

STUDY OF GEOTECHNICAL PROPERTIES AROUND CCCT CAMPUS

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Abstract: *The present study focuses on the evaluation of the geotechnical properties around the “Centre for Computers and Communication Technology” campus. Soil study is a fundamental element in civil engineering which in turn puts to great extent the safety and health of any structure at the care of the characteristics and action of the base soil. From each site we collected four dry and four disturbed soil samples for lab analysis. We did laboratory tests which included moisture content, specific gravity, sieve analysis, Atterberg limits, compaction, direct shear, and core cutter tests as per IS 2720. Sieve analysis was used to put the soil in categories as per the USCS and IS 1498. Also we looked at soil behavior in dry and wet states to see how moisture plays into strength, density, plasticity and stability. We found that which engineering properties present do so very differently with change in moisture content which in turn greatly plays into foundation performance.*

Index Terms: *Soil classification, Geotechnical properties, Unified Soil Classification System (USCS), IS 1498, IS 2720.*

I. INTRODUCTION

Soil is a basic and important material in civil engineering. The safety and stability of structures such as buildings, roads, bridges, and dams depend greatly on the properties of the soil on which they are built. Understanding soil characteristics is essential before any construction work to ensure proper foundation design and long-term performance.

In this project, soil samples were collected from four different locations around the college campus under both dry and wet conditions. Various laboratory tests, including moisture content, specific gravity, sieve analysis, Atterberg limits, and core cutter tests, were carried out according to IS 2720 and IS 1498 standards. The study aims to classify the soil, evaluate its engineering properties, and determine its suitability for construction purposes. The findings can be useful for future site investigations and foundation planning in the study area.

II. NEED OF STUDY

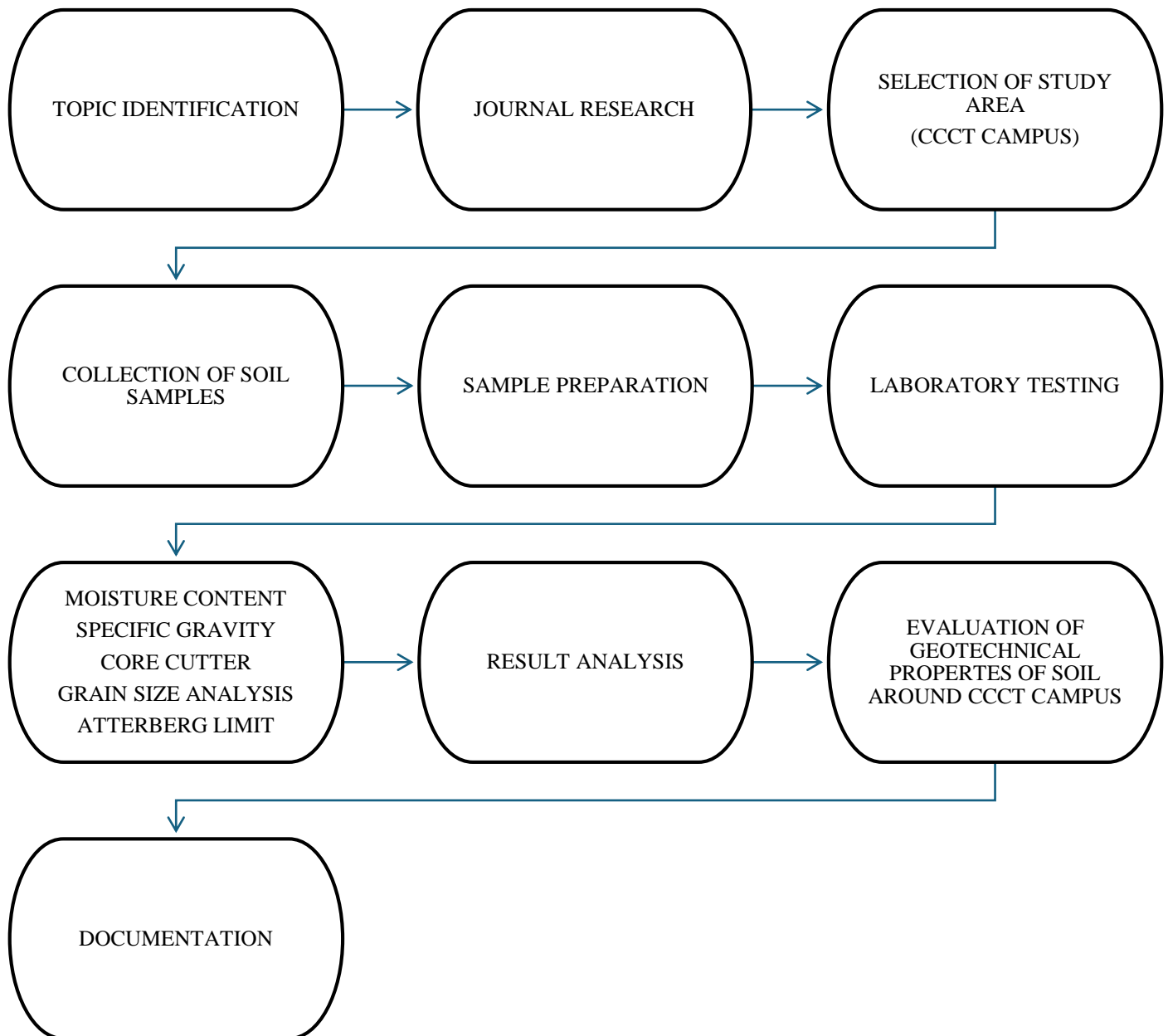
The CCCT Campus is in a hilly part of South Sikkim. That region has steep slopes, high rainfall, and also very different soil types. Geotechnical properties of the soil is what we must know for the the issue of foundation, road, building and slope stability. As infrastructure grows around the campus which in turn does that is when it becomes very important to study the engineering properties of our local soil.

improper assessment of soil properties in this region may cause structural failures, slope instability, excessive settlement, and landslides which is very much during monsoon season. Also it has been seen that very little research has been done on the geotechnical aspects of soil around CCCT Campus. Thus a in depth study of soil properties in this area is very much required for future construction activities, campus growth and infrastructure development. We will present in this study that which data we will put forth will be of great value to civil engineers, urban planners and local authorities to design safe foundations and mitigate geotechnical hazards in the region.

III. OBJECTIVES

1. The characteristics of ground material is necessary for construction purposes. The suitability of the soil for the foundation is determined through these properties. Geotechnical refers to the engineering behavior of earth materials and hence we assess the soil we want to build on.
2. We collected the soil from 4 different places at a distance of 25m from the CCCT Campus. To provide us with some basic information about the geotechnical properties of the soil.
3. Moreover, we can examine how compaction impacts soil permeability. The main objective for carrying out the test performed was to study the effect of compaction on permeability.
4. Testing how compaction affects the permeability of soil that's been dry laid is also a primary objective. The specimen was prepared without adding water and it was clayey in nature.
5. We conducted following lab tests on soil which rear cut sieve analysis specific gravity moisture content Atterberg limit soil core cutter tests. Purpose of study was to determine physical and mechanical properties.

IV. METHODOLOGY



V. LABORATORY TESTS AND RESULTS

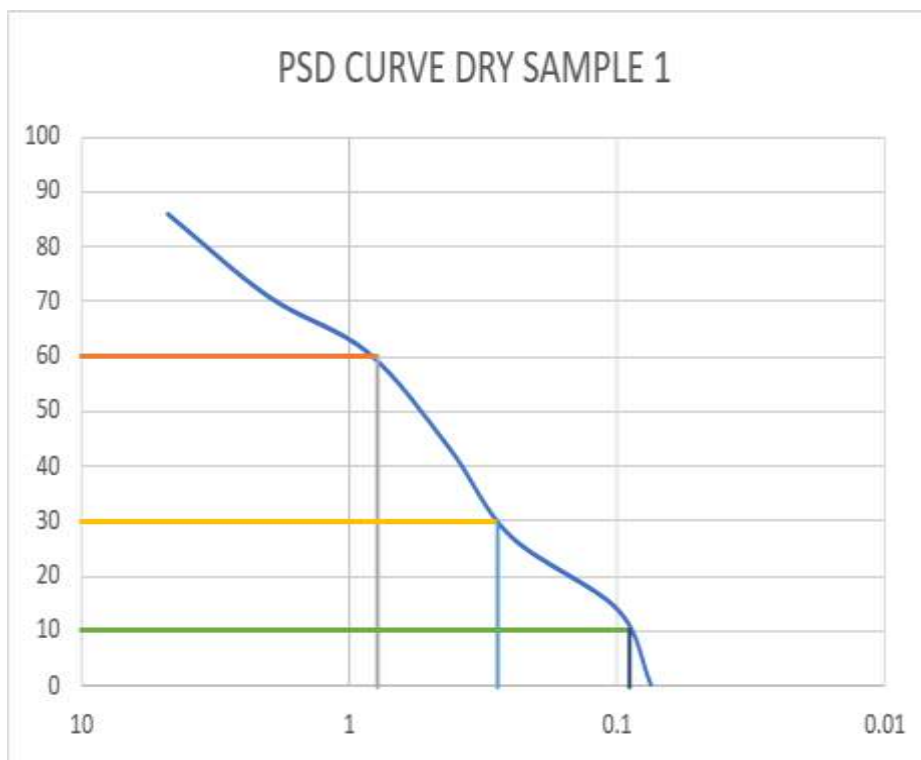
5.1 SIEVE ANALYSIS

The study of which we look at both dry and wet samples mainly have course grained soil with very low fine content which ranges between 0.03% to 0.15% . In this study dry sample 1 and wet sample 2 had the least fine content which is also true for wet sample 4 which had the most. The samples which were seen different but they had similar particle size distribution , excellent drainage and high permeability.

FORMULA : finner % = 100 – retained %

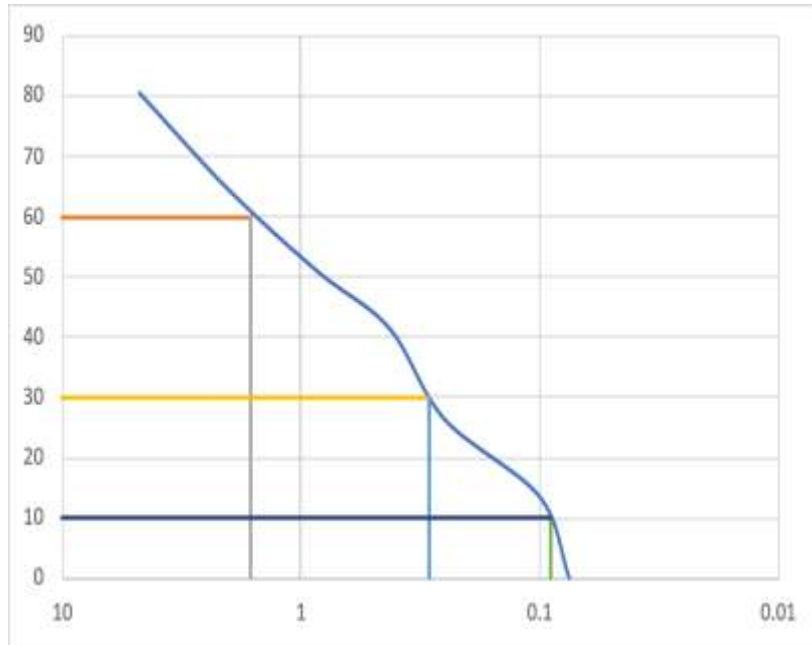
Sieve(mm)	Weight(g)	Retained%	Cumulative%	Finner%
4.75	845.2	14.08	14.08	85.92
2	905.65	15.09	29.17	70.83
0.850	615.54	10.25	49.42	60.58
0.425	1038.75	17.31	56.73	43.27
0.250	972.3	16.2	72.93	27.07
0.01	801.73	13.36	86.29	13.71
0.075	820.97	13.68	99.97	0.03

For dry soil sample:



For wet soil sample:

Sieve(mm)	Weight(g)	Retained%	Cumulative%	Finner%
4.75	1165	19.42	19.42	80.58
2	970.33	16.17	25.59	64.41
0.850	810.45	13.5	49.02	50.91
0.425	565.8	9.43	58.52	41.48
0.250	906.4	15.1	73.62	26.38
0.01	770.15	12.83	86.45	13.55
0.075	811.15	13.51	99.96	0.04



5.2 CORE CUTTER TEST :

In this result soil density is under dry and wet condition due to effect of water content where the wet sample 4 has the highest bulk density 1.901 g/cm³ and also for dry sample 1 shows the highest dry density of 2.58 g/cm³ . The soil shows suitable characteristics such as good compaction and high density for engineering applications.

Formula used:

$$P = M / V$$

Dry Core Cutter test:

Sample	Empty cutter weight (g)	Cutter + soil weight(kg)	Soil weight (kg)	Bulk Density
Sample1	0.970	2.570	1.6	2.58g/cm ³
Sample2	0.970	2.27	1.3	0.565g/cm ³
Sample3	0.970	2.978	2.008	1.70g/cm ³
Sample4	0.970	2.976	2.006	1.70 g/cm ³

Wet Core Cutter test:

Sample	Empty cutter weight (g)	Cutter + soil weight(kg)	Soil weight (kg)	Bulk Density
Sample1	0.970	2.17	1.2	0.403g/cm ³
Sample2	0.970	2.85	1.88	1.50g/cm ³
Sample3	0.970	2.95	1.98	1.66g/cm ³
Sample4	0.970	3.1	2.13	1.901g/cm ²

5.3 SPECIFIC GRAVITY

The study of soil density for both dry and wet samples reported that we see a small range of values. Dry we see a specific gravity range of 0.28 to 0.39 for our samples in which 4 had the highest value and 2 the lowest.

Wet we saw range of 0.29 to 0.34 in which again 2 had the highest value and 1 the lowest.

Formula Used : $(w_2-w_1) / (w_2-w_1)-(w_3-w_4)$

For dry soil sample :

Sample	Empty Bottle (W1) g	Weight of water (w2) g	Weight of soil (w3) kg	Weight of water+ soil + pycnometer (W4) g	Specific Gravity
1	0.670	1.210	0.170	1.590	0.29
2	0.670	1.23	0.180	1.610	0.28
3	0.670	1.420	0.200	1.640	0.34
4	0.670	1.430	0.310	1.470	0.39

For wet soil sample:

Sample	Empty Bottle (W1) g	Weight of water (w2) g	Weight of soil (w3) kg	Weight of water+ soil + pycnometer (W4) g	Specific Gravity
1	0.670	1.280	0.200	1.650	0.29
2	0.670	1.410	0.200	1.600	0.34
3	0.670	1.250	0.200	1.410	0.31
4	0.670	1.370	0.200	1.59	1

5.4 Moisture Content

From the observation the dry samples showed moisture content values ranging approximately from 4.54% to 19.35%. While the wet sample showed values ranging from 0% to 37.5%. Hence, wet samples indicates the presence of more water in the soil pores where as dry samples indicates comparatively lesser water content

Formula used:

Water Content = $w_2-w_3/w_3-w_1 \times 100$

W1= Weight of Empty Container + lid (g)

W2= Weight of container + soil+ lid (g)
 W3= Weight of Container + Lid + Dry soil (g)

For dry samples:

SAMPLE NO.	CONTAINER 1				CONTAINER 2				CONTAINER 3			
	W1	W2	W3	% WC	W1	W2	W3	% WC	W1	W2	W3	% WC
SAMPLE 1	13	59	60	13	13	69	61	66.7	13	72	72	66.63
SAMPLE 2	13	45	41	14.28	13	40	36	17.39	13	77	68	16.36
SAMPLE 3	14	37	36	4.54	14	42	39	12	14	40	37	13.64
SAMPLE 4	14	55	49	17.15	14	51	45	19.35	14	55	49	17.14

For wet samples:

SAMPLE NO.	CONTAINER 1				CONTAINER 2				CONTAINER 3			
	W1	W2	W3	% WC	W1	W2	W3	% WC	W1	W2	W3	% WC
SAMPLE 1	14	33	32	5.55	14	39	34	25	22	52	49	11.11
SAMPLE 2	13	44	38	24	14	39	39	0	14	57	56	2.38
SAMPLE 3	14	37	32	27.77	14	30	26	33.33	13	65	57	18.18
SAMPLE 4	14	36	30	37.5	14	35	31	23.5	14	33	32	5.5

5.5 ATTERBERG LIMIT TEST

Formula Used :

For liquid limit:

$$W = \frac{w_2 - w_3}{w_3 - w_1} \times 100$$

W1 = Empty container (g)

W2 = container + dry soil (g)

W3 = container + wet soil (g)

Weight of the water = W2 – W3 (g)

Weight of a dry soil = W3 – W1 (g)

Plasticity limit:

W1= Mass of wet soil + container

W2= Mass of dry soil + container

W3=mass of container

For Wet Sample :

liquid limit Sample 1:

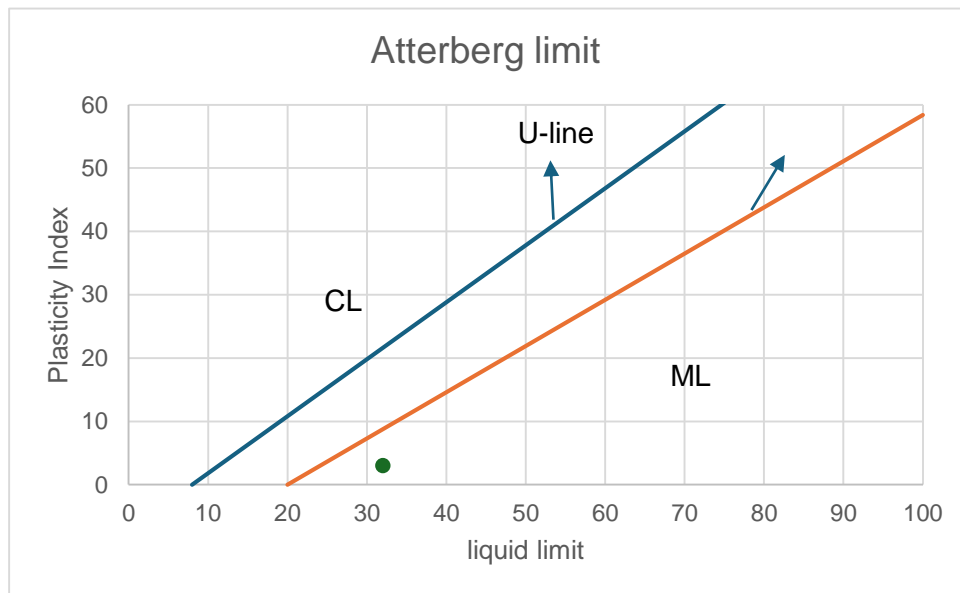
Trail No	No of blows	Container No	W1	W2	W3	W2-W3	W3-W1	Water content %
1.	42	1	14	114	172	58	100	58

Plastic limit sample 1:

Container	W1	W2	W3	Water content %	Plastic limit
1	36	30	14	37.50	30.85
2	40	35	14	23.81	30.85
3	35	30	14	31.25	30.85

Plasticity graph:

A - Line



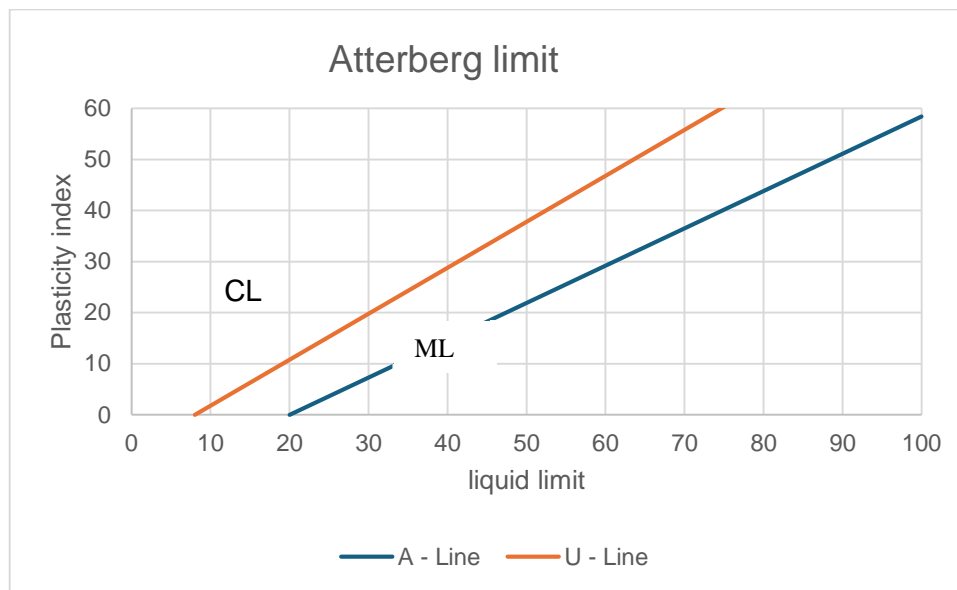
For Dry Sample:

liquid Limit Sample 1:

Trail No	No of blows	Container No	W1	W2	W3	W2-W3	W3-W1	Water content %
1.	48	1	14	114	104	10	90	11.11

Plastic limit Sample 1:

Container	W1	W2	W3	Water content %	Plastic limit
1	30	25	13	41.67	36.11
2	50	41	14	33.33	36.11
3	29	25	13	33.33	36.11



VII. ENGINEERING PROPERTIES OF SOIL

Advantages :

- High Bearing capacity
- Reduces Settlement
- Helps in Designing Safe Foundations
- Helps in Agriculture and Irrigation

Disadvantages :

- Consumes lot of Time
- Results vary from place to place
- Equipment Limitations
- Variability between Labs

VIII. FAILURES IN TESTING THE SOIL SAMPLES

Failure in soil testing refers to getting wrong information or inaccurate, unreliable or unusable data from a soil analysis – due to mistake in sample collection, handling, laboratory testing procedures, or interpretation of results.

It is important to note that such failure does not necessarily indicate deficiencies in the soil itself, but rather deficiencies in the testing process

IX. REMEDIAL MEASURES

- Use Proper Sampling Equipment
- Seal Samples Immediately After Collection

- Correct Borehole Location Planning
- Collect Sufficient Sample Quantity
- Regular Equipment Calibration

X. FUTURE SCOPE OF WORK

Further studies may include Optimum Moisture Content (OMC), Maximum dry density(MDD), and Trial Axial required to determine detailed shear parameters.

XI. CONCLUSION

The soils around the CCCT campus are mainly silty sand. They have mostly poorly graded characteristics and low to medium plasticity. Moisture variation significantly affects soil strength, density, and stability. Proper compaction improves the load-bearing capacity of the soil. Sample 4 shows the best engineering performance. The soil is suitable for most low- and medium-scale construction projects but needs special treatment for heavy structures. Seismic Zone IV conditions require adopting earthquake-resistant design measures for future infrastructure development.

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