# Chittagong University of Engineering and Technology

## Department of Civil Engineering

Project Title: **ENGINEERING CLASSIFICATION OF SOILS.**

Location: **SUGHANDHA RESEDENTIAL AREA,** MURADPUR, CHITTAGONG

Location Coordinates: 22.362687038666472, 91.8277529909123

Course No: **CE-332**

Course Name: **GEOTECHNICAL ENGINEERING(Sessional-I)**

Course Instructor:

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## Introduction

In the field of civil engineering, the engineering classification of soil plays a pivotal role in ensuring the stability of structures, as the load is directly transferred to the soil. As part of our geotechnical engineering course (CE 332), we had the opportunity to undertake a significant lab project under the guidance of CUET professors and the Civil Engineering Department.

Specific Objectives:

- Classify the soil at Sugandha, Muradpur in Chittagong according to certain standards by looking at its properties like water content, weight, grain size, and strength.
- Perform tests in the lab to mimic real-life conditions of the soil.
- Understand how the soil behaves with the different properties we measure.
- Decide which structures can be built on this soil and which ones cannot.

Advantages of the Project:

1. The project allowed us to apply the theoretical knowledge gained in the geotechnical engineering theory course (CE 331) to a real-world context, enhancing our understanding and reinforcing classroom learning.
2. Working in the field and collecting soil samples without prior experience challenged us, but it provided invaluable practical insights into real-world scenarios, preparing us for future challenges.
3. The project provided us with the opportunity to learn and master essential laboratory techniques required for soil testing, which are crucial for our careers as civil engineers.

4. Through the project, we had to make critical decisions on sample collection methods, testing procedures, and data interpretation, improving our ability to make informed choices in professional settings.
5. Analyzing and interpreting the data gathered from the tests honed our ability to draw meaningful conclusions from complex information, a vital skill for analyzing soil properties and making informed engineering decisions.
6. The project's group setting allowed us to improve our communication and teamwork skills, fostering better collaboration and understanding among peers and local communities.
7. The project nurtured our problem-solving skills, making us more adept at handling unforeseen issues in our future careers.
8. We learn how to collect soil samples properly from the field.
9. By just looking at the soil, we can make some predictions about how it will behave.

Application in Real Life:

- In our civil engineering careers, conducting similar projects is common in the industry, and we are well-prepared for such tasks.
- Interacting with local communities during the project improves our communication skills with stakeholders.
- We have acquired proper sample collection techniques for accurate soil assessments.
- Working in a team has boosted our confidence in collaborating with larger groups of professionals.
- It helps us decide what kind of structures can be safely built on different types of soil in real-life construction projects.

- It opens doors for more research and new ideas in this field.
- This project will help us to understand the soil and its behavior in any place.

## Location of the site

Appointed location: Sugandha Housing, Muradpur, cartogram.

Specific location: Iskcon Prabartak Sri Krishna Mandir, Bayazid Bostami Road, Chattogram

Location Coordinates: 22.362687038666472, 91.8277529909123

Topographical features:

- Hilly Area: The location is situated in a hilly area, characterized by significant elevation changes and slopes.

- Greenery: The place is lush and green, indicating the presence of vegetation and possibly a natural environment.

- Sparse Residential Area: While the larger surrounding area may be a residential area, the specific location of soil collection appears to have minimal residential development. Few buildings or houses were observed, and it was relatively uninhabited on the off-day visit.

- Presence of a School: Despite the sparse residential development, a school was present in the vicinity, indicating some educational facilities in the area.

- Uninhabited on Off-day: During the visit on a holiday, the location was uninhabited, suggesting that it might be a quieter area with less human activity on certain days.

- Located Behind a Temple: The place is positioned behind a temple, indicating the presence of religious or cultural significance in the area.

Weather: Sunny day with high humidity.

According to Google, the temperature on 13th July 2023 was 27 degrees, and humidity was nearly 70.

## Sample Collection

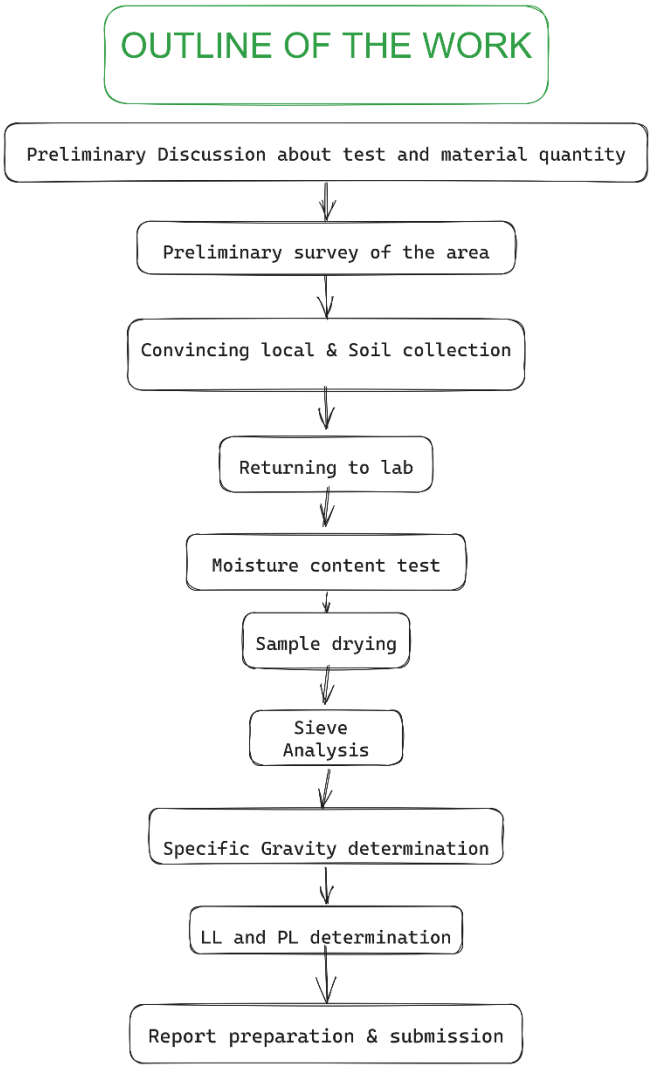
Plan:

- By coordinating and finding a day when all group members were available, we headed to the designated area for sample collection together.
- Arriving at the assigned location, we find a proper place for collecting the sample.
- We arranged the necessary instruments, including a spade, polythene, and bag.
- Around 5kg of soil samples were collected from that place excavating at a depth of one meter.

Collection procedure:

- The sample collection took place at Sugandha Housing in Muradpur,
- Within the Sugandha area at Prabartak we found an abandoned hilly area which was just behind the Iskcon temple.

- To gather soil samples, we excavated a significant hole of approximately 1 meter in depth. The location's uneven terrain and considerable elevation posed challenges during this process.
- Considering the uneven nature of the land, we selected three different points within the area to collect soil samples.
- We collect the soil sample in plastic bag by hand.



## Testing Procedures

MOISTURE CONTENT:

1. The moisture can container number was recorded.
2. The mass of empty, clean, and dry moisture can was recorded.
3. Some in situ sample was taken in the moisture can.
4. The mass of the moisture can containers + moist soil sample was recorded.
5. The moist sample was dried at 105'c for 24 hours.
6. After drying, the sample and can's weight was determined. 3 samples were taken for a test and the average value was selected as the natural moisture content.

SIEVE ANALYSIS:

1. From the collected sample, 500 gm is taken for sieving.
2. The sieve stake vibrates horizontally and vertically for 10 minutes.
3. Then the weight retained on each sieve was measured.

SPECIFIC GRAVITY

1. The dry, clean pycnometer's weight was measured.
2. The weight of water of 250 ml was measured at different temperatures for calibration.
3. 50 gm of sample was taken and the water + sample's volume was made 250 ml.
4. The temperature and the weight of pycnometer+ water+ soil was measured.

Liquid Limit:

1. 100 gm of sample was taken that passed #40 sieve.

2. By adding water to soil, a homogenous paste was made.

3. Placed a portion of the paste on Casagrande apparatus.

4. Cut a groove at the middle by grooving tool

5. Rotated the crank to blow. The blow rate was maintained at 2blow/ sec.

6. Collected a small amount of soil and measured the weight.

6. Counted the blow required for closing the groove.

7. Repeated the above steps 5 times with different water and soil proportions

8. After 24-hour, dry soil's weight was measured

Plastic Limit:

1. 15 gm of soil was mixed with water.
2. Then rolled the soil on a surface until it becomes 3 mm diameter thread and shows sign of crumbling.
3. After crumbling, little amount of soil was placed at oven at 105 degrees Celsius for 24 hours.
4. The dry soil's weight was measured.

Results:

| Location | Coordinate | Moisture Content (%) | Grain size analysis | | | | Atterberg Limit | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Sand (%) | Fines (%) | Silt (%) | Clay (%) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) |
| Sugandha Residential Area, Muradpur, Chittagong | 22.362687038666472, 91.82775299091 23 | 15.59 | 96.4 | 3.6 | - | - | 15.73 | - | |

Therefore, the soil Class as per ASTM D2487-11 is non-plastic sandy soil.

# Discussion

We collected our soil samples from Shugondha, Muradpur, Chittagong. Then conducted tests in CUET Geotechnical Lab. Here, a brief discussion of the results obtained from the tests is presented.

We found the average moisture content of the soil to be 15.59 percent. Moisture content is important for engineering purposes, as we can know how much water is present in the soil and how it might behave under different conditions. It affects various soil properties including its compressibility and strength.

The graphical liquid limit was 15.4%, while the theoretical liquid limit was measured to be 15.73%. Liquid limit shows the water content at which soil transitions from a liquid to a plastic state. We can say good accuracy in test results as there is close agreement between the graphical and theoretical liquid limits.

As less than 40g of soil was retained on the pan during sieve analysis, it was not necessary. to conduct hydrometer analysis. Hydrometer analysis is normally performed on fine-grained. soils to determine their particle size distribution.

No plasticity was observed by us in the soil sample. Plasticity is the ability of soil to undergo deformation without breaking or cracking. The absence of plasticity suggests to us that the soil. does not possess cohesive properties, which could influence its engineering applications.

The theoretical specific gravity was found to be 2.66, while the graphical specific gravity of the soil was calculated to be 2.48. Specific gravity is a measure of the density of soil solids. compared to the density of water. The values obtained can be used for assessing the soils. particle packing and void ratios.

The Coefficient of Curvature was determined to be 1.08 and the Coefficient of Uniformity was. was found to be 4.11. These parameters are important in understanding the gradation of the soil particles and provide information about the soil's potential use for different engineering. purposes.

Based on the tests we can say that the sample from Shugondha, Muradpur, Chittagong. Then is a non-plastic sandy soil, characteristics such as low plasticity, good drainage and coarse particle distribution. Its engineering use may include applications in road construction, drainage systems, embankment construction, shallow foundation projects. However, further and more comprehensive testing is necessary to determine its full engineering potential.

## Annexure-1: Moisture Content Data Sheet with Detailed Calculation

| Can No | Weight of Can(gm) $W_1$ | Weight of Can +wet sample (gm) $W_2$ | Weight of Can+ dry sample(gm) $W_3$ | Moisture content (%) |
|---|---|---|---|---|
| 40 | 10 | 24 | 22.07 | 15.99 |
| 42 | 10 | 21 | 19.43 | 16.64 |
| 45 | 10 | 29 | 26.65 | 14.14 |

Moisture Content = $\left(\frac{W_2-W_3}{W_3-W_1} * 100\right)$ %

For can 40,

Moisture content=$\left(\frac{24-22.07}{22.07-10} * 100\right)$ %

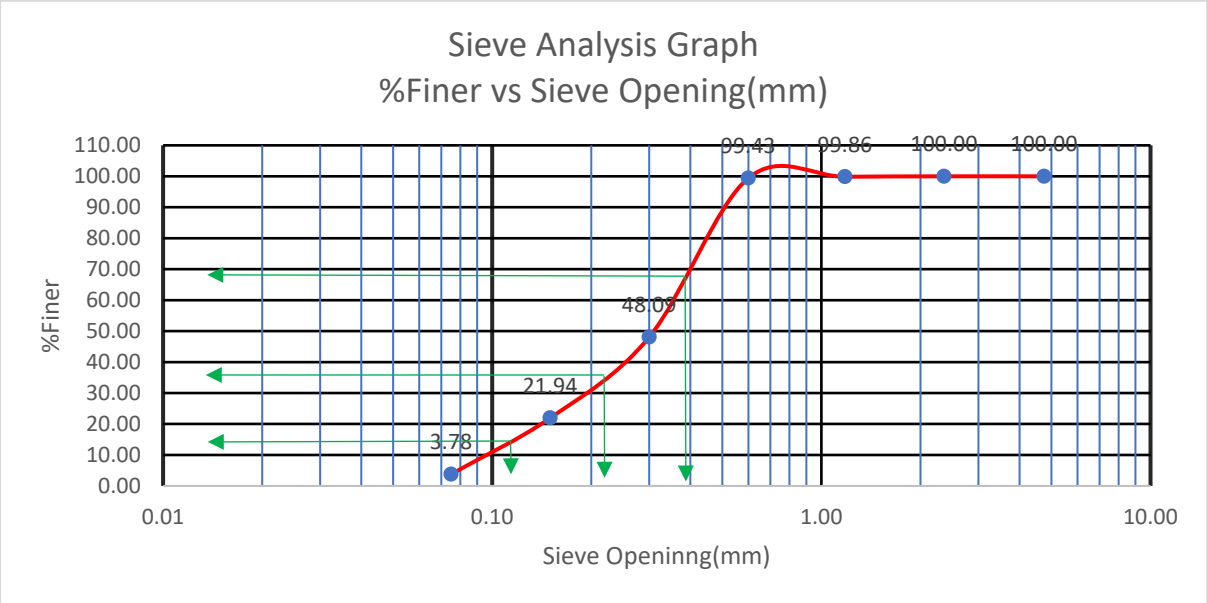
= 15.99 %

Average Moisture Content =$\left(\frac{15.99+16.64+14.14}{3}\right)$%

=15.59%

**Annexure-2: Grain Size Distribution Data Sheet with Detailed Calculation**

| Sieve No | Sieve Size(mm) | Weight Of Retain (gm) | %Weight Retain | Cumulative % Retained | %Finer |
|---|---|---|---|---|---|
| **4** | 4.75 | 0 | 0 | 0 | 100 |
| **8** | 2.36 | 0 | 0 | 0 | 100 |
| **16** | 1.18 | 0.7 | 0.14 | 0.14 | 99.86 |
| **30** | 0.6 | 2.14 | 0.43 | 0.57 | 99.43 |
| **50** | 0.3 | 256.67 | 51.34 | 51.91 | 48.09 |
| **100** | 0.15 | 130.75 | 26.15 | 78.06 | 21.94 |
| **200** | 0.0075 | 90.82 | 18.16 | 96.22 | 3.78 |
| **Pan** | - | 18.92 | 3.78 | 100 | 0 |




From GSD Curve,

$D_{10} = 0.09$

$D_{30} = 0.19$

$D_{60} = 0.37$

Co-efficient of Uniformity $C_u = \frac{D_{60}}{D_{10}}$

$=4.11$

Co-efficient of curvature, $C_c = \frac{{D_{30}}^2}{D_{60} * D_{10}}$

$= 1.08$

**Annexure-3: Specific Gravity Data Sheet with Detailed Calculation**

Sample =50 gm

Weight of pycnometer (gm): $W_B$ = 99.75gm

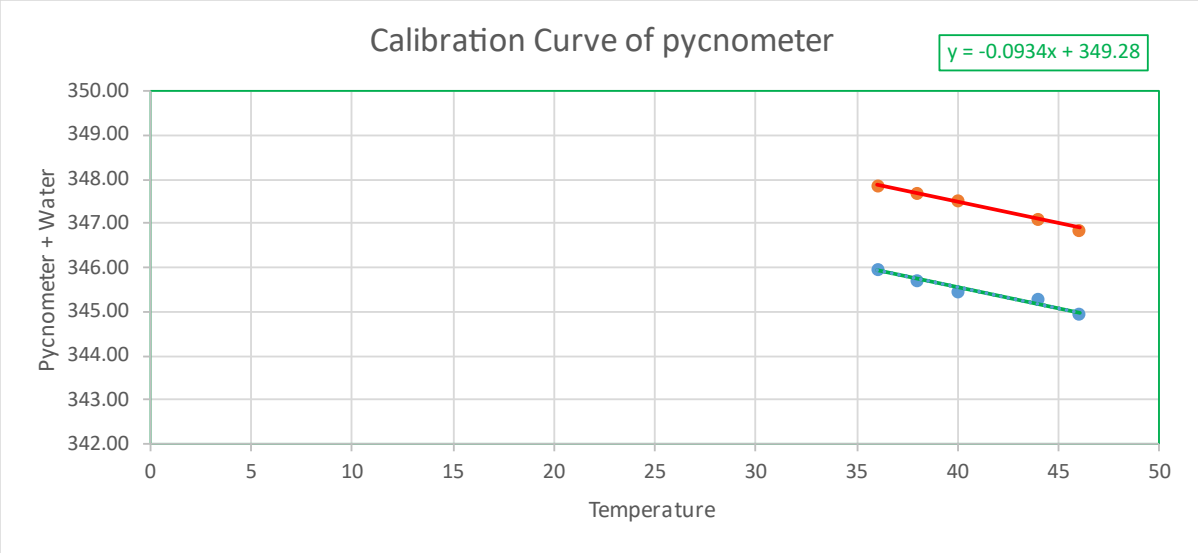
Calibrated volume of pycnometer: $V_B$ = 250 ml

Calibrated temperature of pycnometer: 32℃

Thermal Coefficient of cubical expansion for Pyrex glass, $\epsilon$=0.1∗10−4 $per$ ℃

$\gamma a$=$Unit\ weight\ of\ air\ at\ T\ and\ atmospheric\ pressure$=0.0012 $gm/cm3$

| Serial No | Temperature (°C) | Pycnometer + water $W_2$ | Sp. Gravity or unit weight of water at T ($\gamma$T) | Theoretical pycnometer + water |
|---|---|---|---|---|
| 1 | 36 | 345.98 | 0.99373 | 347.86 |
| 2 | 38 | 345.70 | 0.99300 | 347.70 |
| 3 | 40 | 345.46 | 0.99225 | 347.52 |
| 4 | 44 | 345.27 | 0.99064 | 347.12 |
| 5 | 46 | 344.95 | 0.98960 | 346.86 |




| | |
|---|---|
| Theoretical Specific Gravity | 2.66 |
| Graphical | 2.48 |
| Pycnometer +water +soil (w1) | 378.89 |

Calculation- Calibration of pycnometer(theoretical)

$W_2$=$W_B$+$V_B$(1+$\Delta T$ $\in$)($\gamma_T - \gamma_\alpha$)

At 36℃ ,

$W_2$=99.97 + 250(1+ (36-32) ×0.1×10−4)( 0.99373-0.0012)

=347.86

Similarly other value of $W_2$ is calculated from M.S Excel

From Graph at 40℃

y = -0.0934x + 349.28

$W_2$= 345.54 gm

Theoretical,

$W_2$=347.52 gm

Specific Gravity,

$$G_s = \frac{W_s \times G_T}{W_s - W_1 + W_2}$$

=2.66 (theoretical)

=2.98 (graphical)

Average Specific Gravity =$\frac{2.66+2.98}{2}$

=2.82

**Annexure-4: Atterberg Limit Data Sheet with Detailed Calculation**

| SI No. | Can No | No of blow | Weight of Can ($W_1$) | Can + wet sample ($W_2$) | Can + Dry sample ($W_3$) | Weight of water | Weight of dry soil | Watet content % | Liquid limit (%) | Graphical liquid limit (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 33 | 21 | 8.76 | 14.14 | 13.44 | 0.7 | 4.68 | 14.96 | 15.73 | 15.4 |
| 2 | 24 | 32 | 8.86 | 18.25 | 17.16 | 1.09 | 8.3 | 13.13 | | |
| 3 | 68 | 24 | 8.71 | 14.05 | 13.36 | 0.69 | 4.65 | 14.84 | | |
| 4 | 11 | 39 | 8.99 | 12.53 | 11.93 | 0.6 | 2.94 | 20.41 | | |
| 5 | 102 | 18 | 9.04 | 20.11 | 18.64 | 1.47 | 9.6 | 15.31 | | |

Liquid limit $=\frac{W2-W3}{W3-W1} * 100\%$

For 24 blow, LL$=\frac{18.25-17.16}{17.16-8.86} * 100\%$

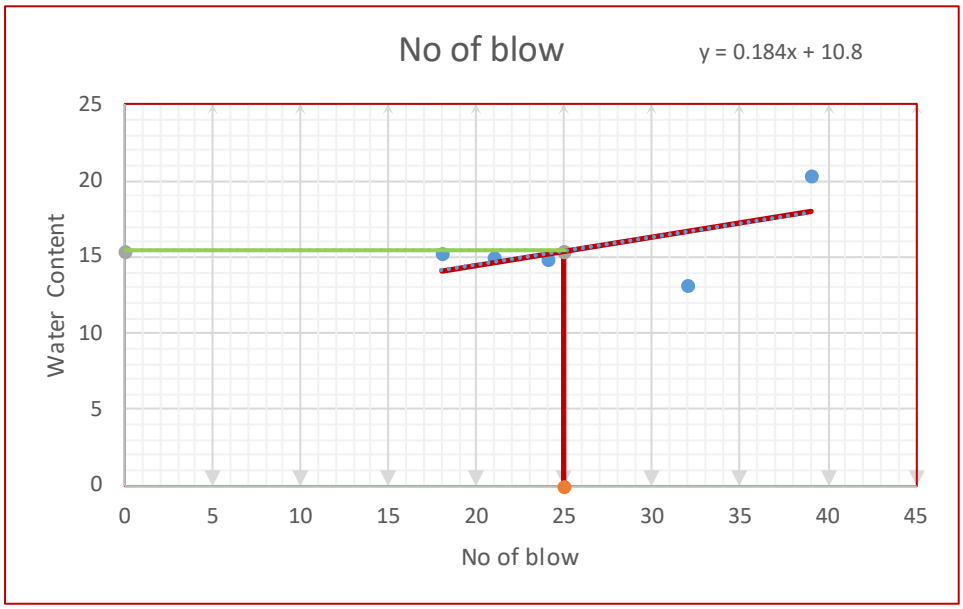
$=13.13\%$

Similar calculation for other value,

Average LL$=\frac{14.96+13.13+14.84+20.41+15.31}{5}$

$= 15.73\%$

## Liquid Limit Graph




From Graph LL= 15.4%

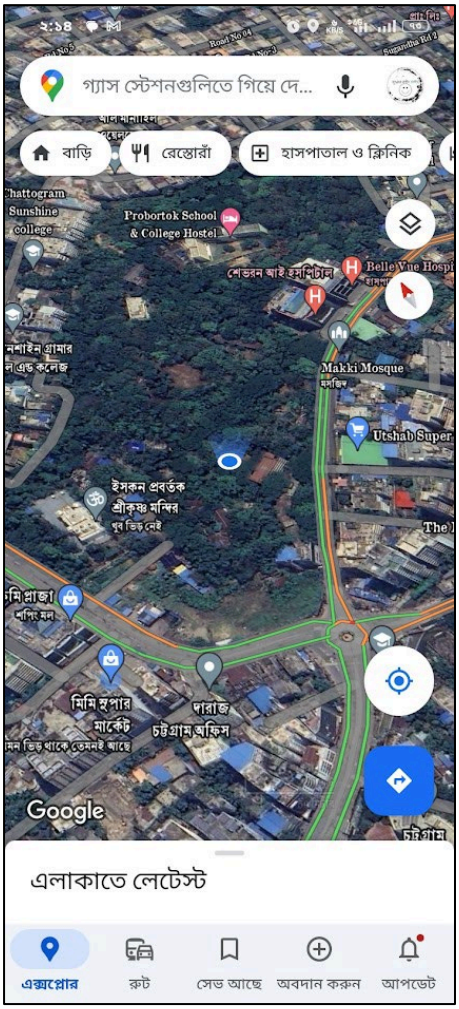
## Annexure-5: Photos



**Group Snapshot after collecting soil from the ground.**



## Group Snapshot at Lab




**Live Location of Sample Collecting Site**



Snapshot during experiment on Geotech Lab



A member of the group working on the Lab




A member of the group working on the Lab