300	3.800	329.050	82.583	17.42
0.150	16.600	345.650	86.749	13.25
0.075	16.000	361.650	90.764	9.24



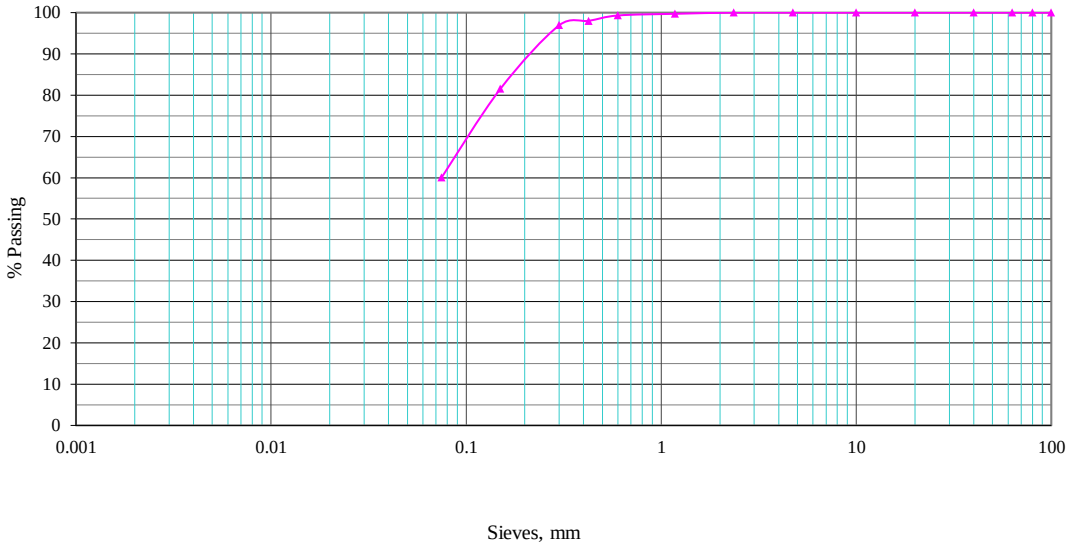
CLAY	SILT	SAND	GRAVEL
0.00 %	9.24 %	33.71 %	57.06 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0893	1.95	6.05	7.88
C_U	88.24	C_C	5.4

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 4.5
Total Wt. (gm) 232.95

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.000	0.000	0.000	100.00
1.180	0.650	0.650	0.279	99.72
0.600	0.950	1.600	0.687	99.31
0.425	3.050	4.650	1.996	98.00
0.300	2.500	7.150	3.069	96.93
0.150	35.800	42.950	18.437	81.56
0.075	50.000	92.950	39.901	60.10



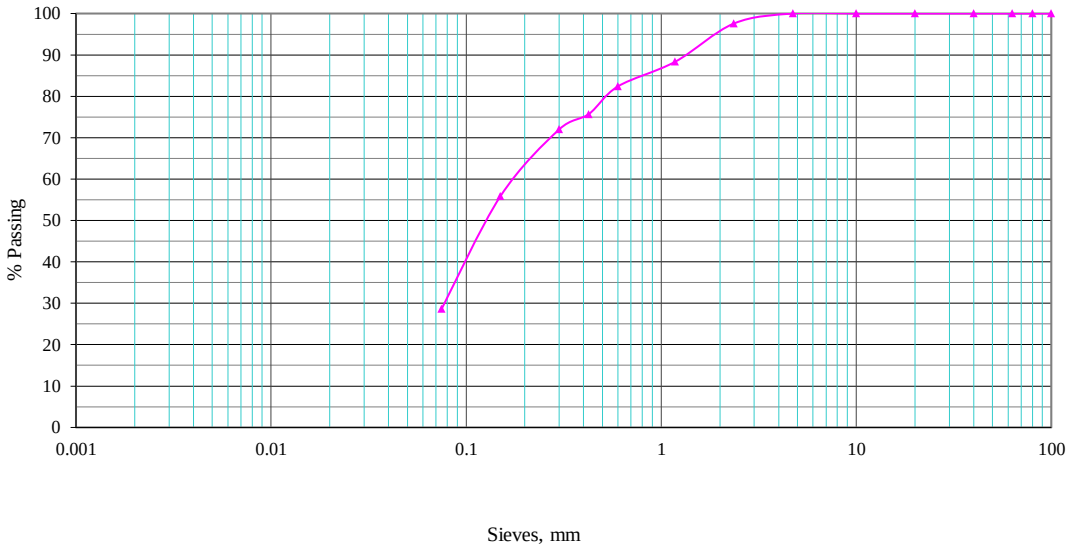
CLAY	SILT	SAND	GRAVEL
0.00 %	60.10 %	39.90 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0125	0.04	0.06	0.07
C_U	5.6	C_C	1.83

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 7.5
Total Wt. (gm) 522.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	12.600	12.600	2.410	97.59
1.180	48.300	60.900	11.650	88.35
0.600	31.150	92.050	17.609	82.39
0.425	35.050	127.100	24.314	75.69
0.300	19.250	146.350	27.996	72.00
0.150	84.300	230.650	44.122	55.88
0.075	142.100	372.750	71.306	28.69



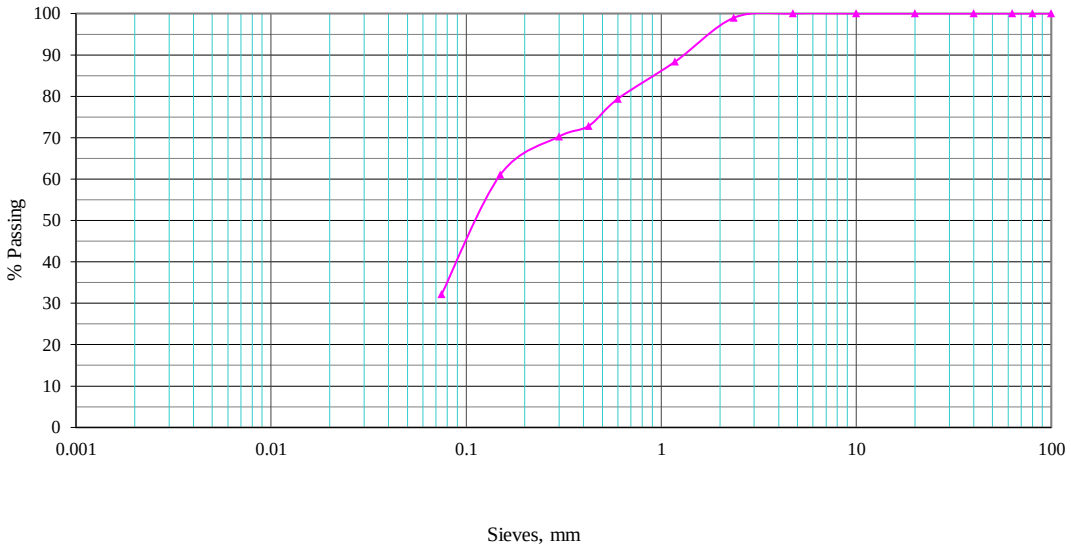
CLAY	SILT	SAND	GRAVEL
0.00 %	28.69 %	71.31 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0261	0.08	0.13	0.19
C_U	7.28	C_C	1.29

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 9.0
Total Wt. (gm) 636.60

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	6.500	6.500	1.021	98.98
1.180	67.450	73.950	11.616	88.38
0.600	57.200	131.150	20.602	79.40
0.425	41.700	172.850	27.152	72.85
0.300	16.300	189.150	29.713	70.29
0.150	58.450	247.600	38.894	61.11
0.075	184.000	431.600	67.798	32.20



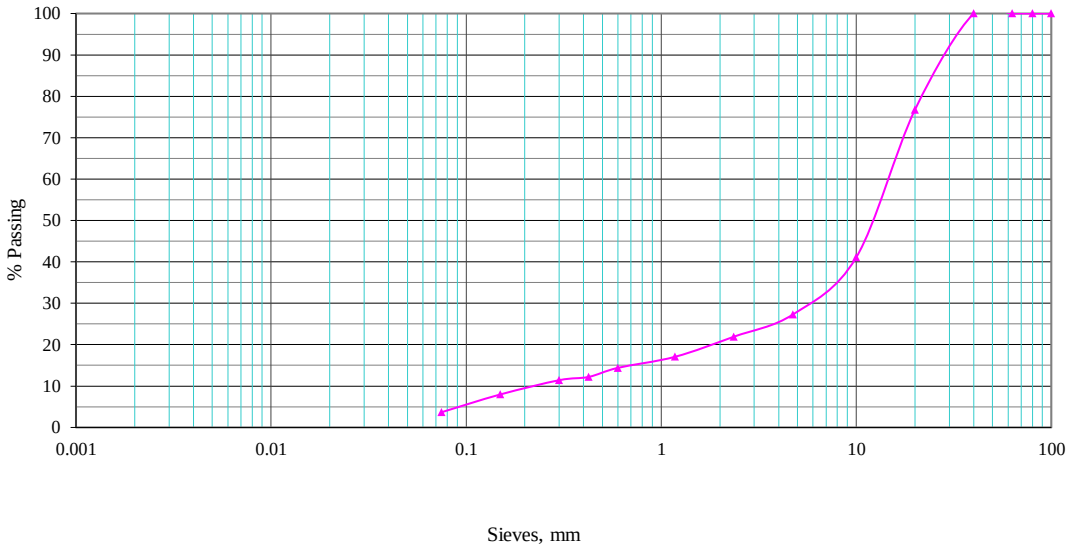
CLAY	SILT	SAND	GRAVEL
0.00 %	32.20 %	67.80 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0233	0.07	0.12	0.15
C_U	6.44	C_C	1.4

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : SPT **Depth (m):** 9.0
Total Wt. (gm) 233.05

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	54.150	54.150	23.235	76.76
10.000	83.150	137.300	58.914	41.09
4.750	32.050	169.350	72.667	27.33
2.360	12.600	181.950	78.073	21.93
1.180	11.300	193.250	82.922	17.08
0.600	6.250	199.500	85.604	14.40
0.425	5.100	204.600	87.792	12.21
0.300	1.850	206.450	88.586	11.41
0.150	8.000	214.450	92.019	7.98
0.075	10.000	224.450	96.310	3.69



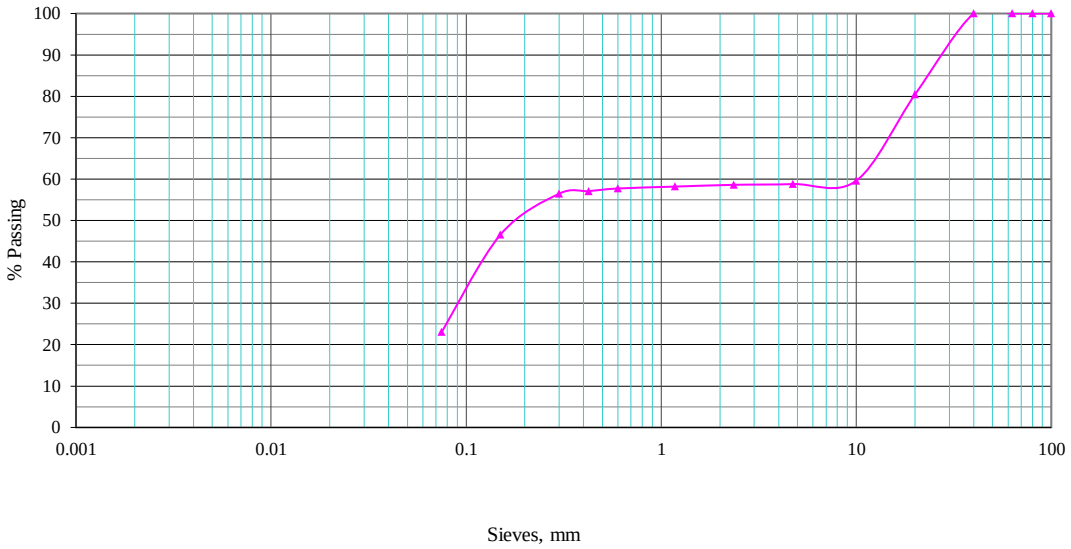
CLAY	SILT	SAND	GRAVEL
0.00 %	3.69 %	23.64 %	72.67 %

D_{10}	D_{30}	D_{50}	D_{60}
0.2382	5.77	12.5	15.3
C_U	64.23	C_C	9.14

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 10.5
Total Wt. (gm) 435.03

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	85.200	85.200	19.585	80.42
10.000	90.550	175.750	40.400	59.60
4.750	3.500	179.250	41.204	58.80
2.360	0.800	180.050	41.388	58.61
1.180	1.850	181.900	41.813	58.19
0.600	2.000	183.900	42.273	57.73
0.425	2.750	186.650	42.905	57.09
0.300	2.700	189.350	43.526	56.47
0.150	43.000	232.350	53.410	46.59
0.075	102.450	334.800	76.960	23.04



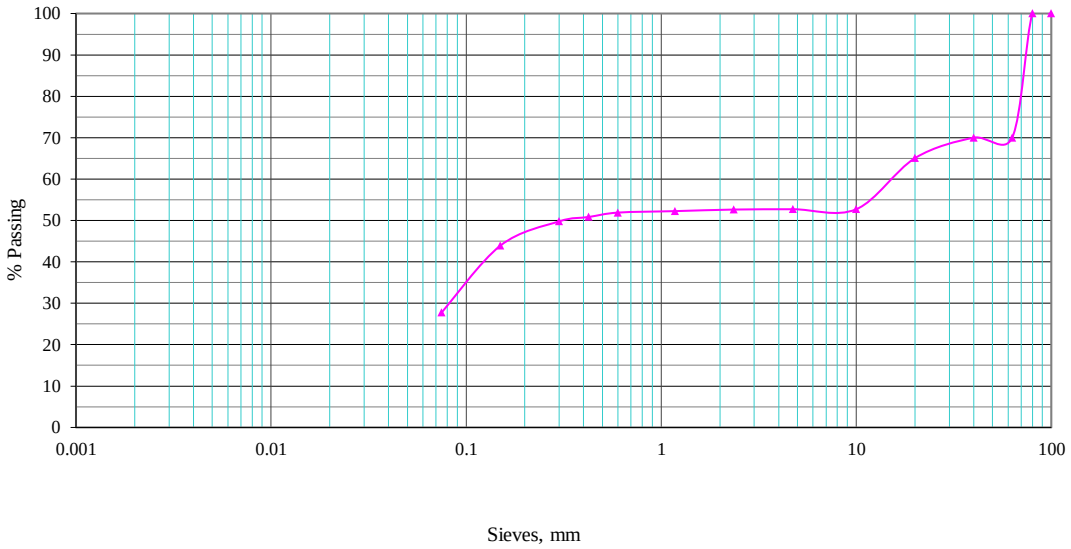
CLAY	SILT	SAND	GRAVEL
0.00 %	23.04 %	35.76 %	41.20 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0326	0.1	0.2	10.19
C_U	312.58	C_C	0.03

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 12.0
Total Wt. (gm) 680.10

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	204.000	204.000	29.996	70.00
40.000	0.000	204.000	29.996	70.00
20.000	33.600	237.600	34.936	65.06
10.000	84.000	321.600	47.287	52.71
4.750	0.000	321.600	47.287	52.71
2.360	0.500	322.100	47.361	52.64
1.180	2.600	324.700	47.743	52.26
0.600	2.400	327.100	48.096	51.90
0.425	7.250	334.350	49.162	50.84
0.300	7.150	341.500	50.213	49.79
0.150	39.700	381.200	56.051	43.95
0.075	110.000	491.200	72.225	27.78



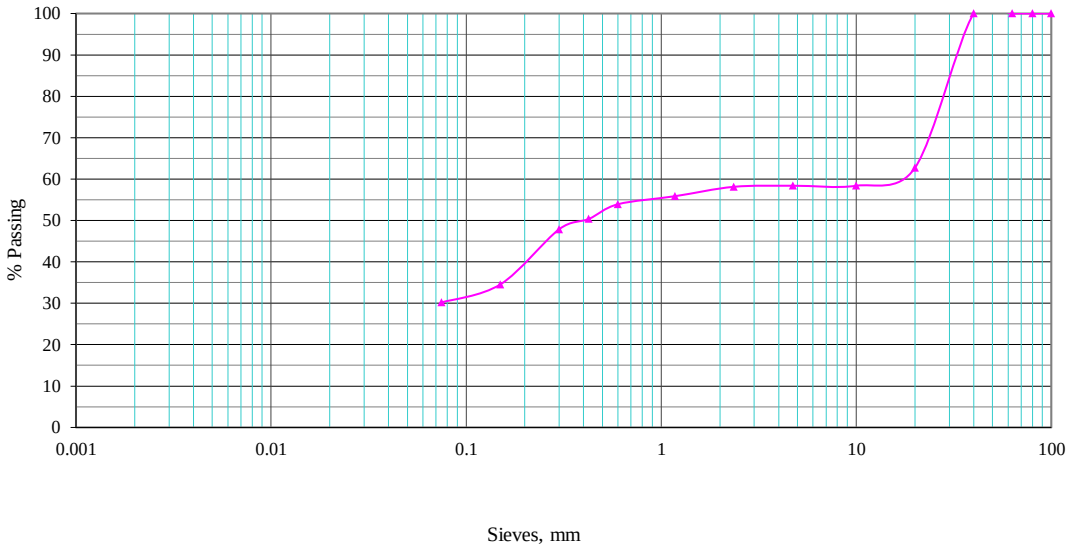
CLAY	SILT	SAND	GRAVEL
0.00 %	27.78 %	24.94 %	47.29 %

D_{10}	D_{30}	D_{50}	D_{60}
0.027	0.09	0.33	15.9
C_U	588.89	C_C	0.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 13.5
Total Wt. (gm) 330.95

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	123.350	123.350	37.271	62.73
10.000	14.350	137.700	41.607	58.39
4.750	0.000	137.700	41.607	58.39
2.360	0.850	138.550	41.864	58.14
1.180	7.500	146.050	44.131	55.87
0.600	6.450	152.500	46.079	53.92
0.425	11.800	164.300	49.645	50.36
0.300	8.150	172.450	52.108	47.89
0.150	44.100	216.550	65.433	34.57
0.075	14.400	230.950	69.784	30.22



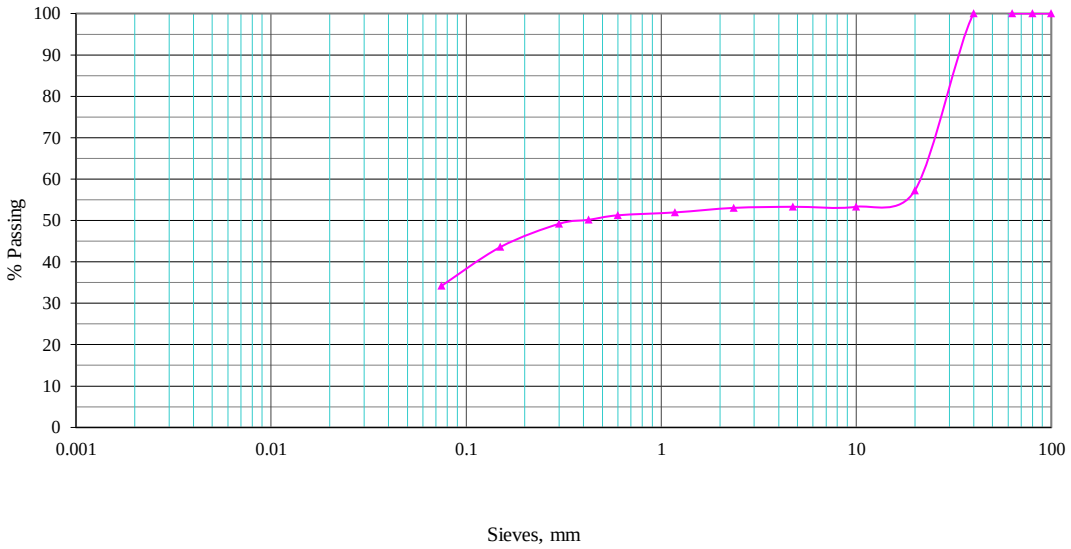
CLAY	SILT	SAND	GRAVEL
0.00 %	30.22 %	28.18 %	41.61 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0248	0.07	0.41	13.71
C_U	552.82	C_C	0.01

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 1
Sample : Disturbed **Depth (m):** 15.0
Total Wt. (gm) 401.45

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	171.450	171.450	42.708	57.29
10.000	16.000	187.450	46.693	53.31
4.750	0.000	187.450	46.693	53.31
2.360	1.050	188.500	46.955	53.05
1.180	4.400	192.900	48.051	51.95
0.600	2.800	195.700	48.748	51.25
0.425	4.400	200.100	49.844	50.16
0.300	3.850	203.950	50.803	49.20
0.150	22.500	226.450	56.408	43.59
0.075	37.600	264.050	65.774	34.23



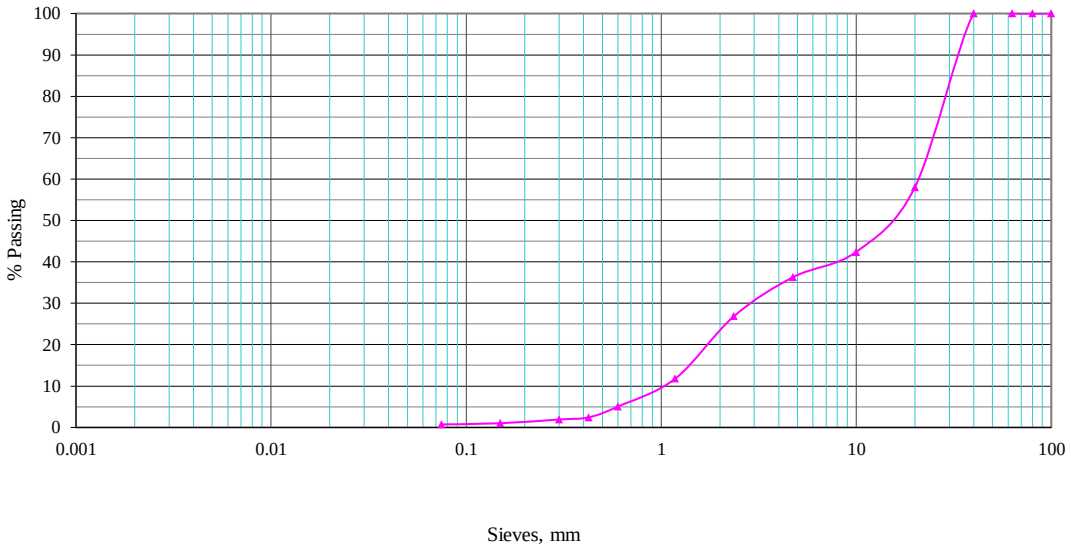
CLAY	SILT	SAND	GRAVEL
0.00 %	34.23 %	19.08 %	46.69 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0219	0.07	0.4	25.07
C_U	1144.75	C_C	0.01

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 1.5
Total Wt. (gm) 172.35

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	72.250	72.250	41.921	58.08
10.000	27.000	99.250	57.586	42.41
4.750	10.500	109.750	63.679	36.32
2.360	16.300	126.050	73.136	26.86
1.180	26.000	152.050	88.222	11.78
0.600	11.600	163.650	94.952	5.05
0.425	4.500	168.150	97.563	2.44
0.300	0.900	169.050	98.085	1.91
0.150	1.550	170.600	98.985	1.02
0.075	0.500	171.100	99.275	0.73



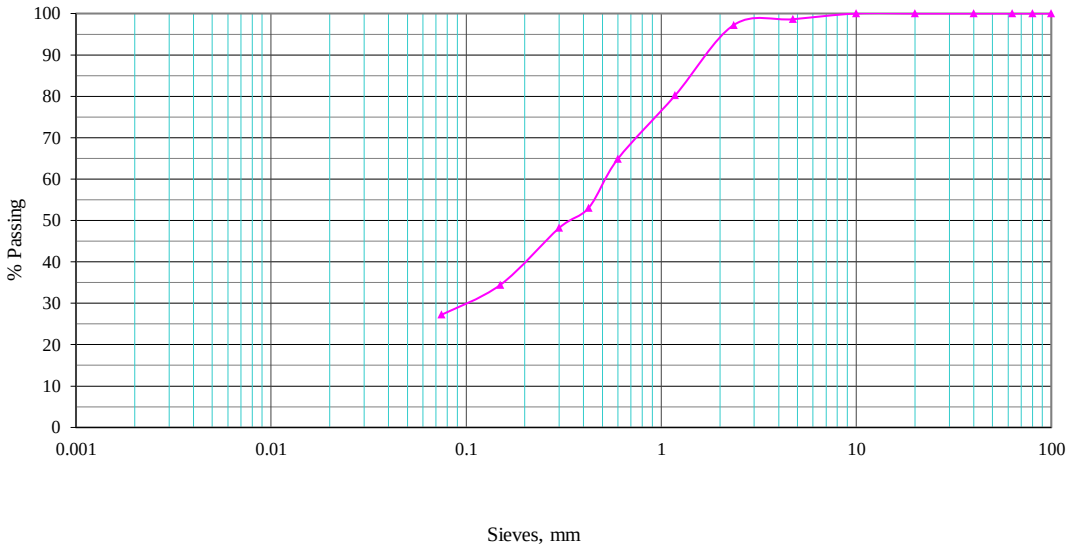
CLAY	SILT	SAND	GRAVEL
0.00 %	0.73 %	35.60 %	63.68 %

D_{10}	D_{30}	D_{50}	D_{60}
1.0268	3.15	14.84	23.67
C_U	23.05	C_C	0.41

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 1.5
Total Wt. (gm) 218.35

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	3.000	3.000	1.374	98.63
2.360	3.000	6.000	2.748	97.25
1.180	37.150	43.150	19.762	80.24
0.600	33.500	76.650	35.104	64.90
0.425	25.850	102.500	46.943	53.06
0.300	10.600	113.100	51.798	48.20
0.150	30.000	143.100	65.537	34.46
0.075	15.750	158.850	72.750	27.25



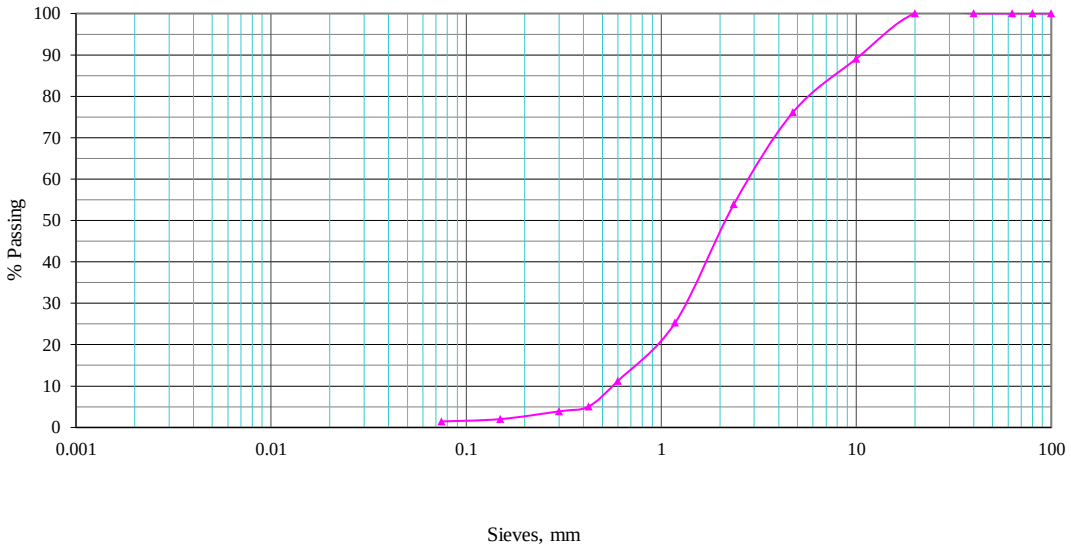
CLAY	SILT	SAND	GRAVEL
0.00 %	27.25 %	71.38 %	1.37 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0275	0.1	0.35	0.53
C_U	19.27	C_C	0.69

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 151.25

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	16.500	16.500	10.909	89.09
4.750	19.500	36.000	23.802	76.20
2.360	33.650	69.650	46.050	53.95
1.180	43.300	112.950	74.678	25.32
0.600	21.300	134.250	88.760	11.24
0.425	9.300	143.550	94.909	5.09
0.300	1.800	145.350	96.099	3.90
0.150	2.850	148.200	97.983	2.02
0.075	0.850	149.050	98.545	1.45



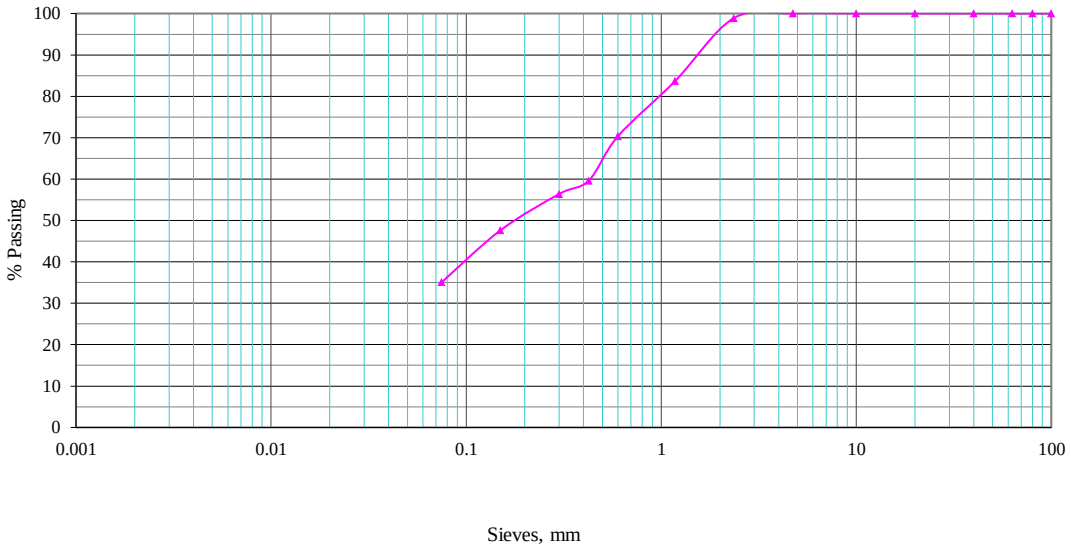
CLAY	SILT	SAND	GRAVEL
0.00 %	1.45 %	74.74 %	23.80 %

D_{10}	D_{30}	D_{50}	D_{60}
0.5647	1.37	2.2	3.01
C_U	5.33	C_C	1.1

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 3.0
Total Wt. (gm) 326.45

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	3.600	3.600	1.103	98.90
1.180	49.600	53.200	16.297	83.70
0.600	43.600	96.800	29.652	70.35
0.425	35.000	131.800	40.374	59.63
0.300	10.500	142.300	43.590	56.41
0.150	28.650	170.950	52.366	47.63
0.075	41.000	211.950	64.926	35.07



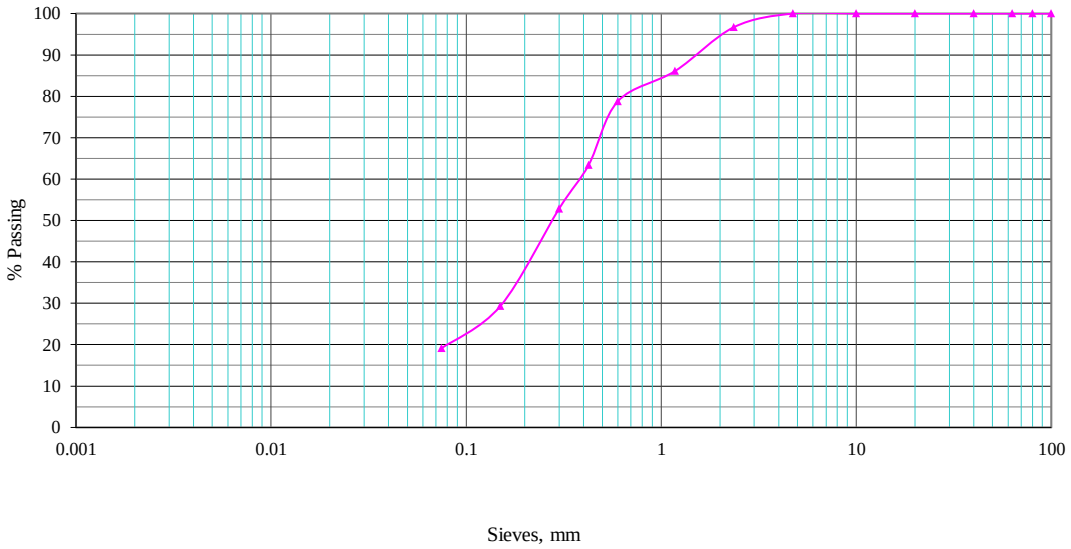
CLAY	SILT	SAND	GRAVEL
0.00 %	35.07 %	64.93 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0214	0.06	0.19	0.43
C_U	20.09	C_C	0.39

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 462.85

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	15.250	15.250	3.295	96.71
1.180	49.000	64.250	13.881	86.12
0.600	33.800	98.050	21.184	78.82
0.425	71.200	169.250	36.567	63.43
0.300	48.800	218.050	47.110	52.89
0.150	109.000	327.050	70.660	29.34
0.075	47.000	374.050	80.815	19.19



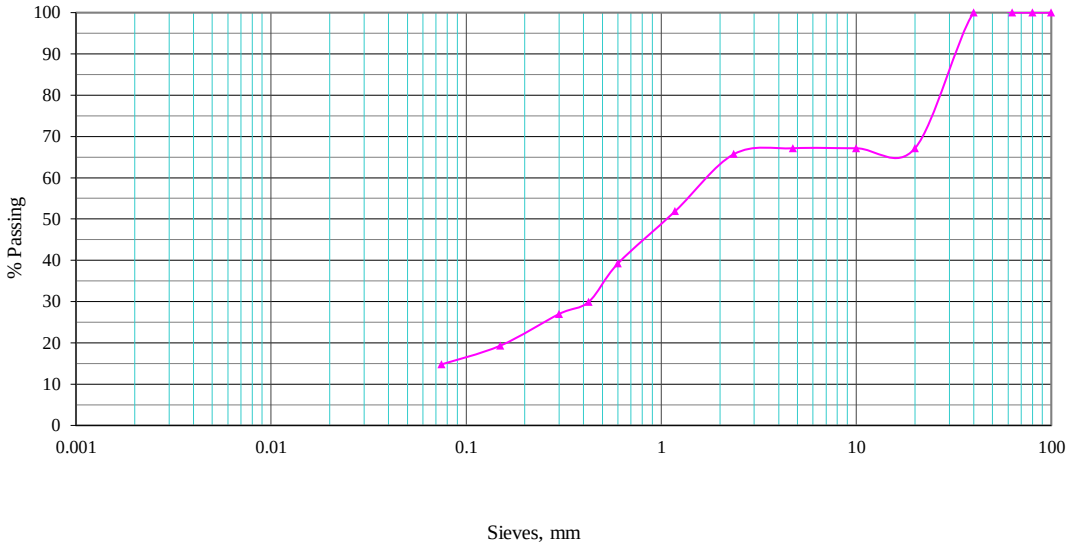
CLAY	SILT	SAND	GRAVEL
0.00 %	19.19 %	80.81 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0391	0.15	0.28	0.38
C_U	9.72	C_C	1.51

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 4.5
Total Wt. (gm) 289.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	95.100	95.100	32.861	67.14
10.000	0.000	95.100	32.861	67.14
4.750	0.000	95.100	32.861	67.14
2.360	4.100	99.200	34.278	65.72
1.180	40.000	139.200	48.100	51.90
0.600	36.700	175.900	60.781	39.22
0.425	26.850	202.750	70.059	29.94
0.300	8.500	211.250	72.996	27.00
0.150	22.200	233.450	80.667	19.33
0.075	13.100	246.550	85.194	14.81



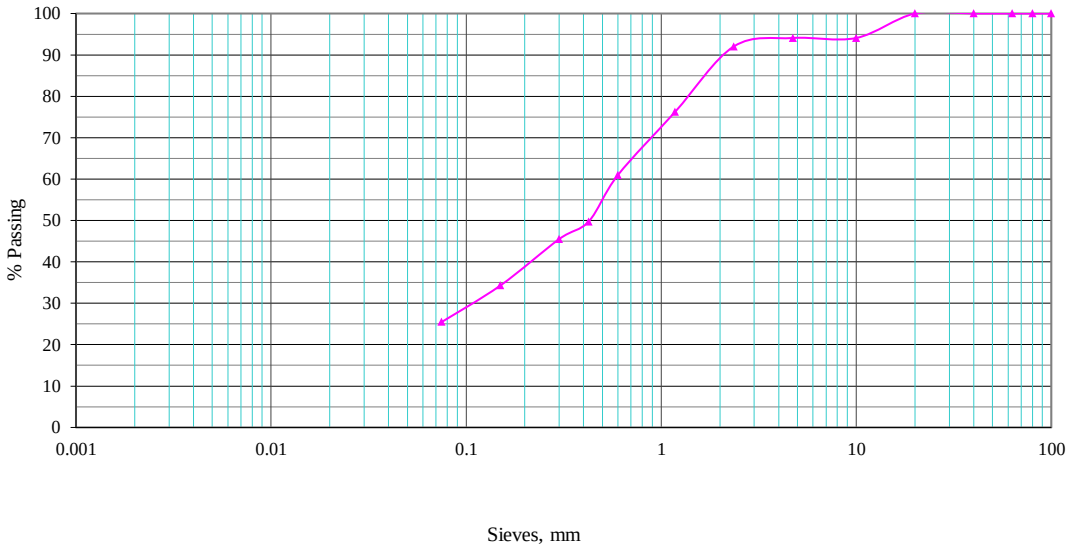
CLAY	SILT	SAND	GRAVEL
0.00 %	14.81 %	52.33 %	32.86 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0507	0.43	1.09	1.87
C_U	36.88	C_C	1.95

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 6.0
Total Wt. (gm) 514.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	30.400	30.400	5.910	94.09
4.750	0.000	30.400	5.910	94.09
2.360	10.450	40.850	7.941	92.06
1.180	81.250	122.100	23.736	76.26
0.600	78.650	200.750	39.026	60.97
0.425	57.700	258.450	50.243	49.76
0.300	21.850	280.300	54.491	45.51
0.150	57.650	337.950	65.698	34.30
0.075	45.350	383.300	74.514	25.49



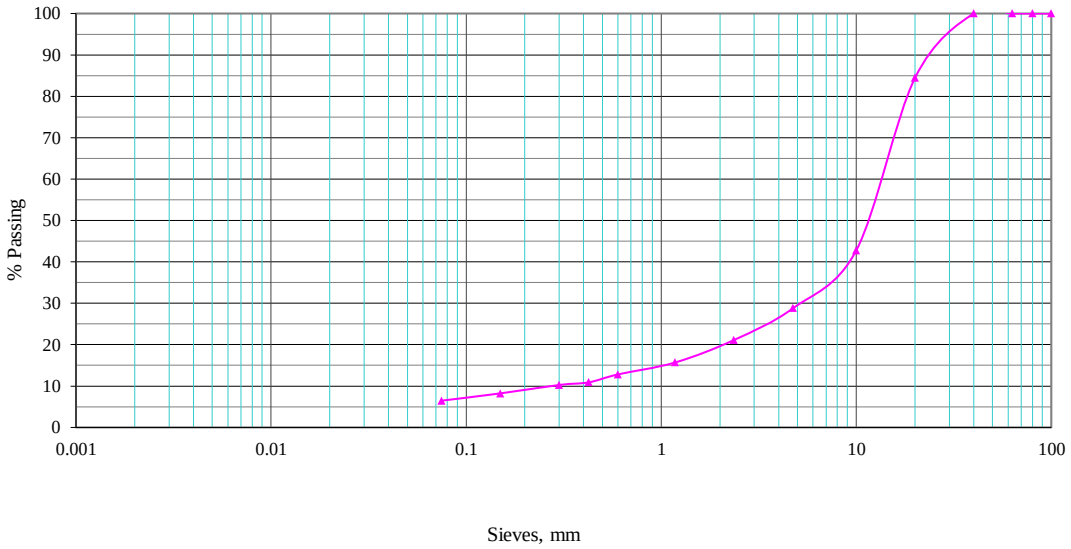
CLAY	SILT	SAND	GRAVEL
0.00 %	25.49 %	68.60 %	5.91 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0294	0.11	0.43	0.58
C_U	19.73	C_C	0.71

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 476.15

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	74.100	74.100	15.562	84.44
10.000	198.400	272.500	57.230	42.77
4.750	66.400	338.900	71.175	28.82
2.360	36.700	375.600	78.883	21.12
1.180	25.800	401.400	84.301	15.70
0.600	13.750	415.150	87.189	12.81
0.425	9.150	424.300	89.111	10.89
0.300	3.000	427.300	89.741	10.26
0.150	9.650	436.950	91.767	8.23
0.075	8.400	445.350	93.531	6.47



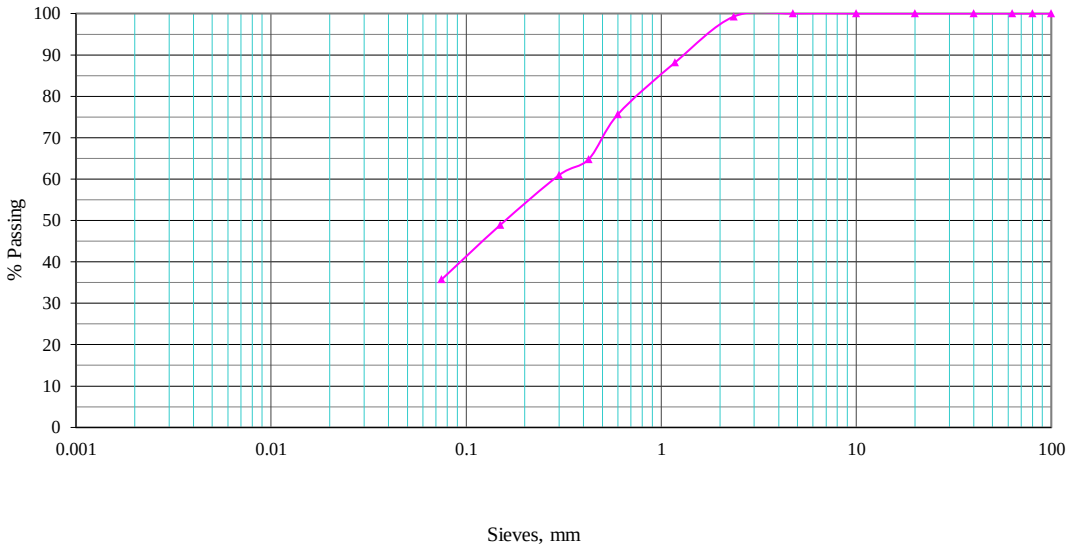
CLAY	SILT	SAND	GRAVEL
0.00 %	6.47 %	22.36 %	71.18 %

D_{10}	D_{30}	D_{50}	D_{60}
0.2808	5.19	11.74	14.14
C_U	50.36	C_C	6.78

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 7.5
Total Wt. (gm) 276.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	2.000	2.000	0.723	99.28
1.180	30.650	32.650	11.798	88.20
0.600	34.750	67.400	24.354	75.65
0.425	30.000	97.400	35.194	64.81
0.300	10.600	108.000	39.024	60.98
0.150	33.250	141.250	51.039	48.96
0.075	36.500	177.750	64.228	35.77



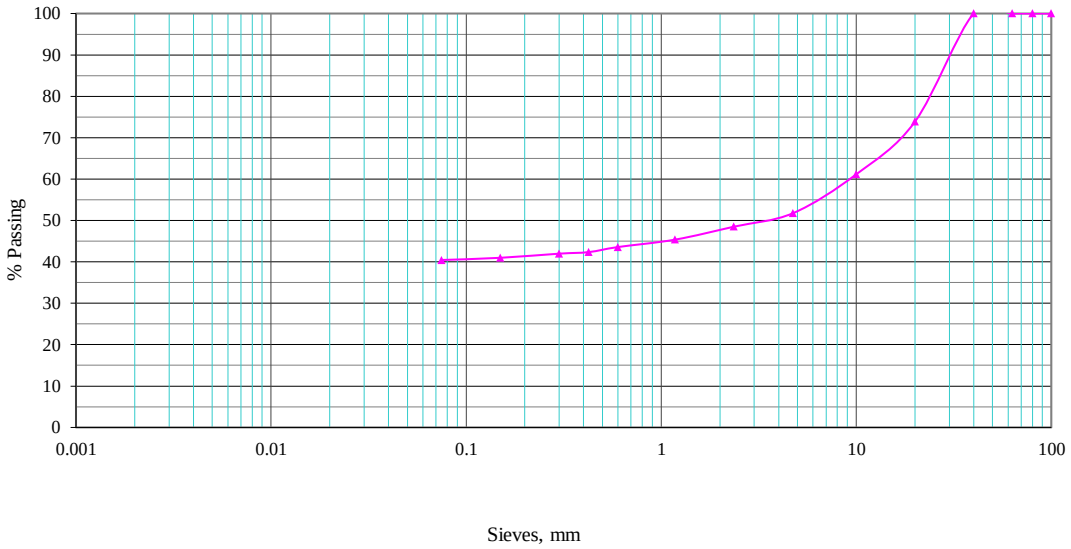
CLAY	SILT	SAND	GRAVEL
0.00 %	35.77 %	64.23 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.021	0.06	0.16	0.29
C_U	13.81	C_C	0.59

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 7.5
Total Wt. (gm) 320.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	83.600	83.600	26.125	73.88
10.000	40.700	124.300	38.844	61.16
4.750	30.000	154.300	48.219	51.78
2.360	10.500	164.800	51.500	48.50
1.180	10.000	174.800	54.625	45.38
0.600	5.750	180.550	56.422	43.58
0.425	3.900	184.450	57.641	42.36
0.300	1.200	185.650	58.016	41.98
0.150	3.200	188.850	59.016	40.98
0.075	1.700	190.550	59.547	40.45



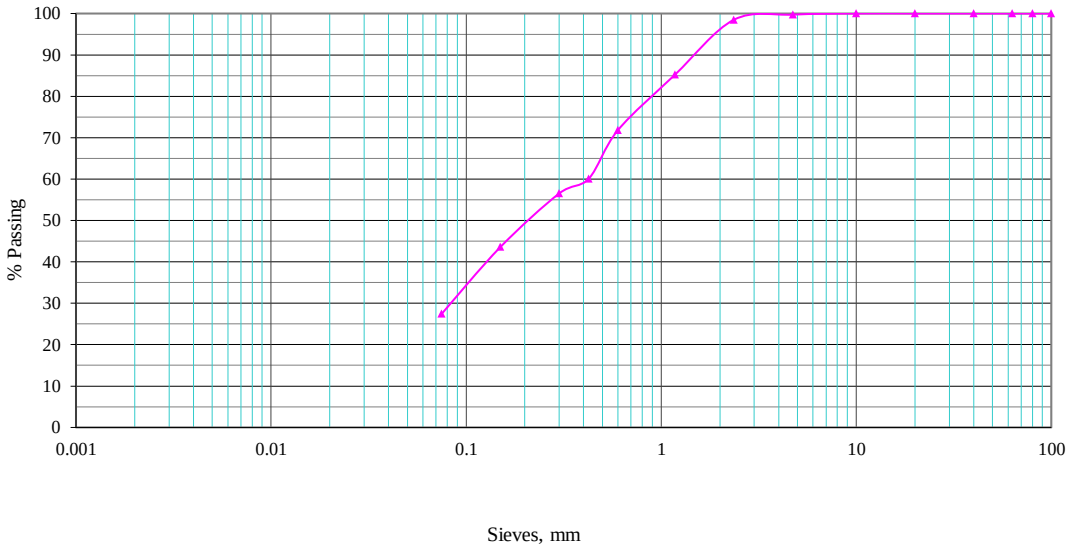
CLAY	SILT	SAND	GRAVEL
0.00 %	40.45 %	11.33 %	48.22 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0185	0.06	3.45	9.35
C_U	505.41	C_C	0.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 9.0
Total Wt. (gm) 185.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.500	0.500	0.269	99.73
2.360	2.300	2.800	1.507	98.49
1.180	24.550	27.350	14.724	85.28
0.600	25.000	52.350	28.183	71.82
0.425	21.800	74.150	39.919	60.08
0.300	6.600	80.750	43.472	56.53
0.150	24.000	104.750	56.393	43.61
0.075	30.000	134.750	72.544	27.46



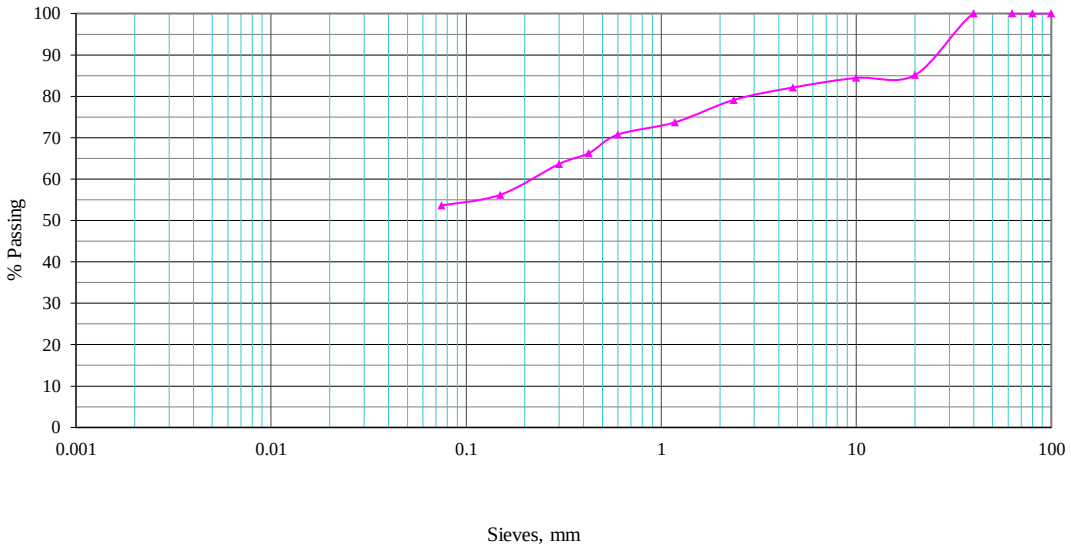
CLAY	SILT	SAND	GRAVEL
0.00 %	27.46 %	72.27 %	0.27 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0273	0.09	0.22	0.42
C_U	15.38	C_C	0.71

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : SPT **Depth (m):** 9.0
Total Wt. (gm) 370.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	55.000	55.000	14.865	85.14
10.000	2.600	57.600	15.568	84.43
4.750	8.500	66.100	17.865	82.14
2.360	11.100	77.200	20.865	79.14
1.180	20.000	97.200	26.270	73.73
0.600	11.000	108.200	29.243	70.76
0.425	16.700	124.900	33.757	66.24
0.300	9.550	134.450	36.338	63.66
0.150	27.550	162.000	43.784	56.22
0.075	9.450	171.450	46.338	53.66



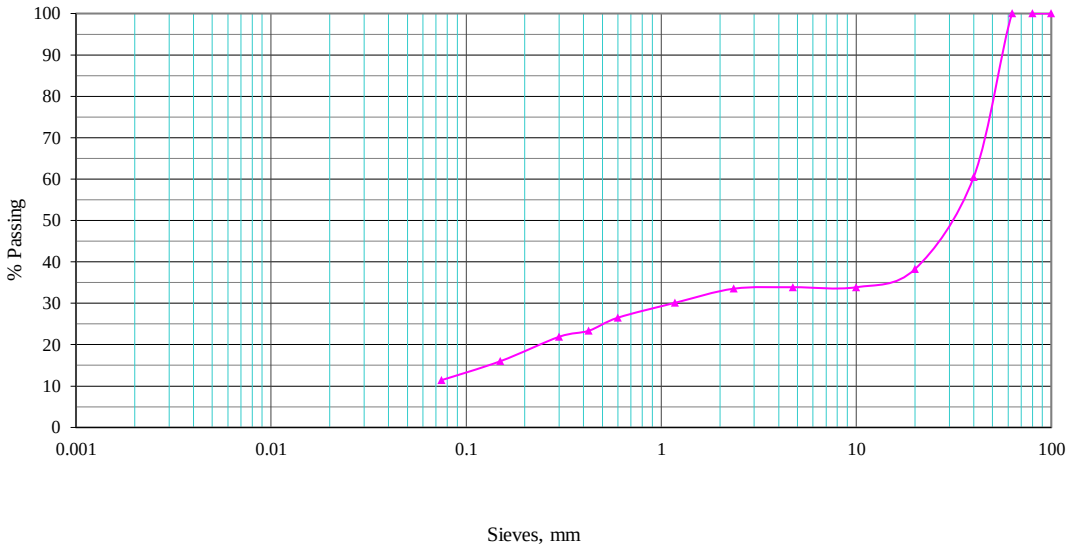
CLAY	SILT	SAND	GRAVEL
0.00 %	53.66 %	28.47 %	17.86 %

D_{10}	D_{30}	D_{50}	D_{60}
0.014	0.04	0.07	0.23
C_U	16.43	C_C	0.5

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 2
Sample : Disturbed **Depth (m):** 10.5
Total Wt. (gm) 645.25

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	255.000	255.000	39.520	60.48
20.000	143.400	398.400	61.744	38.26
10.000	28.300	426.700	66.129	33.87
4.750	0.000	426.700	66.129	33.87
2.360	2.250	428.950	66.478	33.52
1.180	22.000	450.950	69.888	30.11
0.600	23.200	474.150	73.483	26.52
0.425	20.400	494.550	76.645	23.36
0.300	9.400	503.950	78.102	21.90
0.150	38.000	541.950	83.991	16.01
0.075	29.500	571.450	88.563	11.44



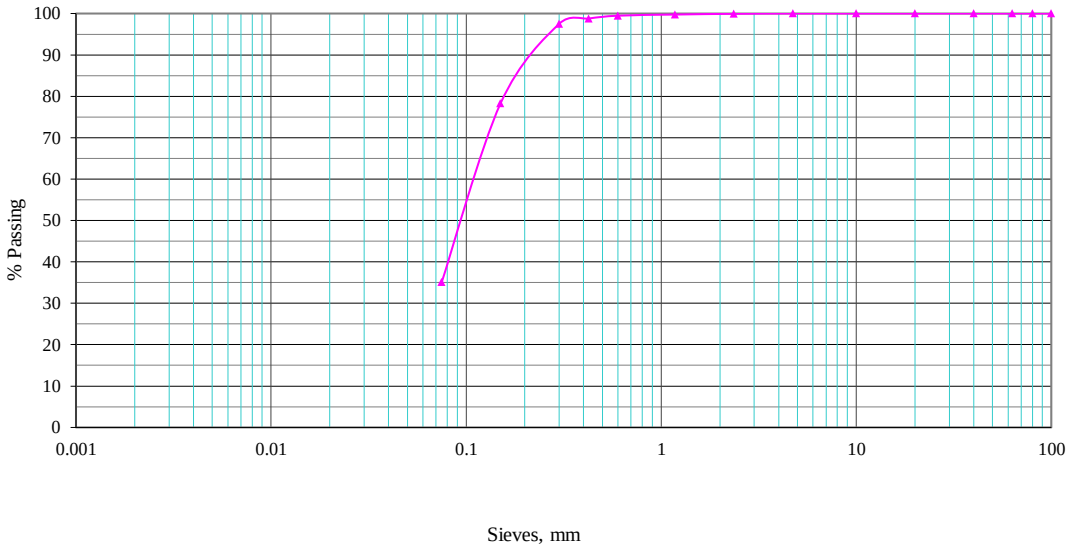
CLAY	SILT	SAND	GRAVEL
0.00 %	11.44 %	22.43 %	66.13 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0656	1.16	30.57	39.57
C_U	603.2	C_C	0.52

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 1.5
Total Wt. (gm) 284.95

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.200	0.200	0.070	99.93
1.180	0.500	0.700	0.246	99.75
0.600	0.800	1.500	0.526	99.47
0.425	1.950	3.450	1.211	98.79
0.300	3.650	7.100	2.492	97.51
0.150	54.850	61.950	21.741	78.26
0.075	123.000	184.950	64.906	35.09



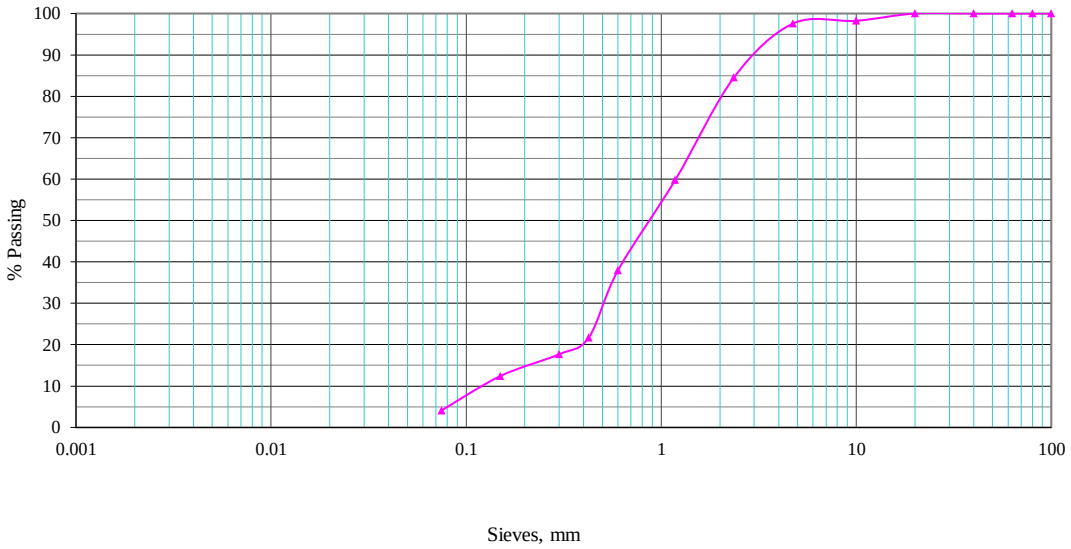
CLAY	SILT	SAND	GRAVEL
0.00 %	35.09 %	64.91 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0214	0.06	0.1	0.12
C_U	5.61	C_C	1.4

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 727.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	12.800	12.800	1.761	98.24
4.750	4.700	17.500	2.407	97.59
2.360	95.000	112.500	15.475	84.53
1.180	180.000	292.500	40.234	59.77
0.600	158.800	451.300	62.077	37.92
0.425	117.850	569.150	78.287	21.71
0.300	29.400	598.550	82.331	17.67
0.150	38.100	636.650	87.572	12.43
0.075	60.350	697.000	95.873	4.13



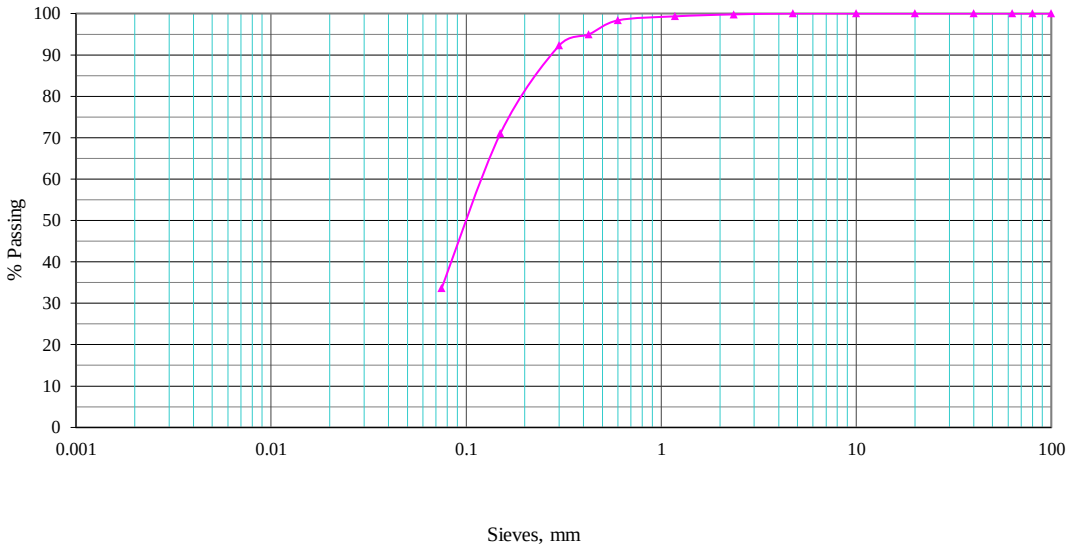
CLAY	SILT	SAND	GRAVEL
0.00 %	4.13 %	93.47 %	2.41 %

D_{10}	D_{30}	D_{50}	D_{60}
0.1281	0.51	0.92	1.19
C_U	9.29	C_C	1.71

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 3.0
Total Wt. (gm) 552.65

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	1.150	1.150	0.208	99.79
1.180	2.600	3.750	0.679	99.32
0.600	5.400	9.150	1.656	98.34
0.425	18.800	27.950	5.057	94.94
0.300	14.800	42.750	7.735	92.26
0.150	117.200	159.950	28.942	71.06
0.075	206.700	366.650	66.344	33.66



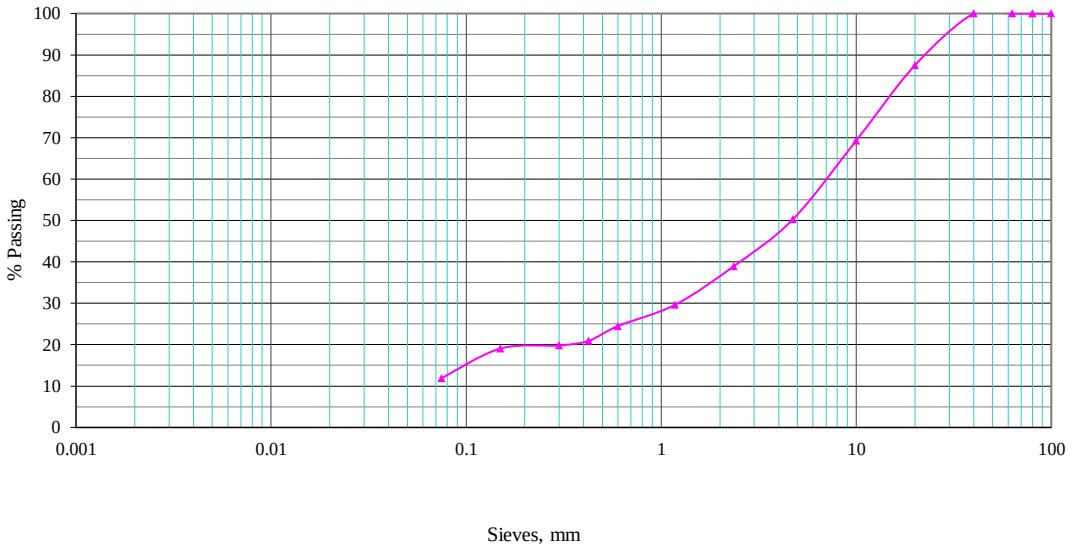
CLAY	SILT	SAND	GRAVEL
0.00 %	33.66 %	66.34 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0223	0.07	0.11	0.13
C_U	5.83	C_C	1.69

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 604.65

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	75.550	75.550	12.495	87.51
10.000	110.000	185.550	30.687	69.31
4.750	114.700	300.250	49.657	50.34
2.360	68.750	369.000	61.027	38.97
1.180	56.400	425.400	70.355	29.65
0.600	31.150	456.550	75.506	24.49
0.425	21.500	478.050	79.062	20.94
0.300	6.800	484.850	80.187	19.81
0.150	4.500	489.350	80.931	19.07
0.075	43.300	532.650	88.092	11.91



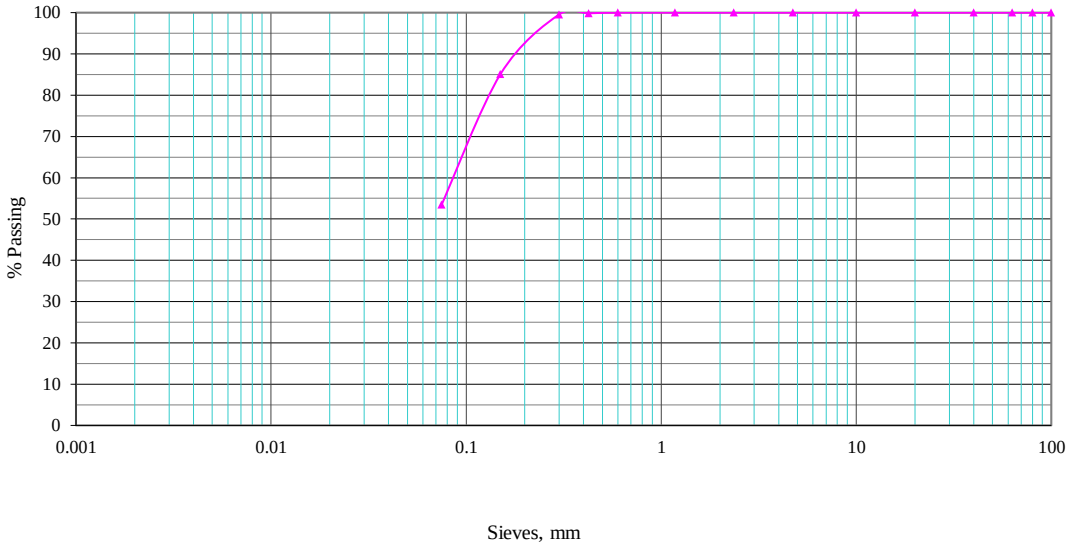
CLAY	SILT	SAND	GRAVEL
0.00 %	11.91 %	38.44 %	49.66 %

D_{10}	D_{30}	D_{50}	D_{60}
0.063	1.22	4.68	7.42
C_U	117.78	C_C	3.18

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 4.5
Total Wt. (gm) 369.65

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.000	0.000	0.000	100.00
1.180	0.000	0.000	0.000	100.00
0.600	0.000	0.000	0.000	100.00
0.425	0.600	0.600	0.162	99.84
0.300	1.000	1.600	0.433	99.57
0.150	53.450	55.050	14.892	85.11
0.075	116.850	171.900	46.503	53.50



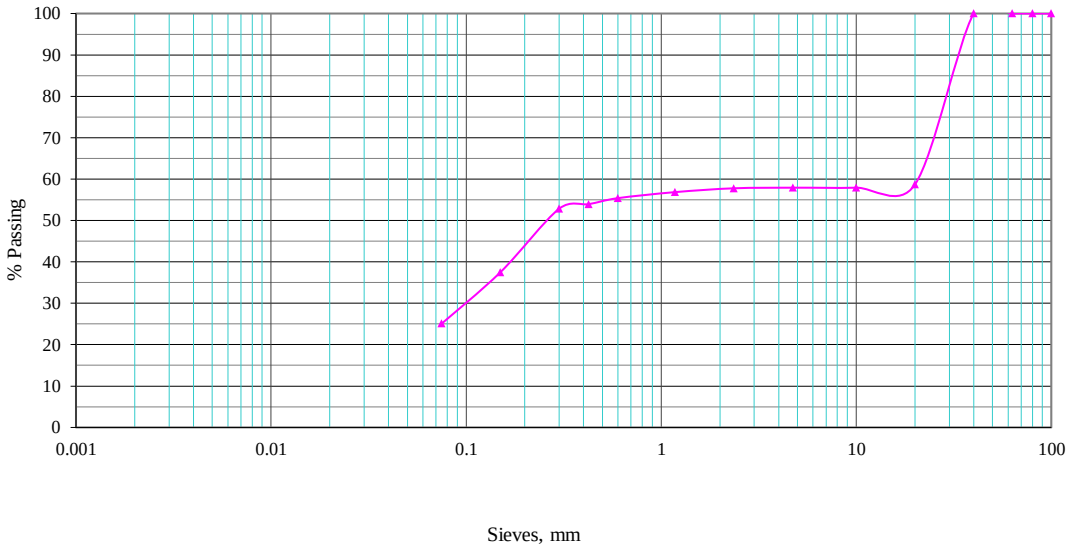
CLAY	SILT	SAND	GRAVEL
0.00 %	53.50 %	46.50 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.014	0.04	0.07	0.09
C_U	6.43	C_C	1.27

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 6.0
Total Wt. (gm) 686.55

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	283.600	283.600	41.308	58.69
10.000	5.300	288.900	42.080	57.92
4.750	0.000	288.900	42.080	57.92
2.360	1.000	289.900	42.226	57.77
1.180	6.350	296.250	43.151	56.85
0.600	10.000	306.250	44.607	55.39
0.425	10.000	316.250	46.064	53.94
0.300	7.500	323.750	47.156	52.84
0.150	105.250	429.000	62.486	37.51
0.075	85.250	514.250	74.904	25.10



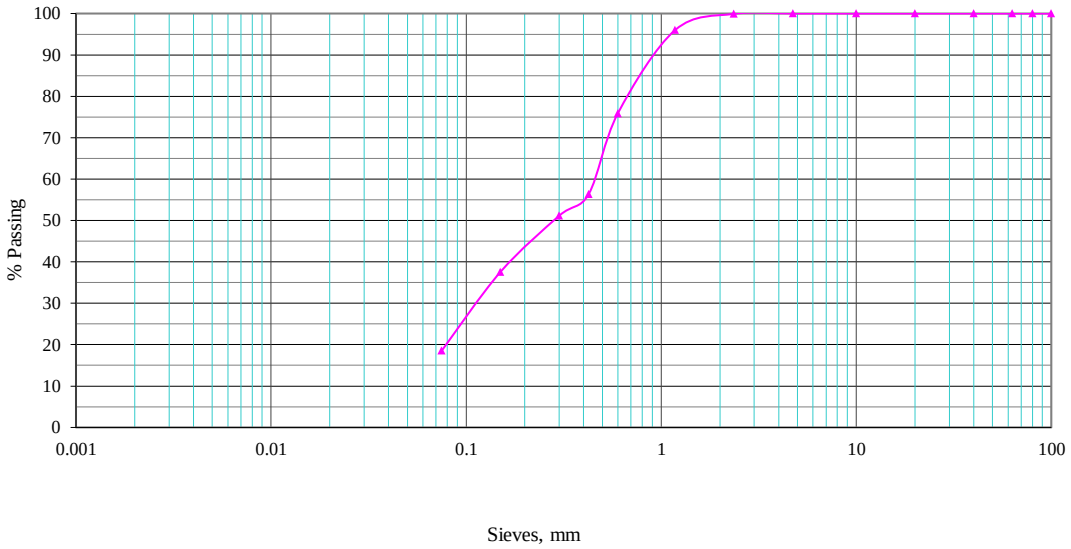
CLAY	SILT	SAND	GRAVEL
0.00 %	25.10 %	32.82 %	42.08 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0299	0.1	0.27	22.53
C_U	753.51	C_C	0.01

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 7.5
Total Wt. (gm) 614.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.500	0.500	0.081	99.92
1.180	23.950	24.450	3.977	96.02
0.600	123.700	148.150	24.099	75.90
0.425	120.000	268.150	43.619	56.38
0.300	32.200	300.350	48.857	51.14
0.150	83.400	383.750	62.424	37.58
0.075	117.000	500.750	81.456	18.54



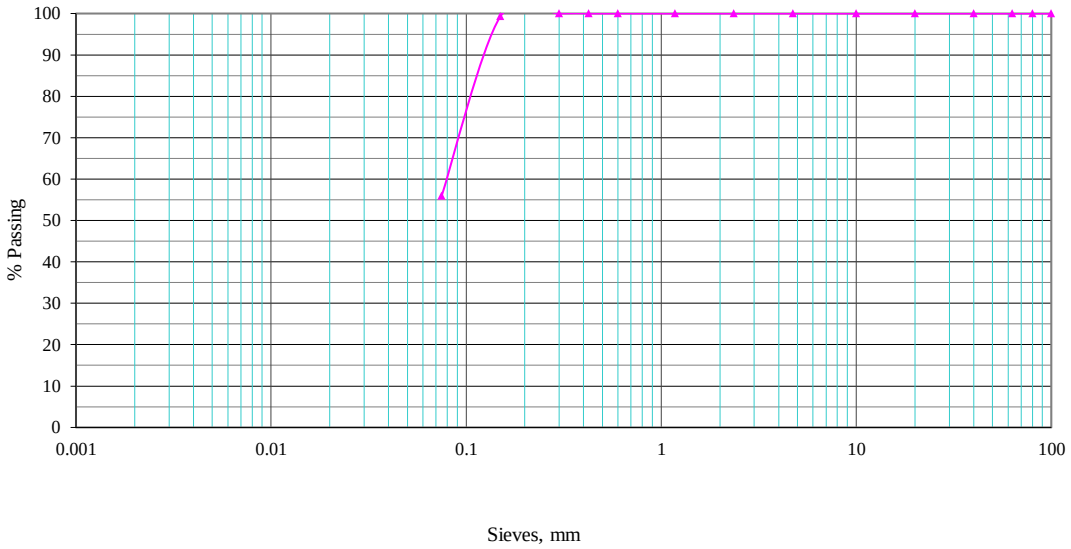
CLAY	SILT	SAND	GRAVEL
0.00 %	18.54 %	81.46 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0404	0.12	0.29	0.46
C_U	11.39	C_C	0.77

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : SPT **Depth (m):** 7.5
Total Wt. (gm) 415.25

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	0.000	0.000	0.000	100.00
1.180	0.000	0.000	0.000	100.00
0.600	0.000	0.000	0.000	100.00
0.425	0.000	0.000	0.000	100.00
0.300	0.000	0.000	0.000	100.00
0.150	2.800	2.800	0.674	99.33
0.075	180.000	182.800	44.022	55.98



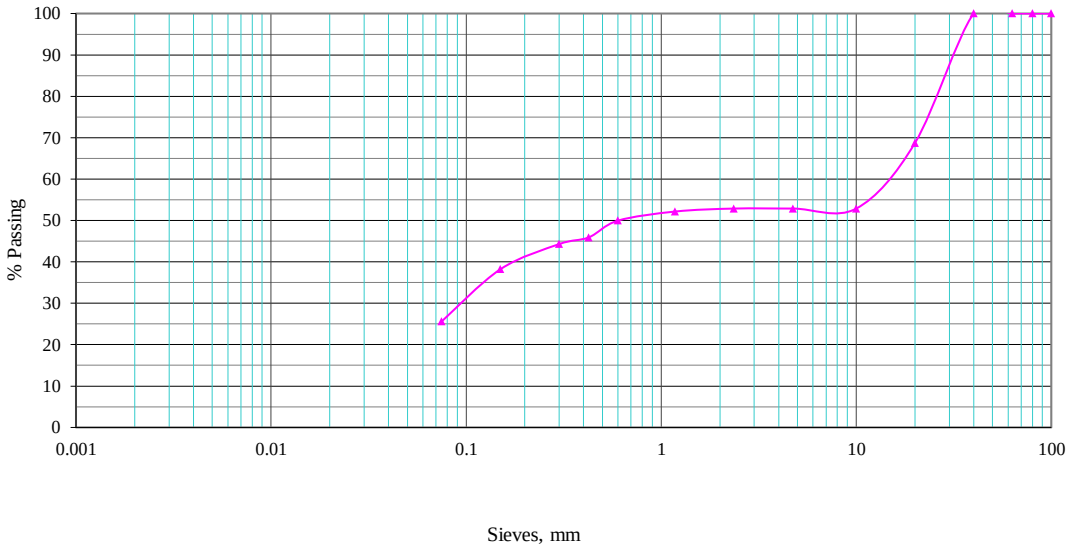
CLAY	SILT	SAND	GRAVEL
0.00 %	55.98 %	44.02 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0134	0.04	0.07	0.08
C_U	5.97	C_C	1.49

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 9.0
Total Wt. (gm) 722.70

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	226.000	226.000	31.272	68.73
10.000	114.550	340.550	47.122	52.88
4.750	0.000	340.550	47.122	52.88
2.360	0.000	340.550	47.122	52.88
1.180	5.200	345.750	47.841	52.16
0.600	15.900	361.650	50.042	49.96
0.425	29.250	390.900	54.089	45.91
0.300	11.700	402.600	55.708	44.29
0.150	43.800	446.400	61.768	38.23
0.075	91.150	537.550	74.381	25.62



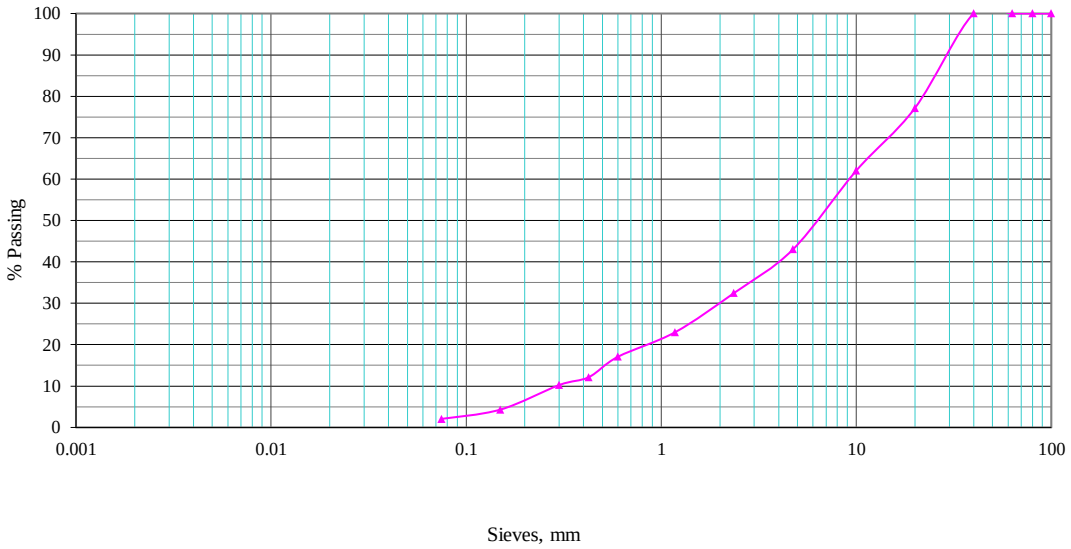
CLAY	SILT	SAND	GRAVEL
0.00 %	25.62 %	27.26 %	47.12 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0293	0.1	0.61	14.49
C_U	494.54	C_C	0.02

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : SPT **Depth (m):** 9.0
Total Wt. (gm) 579.90

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	132.350	132.350	22.823	77.18
10.000	87.800	220.150	37.963	62.04
4.750	110.000	330.150	56.932	43.07
2.360	61.500	391.650	67.538	32.46
1.180	54.800	446.450	76.987	23.01
0.600	34.450	480.900	82.928	17.07
0.425	28.600	509.500	87.860	12.14
0.300	11.000	520.500	89.757	10.24
0.150	34.400	554.900	95.689	4.31
0.075	13.000	567.900	97.931	2.07



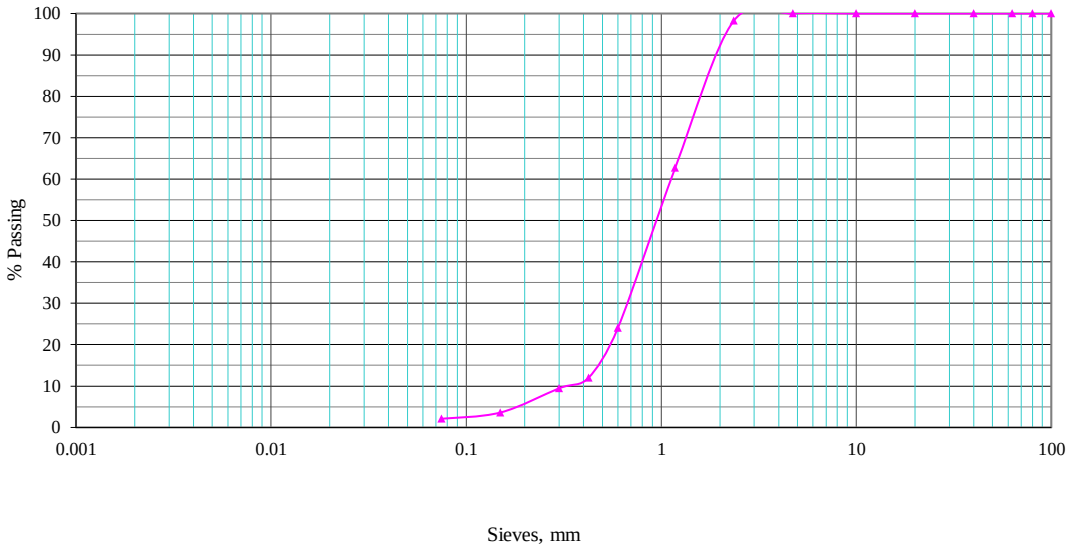
CLAY	SILT	SAND	GRAVEL
0.00 %	2.07 %	41.00 %	56.93 %

D_{10}	D_{30}	D_{50}	D_{60}
0.2939	2.05	6.67	9.44
C_U	32.12	C_C	1.51

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 10.0
Total Wt. (gm) 290.15

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	5.000	5.000	1.723	98.28
1.180	103.200	108.200	37.291	62.71
0.600	112.200	220.400	75.961	24.04
0.425	34.800	255.200	87.955	12.05
0.300	7.500	262.700	90.539	9.46
0.150	17.000	279.700	96.398	3.60
0.075	4.350	284.050	97.898	2.10



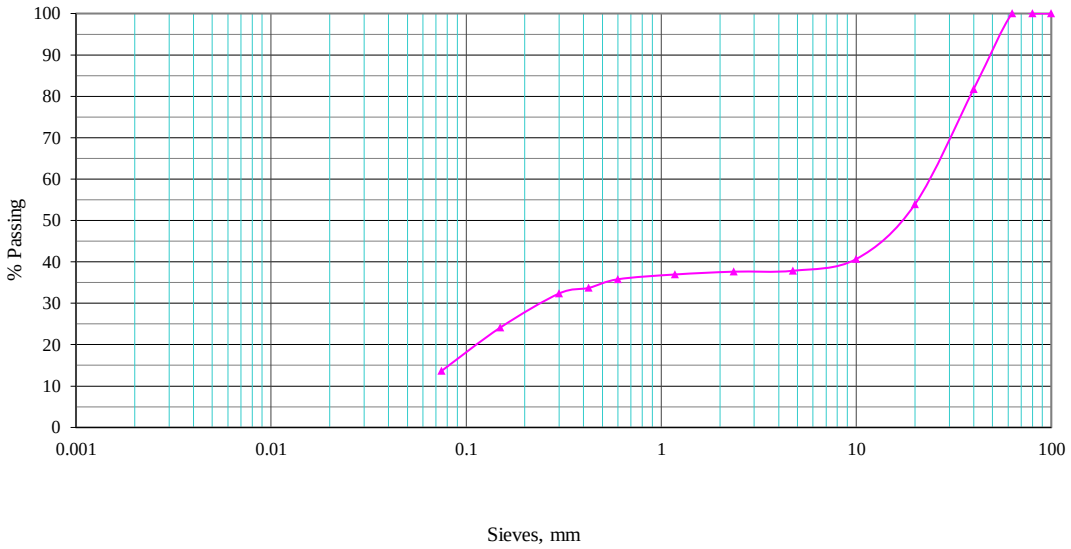
CLAY	SILT	SAND	GRAVEL
0.00 %	2.10 %	97.90 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.3261	0.69	0.99	1.14
C_U	3.5	C_C	1.28

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 3
Sample : Disturbed **Depth (m):** 10.5
Total Wt. (gm) 622.90

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	113.600	113.600	18.237	81.76
20.000	173.450	287.050	46.083	53.92
10.000	82.400	369.450	59.311	40.69
4.750	17.650	387.100	62.145	37.86
2.360	1.400	388.500	62.370	37.63
1.180	4.200	392.700	63.044	36.96
0.600	7.200	399.900	64.200	35.80
0.425	13.000	412.900	66.287	33.71
0.300	8.400	421.300	67.635	32.36
0.150	51.150	472.450	75.847	24.15
0.075	65.250	537.700	86.322	13.68



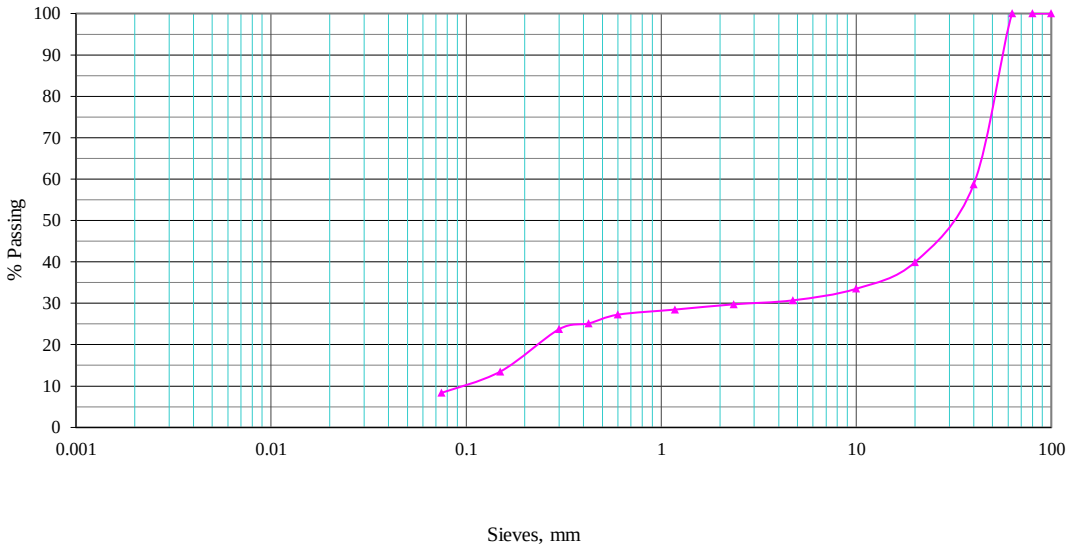
CLAY	SILT	SAND	GRAVEL
0.00 %	13.68 %	24.18 %	62.14 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0548	0.26	17.04	24.37
C_U	444.71	C_C	0.05

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturebed **Depth (m):** 1.5
Total Wt. (gm) 496.50

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	205.000	205.000	41.289	58.71
20.000	93.250	298.250	60.070	39.93
10.000	31.900	330.150	66.495	33.50
4.750	13.850	344.000	69.285	30.72
2.360	4.800	348.800	70.252	29.75
1.180	6.300	355.100	71.521	28.48
0.600	6.150	361.250	72.759	27.24
0.425	10.500	371.750	74.874	25.13
0.300	6.850	378.600	76.254	23.75
0.150	50.800	429.400	86.485	13.51
0.075	25.500	454.900	91.621	8.38



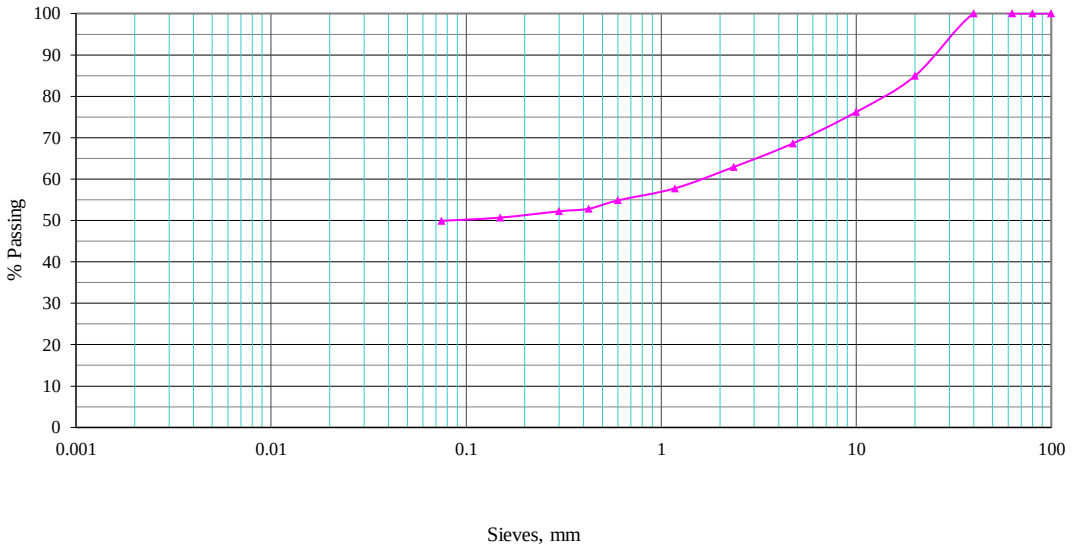
CLAY	SILT	SAND	GRAVEL
0.00 %	8.38 %	22.34 %	69.28 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0987	2.98	30.72	41.87
C_U	424.21	C_C	2.15

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : SPT **Depth (m):** 3.0
Total Wt. (gm) 360.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	54.300	54.300	15.083	84.92
10.000	31.350	85.650	23.792	76.21
4.750	27.200	112.850	31.347	68.65
2.360	20.550	133.400	37.056	62.94
1.180	18.600	152.000	42.222	57.78
0.600	10.500	162.500	45.139	54.86
0.425	7.300	169.800	47.167	52.83
0.300	2.200	172.000	47.778	52.22
0.150	5.500	177.500	49.306	50.69
0.075	2.800	180.300	50.083	49.92



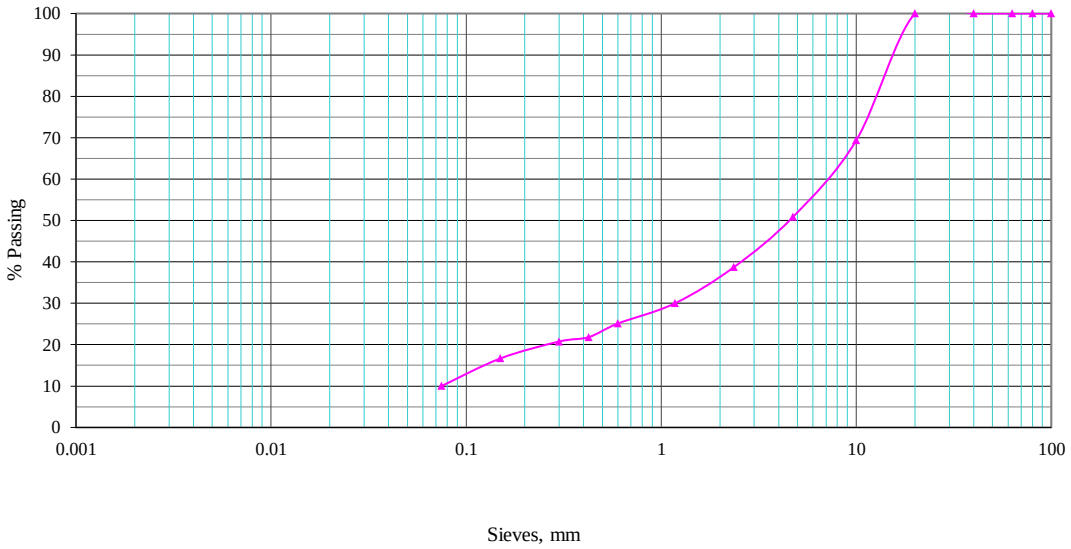
CLAY	SILT	SAND	GRAVEL
0.00 %	49.92 %	18.74 %	31.35 %

D_{10}	D_{30}	D_{50}	D_{60}
0.015	0.05	0.08	1.69
C_U	112.67	C_C	0.1

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 3.0
Total Wt. (gm) 375.36

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	115.000	115.000	30.637	69.36
4.750	69.300	184.300	49.100	50.90
2.360	45.700	230.000	61.275	38.73
1.180	32.710	262.710	69.989	30.01
0.600	18.400	281.110	74.891	25.11
0.425	12.350	293.460	78.181	21.82
0.300	4.000	297.460	79.247	20.75
0.150	15.300	312.760	83.323	16.68
0.075	25.000	337.760	89.983	10.02



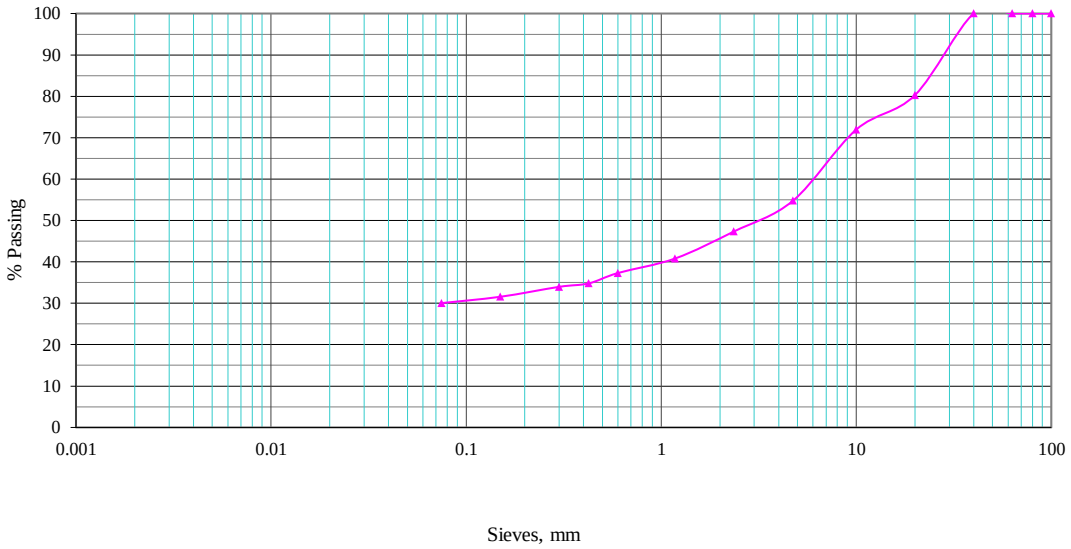
CLAY	SILT	SAND	GRAVEL
0.00 %	10.02 %	40.88 %	49.10 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0749	1.18	4.57	7.34
C_U	98	C_C	2.53

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : SPT **Depth (m):** 4.5
Total Wt. (gm) 480.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	94.600	94.600	19.708	80.29
10.000	40.000	134.600	28.042	71.96
4.750	82.300	216.900	45.188	54.81
2.360	35.850	252.750	52.656	47.34
1.180	31.300	284.050	59.177	40.82
0.600	16.900	300.950	62.698	37.30
0.425	12.000	312.950	65.198	34.80
0.300	4.000	316.950	66.031	33.97
0.150	11.500	328.450	68.427	31.57
0.075	7.350	335.800	69.958	30.04



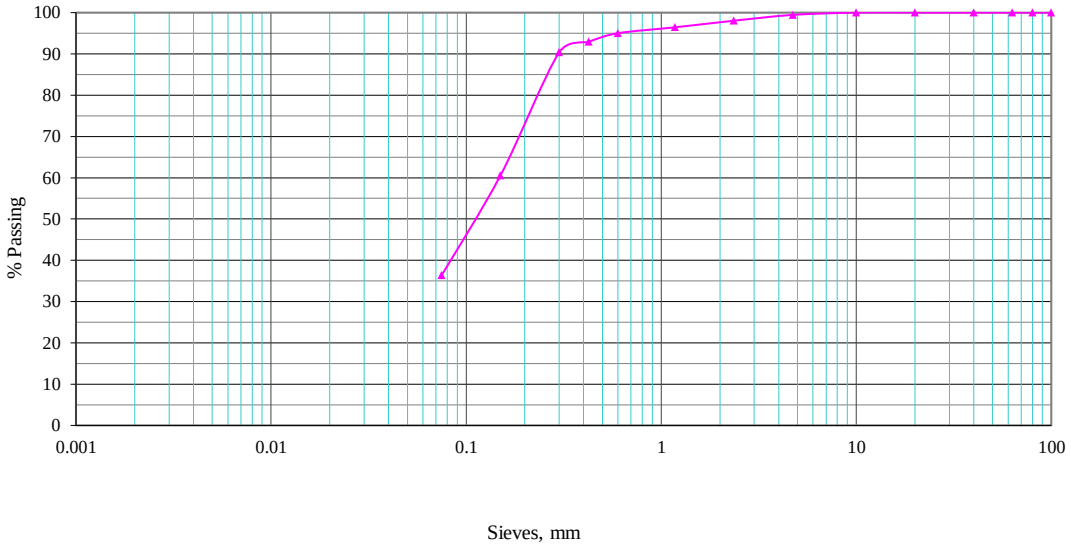
CLAY	SILT	SAND	GRAVEL
0.00 %	30.04 %	24.77 %	45.19 %

D_{10}	D_{30}	D_{50}	D_{60}
0.025	0.07	3.21	6.34
C_U	253.6	C_C	0.03

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 4.5
Total Wt. (gm) 250.75

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	1.350	1.350	0.538	99.46
2.360	3.550	4.900	1.954	98.05
1.180	4.000	8.900	3.549	96.45
0.600	3.600	12.500	4.985	95.01
0.425	5.150	17.650	7.039	92.96
0.300	6.500	24.150	9.631	90.37
0.150	74.750	98.900	39.442	60.56
0.075	60.500	159.400	63.569	36.43



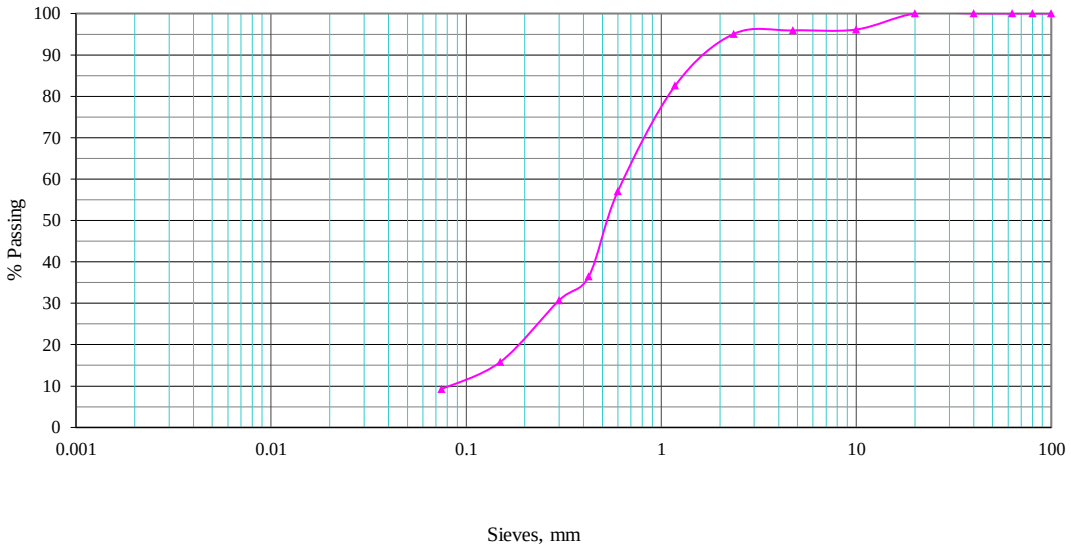
CLAY	SILT	SAND	GRAVEL
0.00 %	36.43 %	63.03 %	0.54 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0206	0.06	0.12	0.15
C_U	7.28	C_C	1.17

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 6.0
Total Wt. (gm) 335.85

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	13.000	13.000	3.871	96.13
4.750	0.700	13.700	4.079	95.92
2.360	2.800	16.500	4.913	95.09
1.180	42.000	58.500	17.418	82.58
0.600	85.650	144.150	42.921	57.08
0.425	69.300	213.450	63.555	36.44
0.300	19.200	232.650	69.272	30.73
0.150	50.000	282.650	84.160	15.84
0.075	22.000	304.650	90.710	9.29



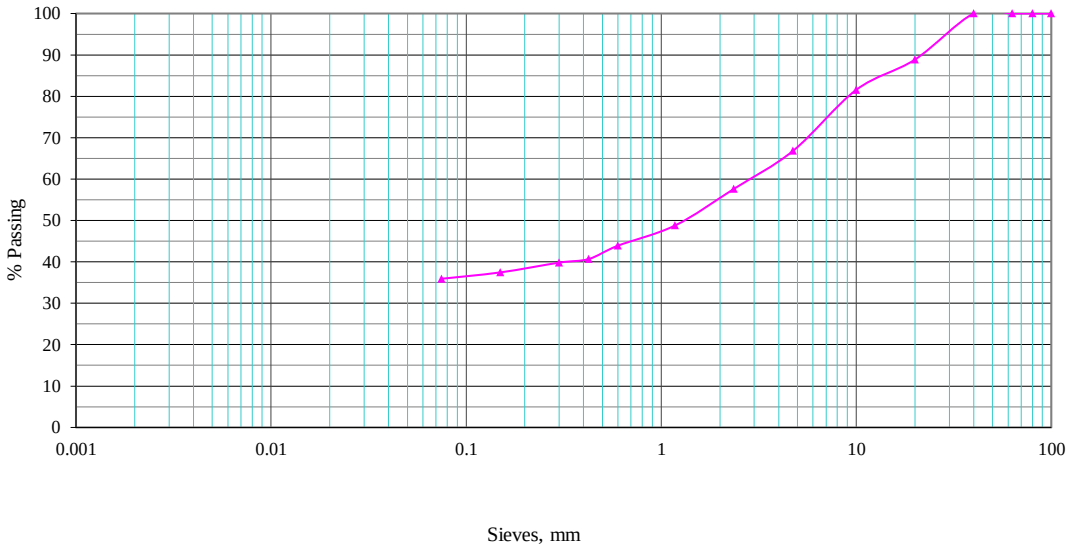
CLAY	SILT	SAND	GRAVEL
0.00 %	9.29 %	86.63 %	4.08 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0831	0.29	0.54	0.67
C_U	8.06	C_C	1.51

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : SPT **Depth (m):** 6.0
Total Wt. (gm) 715.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	79.550	79.550	11.126	88.87
10.000	52.300	131.850	18.441	81.56
4.750	105.150	237.000	33.147	66.85
2.360	65.850	302.850	42.357	57.64
1.180	63.200	366.050	51.196	48.80
0.600	35.000	401.050	56.091	43.91
0.425	23.000	424.050	59.308	40.69
0.300	6.250	430.300	60.182	39.82
0.150	16.850	447.150	62.538	37.46
0.075	11.000	458.150	64.077	35.92



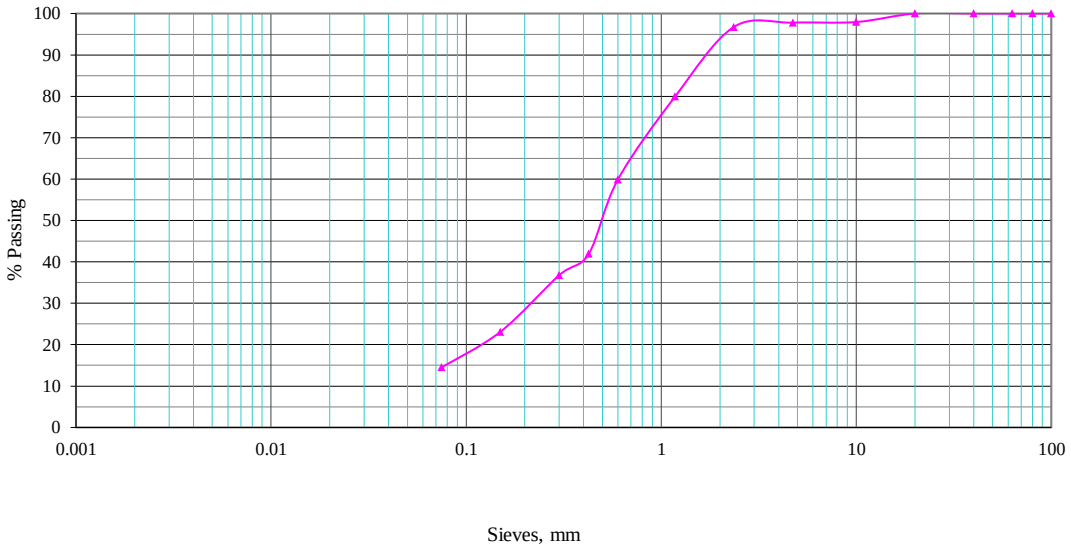
CLAY	SILT	SAND	GRAVEL
0.00 %	35.92 %	30.93 %	33.15 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0209	0.06	1.34	2.97
C_U	142.11	C_C	0.06

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 7.5
Total Wt. (gm) 378.40

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	7.800	7.800	2.061	97.94
4.750	0.550	8.350	2.207	97.79
2.360	3.900	12.250	3.237	96.76
1.180	63.500	75.750	20.018	79.98
0.600	76.000	151.750	40.103	59.90
0.425	68.000	219.750	58.073	41.93
0.300	19.500	239.250	63.227	36.77
0.150	51.700	290.950	76.890	23.11
0.075	32.450	323.400	85.465	14.53



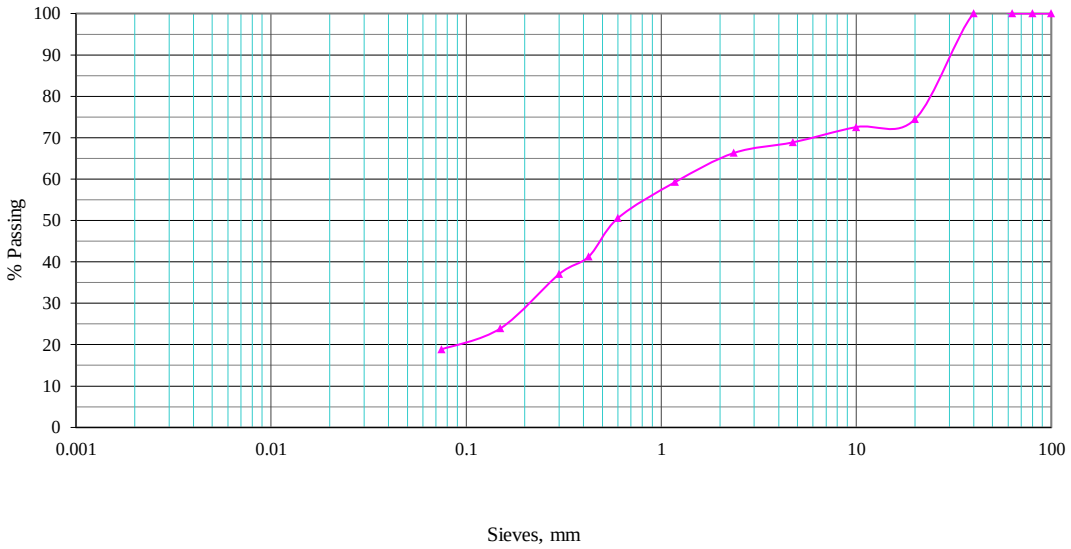
CLAY	SILT	SAND	GRAVEL
0.00 %	14.53 %	83.26 %	2.21 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0516	0.23	0.5	0.6
C_U	11.63	C_C	1.71

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : SPT **Depth (m):** 7.5
Total Wt. (gm) 225.45

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	57.600	57.600	25.549	74.45
10.000	4.250	61.850	27.434	72.57
4.750	8.300	70.150	31.116	68.88
2.360	5.800	75.950	33.688	66.31
1.180	15.850	91.800	40.719	59.28
0.600	19.650	111.450	49.434	50.57
0.425	20.950	132.400	58.727	41.27
0.300	9.500	141.900	62.941	37.06
0.150	29.600	171.500	76.070	23.93
0.075	11.350	182.850	81.104	18.90



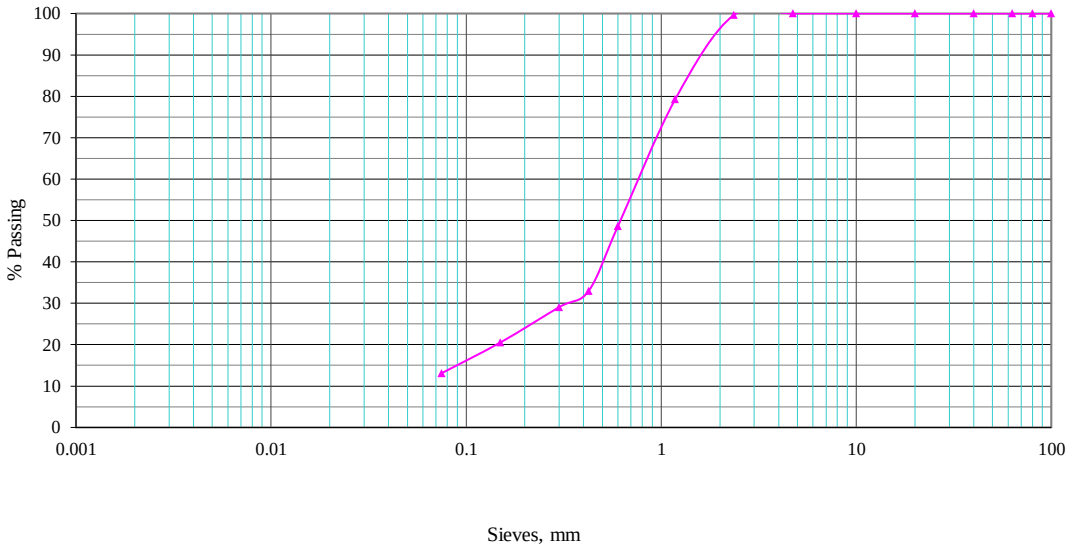
CLAY	SILT	SAND	GRAVEL
0.00 %	18.90 %	49.99 %	31.12 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0397	0.22	0.59	1.3
C_U	32.75	C_C	0.94

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 9.0
Total Wt. (gm) 448.95

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	1.650	1.650	0.368	99.63
1.180	91.400	93.050	20.726	79.27
0.600	137.700	230.750	51.398	48.60
0.425	70.000	300.750	66.990	33.01
0.300	17.700	318.450	70.932	29.07
0.150	38.300	356.750	79.463	20.54
0.075	33.300	390.050	86.880	13.12



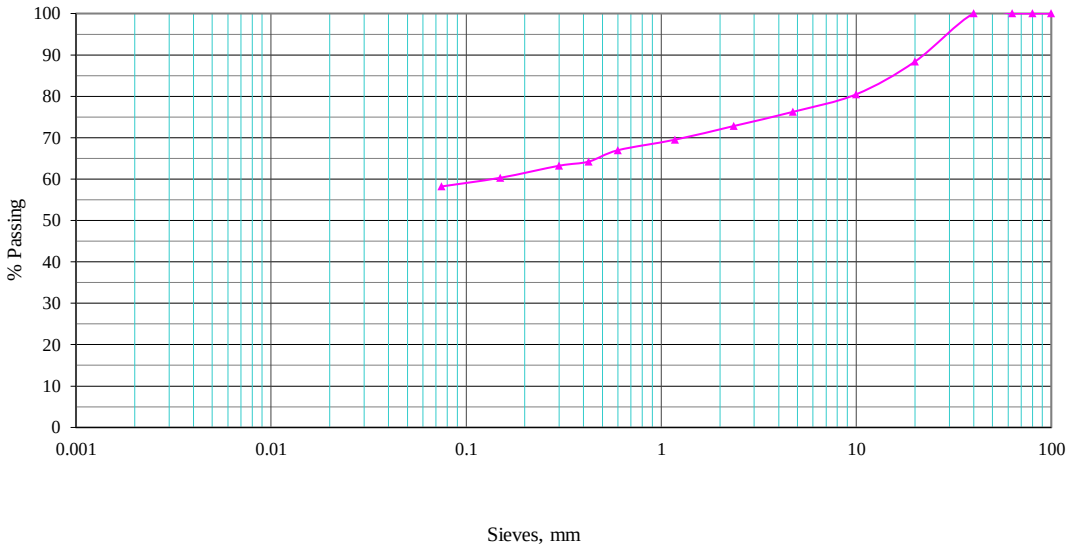
CLAY	SILT	SAND	GRAVEL
0.00 %	13.12 %	86.88 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0572	0.33	0.63	0.82
C_U	14.34	C_C	2.32

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : SPT **Depth (m):** 9.0
Total Wt. (gm) 620.00

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	72.000	72.000	11.613	88.39
10.000	49.000	121.000	19.516	80.48
4.750	26.200	147.200	23.742	76.26
2.360	21.250	168.450	27.169	72.83
1.180	20.500	188.950	30.476	69.52
0.600	15.840	204.790	33.031	66.97
0.425	17.000	221.790	35.773	64.23
0.300	6.200	227.990	36.773	63.23
0.150	18.000	245.990	39.676	60.32
0.075	13.000	258.990	41.773	58.23



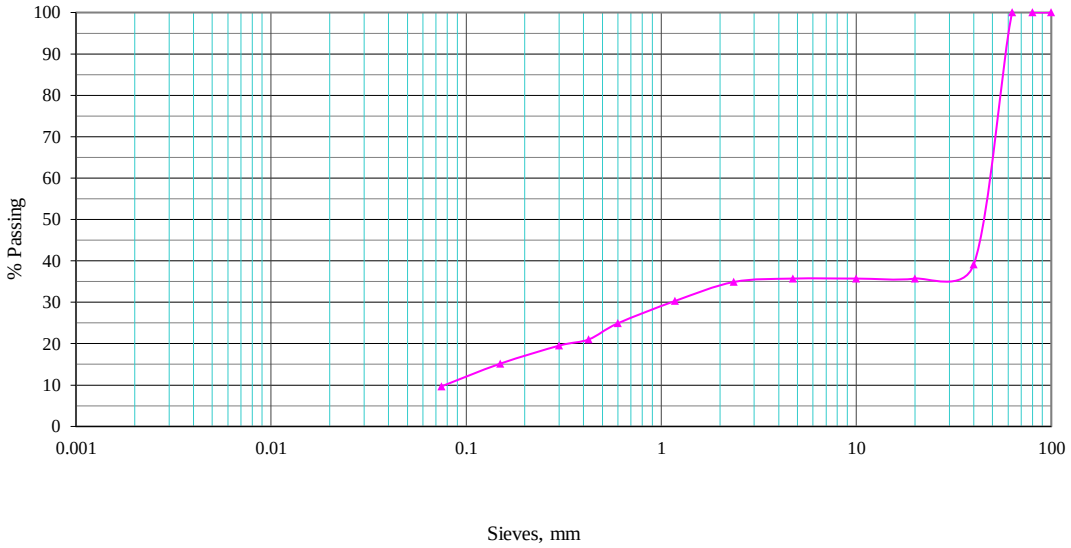
CLAY	SILT	SAND	GRAVEL
0.00 %	58.23 %	18.03 %	23.74 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0129	0.04	0.06	0.14
C_U	10.85	C_C	0.89

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 10.5
Total Wt. (gm) 837.30

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	510.000	510.000	60.910	39.09
20.000	28.200	538.200	64.278	35.72
10.000	0.000	538.200	64.278	35.72
4.750	0.000	538.200	64.278	35.72
2.360	6.850	545.050	65.096	34.90
1.180	38.350	583.400	69.676	30.32
0.600	45.300	628.700	75.087	24.91
0.425	32.600	661.300	78.980	21.02
0.300	12.550	673.850	80.479	19.52
0.150	36.350	710.200	84.820	15.18
0.075	45.900	756.100	90.302	9.70



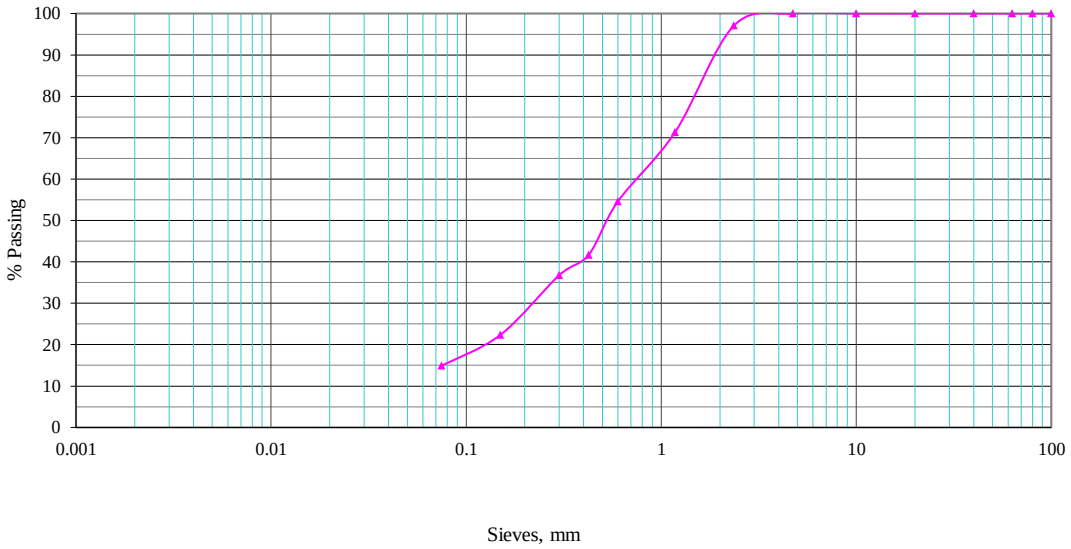
CLAY	SILT	SAND	GRAVEL
0.00 %	9.70 %	26.02 %	64.28 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0791	1.15	50.75	60.6
C_U	766.12	C_C	0.28

GRAIN SIZE ANALYSIS

Project : Geotechnical Investigation of Proposed Substation Site
Client : Nepal Electricity Authority
Location : Damauli, Tanahun
Bore Hole : 4
Sample : Disturbed **Depth (m):** 12.0
Total Wt. (gm) 404.15

Sieve (mm)	Weight Retained (gm)	Cum.Wt. Retained (gm)	Cum. Wt. Retained %	% Passing
100.000	0.000	0.000	0.000	100.00
80.000	0.000	0.000	0.000	100.00
63.000	0.000	0.000	0.000	100.00
40.000	0.000	0.000	0.000	100.00
20.000	0.000	0.000	0.000	100.00
10.000	0.000	0.000	0.000	100.00
4.750	0.000	0.000	0.000	100.00
2.360	11.850	11.850	2.932	97.07
1.180	103.850	115.700	28.628	71.37
0.600	67.750	183.450	45.392	54.61
0.425	52.100	235.550	58.283	41.72
0.300	20.000	255.550	63.231	36.77
0.150	58.200	313.750	77.632	22.37
0.075	30.000	343.750	85.055	14.94



CLAY	SILT	SAND	GRAVEL
0.00 %	14.94 %	85.06 %	0.00 %

D_{10}	D_{30}	D_{50}	D_{60}
0.0502	0.23	0.54	0.79
C_U	15.74	C_C	1.33

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines
Location: Kaski and Tanahun Districts

Sample : SPT Depth m : 1.5+3
Borehole No. : 1

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3		1	2
2	No. of Blows		4	12	32			
3	Wt. of Container + Wet Soil	gms	27.70	20.97	43.96		9.25	8.97
4	Wt. of Container + Dry Soil	gms	23.47	18.01	38.11		9.02	8.61
5	Wt. of Water Present	gms	4.23	2.96	5.85		0.23	0.36
6	Wt. of Empty Container	gms	7.27	5.23	7.58		7.54	6.58
7	Wt. of Dry Soil	gms	16.20	12.78	30.53		1.48	2.03
8	Moisture Content	%	26.11	23.16	19.16		15.54	17.73

Results :

Liquid Limit : 20.2
Plastic Limit : 15.5
Plasticity Index : 4.7

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines
Location: Kaski and Tanahun Districts

Sample : SPT Depth m : 1.5+3
Borehole No. : 5

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3	4	1	2
2	No. of Blows		18	20	29	32		
3	Wt. of Container + Wet Soil	gms	30.60	29.00	41.20	29.70	24.10	24.30
4	Wt. of Container + Dry Soil	gms	28.20	27.10	39.20	27.80	23.60	23.70
5	Wt. of Water Present	gms	2.40	1.90	2.00	1.90	0.50	0.60
6	Wt. of Empty Container	gms	21.40	21.60	33.00	21.70	21.80	21.60
7	Wt. of Dry Soil	gms	6.80	5.50	6.20	6.10	1.80	2.10
8	Moisture Content	%	35.29	34.55	32.26	31.15	27.78	28.57

Results :

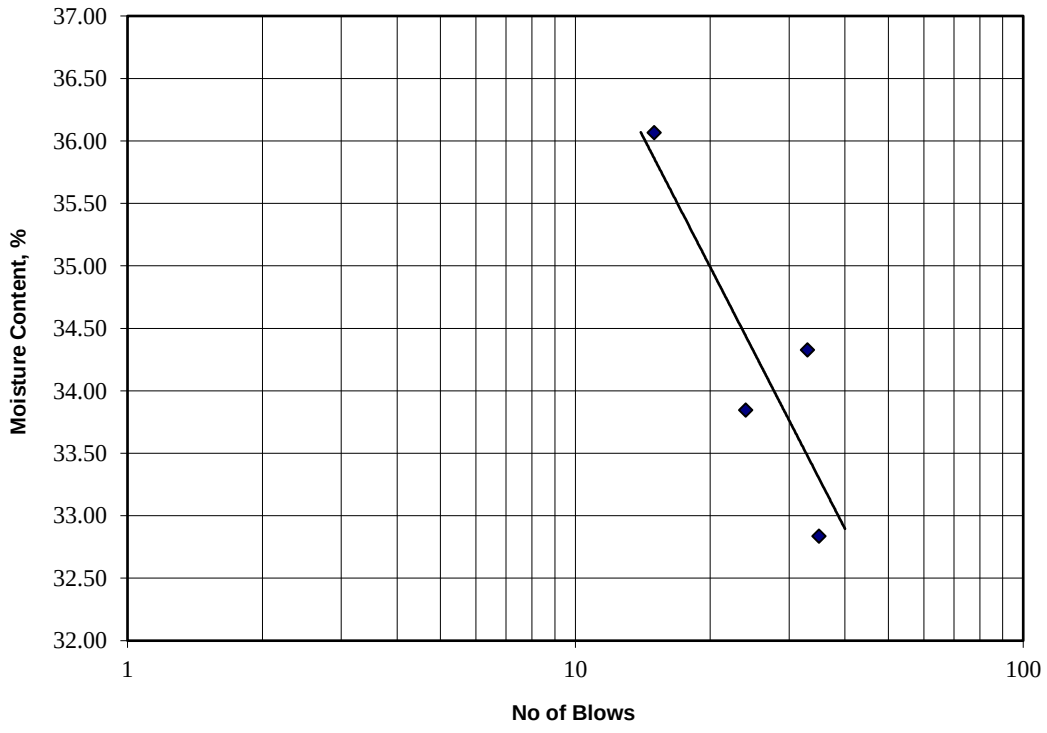
Liquid Limit : 33.0
Plastic Limit : 27.8
Plasticity Index : 5.3

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines
Location: Kaski and Tanahun Districts

Sample : SPT
Depth m : 4.5+6
Borehole No. : 5

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3	4	1	2
2	No. of Blows		15	24	33	35		
3	Wt. of Container + Wet Soil	gms	30.30	30.40	30.20	30.80	23.40	23.80
4	Wt. of Container + Dry Soil	gms	28.10	28.20	27.90	28.60	23.05	23.30
5	Wt. of Water Present	gms	2.20	2.20	2.30	2.20	0.35	0.50
6	Wt. of Empty Container	gms	22.00	21.70	21.20	21.90	21.80	21.70
7	Wt. of Dry Soil	gms	6.10	6.50	6.70	6.70	1.25	1.60
8	Moisture Content	%	36.07	33.85	34.33	32.84	28.00	31.25



Results :

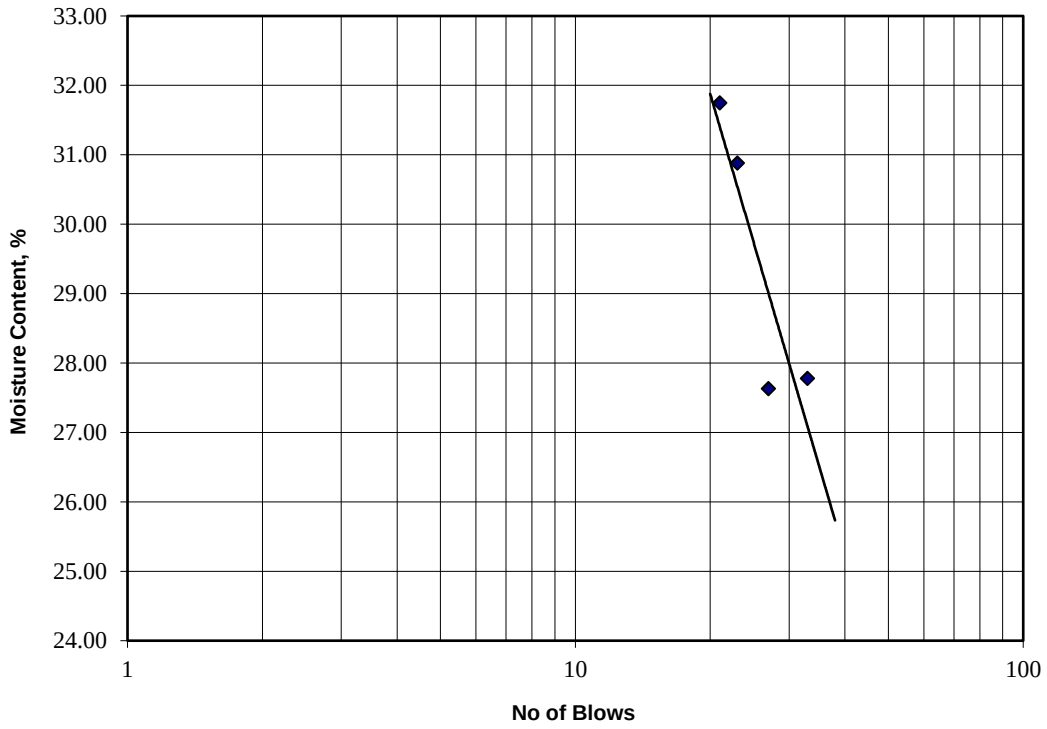
Liquid Limit	:	34.3
Plastic Limit	:	28.0
Plasticity Index	:	6.3

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Sites of Substations and Transmission Lines
Location: Kaski and Tanahun Districts

Sample : SPT Depth m : 1.5+3
Borehole No. : 7

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3	4	1	2
2	No. of Blows		21	23	27	33		
3	Wt. of Container + Wet Soil	gms	17.00	17.80	18.90	18.00	23.40	23.80
4	Wt. of Container + Dry Soil	gms	15.00	15.70	16.80	16.00	23.10	23.30
5	Wt. of Water Present	gms	2.00	2.10	2.10	2.00	0.30	0.50
6	Wt. of Empty Container	gms	8.70	8.90	9.20	8.80	21.80	21.70
7	Wt. of Dry Soil	gms	6.30	6.80	7.60	7.20	1.30	1.60
8	Moisture Content	%	31.75	30.88	27.63	27.78	23.08	31.25



Results :

Liquid Limit : 29.7
Plastic Limit : 23.1
Plasticity Index : 6.7

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Site
Location: Kaski

Sample No. : SPT Depth m : 1.5
Borehole No. : 3

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3	4	1	2
2	No. of Blows		30	26	21	18		
3	Wt. of Container + Wet Soil	gms	27.20	25.63	24.22	25.85	10.21	10.74
4	Wt. of Container + Dry Soil	gms	25.70	24.40	23.52	24.20	9.90	10.30
5	Wt. of Water Present	gms	1.50	1.23	0.70	1.65	0.31	0.44
6	Wt. of Empty Container	gms	21.55	21.14	21.80	20.40	8.94	8.96
7	Wt. of Dry Soil	gms	4.15	3.26	1.72	3.80	0.96	1.34
8	Moisture Content	%	36.14	37.73	40.70	43.42	32.29	32.84

Results :

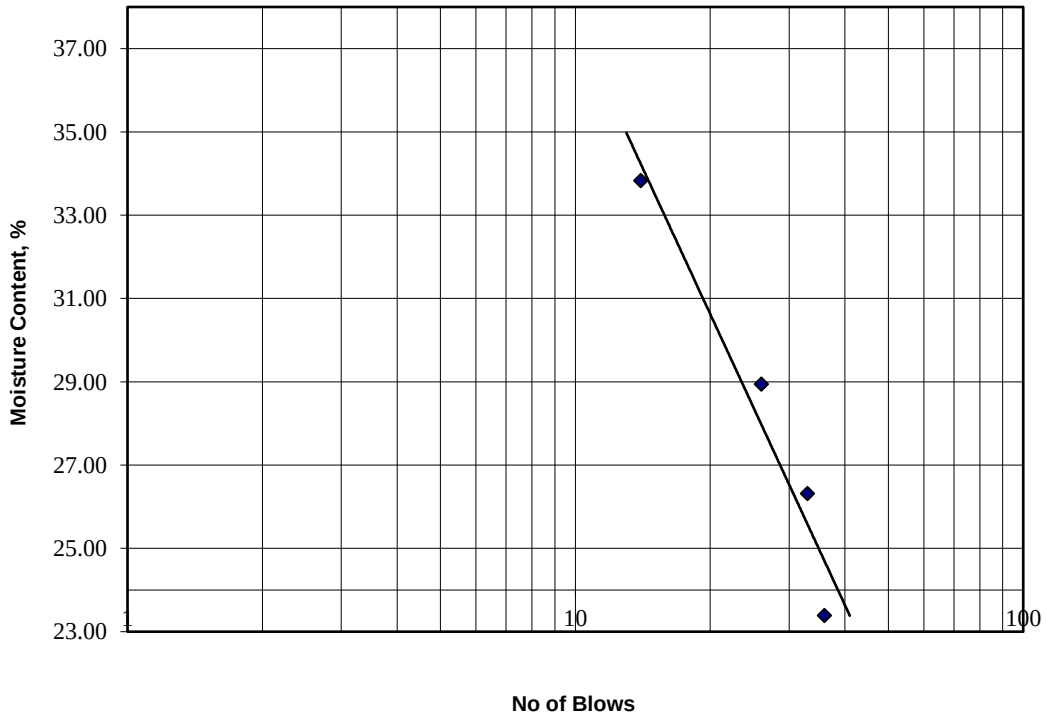
Liquid Limit : 38.5
Plastic Limit : 32.3
Plasticity Index : 6.2

LIQUID LIMIT & PLASTIC LIMIT

Project: Geotechnical Investigation of Proposed Site
Location: Kaski

Sample No. : SPT Depth m : 4.5
Borehole No. : 3

			Liquid Limit				Plastic Limit	
1	Specimen No.		1	2	3	4	1	2
2	No. of Blows		14	26	33	36		
3	Wt. of Container + Wet Soil	gms	25.90	26.41	39.42	25.92	10.28	10.44
4	Wt. of Container + Dry Soil	gms	24.99	25.42	38.52	25.12	10.00	10.20
5	Wt. of Water Present	gms	0.91	0.99	0.90	0.80	0.29	0.24
6	Wt. of Empty Container	gms	22.30	22.00	35.10	21.70	8.70	9.20
7	Wt. of Dry Soil	gms	2.69	3.42	3.42	3.42	1.30	1.00
8	Moisture Content	%	33.83	28.95	26.32	23.39	22.01	24.00



Results :

Liquid Limit : 28.4
Plastic Limit : 22.0
Plasticity Index : 6.4

DIRECT SHEAR TEST

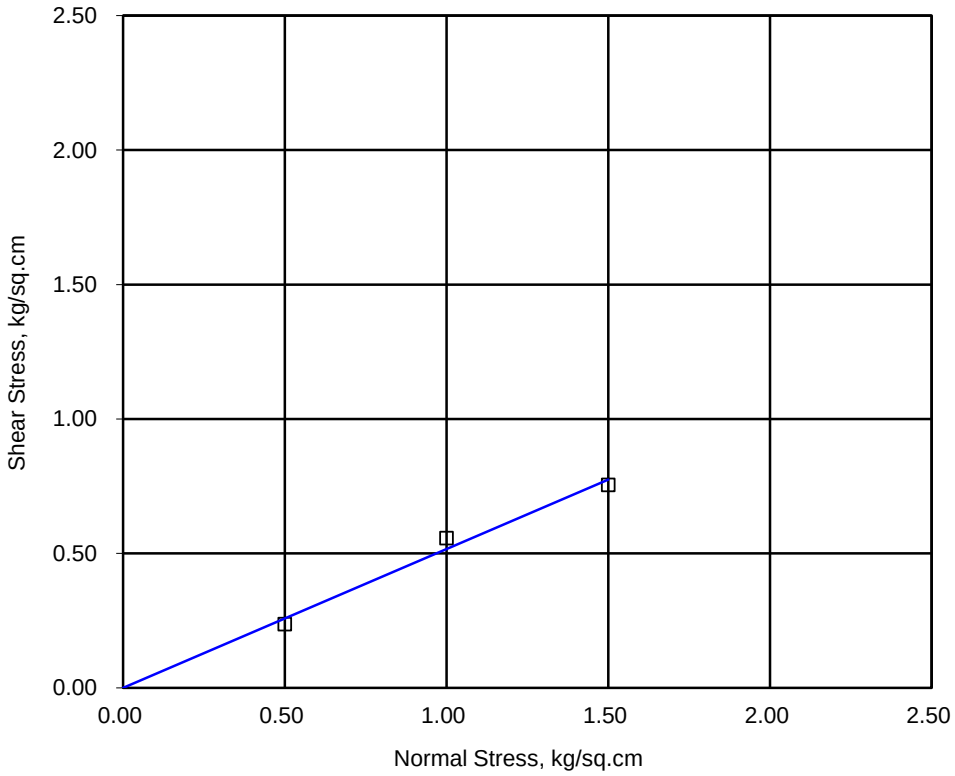
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 3.00
Borehole No.: 1 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	23.00	0.101	54.00	0.237	87.00	0.382
0.2	34.00	0.149	67.00	0.294	105.00	0.461
0.3	46.00	0.202	73.00	0.320	112.00	0.491
0.4	54.00	0.237	88.00	0.386	125.00	0.548
0.5	53.00	0.232	96.00	0.421	133.00	0.583
0.6			105.00	0.461	145.00	0.636
0.7			113.00	0.496	156.00	0.684
0.8			127.00	0.557	159.00	0.697
0.9					168.00	0.737
1.0					172.00	0.754
1.1					170.00	0.746
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 27°$



DIRECT SHEAR TEST

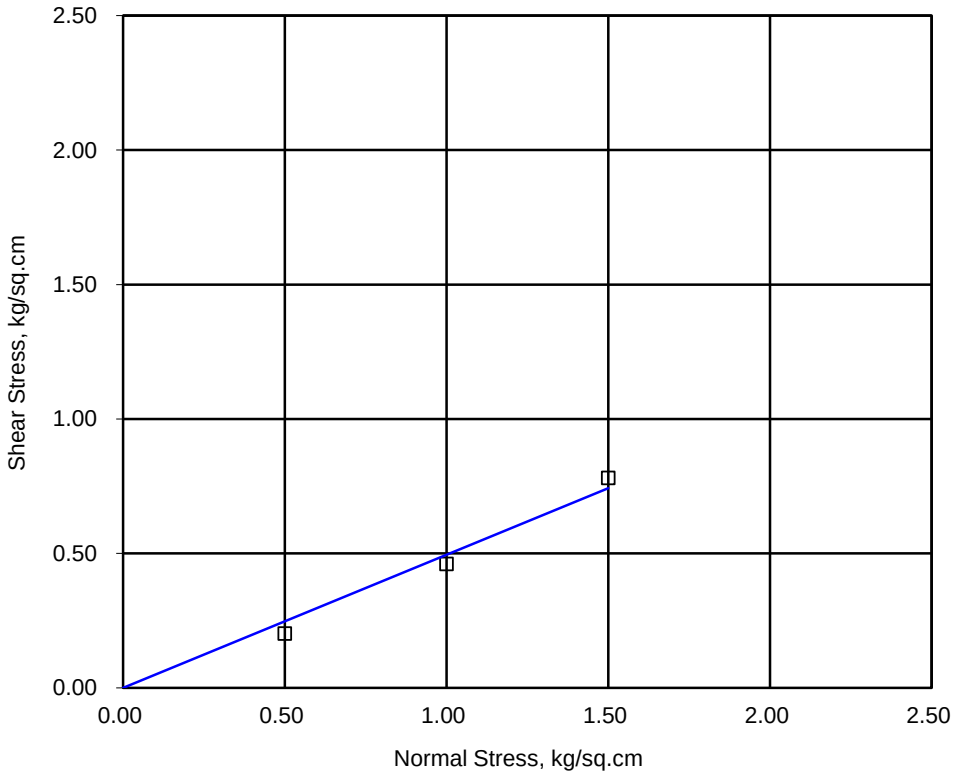
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 4.50
Borehole No.: 1 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	19.00	0.083	55.00	0.241	78.00	0.342
0.2	23.00	0.101	68.00	0.298	92.00	0.404
0.3	33.00	0.145	78.00	0.342	104.00	0.456
0.4	46.00	0.202	85.00	0.373	113.00	0.496
0.5	45.00	0.197	96.00	0.421	127.00	0.557
0.6			105.00	0.461	133.00	0.583
0.7			103.00	0.452	145.00	0.636
0.8					156.00	0.684
0.9					168.00	0.737
1.0					178.00	0.781
1.1					176.00	0.772
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 26°$



DIRECT SHEAR TEST

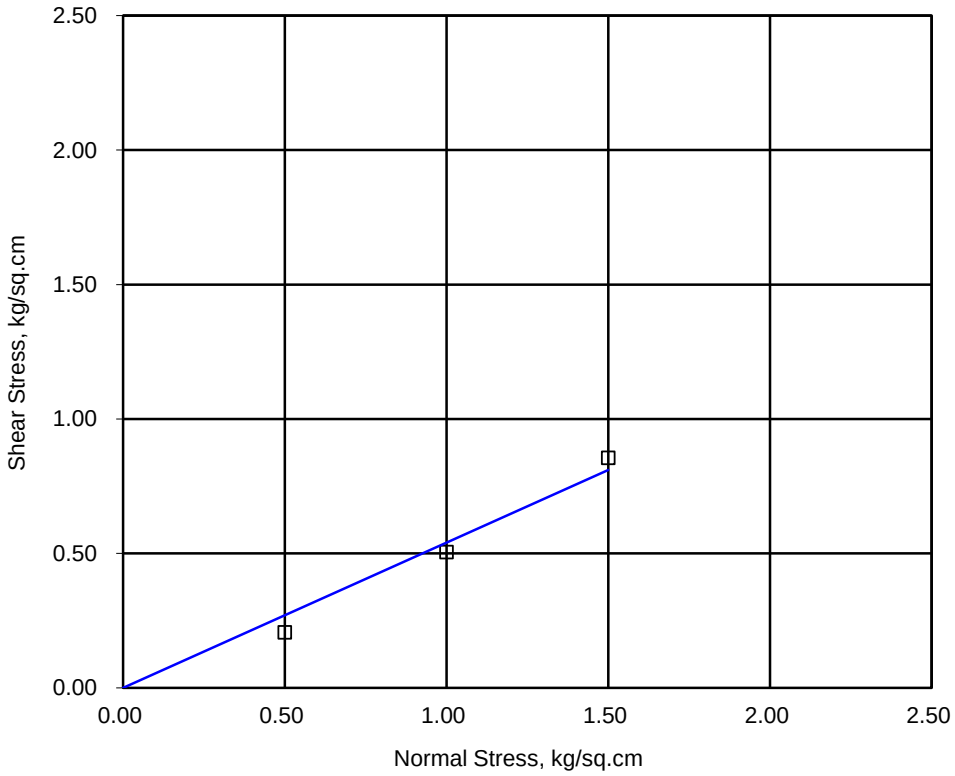
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 1.50
Borehole No.: 2 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	27.00	0.118	62.00	0.272	94.00	0.412
0.2	33.00	0.145	78.00	0.342	113.00	0.496
0.3	47.00	0.206	85.00	0.373	126.00	0.553
0.4	45.00	0.197	96.00	0.421	137.00	0.601
0.5			107.00	0.469	145.00	0.636
0.6			115.00	0.504	158.00	0.693
0.7			113.00	0.496	167.00	0.732
0.8					178.00	0.781
0.9					187.00	0.820
1.0					195.00	0.855
1.1					193.00	0.846
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 28°$



DIRECT SHEAR TEST

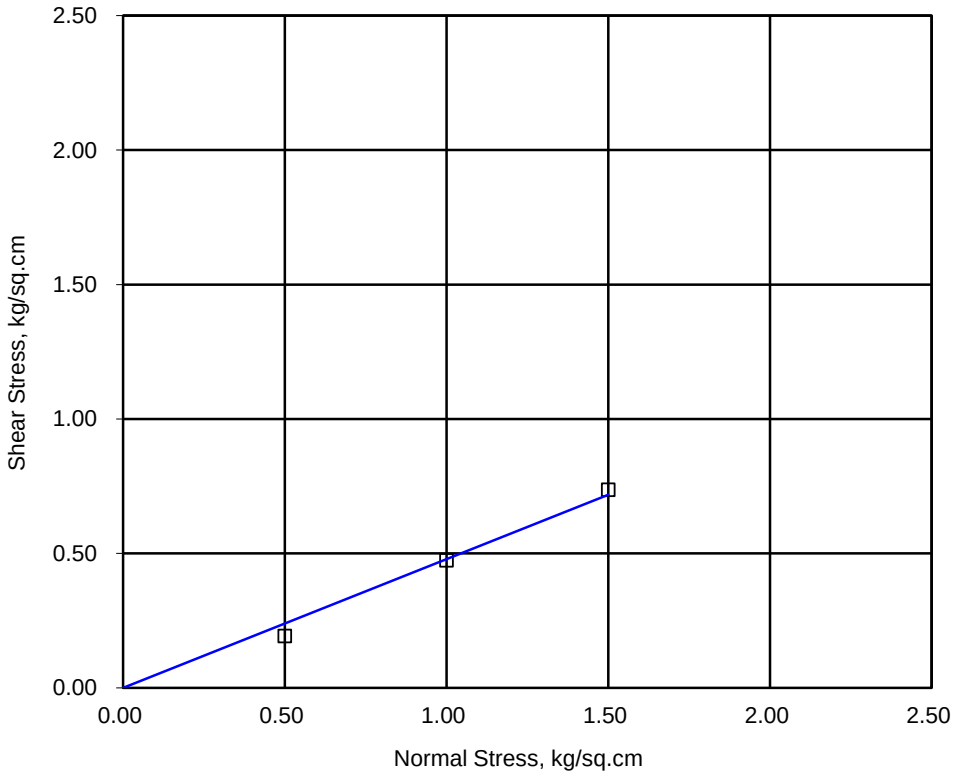
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 3.00
Borehole No.: 2 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	25.00	0.110	65.00	0.285	87.00	0.382
0.2	38.00	0.167	79.00	0.346	105.00	0.461
0.3	44.00	0.193	82.00	0.360	113.00	0.496
0.4	42.00	0.184	96.00	0.421	126.00	0.553
0.5			108.00	0.474	133.00	0.583
0.6			105.00	0.461	145.00	0.636
0.7					156.00	0.684
0.8					164.00	0.719
0.9					168.00	0.737
1.0					166.00	0.728
1.1						
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 26°$



DIRECT SHEAR TEST

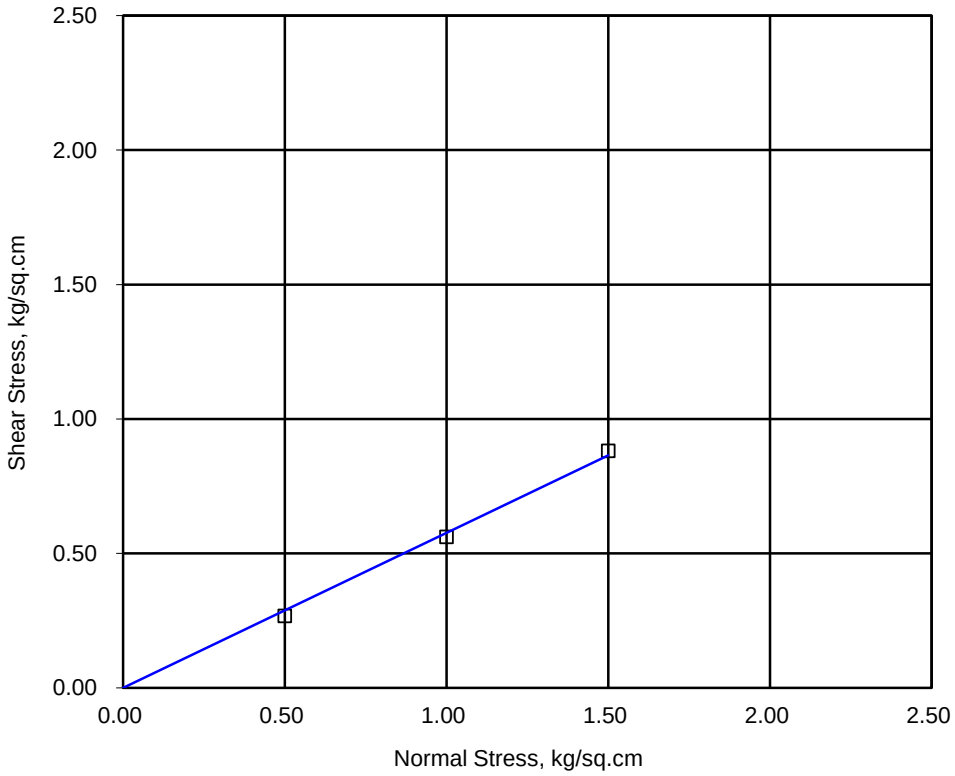
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 1.50
Borehole No.: 3 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	19.00	0.083	57.00	0.250	95.00	0.417
0.2	23.00	0.101	65.00	0.285	113.00	0.496
0.3	45.00	0.197	78.00	0.342	125.00	0.548
0.4	61.00	0.268	85.00	0.373	133.00	0.583
0.5	52.00	0.228	99.00	0.434	148.00	0.649
0.6			112.00	0.491	156.00	0.684
0.7			128.00	0.561	167.00	0.732
0.8			122.00	0.535	175.00	0.768
0.9					188.00	0.825
1.0					201.00	0.882
1.1					192.00	0.842
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 30°$



DIRECT SHEAR TEST

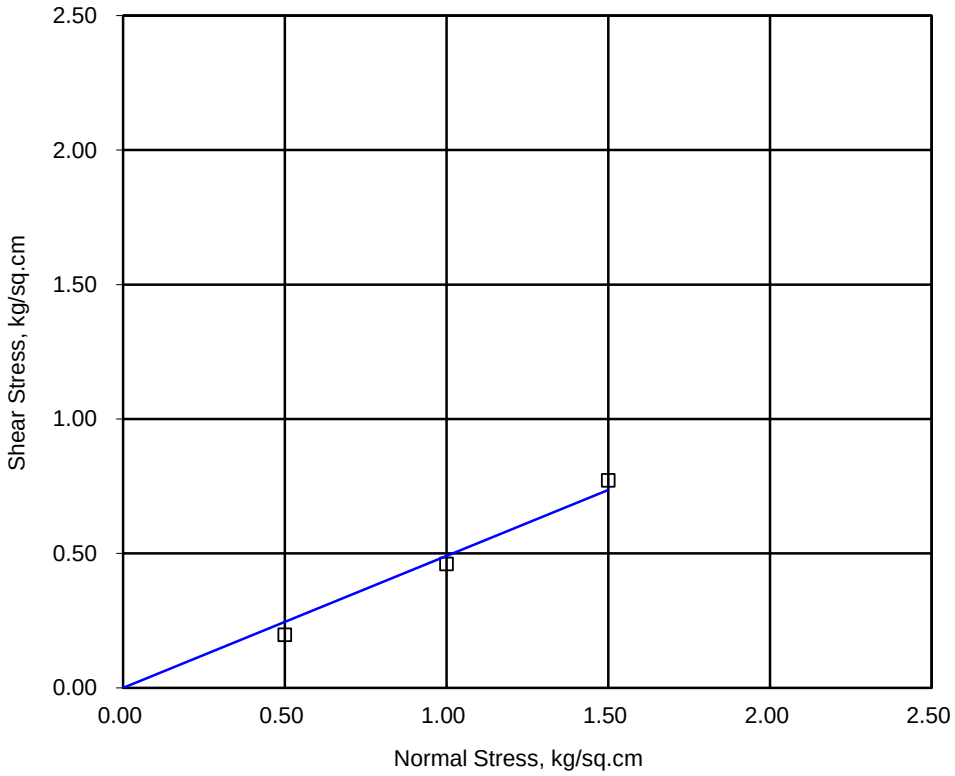
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 4.50
Borehole No.: 3 - NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	27.00	0.118	68.00	0.298	87.00	0.382
0.2	33.00	0.145	76.00	0.333	105.00	0.461
0.3	45.00	0.197	84.00	0.368	113.00	0.496
0.4	43.00	0.189	97.00	0.425	125.00	0.548
0.5			105.00	0.461	133.00	0.583
0.6			101.00	0.443	145.00	0.636
0.7					156.00	0.684
0.8					168.00	0.737
0.9					175.00	0.768
1.0					176.00	0.772
1.1						
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 26°$



DIRECT SHEAR TEST

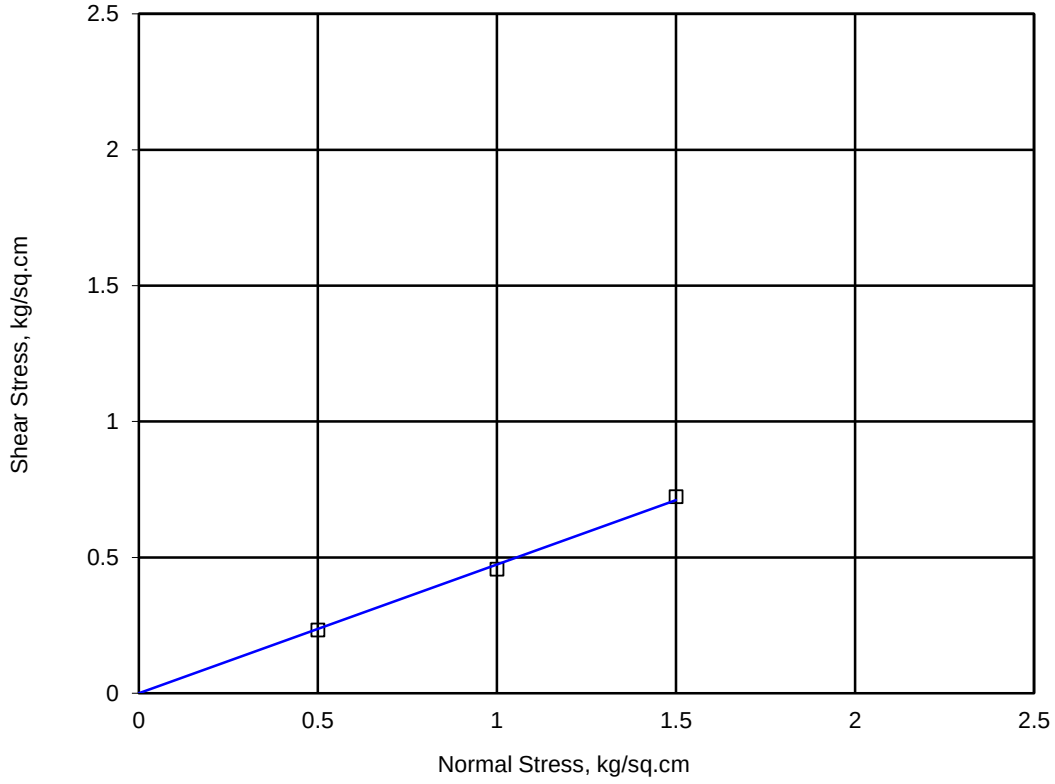
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 3.0
Borehole No.: 4- NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	16.00	0.070	57.00	0.250	87.00	0.382
0.2	23.00	0.101	72.00	0.316	104.00	0.456
0.3	38.00	0.167	86.00	0.377	113.00	0.496
0.4	52.00	0.228	95.00	0.417	126.00	0.553
0.5	47.00	0.206	112.00	0.491	133.00	0.583
0.6			123.00	0.539	145.00	0.636
0.7			121.00	0.531	158.00	0.693
0.8					178.00	0.781
0.9					192.00	0.842
1.0					202.00	0.886
1.1					200.00	0.877
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 30°$



DIRECT SHEAR TEST

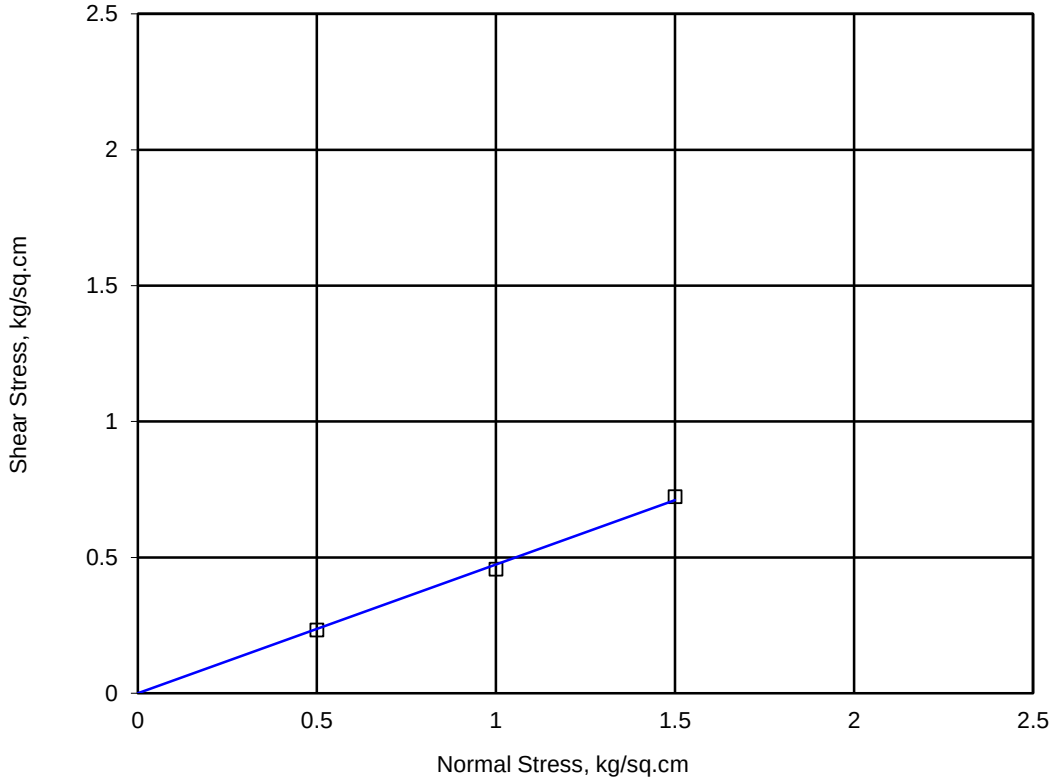
Project: Geotechnical Investigation of Proposed Substation Site
Client: Nepal Electricity Authority
Location: Damauli, Tanahun

Depth , m: 6.0
Borehole No.: 4- NEW

SDT	Test No. 1		Test No. 2		Test No. 3	
	Normal Stress 0.5 kg/cm²		Normal Stress 1.0 kg/cm²		Normal Stress 1.5 kg/cm²	
cm	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²	PRDRg	SST kg/cm²
0.1	27.00	0.118	52.00	0.228	95.00	0.417
0.2	38.00	0.167	68.00	0.298	112.00	0.491
0.3	56.00	0.246	78.00	0.342	126.00	0.553
0.4	51.00	0.224	86.00	0.377	134.00	0.588
0.5			99.00	0.434	145.00	0.636
0.6			109.00	0.478	162.00	0.711
0.7			104.00	0.456	179.00	0.785
0.8					188.00	0.825
0.9					204.00	0.895
1.0					210.00	0.921
1.1					204.00	0.895
1.2						
1.3						
1.4						
1.5						

SDT = Shear Displacement; PRDRg = Proving Ring Dial Reading; SST = Shear Stress

$\phi = 30°$



ANNEX-III
PHOTOGRAPHS

BOREHOLE -01

Conduction of Standard Penetration Test at Depth 1.5m

Conduction of Standard Penetration Test at Depth 6.0 m

Standard Penetration Test Sample at 1.5 m

Standard Penetration Test Sample at 6.0 m

BOREHOLE -02

Test scratches at site

Conduction of Standard Penetration Test

Standard Penetration Test at Site at depth of 1.5 m

BOREHOLE -03 – NEW – TRANSMISSION TOWER

Excavation of Trial Pits in Transmission Tower Location BH 3

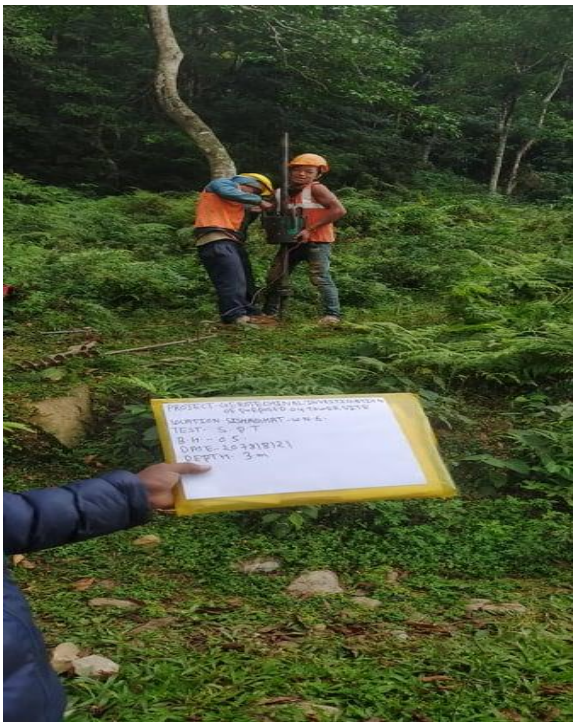
Augering in Process in Transmission Tower BH 3

Augering in Process in Transmission Tower BH 3

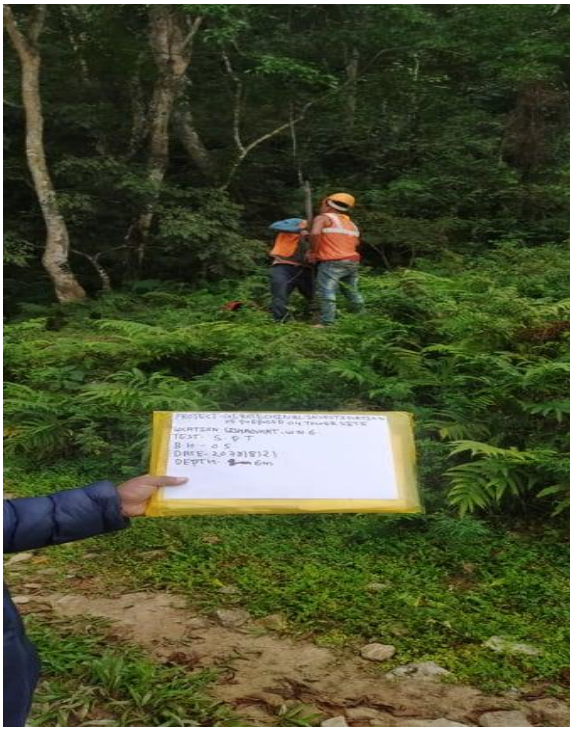
Soil Sample in Split Spoon Sampler of Transmission Tower BH 3

Conduction of Standard Penetration Test in Transmission Tower BH 3

BOREHOLE -04



Conduction of Standard Penetration Test at Depth 3.0m



Conduction of Standard Penetration Test at Depth 6.0 m

Standard Penetration Test Sample at 6.0m

BOREHOLE -05

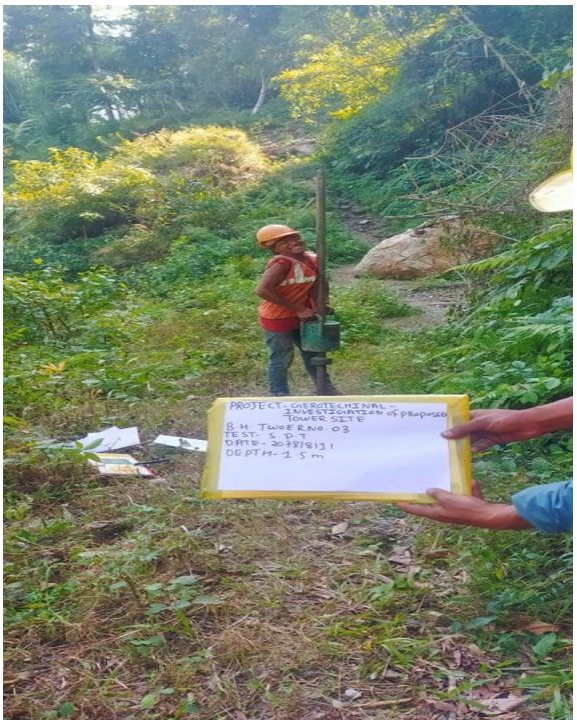
Drilling by Auger

Conduction of Standard Penetration Test at Depth 4.5 m

Conduction of Standard Penetration Test at Depth 6.0 m

Standard Penetration Test Sample at 3.0m

BOREHOLE -06



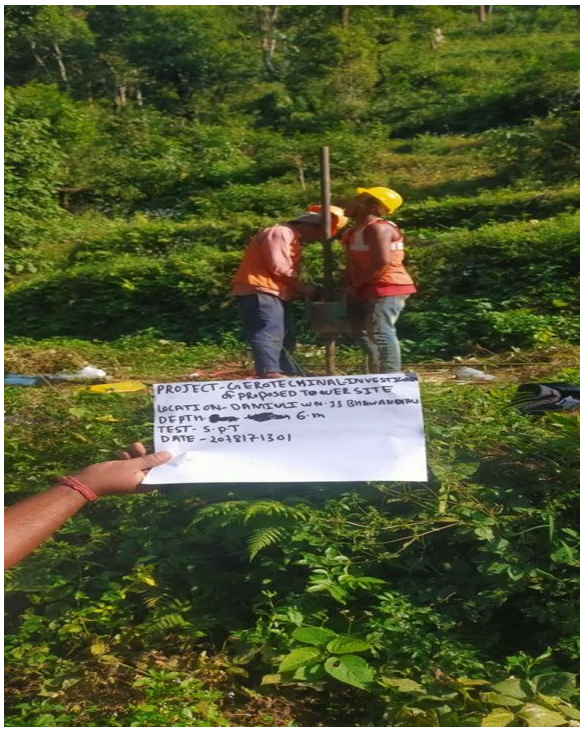
Conduction of Standard Penetration Test at Depth 1.5 m

Standard Penetration Test Sample at 1.5m

BOREHOLE -07

Conduction of Standard Penetration Test at Depth 3.0 m

Conduction of Standard Penetration Test at Depth 4.5 m



Conduction of Standard Penetration Test at Depth 6.0 m

Standard Penetration Test Sample at 6.0m

BOREHOLE -08 (DAMAULI SUBSTATION)

Conduction of Dynamic Cone Penetration Test at Depth 6.0 m

Conduction of Standard Penetration Test at Depth 9.0 m

Conduction of Dynamic Cone Penetration Test at Depth 15.0 m

Standard Penetration Test Sample at 9.0m

BOREHOLE -09 (LEKHNATH SUBSTATION)

Conduction of Dynamic Cone Penetration Test at Depth 3.0 m

Conduction of Dynamic Cone Penetration Test at Depth 4.5 m

Conduction of Dynamic Cone Penetration Test at Depth 6.0 m

Core Sample 0-5.0m

Core Sample 5.0-10.0m

Core Sample 10.0-15.0m

BOREHOLE – 1 TO 4 (NEW) (DAMAULI SUBSTATION)

Conduction of Standard Penetration Test at New Borehole 1 of Damauli SS; Depth 4.5 m

Conduction of Dynamic Cone Penetration Test at New Borehole 1 of Damauli SS; Depth 15 m

Conduction of Standard Penetration Test at New Borehole 2 of Damauli SS; Depth 1.5 m

Conduction of Standard Penetration Test at New Borehole 2 of Damauli SS; Depth 7.5 m

Conduction of Standard Penetration Test at New Borehole 3 of Damauli SS; Depth 7.5 m

Conduction of Dynamic Cone Penetration Test at New Borehole 3 of Damauli SS; Depth 15 m

Conduction of Standard Penetration Test at New Borehole 4 of Damauli SS; Depth 3 m

Conduction of Dynamic Cone Penetration Test at New Borehole 4 of Damauli SS; Depth 13.5 m

Soil Sample in Split Spoon Sampler of New Borehole 1 of Damauli SS; Depth 1.5 m

Soil Sample in Split Spoon Sampler of New Borehole 1 of Damauli SS; Depth 3 m

Soil Sample in Split Spoon Sampler of New Borehole 1 of Damauli SS; Depth 4.5 m

Soil Sample in Split Spoon Sampler of New Borehole 1 of Damauli SS; Depth 9 m

Soil Sample in Split Spoon Sampler of New Borehole 3 of Damauli SS; Depth 3 m

Soil Sample in Split Spoon Sampler of New Borehole 3 of Damauli SS; Depth 4.5 m

Soil Sample in Split Spoon Sampler of New Borehole 3 of Damauli SS; Depth 9 m

Soil Sample in Split Spoon Sampler of New Borehole 4 of Damauli SS; Depth 7.5 m

Soil Sample in Split Spoon Sampler of New Borehole 4 of Damauli SS; Depth 9 m

Soil Sample in Split Spoon Sampler of New Borehole 4 of Damauli SS; Depth 3 m

ANNEX-IV
FORMAT OF ANALYSIS

BOREHOLE 1					
S. No.	Depth (m)	DCPT		SPT (N)	Observed SPT
		no. of blows	penetration (cm)		
	0				
1	1.5			34	**34**
2	3			36	**36**
3	4.5			40	**40**
4	6			47	**47**

NCEER-1998: Youd et al. 2001

Correction to SPT (Modified from Skempton 1986) as listed by Robertson and Wride (1998)

Factor (1)	Equipment variable (2)	Term (3)	Correction (4)
Overburden pressure	—	C_N	$(P_a/\sigma'_{vo})^{0.5}$
Overburden pressure	—	C_N	$C_N \leq 1.7$
Energy ratio	Donut hammer	C_E	0.5–1.0
Energy ratio	Safety hammer	C_E	0.7–1.2
Energy ratio	Automatic-trip Donut-type hammer	C_E	0.8–1.3
Borehole diameter	65–115 mm	C_B	1.0
Borehole diameter	150 mm	C_B	1.05
Borehole diameter	200 mm	C_B	1.15
Rod length	<3 m	C_R	0.75
Rod length	3–4 m	C_R	0.8
Rod length	4–6 m	C_R	0.85
Rod length	6–10 m	C_R	0.95
Rod length	10–30 m	C_R	1.0
Sampling method	Standard sampler	C_S	1.0
Sampling method	Sampler without liners	C_S	1.1–1.3

Borehole Diameter (mm)= 76
Sampler type = Standard
Sampling method (Standard=1, without liner=1.1-1.3)
BOREHOLE BOREHOLE 1

					Correction for				
S.No.	**Depth (m)**	**Measured (N)**		**Rod length (m)**	**Energy Ratio (C_E)**	**Borehole diameter (C_B)**	**Rod length (C_R)**	**Sampler type (C_S)**	**N_{60}**
1	1.5	34		2.7	0.92	1	0.75	1	23
2	3	36		4.2	0.92	1	0.85	1	28
3	4.5	40		5.7	0.92	1	0.85	1	31
4	6	47		7.2	0.92	1	0.95	1	41

Note: Em =0.55 for hand drop hammer; is the rod energy ratio for hammer used in the investigation, due to lack of true verticalness and proper speed of SPT blow (Kovacs 1983)

BOREHOLE 1						
Description	**Unit**	**Symbol**	**Data**			
Soil Unit Weight	kN/m^3	g	17	17	17	17
Depth to WT (Critical)	m	Dw	0	0	0	0
Submerged Unit Weight	kN/m^3	g_{sub}	7.19	7.19	7.19	7.19
Adopted observed SPT Value	-	N	23	28	31	41
Depth	m	D	1.5	3.0	4.5	6.0
Effective Overburden Pressure	kN/m^2	p_0'	11	22	32	43
Correction Factor	-	C_N	1.75	1.51	1.38	1.28
N-Value after Overburden correction	-	N'	40	42	43	53
N-Value after Dilatancy correction	-	N''	28	29	29	34

BOREHOLE 1							
Depth,m	1.5	3	4.5	6			
Corrected N-value	28	29	29	34			
ISOLATED FOOTING - N-VALUE							
Depth (D_f,m)				1.50			
Width (B, m)	1.50	2.00	2.25	2.50	3.00	3.50	4.00
Length (L, m)	1.50	2.00	2.25	2.50	3.00	3.50	4.00
Effective Depth	4.5	5.5	6.0	6.5	7.5	8.5	9.5
Ncorr	28	30	30	30	30	30	30
Adopted Ncorr	27.58						

Calculation of Bearing Capacity of Open Foundation

From Shear Failure Criteria (IS 6403-1981)							
Bore Hole. No:	1						
Depth (D_f,m)				1.50			
Depth of water table below GL (Z_W,m)				0.00			
Unit wt of soil (KN/m^3)	17.00						
C (KN/m^2), FORMULA							
C (KN/m^2), LAB							
C (KN/m^2), For Design	0.00						
Width (B, m)	1.50	2.00	2.25	2.50	3.00	3.50	4.00
Length (L, m)	1.50	2.00	2.25	2.50	3.00	3.50	4.00
Eccentricity along X- dirn (e_x,m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eccentricity along Y- dirn (e_y,m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Corrected SPT Value (N_{corr})	27.58	27.58	27.58	27.58	27.58	27.58	27.58
Angle of Shearing Resistance (ϕ), FORMULA	33.19	33.19	33.19	33.19	33.19	33.19	33.19
Angle of Shearing Resistance (ϕ), LAB	-	-	-	-	-	-	-
Angle of shearing resistance (ϕ), For Design	33.19	33.19	33.19	33.19	33.19	33.19	33.19
Bearing Capacity factor (N_q)	26.71	26.71	26.71	26.71	26.71	26.71	26.71
Bearing Capacity factor (N_c)	39.29	39.29	39.29	39.29	39.29	39.29	39.29
Bearing Capacity factor (N_γ)	36.23	36.23	36.23	36.23	36.23	36.23	36.23
Shape factor (S_c)	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Shapr factor (S_q)	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Shape factor (S_γ)	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Sqrt (Nϕ)	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Depth factor (d_c)	1.37	1.28	1.25	1.22	1.18	1.16	1.14
Depth factor (d_q)	1.18	1.14	1.12	1.11	1.09	1.08	1.07
Depth factor (d_γ)	1.18	1.14	1.12	1.11	1.09	1.08	1.07
qu	10.50						
Inclination factor (i_c)	1.00						
Inclination factor (i_q)	1.00						
Inclination factor (i_γ)	1.00						
Correction for water table level ($R_{W)}$	0.00	0.13	0.17	0.20	0.25	0.29	0.31
Correction for water table level (R_W, m)	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Net Ultimate Bearing Capacity (q_{ult},KN/m^2)	602.71	649.33	675.13	701.93	757.53	814.84	873.22
Factor of Safety (FOS)	3.00						
Net Allowable Bearing Pressure (q_{na},KN/m^2)	201	216	225	234	253	272	291

From Settlement Criteria (Meyerhoff's modified Method)- Bowle's 1982 method							
Depth Correction (R_D)	1.33	1.25	1.22	1.20	1.17	1.14	1.12
Correction for water table level (R_{W2})	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Permissible settlement (mm)	20						
$q_{safe\text{-}pr\ 20mm}$ (KN/m^2)	264.15	227.55	216.13	207.27	194.43	185.58	179.11
Adopt Safe Bearing Capacity in KN/m^2(For 20 mm Permissible Settlement)	201	216	216	207	194	186	179

BH 1	BH 2	BH 3	BH 4	BH 8
22	50	17	50	16
14	22	24	12	19
22	50	21	16	17
11	26	10	21	17
8	18	6	18	24
37	10	49	50	34
50	50	50	50	33
50	50	50	50	35
50	50	50	50	50
50	50	50	50	50

MODELLED STRATA- NEW BH 1, 2,3,4 & BH 8						
S. No.	Depth (m)	DCPT no. of blows	DCPT penetration (cm)	SPT (N)	Corelated SPT	Observed SPT
	0					
1	1.5			16	**16**	**16**
2	3			12	**12**	**12**
3	4.5			16	**16**	**16**
4	6			10	**10**	**10**
5	7.5			6	**6**	**6**
6	9			10	**10**	**10**
7	10.5			33	**33**	**33**
8	12			35	**35**	**35**
9	13.5			50	**50**	**50**
10	15			50	**50**	**50**

NCEER-1998: Youd et al. 2001

Correction to SPT (Modified from Skempton 1986) as listed by Robertson and Wride (1998)

Borehole Diameter (mm)= 96

Sampler type = Standard

Sampling method (Standard=1, without liner=1.1-1.3)

BOREHOLE MODELLED STRATA- NEW BH 1, 2,3,4 & BH 8

						Correction for				
S.No.	**Depth (m)**	**Measured (N)**			**Rod length (m)**	**Energy Ratio (C_E)**	**Borehole diameter (C_B)**	**Rod length (C_R)**	**Sampler type (C_S)**	**N_{60}**
1	1.5	16			2.7	0.92	1	0.75	1	11
2	3	12			4.2	0.92	1	0.85	1	9
3	4.5	16			5.7	0.92	1	0.85	1	13
4	6	10			7.2	0.92	1	0.95	1	9
5	7.5	6			8.7	0.92	1	0.95	1	5
6	9	10			10.2	0.92	1	1	1	9
7	10.5	33			11.7	0.92	1	1	1	30
8	12	35			13.2	0.92	1	1	1	32
9	13.5	50			14.7	0.92	1	1	1	46
10	15	50			16.2	0.92	1	1	1	46

S. No.	Depth (m)	Correlated SPT	Lab data available (Y/N) ?	Data From Lab test C_u	Data From Lab test Φ°	Soil Contain (C, Φ,C- Φ)	major soil type: Gravel (G), Sand (S),Silt (M), Clay (C)	Stratum consists of fine sand or silty sand ? no(n)/yes(y)	Bulk Unit wt. KN/m^3	Submerged unit weight KN/m^3	effective unit weight KN/m^3	Angle of Shearing Resistance Φ°	Undrained cohesion Cu C_u	Total stress KN/m^2	Eff. stress KN/m^2	Overburden correction Factor (C_N)	$(N_1)_{60}$ after overburden correction	$(N_1)_{60}$ after dilatancy correction
1	1.5	**11**	**N**			Φ	S	y	17	10	7.0	29	0	30	11	1.8	19	17
2	3	**9**	**N**			Φ	S	y	17	10	7.0	27	0	60	21	1.5	13	13
3	4.5	**13**	**N**			Φ	S	y	17	10	7.0	29	0	90	32	1.4	18	17
4	6	**9**	**N**			Φ	S	y	17	10	7.0	26	0	120	42	1.3	11	11
5	7.5	**5**	**N**			Φ	S	y	17	10	7.0	23	0	150	53	1.2	6	6
6	9	**9**	**N**			Φ	S	y	17	10	7.0	26	0	180	63	1.2	10	10
7	10.5	**30**	**N**			Φ	G	y	17	10	7.0	34	0	210	74	1.1	33	24
8	12	**32**	**N**			Φ	G	y	17	10	7.0	34	0	240	84	1.1	33	24
9	13.5	**46**	**N**			Φ	G	y	17	10	7.0	36	0	270	95	1.0	46	31
10	15	**46**	**N**			Φ	G	y	17	10	7.0	36	0	300	105	1.0	45	30

ALLOWABLE BEARING CAPACITY Of BORED PILES IN SOIL

Type of Pile = Bored cast

Proposed length of Pile = 9 m

Dia of pile = 0.5 m

Pile Material = Concrete

GWT = 0 m

N_q,base = 48

N_c= 9

Restricts effective vertical stress = Yes

Effective vertical stress at pile base = 47.25 KN/m^2

γ' = 7 KN/m^3

Type of Consolidation = Normally

Critical depth = 19.7

σ_{0c}' = KN/m^2

Over Consolidation Ratio = 2.5

Sand Type = Unknown

Limiting Friction (KN/m^2) = 200000

Cross sectional Area of Pile = 0.20 m^2

Undarined cohesion at pile base = **0** KN/m^2

Liquefaction Considered = Yes

FoS against Liquefaction = 1

FoS against Bearing = 2.5

Assumed Scour Depth (m) = 1.5

Depth of Pile Top from normal ground level, m = 1.5

Depth of pile tip from normal ground level= 10.5

Angle of internal friction at pile tip= 35.00

Length of penetration of pile in the bearing strata, m= 9

																Shaft Resistance			Base Resistance					Considering Liquefaction	
Layer	H	Soil Type	Le	$N_{corrected}$	φ	undrained cohesion Cu	effective unit weight	effective overburden pressure	effective overburden pressure	Shaft area A_s	wall friction δ	Beta (K tan δ)	Undrained cohesion (Cu)	Adhesion factor (alpha)	Skin friction using alpha method (KN/m2)	Skin friction using beta method (KN/m2)	Qs Shaft (alpha) KN	Qs Shaft (beta) KN	Qs Shaft KN	Qb (alpha) KN	Qb (beta) KN	$Q_{b,\ base}$	Total Resistance (KN)	FOS against Liquefaction	Qs Shaft (KN)
						kN/m²	kN/m³	kN/m²		m²															
1.5	0	Φ	0	17	29	0.0	7	11	11	0.00	21.96	0.21	0.00	0.00	0.00	2.16	0.00	0.00	0.00					1.50	0.00
3	1.5	Φ	1.5	13	27	0.0	7	21	21	2.36	20.62	0.20	0.00	0.00	0.00	4.25	0.00	10.02	10.02					0.80	0.00
4.5	1.5	Φ	3	17	29	0.0	7	32	32	2.36	21.80	0.21	0.00	0.00	0.00	6.48	0.00	15.26	15.26					0.80	0.00
6	1.5	Φ	4.5	11	26	0.0	7	42	42	2.36	19.87	0.20	0.00	0.00	0.00	8.41	0.00	19.81	19.81					0.80	0.00
7.5	1.5	Φ	6	6	23	0.0	7	53	47	2.36	17.61	0.19	0.00	0.00	0.00	9.02	0.00	21.26	21.26	0.00	442.19	442.19	**554.09**	0.80	0.00
9	1.5	Φ	7.5	10	26	0.0	7	63	47	2.36	19.47	0.20	0.00	0.00	0.00	9.39	0.00	22.13	22.13					0.80	0.00
10.5	1.5	Φ	9	24	34	0.0	7	74	47	2.36	25.76	0.21	0.00	0.00	0.00	9.94	0.00	23.41	23.41					1.50	23.41
12	1.5	Φ	10.5	24	34	0.0	7	84	47	0.00	25.76	0.21	0.00	0.00	0.00	9.94	0.00	0.00	0.00					1.50	0.00
13.5	1.5	Φ	12	31	36	0.0	7	95	47	0.00	27.14	0.21	0.00	0.00	0.00	9.92	0.00	0.00	0.00					1.50	0.00
15	1.5	Φ	13.5	30	36	0.0	7	105	47	0.00	27.04	0.21	0.00	0.00	0.00	9.92	0.00	0.00	0.00					1.50	0.00
															otal Resistance (KN) =		**0.00**	**111.90**	**111.90**	**0.00**	**442.19**	**442.19**	**554.09**		**23.41**

Decrease in Frictional resistance due to Liquefaction = **88.5** **KN**

Total Tip Resistance = **442.2** **KN**

Total Frictional resistance = **23.4** **KN**

Total Resistance = **465.6** **KN**

Allowable Bearing = 186.24 KN

Annex D5-1

220/132 kV Lekhnath Substation Extension Single Line Diagram

Future 1
Begnas Pump Storage 1
To Damauli 1
Bus Coupler
To Damauli 2
Begnas Pump Storage 2
Future 2

Lekhnath 220/132kV extension
(KfW project scope of work)

GIS, DBB, 220kV, 40kA, 3150A

D01 D02 D03 D04 D05 (D05) D06 D07 D08 D09

Measuring Bay

3x1-ph., 220/132/33kV 105MVA (315MVA), Uk=12%

3x1-ph., 220/132/33kV 105MVA (315MVA), Uk=12%

K01 K02 K03 K04

SBB AIS 33kV, 25kA, 2000A

SBB AIS 33kV, 25kA, 2000A

Aux TR1 33/0.4kV 630kVA

Aux TR2 33/0.4kV 630kVA

AT2 Bay AT1 Bay

Existing Lekhnath 132kV

132kV AIS

Transfer Bus Bar

Main Bus Bar

Empty Bay

Transformer Bay 2 132/11kV 18/22.5MVA

Transformer Bay 1 132/11/6.6kV 22.5/22.5/7.5MVA

11kV

Transformer 132/33kV 24/27/30MVA

33kV

Existing 11kV Outgoing Feeders

Pokhara Bay | Bus Coupler Bay | Super Madi Bay Under Construction | Syangja Bay | Damauli Bay | Bhagawati Hydro Bay | Upper Madi Bay | Lahachowck 1 | Lahachowck 2

E14 E13 E12 E11 E10 E09 E08 E07 E06 E05 E04 E03 E02 E01

Legend

- Disconnector (for 220kV and 132kV motor operated)
- Circuit breaker (motor operated)
- Earthing switch (for 220kV and 132kV motor operated)
- Fast Earthing Switch (motor operated)
- Withdrawable Circuit Breaker (motor operated)
- Auto Transformer
- Zig-zag Transformer
- Power Transformer
- Power Transformer
- Current Transformer
- Surge arrester
- SA with Manual Removable Link
- Capacitive Voltage Transformer
- Inductive Voltage Transformer
- Bushing SF_6/AIR
- Cable
- Fuse
- Provision for future extension

Notes:
(1) The number of CTs cores is specified in the Data Sheet.

(2) The existing 132kV switchyard shall be integrated into the new 220 kV SCMS, except for the existing 132/11kV & 132/33kV transformers and the 11kV & 33kV feeders.

Annex D5-1

REV	DATE	NAME	CHECKED	NOTE
4	13.06.24	AKHALADZE	GRIESBAUM	Revised According NEA Comments
3	13.05.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	30.11.21	AKHALADZE	GATTI	Revision for Final Design Report
0	18.06.21	AKHALADZE	FUGAZZA	First Emission for Draft Design Report

FICHTNER

NEPAL ELECTRICITY AUTHORITY (NEA)

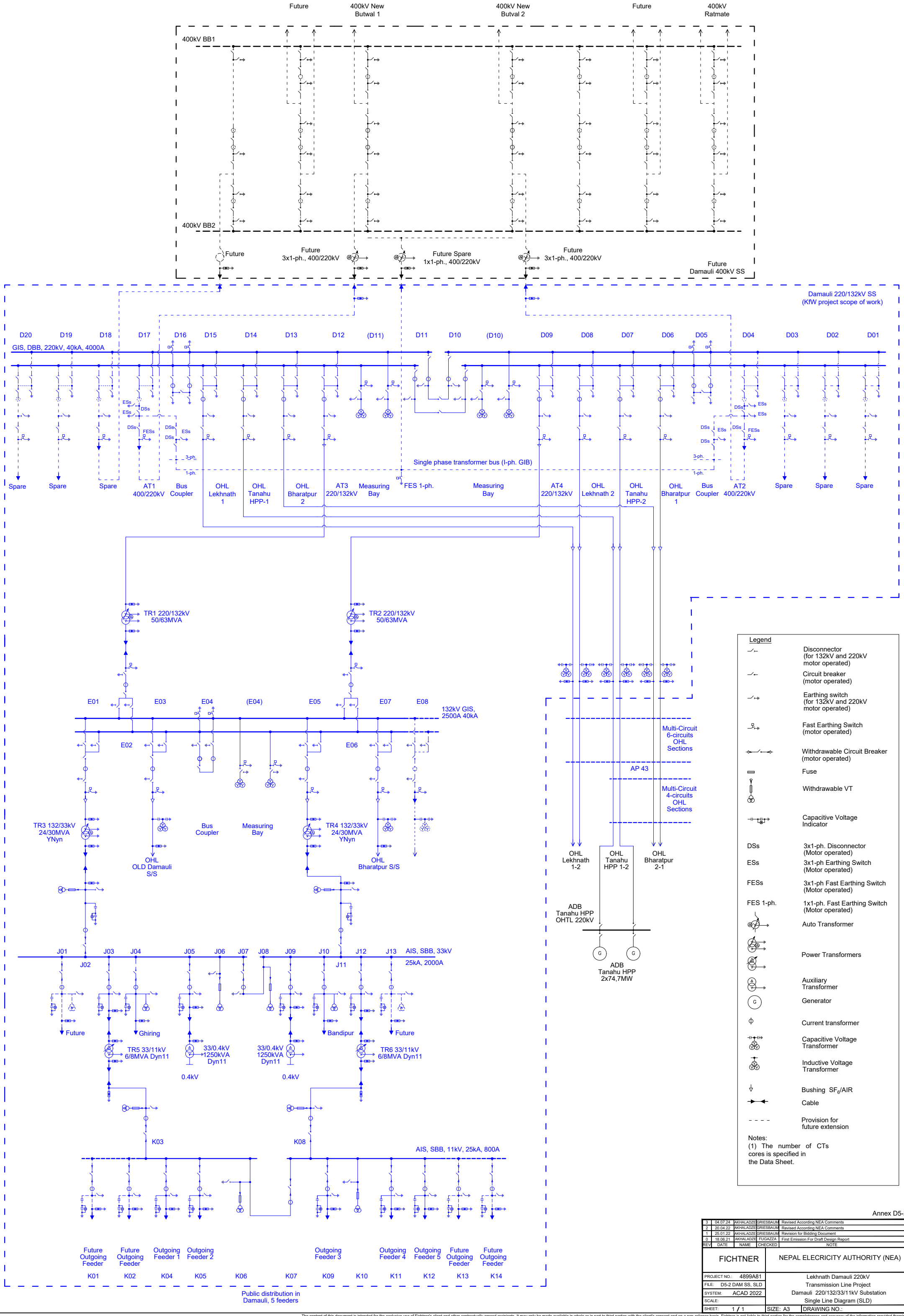
PROJECT NO.: 4899A81
FILE: D5-1 LEKH SS, SLD
SYSTEM: ACAD 2022
SCALE:
SHEET: 1 / 1

Lekhnath Damauli 220kV Transmission Line Project
SS Lekhnath 220/132kV Substation Extension
Single Line Diagram (SLD)

SIZE: A3 DRAWING NO.:

Annex D5-2

220/132/33/11 kV New Damauli Substation Single Line Diagram



Annex D5-2

REV	DATE	NAME	CHECKED	NOTE
3	04.07.24	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	20.04.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
1	25.01.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
0	18.06.21	AKHALADZE	FUGAZZA	First Emission For Draft Design Report

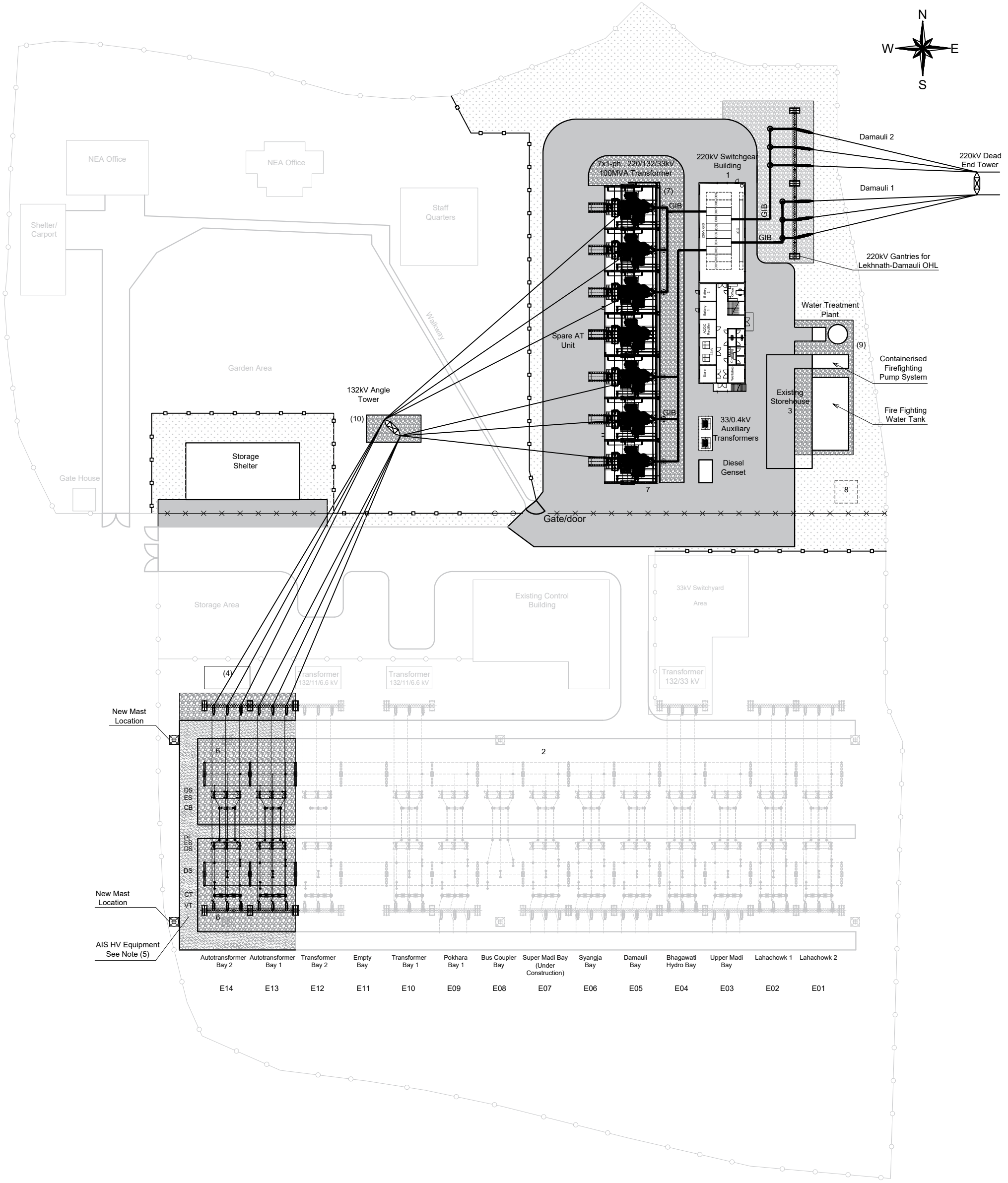
FICHTNER

NEPAL ELECRICITY AUTHORITY (NEA)

PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-2 DAM SS, SLD	Damauli 220/132/33/11kV Substation
SYSTEM: ACAD 2022	Single Line Diagram (SLD)
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-3

Lekhnath Substation Extension Layout



Notes:
(1) The 220kV GIS building shall include a separate two-story section housing for the 33kV switchgear (1st floor) and the P&C, SCMS and auxiliary supply systems (2nd floor).
(2) The representation of the existing 132kV bays - drawn in dotted line - is approximate and shown for the sake completeness only.
(3) Due to limited available space, the existing storehouse shall be demolished prior to the substation extension.
(4) Out of service transformer to be relocated by the Contractor.
(5) HV equipment designation for AT1 and AT2 bays only.
(6) No.2 (two) existing masts (lightning protection) to be relocated by Contractor
(7) Gantry and transfer bus for fast connection of spare autotransformer.
(8) Future location of Lahachowk 132kV OHL tower (out of project scope).
(9) The Water Treatment Plant shall serve the substation's facilities, as well as the existing Staff Quarters.
(10) 132kV Angle Tower and OHL from 132kV gantry to Autotransformer gantry in scope of Package (A) OHL

GIB Gas Insulated Bus Duct (with SF6/Air Bushings)

Legend

- Existing fence
- Existing fence to be dismantled
- New fence
- New road and transportation area (Asphalt)
- Vegetation
- Crushed rock
- Extension of existing roads

Scale (m) 0 5 10 15 20

Note:
The Layout and dimensions are tentative and represent minimum requirements subject to design by Contractor during design phase.

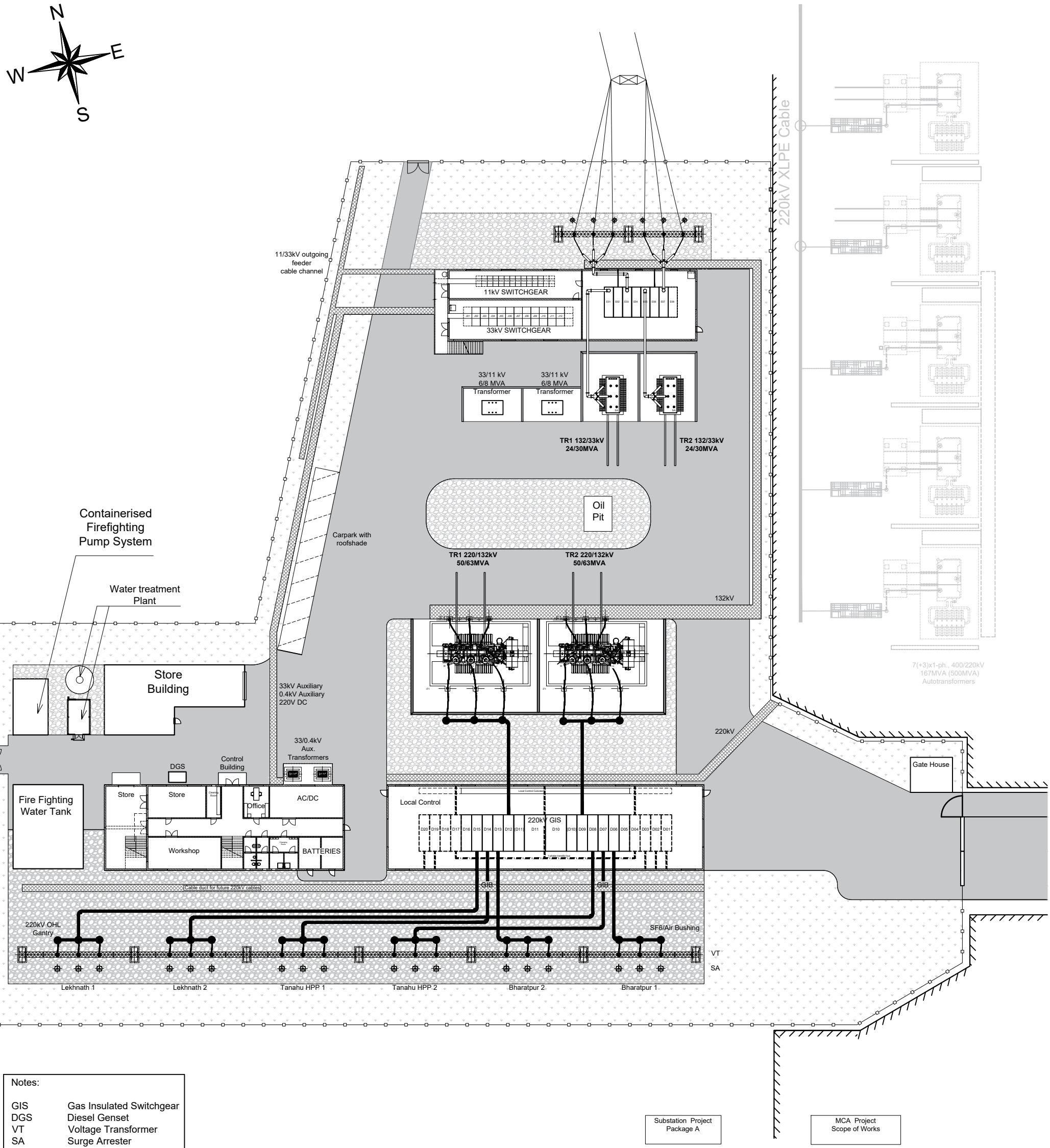
Annex D5-3

REV	DATE	NAME	CHECKED	NOTE
3	13.06.24	AKHALADZE	GRIESBAUM	Revised for Bidding Document
2	17.06.22	AKHALADZE	GRIESBAUM	Revised according NEA comments
1	30.11.21	AKHALADZE	GATTI	Revised for final design report
0	18.06.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project Lekhnath Substation Layout
FILE: D5-3 LEKH Layout	
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-4

New Damauli Substation Layout



Notes:

GIS	Gas Insulated Switchgear
DGS	Diesel Genset
VT	Voltage Transformer
SA	Surge Arrester

Fence

Road (Concrete)

Vegetation

Crushed rock

Cable channel

Substation Project Package A

MCA Project Scope of Works

Scale (m) 0 5 10 15 20

Note:
The Layout and dimensions are tentative and represent minimum requirements subject to design by Contractor during design phase.

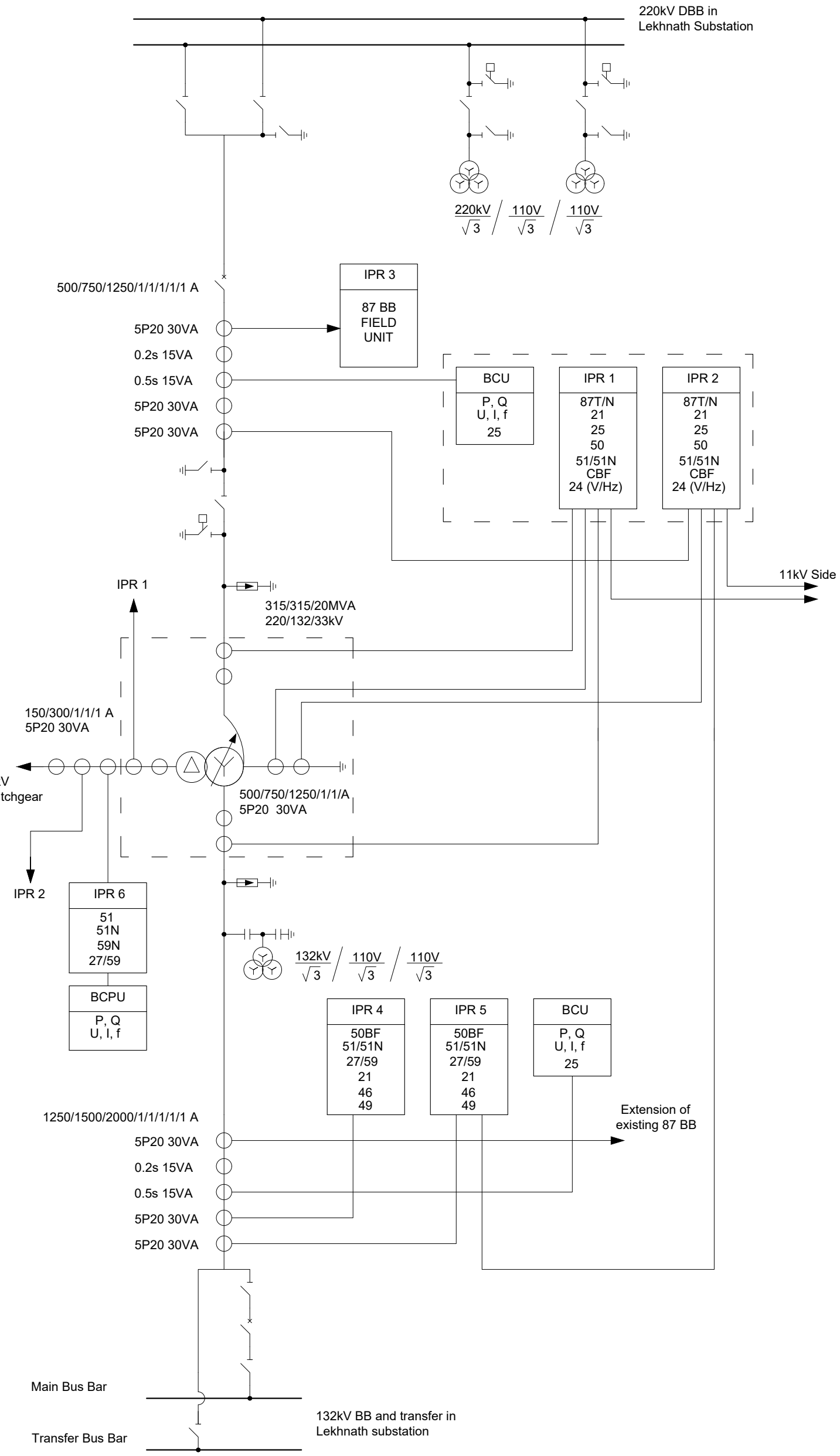
Annex D5-4

REV	DATE	NAME	CHCKED	NOTE
3	17.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	31.01.22	AKHALADZE	CUITUNEN	For Tender Documents
1	06.12.21	AKHALADZE	GATTI	Final Design Report
0	14.06.21	AKHALADZE	GATTI	First Isuue

FICHTNER	NEPAL ELECRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission line Project New Damauli Substatiom Layout
FILE: D5-4 DAM Layout	
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-5

Lekhnath 220/132/33 kV Autotransformer Protection Scheme



Legend

- Circuit Breaker
- Disconnector
- Earthing Switch
- Fast Earthing Switch FES
- Current Transformer
- Capacitive Voltage Transformer
- Inductive Voltage Transformer
- Surge Arrester
- Autotransformer

Note

1. Only IPR main functions are shown (for details refer to VII-1 scope and VII-5 technical specification).
2. All CT's and VT's secondary outputs shall be provided with test switches.
3. CT requirements are minimum values. The contractor shall check the suitability for the actual IPRs and measuring/metering systems. Bushing CT's ratios and specification to be optimized by the transformer manufacturer subject to employer's/engineer's approval.
4. Number and function allocation of IPRs shall be optimized by the contractor subject to employer's/engineer's approval.
5. Voltage input to IPRs not shown.
6. CT ratios to be verified by the contractor, Especially in regards to suitability to the existing 132kV Bus Bar protection at Lekhnat.

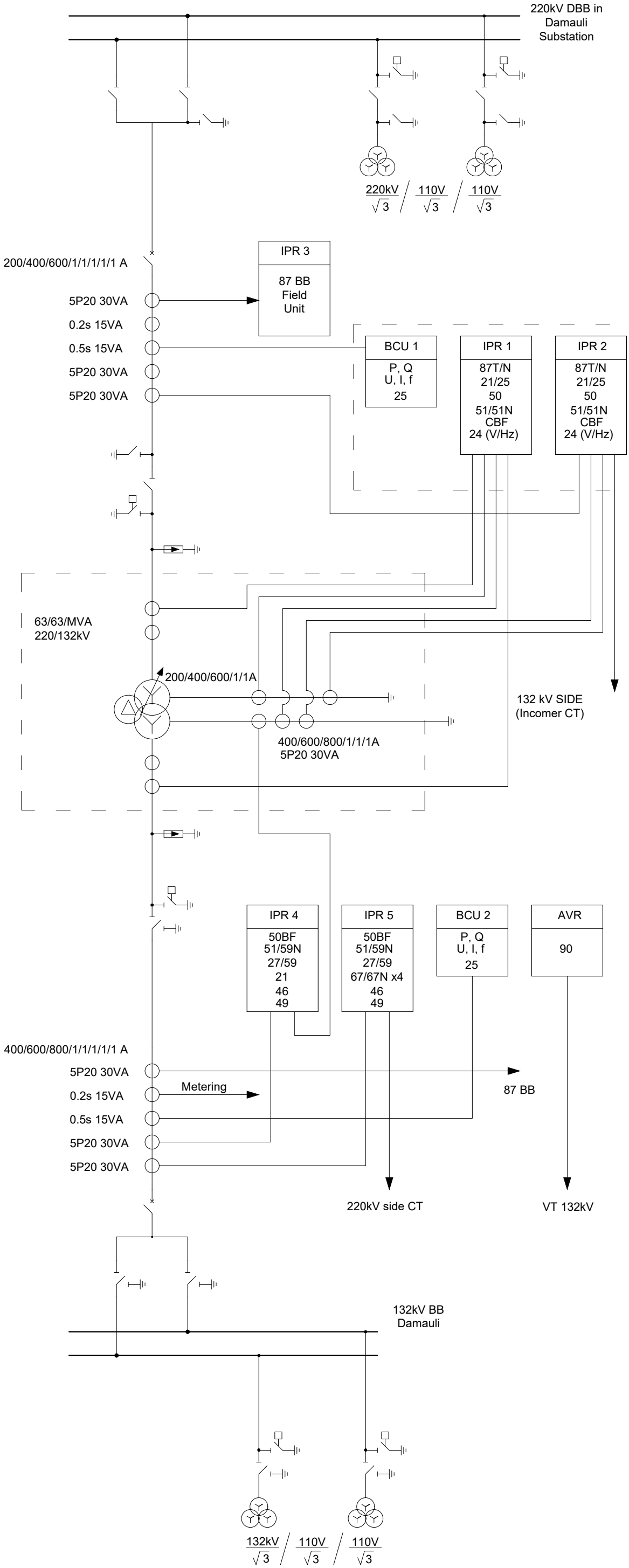
Annex D5-5

REV	DATE	NAME	CHECKED	NOTE
3	13.06.24	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	30.11.21	AKHALADZE	GATTI	Revised for Final Design Report
0	18.06.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-5 LEK P&C SLD	
SYSTEM: ACAD 2022	Lekhnat 220/132/33kV Autotransformer Protection Scheme
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-6

New Damauli 220/132 kV Power Transformer Protection Scheme



Legend

- Circuit Breaker
- 3 Position Switch
- Fast Earthing Switch FES
- Earthing Switch
- Disconnector
- Surge Arrester
- Current Transformer
- Capacitive Voltage Transformer
- Inductive Voltage Transformer
- Power Transformer

Note

1. Only IPR main functions are shown (for details refer to VII-1 scope and VII-5 technical specification).
2. All CT's and VT's secondary outputs shall be provided with test switches.
3. CT requirements are minimum values. The contractor shall check the suitability for the actual IPRs and measuring/metering systems. Bushing CT's ratios and specification to be optimized by the transformer manufacturer subject to employer's/engineer's approval.
4. Number and function allocation of IPRs shall be optimized by the contractor subject to employer's/engineer's approval.
5. Voltage input to IPRs not shown.
6. CT ratios to be verified by the contractor.

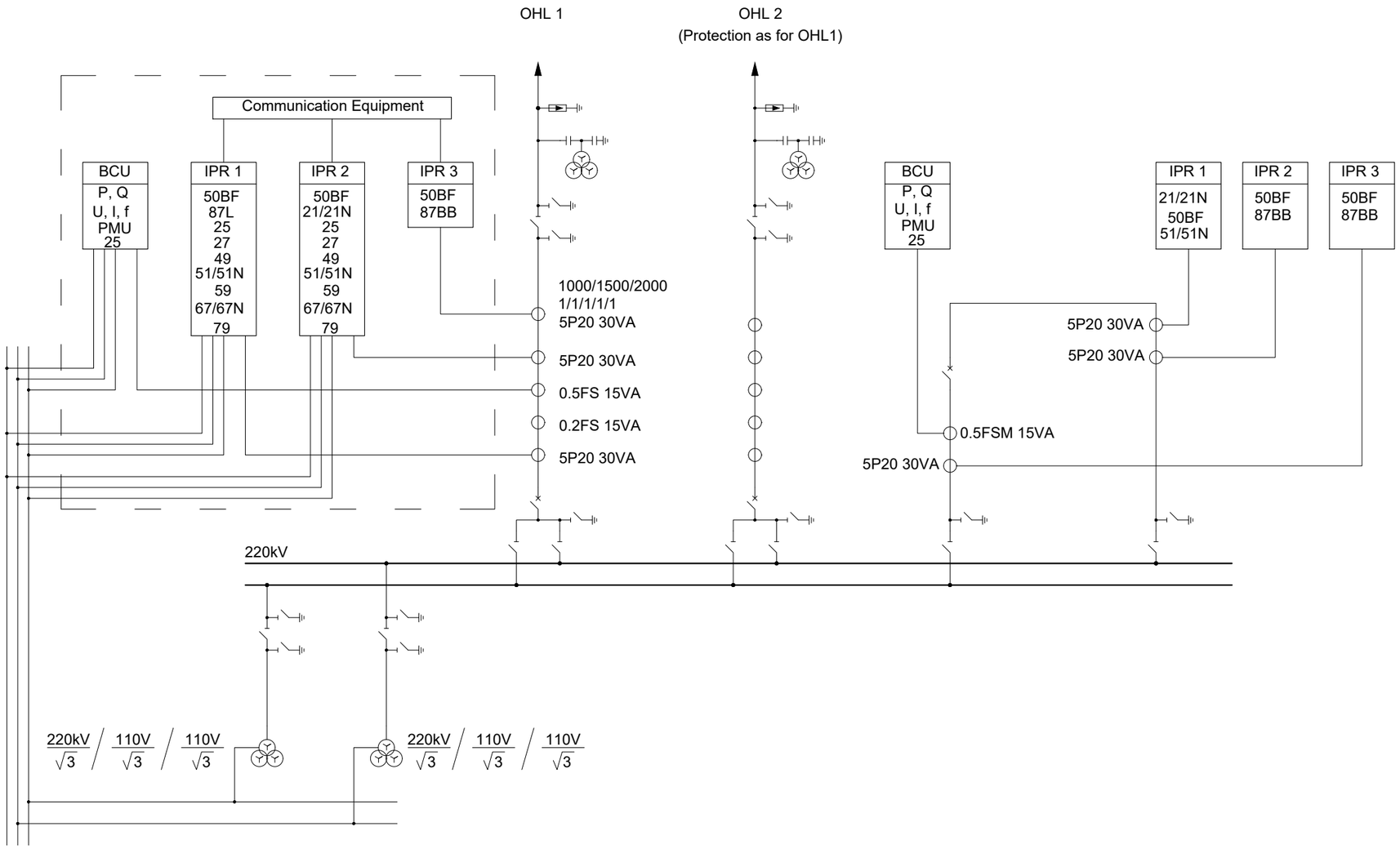
Annex D5-6

REV	DATE	NAME	CHECKED	NOTE
3				
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	30.11.21	AKHALADZE	GATTI	Revised for Final Design Report
0	18.06.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-6 DAM P&C SLD	New Damauli 220/132kV Power Transformer Protection Scheme
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-7

Lekhnath Extension and New Damauli 220 kV Overhead Transmission Line Protection Scheme



Legend

- Circuit Breaker
- Disconnector
- Earthing Switch
- Current Transformer
- Surge Arrester
- Inductive Voltage Transformer
- Capacitive Voltage Transformer

Note

1. Only IPR main functions are shown (for details refer to VII-1 scope and VII-5 technical specification)
2. All CTs and VTs secondary output have to be provided with test switches (not shown)
3. Number and function allocation of IPRs shall be optimized by the contractor subject to employer's/engineers's approval.

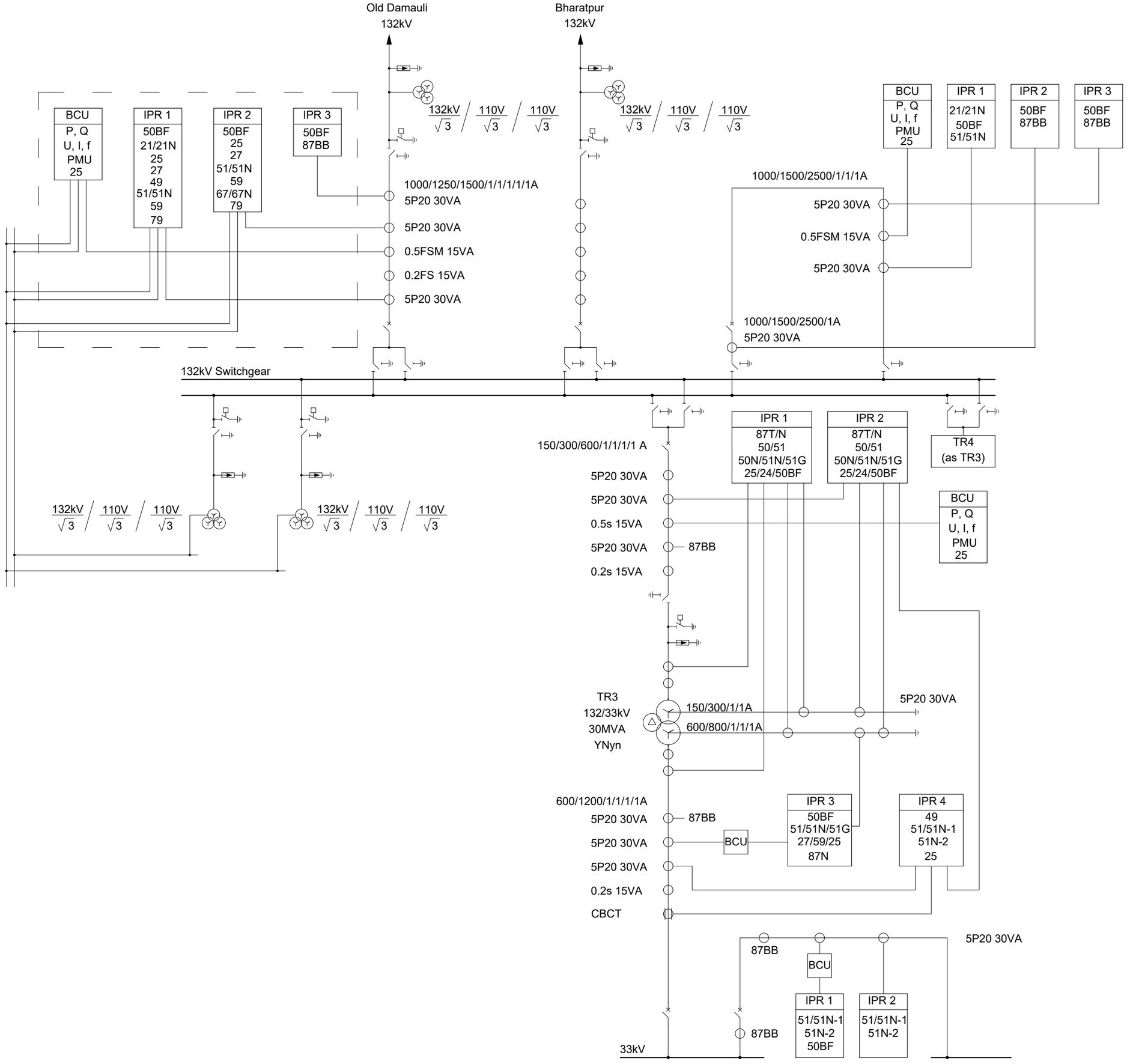
Annex D5-7

REV	DATE	NAME	CHECKED	NOTE
3	24.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	09.12.21	AKHALADZE	GATTI	Revised for Final Design Report
0	18.06.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-7 LEK P&C 220kV	
SYSTEM: ACAD 2022	Lekh. & New Dam. 220kV Overhead Transmission Line and Buscoupler Protection Scheme
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-8

New Damauli 132 kV Overhead Transmission Line and 132/33 kV Transformer Protection Scheme



Legend

- Circuit Breaker
- Disconnector
- Earthing Switch
- 3 Position Switch
- Fast Eearthing Switch (FES)
- Current Transformer
- Surge Arrester
- Inductive Voltage Transformer

Note

1. Only IPR main functions are shown (for details refer to VII-1 scope and VII-5 technical specification)
2. CTs and VTs secondary output has to be provided with test switches (not shown)
3. CT placement and sizing to be optimized by the Contractor

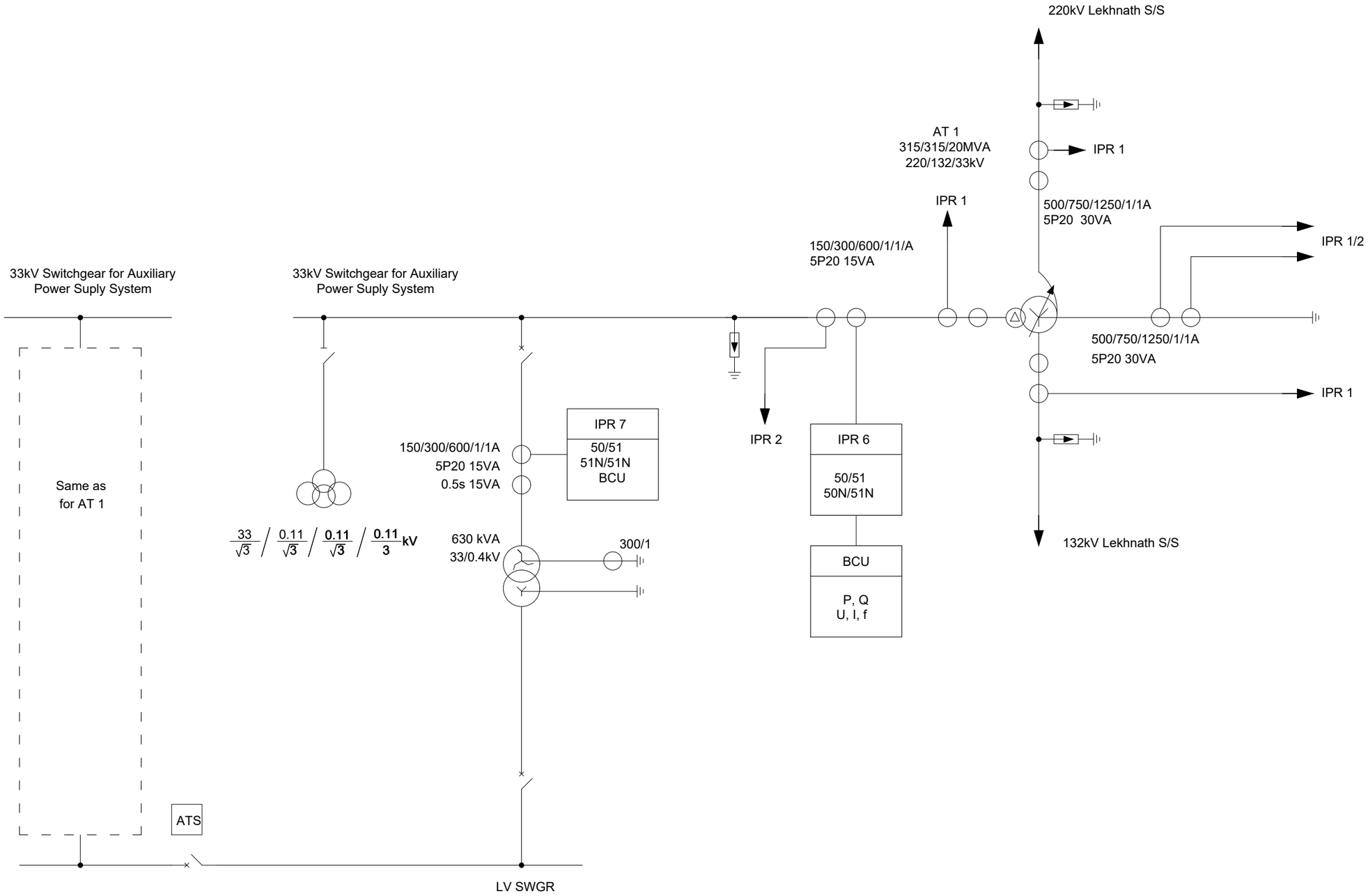
Annex D5-8

REV	DATE	NAME	CHECKED	NOTE
3	24.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	30.11.21	AKHALADZE	GATTI	Revised for Final Design Report
0	18.06.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-8 DAM P&C 132kV	New Damauli 132kV Overhead Transmission Line and 132/33kV Transformer Protection Scheme
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-9-A

Lekhnath Extension 33 kV Protection Scheme



Legend

- Circuit Breaker
- Disconnector
- Earthing Switch
- Current Transformer
- Surge Arrester
- Autotransformer
- Zig-zag auxiliary Transformer
- Inductive Voltage Transformer
- Earthing Resistor
- ATS — Automatic Transfer Switch

Note

1. CT placement to be optimized by contractor;
2. CT ratings are min. requirements;
3. Ref. for HV to Annex 5.5;
4. Protection of LV integral part of LV circuit breaker.

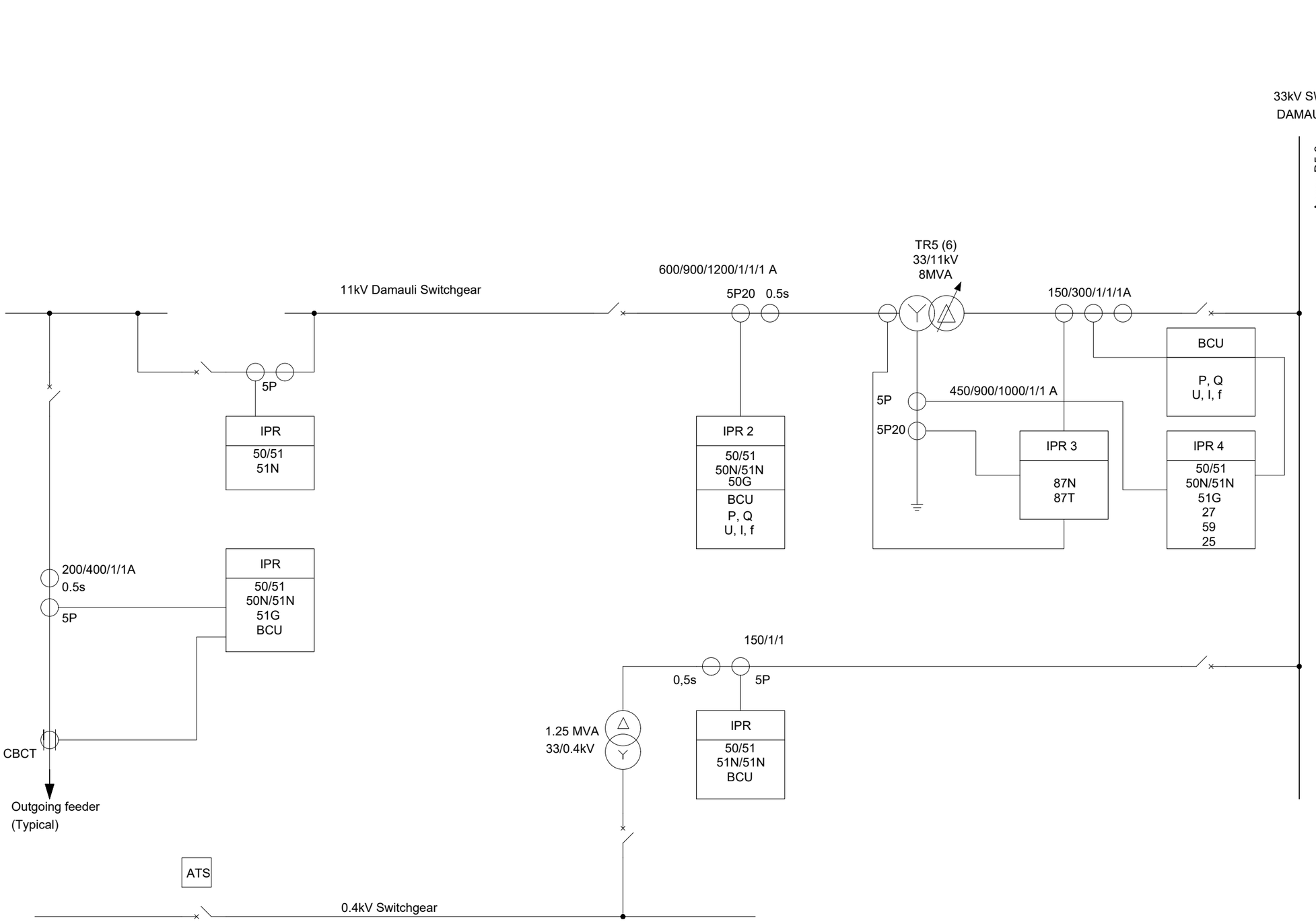
Annex D5-9A

REV	DATE	NAME	CHECKED	NOTE
4	13.06.24	AKHALADZE	GRIESBAUM	Revised According NEA Comments
3	24.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	30.11.21	AKHALADZE	GATTI	Revised for final design report
0	30.06.21	AKHALADZE	POPESCU	First Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project Lekhnath Extension 33kV Protection Scheme
FILE: D5-9A LEK.33kV Prot	
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-9-B

Damauli 33/11 kV Protection Scheme



NOTE

1. CT Placement and Sizing to be Optimized by Contractor.
2. For the 33kV Refer to Annex D5-8.
3. VT Connection not shown;
4. Protection of LV integral partt of LV circuit breaker.

Annex D5-9B

REV	DATE	NAME	CHECKED	NOTE
4	04.07.24	AKHALADZE	GRIESBAUM	Revised According NEA Comments
3	24.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
2	08.02.22	AKHALADZE	GRIESBAUM	Revision for Bidding Document
1	08.21.21	AKHALADZE	GATTI	That Revised for Final Design Report
0	30.06.21	AKHALADZE	POPESCU	Firset Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project Damauli 33/11kV Protection Scheme
FILE: D5-9B DAM.11kV Prot	
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

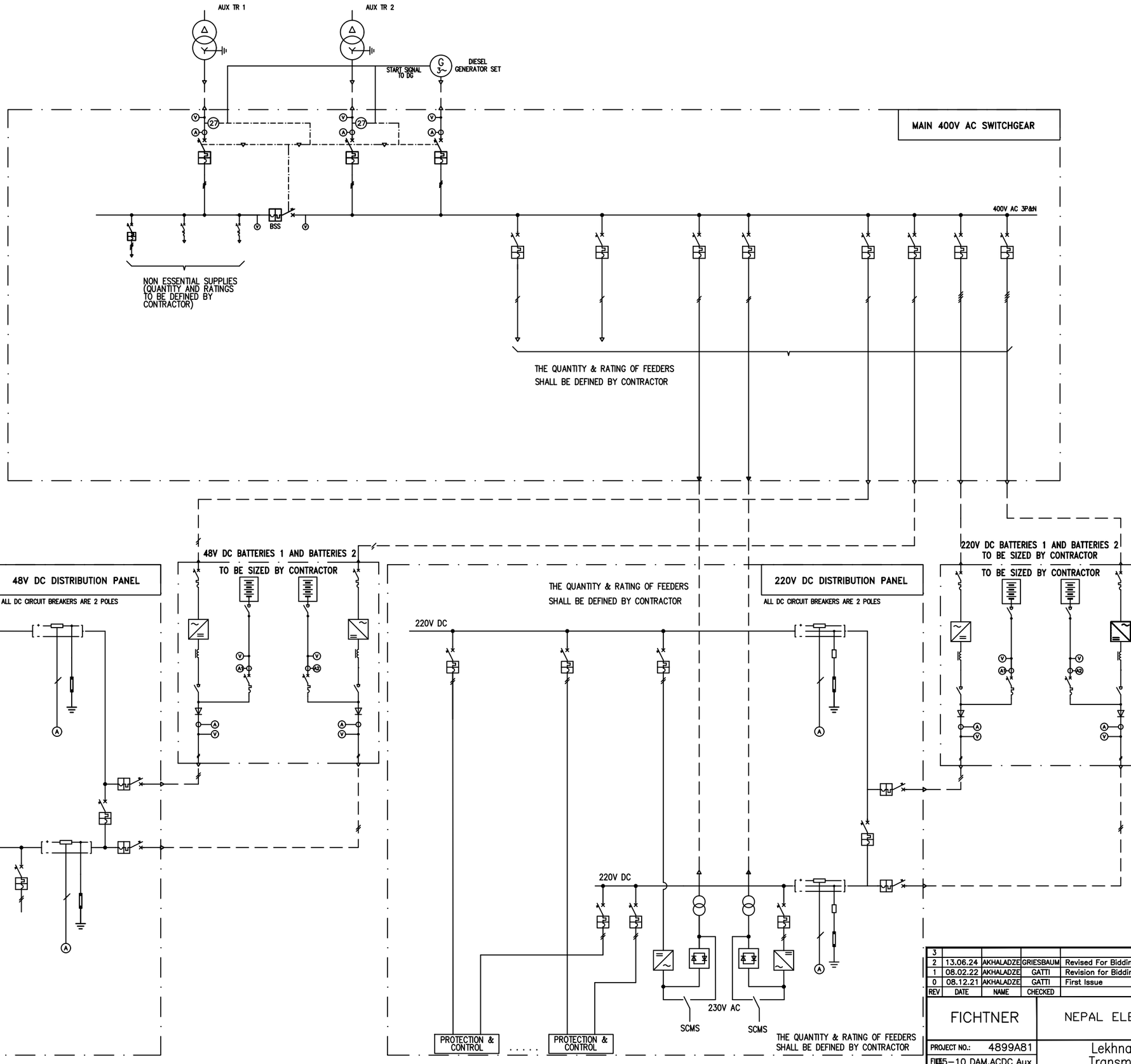
Annex D5-10

New Damauli AC/DC Auxiliary System Scheme

NOTES
1. MAIN LV SWITCHGEAR TO BE FORM 4b.
2. LOSS OF VOLTAGE ON INCOMER 1 WILL CAUSE INCOMER 1 TO OPEN AND BSS TO CLOSE. RETURN OF VOLTAGE ON INCOMER 1 WILL CAUSE INCOMER 1 TO CLOSE AND BSS TO OPEN.
3. LOSS ON VOLTAGE ON BOTH INCOMER 1&2 LOCKS BSS OPEN AND SENDS A START SIGNAL TO THE DIESEL GENERATOR WHEN THE VOLTAGE AND FREQUENCY FROM THE DIESEL GENERATOR ARE WITHIN LIMITS THE GENERATOR INCOMER CLOSES TO SUPPORT THE ESSENTIAL LOAD RETURN OF VOLTAGE TO EITHER INCOMER 1&2 SENDS A STOP SIGNAL TO THE GENERATOR AND AUTOMATICALLY OPENS THE GENERATOR INCOMER AND PERMITS INCOMER 1&2 TO CLOSE.
4. ALL INCOMERS AND BUS COUPLER TO BE 4 POLES.

LEGEND

- MINIATURE CIRCUIT BREAKER
- LOAD BREAK SWITCH
- DIODE
- AMMETER
- VOLTMETER
- BATTERY
- AUX TRANSFORMER
- CABLE
- STATIC BYPASS SWITCH
- INVERTER
- RECTIFIER
- EARTH
- RESISTOR
- DISCONNECT LINK



ANNEX D5-10

REV	DATE	NAME	CHECKED	NOTE
3				
2	13.06.24	AKHALADZE	GRIESBAUM	Revised For Bidding Document
1	08.02.22	AKHALADZE	GATTI	Revision for Bidding Document
0	08.12.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project
FILE: D5-10 DAM.ACDC Aux	New Damauli AC/DC Auxiliary System Scheme
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

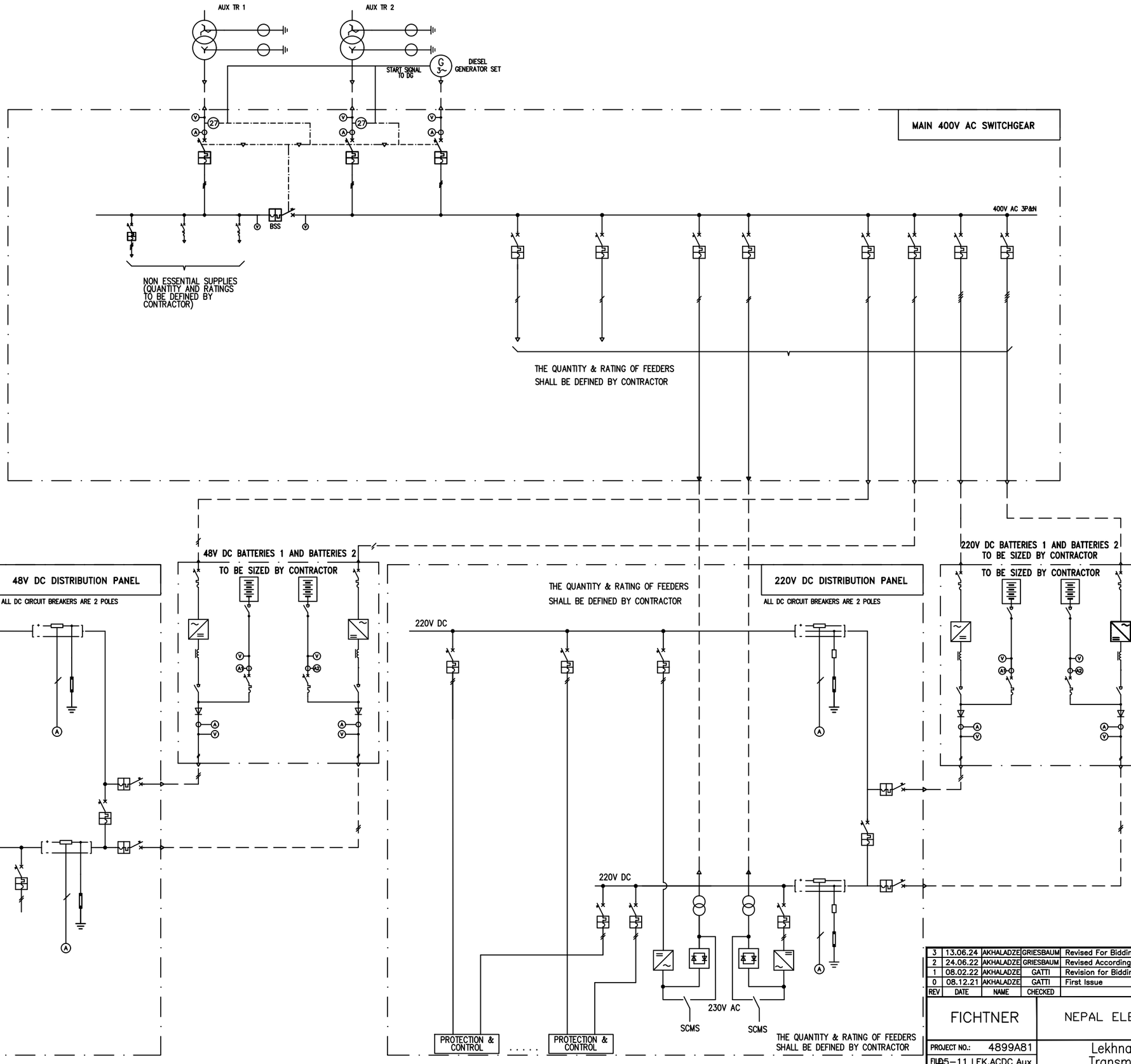
Annex D5-11

Lekhnath Extension AC/DC Auxiliary System Scheme

NOTES
1. MAIN LV SWITCHGEAR TO BE FORM 4b.
2. LOSS OF VOLTAGE ON INCOMER 1 WILL CAUSE INCOMER 1 TO OPEN AND BSS TO CLOSE. RETURN OF VOLTAGE ON INCOMER 1 WILL CAUSE INCOMER 1 TO CLOSE AND BSS TO OPEN.
3. LOSS ON VOLTAGE ON BOTH INCOMER 1&2 LOCKS BSS OPEN AND SENDS A START SIGNAL TO THE DIESEL GENERATOR WHEN THE VOLTAGE AND FREQUENCY FROM THE DIESEL GENERATOR ARE WITHIN LIMITS THE GENERATOR INCOMER CLOSES TO SUPPORT THE ESSENTIAL LOAD RETURN OF VOLTAGE TO EITHER INCOMER 1&2 SENDS A STOP SIGNAL TO THE GENERATOR AND AUTOMATICALLY OPENS THE GENERATOR INCOMER AND PERMITS INCOMER 1&2 TO CLOSE.
4. ALL INCOMERS AND BUS COUPLER TO BE 4 POLES.

LEGEND

- MINIATURE CIRCUIT BREAKER
- LOAD BREAK SWITCH
- DIODE
- AMMETER
- VOLTMETER
- BATTERY
- AUX TRANSFORMER
- CABLE
- STATIC BYPASS SWITCH
- INVERTER
- RECTIFIER
- EARTH
- RESISTOR
- DISCONNECT LINK



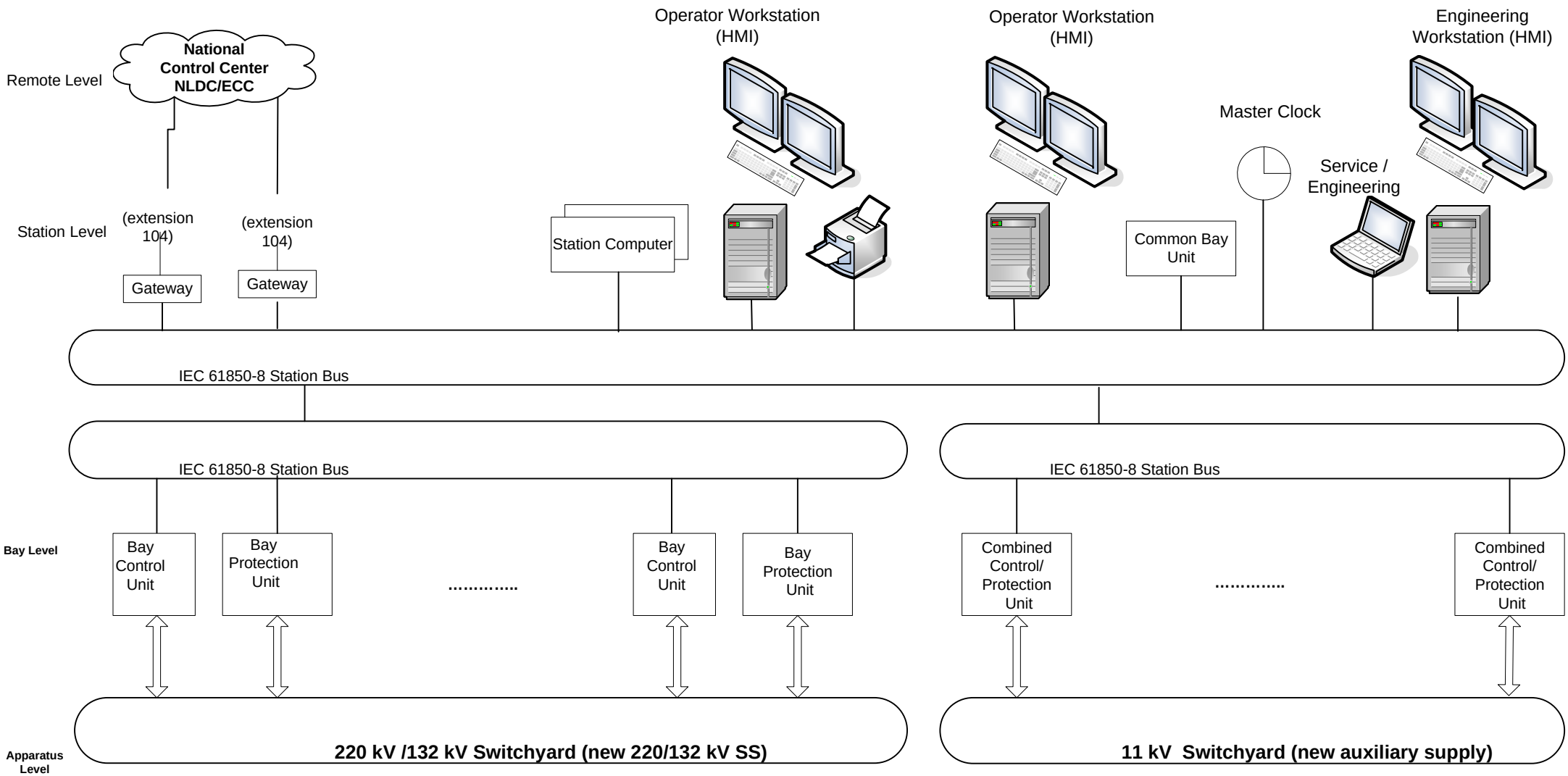
ANNEX D5-11

REV	DATE	NAME	CHECKED	NOTE
3	13.06.24	AKHALADZE	GRIESBAUM	Revised For Bidding Document
2	24.06.22	AKHALADZE	GRIESBAUM	Revised According NEA Comments
1	08.02.22	AKHALADZE	GATTI	Revision for Bidding Document
0	08.12.21	AKHALADZE	GATTI	First Issue

FICHTNER	NEPAL ELECTRICITY AUTHORITY (NEA)
PROJECT NO.: 4899A81	Lekhnath Damauli 220kV Transmission Line Project Lekhnath Extension AC/DC Auxiliary System Scheme
FILE: D5-11 LEK.ACDC Aux	
SYSTEM: ACAD 2022	
SCALE:	
SHEET: 1 / 1	SIZE: A3 DRAWING NO.:

Annex D5-14

Principle System Architecture of the 220/132/11 kV Lekhnath Substation Extension



Annex D5-14
Principle System Architecture of the
Lekhnath 220/132/11 kV Substation
New Substation Control and Monitoring System (SCMS)

SUBSTATION:
LEKHNATH
220/132/11 kV
New SCMS Substation Control and Monitoring System

Lekhnath-Damauli 220 kV OHTL Project

FICHTNER

Lekhnath-Damauli 220 kV OHTL Project

NEPAL ELECTRICITY AUTHORITY नेपाल विद्युत प्राधिकरण

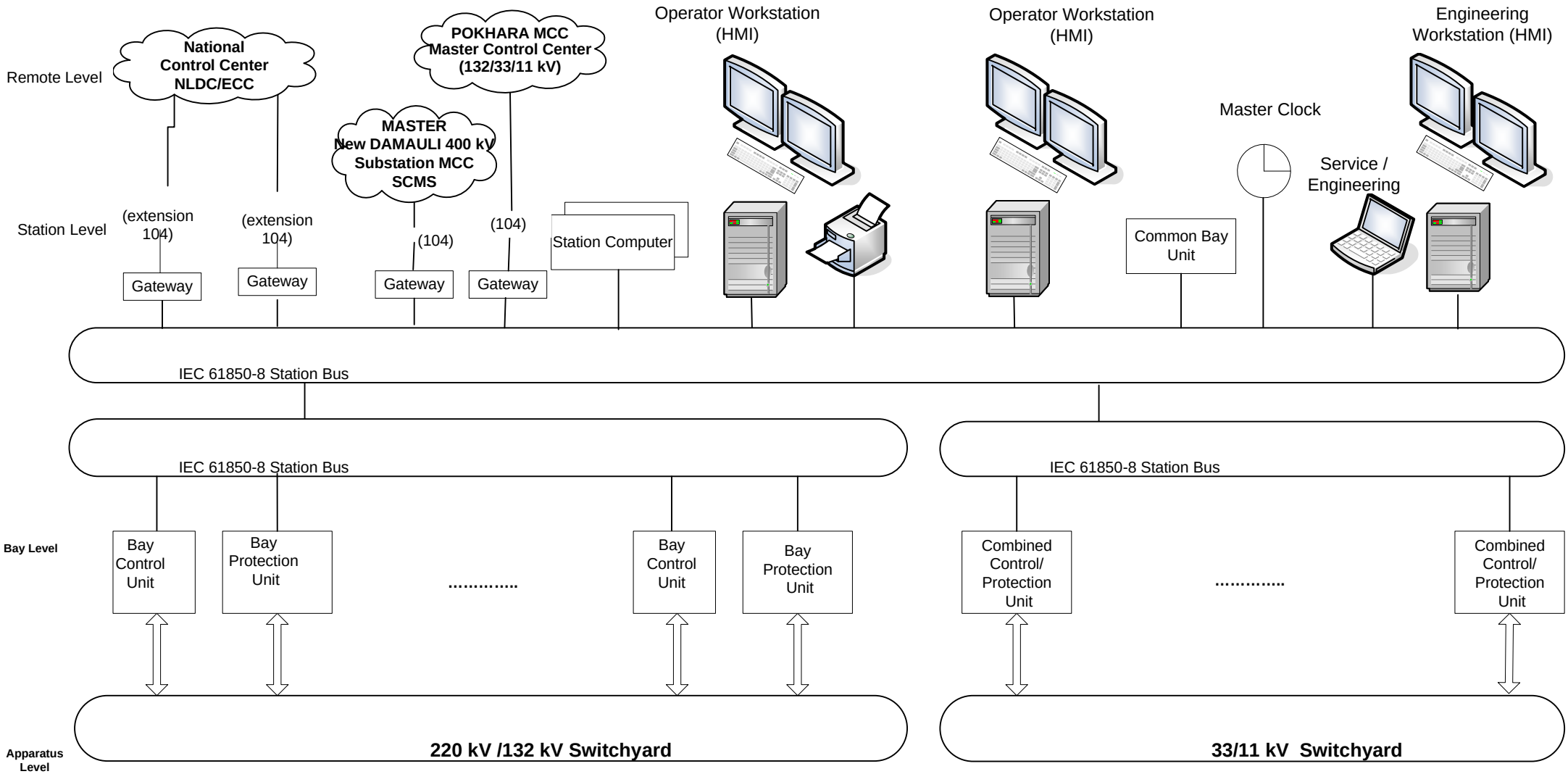
	NOM	DATE
Prep.	DIT	2024-07-01
Ver.		
Replaced		

Principle System Architecture of the Lekhnath 220/132/11 kV Substation New Substation Control and Monitoring System (SCMS)

Projet N°.	Format:	Echelle:	Document/Plan No.	REV.
4899A81	A4	-	XXXX	2

Annex D5-15

Principle System Architecture of the 220/132/33/11 kV New Damauli Substation



Annex D5-15
Principle System Architecture of the
New DAMAULI 220/132/33/11 kV Substation
New Substation Control and Monitoring System (SCMS)

SUBSTATION:
New DAMAULI
220/132/33/11 kV
New SCMS Substation Control and Monitoring System

Lekhnath-Damauli 220 kV OHTL Project

FICHTNER

Lekhnath-Damauli 220 kV OHTL Project

NEPAL ELECTRICITY AUTHORITY
नेपाल विद्युत प्राधिकरण

	NOM	DATE
Prep.	DIT	2024-07-01
Ver.		
Replaced		

Principle System Architecture of the Damauli 220/132/33/11 kV Substation New Substation Control and Monitoring System (SCMS)

Projet N°.	Format:	Echelle:	Document/Plan No.	REV.
4899A81	A4	-	XXXX	2