P.S.R. ENGINEERING COLLEGE

SEVALPATTI - 626 140
SIVAKASI
Virudhunagar District.

BONAFIDE CERTIFICATE

Certified that this is a Bonafide Record of work done by J. Anandha Kumari

Roll No 18CE001 in the 161CE58 - Soil Mechanics

Laboratory of this College during the academic year 2020 - 2021.

2/2/21

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Internal Examiner

02 02 21

External Examiner

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Specific gravity of soil grains

Aim:

To determine the specific gravity of given soil sample.

Apparatus required:

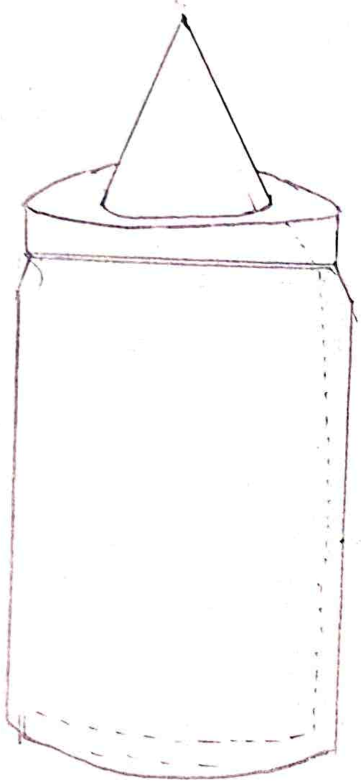
1) Pycnometer
2) Balance (0·1g Sensitivity)
3) Distilled water

Procedure:

1) The Pycnometer is thoroughly cleaned and dried, its empty weight is taken (W_1) gm.

2) Take about 150g (approximately) of dry sand & put it the bottle and find its weight (W_2) gm.

3) The density bottle is now filled with distilled water up to the mark (marked in bottle) and weigh as (W_3) gm.



Pycnometer

Specific gravity of soil grains

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2) Balance (0.1g sensitivity)
3) Distilled water

Procedure:

1) The Pycnometer is thoroughly cleaned and dried, its empty weight is taken (W_1) gm.

2) Take about 150g (approximately) of dry sand & put it the bottle and find its weight (W_2) gm.

3) The density bottle is now filled with distilled water up to the mark (marked in bottle) and weigh as (W_3) gm.

Observation:

SNO	Particulars	Weight in grams Trial-1	Weight in grams Trial-2	Weight in grams Trial-3
1.	Weight of pycnometer (W_1)	625.5	626.0	626.5
2.	Weight of pycnometer + soil (W_2)	1045.0	1043.5	1072.5
3.	Weight of pycnometer + soil + water (W_3)	1787.0	1771.0	1782.0
4.	Weight of pycnometer + water (W_4)	1506.5	1508.0	1518.5
5.	Specific gravity (G)	3	2.7	2.4

Calculation:

Specific gravity of soil (G) $= \dfrac{W_2 - W_1}{[W_2 - W_1] - [W_3 - W_4]}$

$= \dfrac{1045.0 - 625.5}{(1045.0 - 625.5) - (1787.0 - 1506.5)}$

$= 3$

Exp. No.: 1
Date : 01.08.20

4) The bottle is now emptied, completely fill with only distilled water the mark and find its weight (W_4) g

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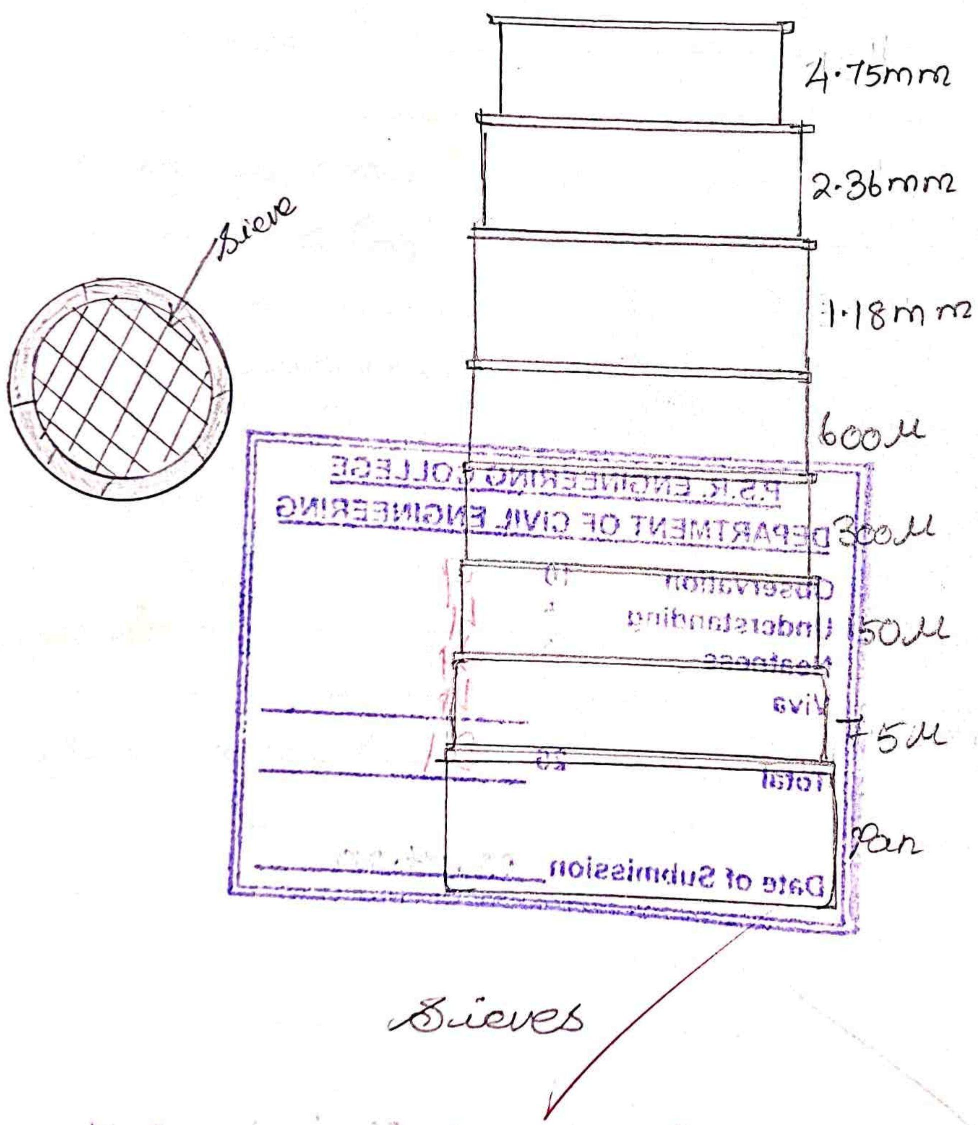
Observation	10	9
Understanding	5	4
Neatness	5	4
Viva	5	4
Total	25	21

Date of Submission 02.08.20

Result:

Specific gravity of soil (G) = 2.7


Sieve
4.75mm
2.36mm
1.18mm
600µ
300µ
150µ
75µ
Pan
Sieves

Sieve Analysis

Aim:

To determine the grained size distribution of coarse grained soil by sieving.

Description:

Soils having particles larger than 0.075mm sieve are termed as coarse grained soils. Coarse grained soils are classified mainly by sieve analysis. The grain size distribution curve gives an idea regarding the graduation of soil whether the soil is well graded or poorly graded. In mechanical soil stabilization the main principle is to mix a few soils in such a proportion that a desired grain size distribution is obtained for the design mix. Hence for proportioning the selected soils, the grain size distribution of each soil should be known.

Observation:

Tabulation:

S.No	I.S. sieve	Weight retained (gms)			Cumulative weight retained (gms)	Cumulative % retained (gms)	% Finer
		Empty weight of sieve (gms)	Retained weight of sieve (gms)	Retained weight of soil (gms)			
1.	4.75mm	418	424	6	6	0.6	99.4
2.	2.36mm	389	682	293	299	29.9	70.1
3.	1.18mm	346	589	243	542	54.2	45.8
4.	600μ	389	528	139	681	68.1	31.9
5.	300μ	334	543	209	890	89	11
6.	150μ	372	448	76	966	96.6	3.4
7.	75μ	332	349	17	983	98.3	1.7
8.	Pan	307	322	15	998	99.8	0.2

Exp. No.: 2
Date: 10.08.20

Apparatus Required:

A set of specified sieves, sieve shaker, Weighing balance.

Procedure:

1) Take suitable quantity (1000gms) of oven dried soil retained in 75 sieve.

2) Sieve the soil through 4.75mm, 2.36mm, 1.18mm, 600μ, 300μ, 150μ and 75μ using a mechanical shaker for 5 minutes.

3) Each sieve and pan with soil retained on them is weighted carefully and note it in the observation.

4) The sum of the retained soil is checked against the original mass of soil taken.

5) All the observations are entered in the data sheet and the calculations are made.

6) By using the formula find the uniformly co-efficient of curvature from semi log graph.

Calculation:

1) Effective size of the soil $= D_{10}$

$= 0.53$

2) Uniformity coefficient $(C_u) = D_{60}/D_{10}$

$= \frac{1.21}{0.53}$

$= 4.03$

3) Coefficient of curvature $(C_c) = \frac{(D_{30})^2}{(D_{10} \times D_{60})}$

$= \frac{(0.91)^2}{(0.53 \times 1.21)}$

$= 0.301$

4) Fineness modulus $= \frac{\text{Total sum of the cumulative \% reta}}{100}$

$= \frac{337}{100}$

$= 3.37$

Graph:

Plot the particle size distributional curve between the particle dia in (mm) and % finer in semi log sheet.

Formula:

1) Effective size of the soil = D_{10}
2) Uniformity coefficient (C_u) = D_{60}/D_{10}
3) Coefficient of curvature (C_c) = $(D_{30})^2/(D_{10} \times D_{60})$
4) Fineness modulus = Total sum of the cumulative % retained/100

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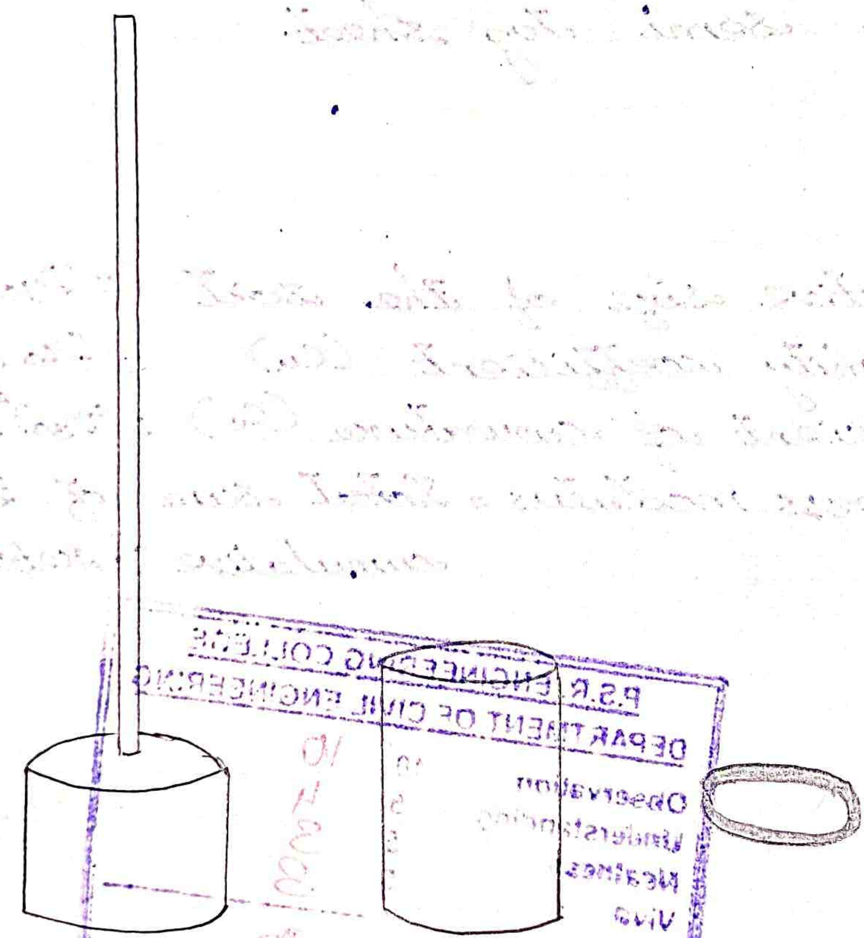
Observation	10	10
Understanding	5	4
Neatness	5	3
Viva	5	3
Total	25	20

Date of Submission 11.08.20

Result:

1) Uniformity coefficient (C_u) = 4.03

2) Coefficient of curvature (C_c) = 0.50



Cylinder cutter

Field Density Test - Core Cutter Method.

Aim:

To determine the field density of soil sample by core cutter method.

Apparatus Required:

1) Cylinder cutter.
2) Balance

Procedure:

1) Take a core cutter of standard dimensions and determine its volume (v) by knowing its diameter + height of the core cutter.

2) Oil the core cutter from inside

3) Clean + level the ground surface where field density is measured.

4) Place the core cutter in freshly prepare a plain ground with top cap on it and gently hammer it until the cutter

Observation:

Height of core cutter (h) = 12.7 cm

Internal dia of core cutter (d) = 10 cm

Volume $(v) = (\pi d^2/4) \times h\ cm^3 = 1266.76\ cm^3$

Empty weight of core cutter (w_1) = 884

Tabulation:

Trial	W_2 (gm)	Weight of soil alone $W = (W_2 - W_1)$ gm	Density of soil $\rho = W/V$ g/cc
I	3538.0	2653	2.0943
II	3467.0	2582	2.0382
		Average	2.066

is completely pushed into the soil.

5) Remove the side material and take out filled up core cutter gently, properly clean the top & bottom surfaces.

6) Find the weight of core cutter with soil (W_2)

Calculation:

$$\text{Field density} = \frac{\text{Weight of soil}}{\text{Volume of the core cutter}}$$

$$\text{Volume } (v) = \frac{\pi d^2}{4} \times h$$

$$= \frac{\pi \times 10^2}{4} \times 12.7$$

$$= 1266.76 \text{ cm}^3$$

$$\text{Field density} = \frac{2582}{1266.76} = 2.0382 \text{ g/cc}$$

$$\text{Average field density} = \frac{2.0943 + 2.0382}{2}$$

$$= 2.066 \text{ g/cc}$$

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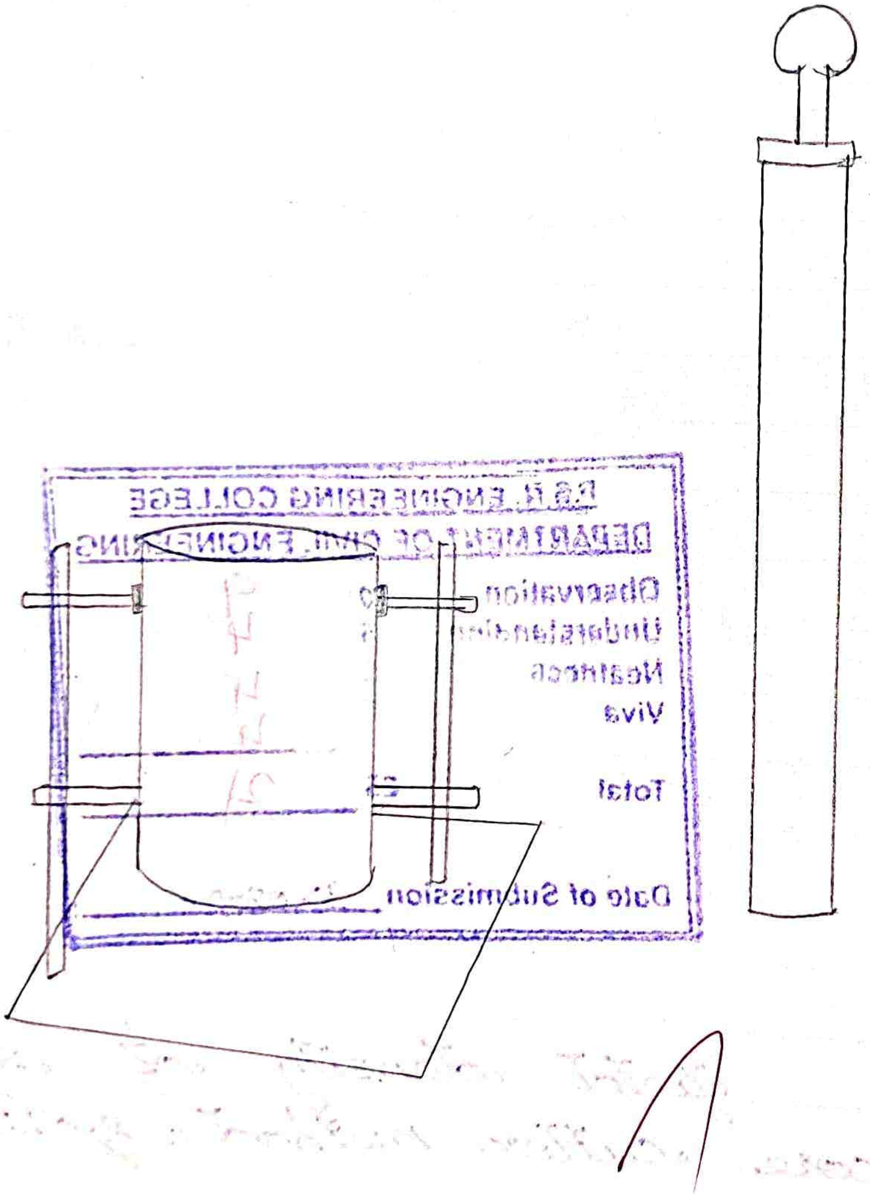
Observation	10	9
Understanding	5	4
Neatness	5	4
Viva	5	4
Total	25	21

Date of Submission 11-08-20

Result:

The field density of soil mass by core cutter method = 2.066 g/cm³



Proctor compaction apparatus

Standard Proctor's Compaction Test

Aim:

To determine the optimum water content and maximum dry density of a soil by standard proctor test.

Apparatus Required:

1) Cylindrical mould
2) Standard rammer
3) Straight edge
4) Drying crucibles
5) Measuring jar
6) Balance

Procedure:

1) Weigh the standard proctor mould with base and without collar (W_1) gm.

2) Take about 3 kg of air dried soil passing through 4·75mm sieve.

3) Take known quantity of water (6·/. by the weight of dry soil) and mix

Observations :

Soil sample = 3kg

Specific gravity = 2.7

Diameter of mould = 10cm

Height of mould = 12.2cm

Volume of mould = 958.18cm^3

Weight of soil taken = 3kg

Weight of rammer = 2.5kg

Number of layers = 3

Number of blows = 25

Weight of mould = 1935gm

well with the soil.

4) Attach the collar with proctor mould and fill the mixed soils in the mould in three equal layers.

5) Compact each layer by the rammer weighing 2.6 kg allowing it to drop 25 times from the height of 310mm.

6) The total height of the compacted soil should be slightly more than the height of the mould.

7) Remove the collar and cut out the projected soils to have a level surface with the top of the mould.

8) Weigh the mould with the soil (W_2) gm.

9) Remove the soil from the cylinder and break up the soil by hand. Now increase the moisture content by 2% and mix thoroughly. Repeat the experiment.

10) In the repeating process each time raise the moisture content by 2% until three is a considerable fall in

Tabulation:

S.No	Water content (w) %	Weight of mould + Soil (W_2)	Weight of Soil (W) = $W_2 - W_1$	Bulk density $\gamma = W/V$	Dry density $\gamma_d = \gamma/(1+w)$	γ_d 100% Saturation g/cc
1.	6	4142	2207	2.303	2.172	2.32
2.	8	4184	2249	2.347	2.173	2.22
3.	10	4151	2216	2.312	2.101	2.125
4.	12	4148	2213	2.304	2.057	2.039
5.	14	4158	2223	2.320	2.035	1.959

Calculations:

$$\text{Wet density} = \frac{W_2 - W_1}{V}$$

$$= \frac{4142 - 1935}{958.18}$$

$$= 2.303 \text{ g/cc}$$

the weight of the mould with compacted soil.

11) Take samples from each operation and calculate the moisture content and corresponding dry density.

12) Draw the graph between dry density and moisture content. Draw the saturation line in the same graph.

13) Find the dry density and optimum moisture content from the graph.

$$\text{Dry density} = \frac{\text{Wet density}}{(1+m)}$$

$$= \frac{2.303}{(1+0.06)}$$

$$= 2.173 \, g/cc$$

The point on the saturation lines are obtained by using the following relation.

$$\text{Dry density} = \frac{G \times \gamma_w}{(1+mG)}$$

$$= \frac{2.7 \times 1}{(1+(0.06 \times 2.7))}$$

$$= 2.32 \, g/cc$$

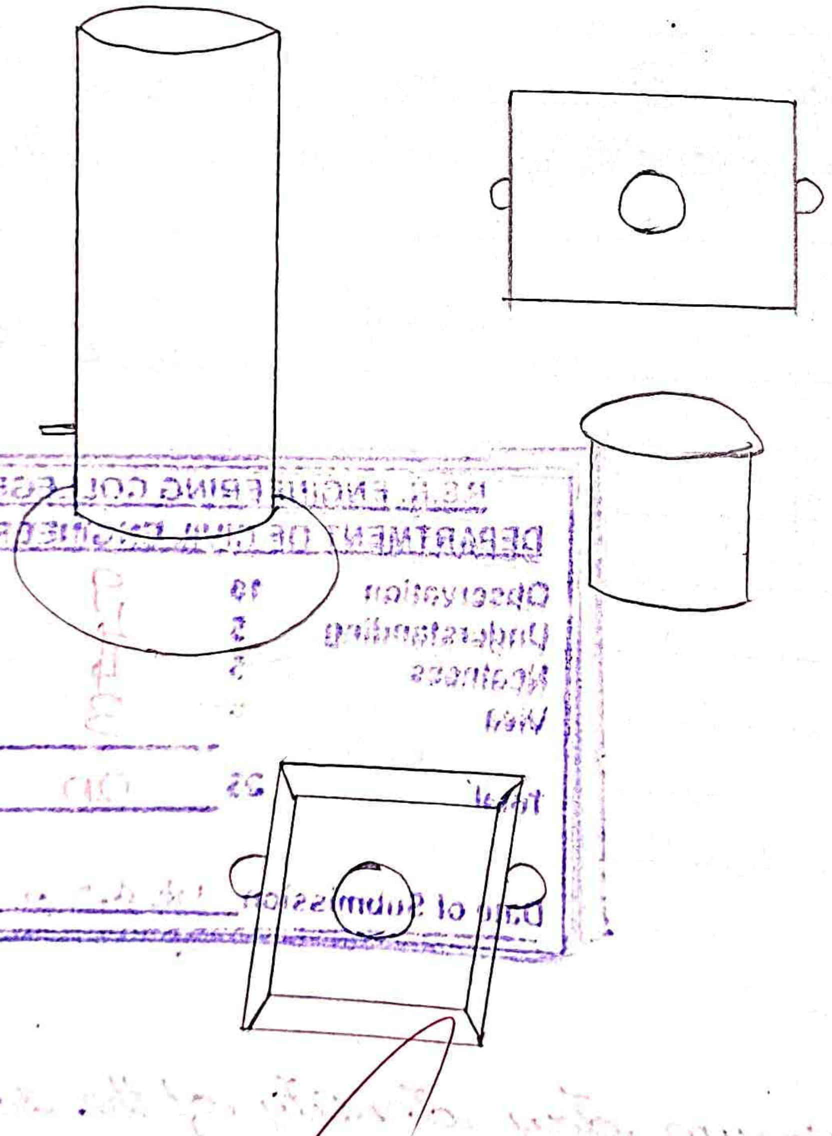
Observation	10	9
Understanding	5	4
Neatness	5	4
Viva	5	3
Total	25	20

Date of Submission 18.8.20

Results:

1) Maximum dry density of the soil = 2.173 g/cc

2) Optimum moisture content = 8%



Sand Pouring cylinder

Field Density Test - Sand Replacement Method

Aim:

To determine the field density of soil sample by sand replacement method.

Apparatus Required:

1) Sand pouring cylinder of standard capacity.
2) Tools for excavating holes
3) Calibrating containers
4) Metal tray with holes
5) Clean, uniform grade metal, passing through 1mm sieve + retained in a 60mm sieve.

Procedure:

1) A pit of outer dia equal to the diameter of sand cone apparatus is excavated in the field and soil is removed and kept in the tray. The height of pit should be equal to the height of calibrating cylinder (about 15 cm).

Observation:

1) Weight of sand pouring cylinder with full sand (W_1) } = 7424 gm

2) Weight of sand in cone (W_2) = 384 gm

3) Weight of cylinder and sand after filling the calibrating container (W_3) } = 5387 gm

4) Weight of sand filling calibrating container and cone (W_a) = ($W_1 - W_2 - W_3$) } = 1653 gm

5) Weight of sand cone apparatus after refilling with full of sand (W_4) } = 7384 gm

6) Weight of soil taken from the field. (W_5) } = 2665 gm

7) Weight of sand cone apparatus after filling the field hole (W_6) } = 4719 gm

8) Weight of sand in the excavated hole (W_b) = ($W_4 - W_2 - W_6$) } = 2281 gm

9) Volume of sand filling the excavated hole (V_h) = W_b / γ_s } = 1520.67 cm^3

10) Diameter of standard cylinder (D) = 10 cm

11) Height of standard cylinder (H) = 14 cm

2) The weight of soil removed from the pit is taken respect (W5).

3) The sand cone apparatus is filled with sand (sieve graded) upto the top level & its weight in (W_1).

4) The apparatus in placed exactly over the pit and the silt is removed and allow the sand the flow into the excavated pit.

5) Close the value when the flow has stopped and the sand cone apparatus weighted (W_6).

6) Now, place the sand cone apparatus on a paper placed and a horizontal table open the value again and allow the sand to flow & fill the cone.

7) Close the value and take the weight of sand cone apparatus (W_2) from their weight. The weight of sand filling the excavated pit can the determined for density cylinder, following procedure is adopted.

Calculation:

1) Volume of standard cylinder $(V_c) = \frac{\pi D^2}{4} \times H$

$$V_c = \frac{\pi \times 10^2}{4} \times 14$$

$$= 1099.55 cm^3$$

2) Bulk density of sand $(\gamma_s) = \frac{\text{Weight of sand } (W_a)}{\text{Volume of standard cylinder } (V_c)}$

$W_a = W_1 - W_2 - W_3$

$W_a = 7424 - 384 - 5387$

$= 1653 gm$

$$\gamma_s = \frac{1653}{1099.55}$$

$$\gamma_s = 1.5 g/cc$$

5) Field density of soil $(\gamma_f) = W_5 / V_h$

$$V_h = \frac{W_b}{\gamma_s}$$

$W_b = 7384 - 384 - 4719$

$= 2281 gm$

$$V_h = \frac{2281}{1.5} = 1520.67 cm^3$$

$$= \frac{2665}{V_h}$$

$$\gamma_f = \frac{2665}{1520.67}$$

$$\gamma_f = 1.75 g/cc$$

8) Place the sand fill up in cone apparatus again with the sand is weighted (W_4).

9) Place the apparatus on a standard cylinder and open the valve. Now, find the weight of sand cone apparatus (W_3) and find the weight of standard cylinder and find its volume.

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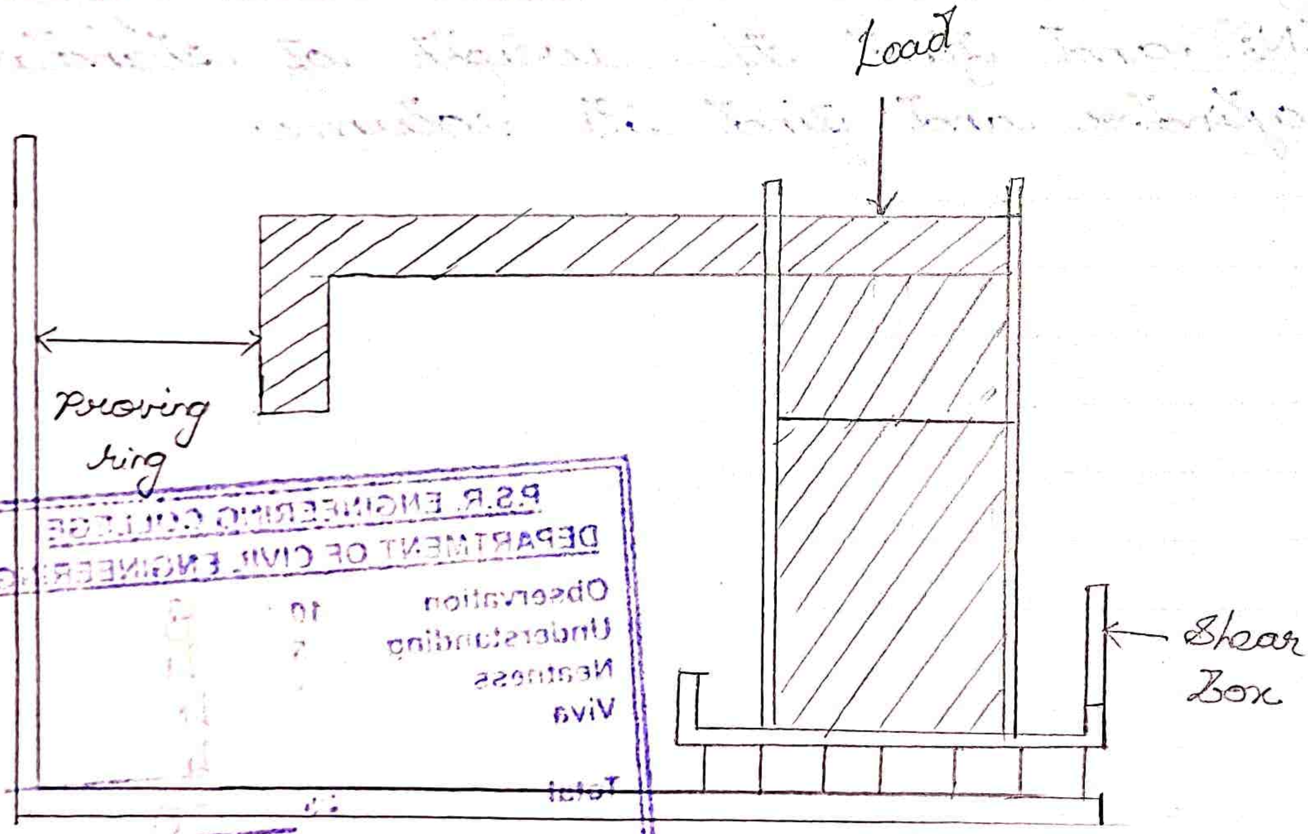
Observation	10	8
Understanding	5	4
Neatness	5	4
Viva	5	4
Total	25	20

Date of Submission 05.09.20

Result:

The field density of soil mass by sand replacement method = $1.75\ g/cm^3$



Shear Box Test apparatus

Direct Shear Test On Cohesionless Soil

Aim :

To determine the friction angle of the given soil sample.

Apparatus Required:

1) Shear box assembly
2) Balance
3) Proving ring
4) Dial gauge
5) Weights.

Description:

In the shear box test, failure is caused in a predetermined plane of the soil. The shear strength or shearing resistance and the normal stress both being measured directly.

The shear box assembly consists of a container and two pieces of 6×6×2cm. The two halves of the shear box are

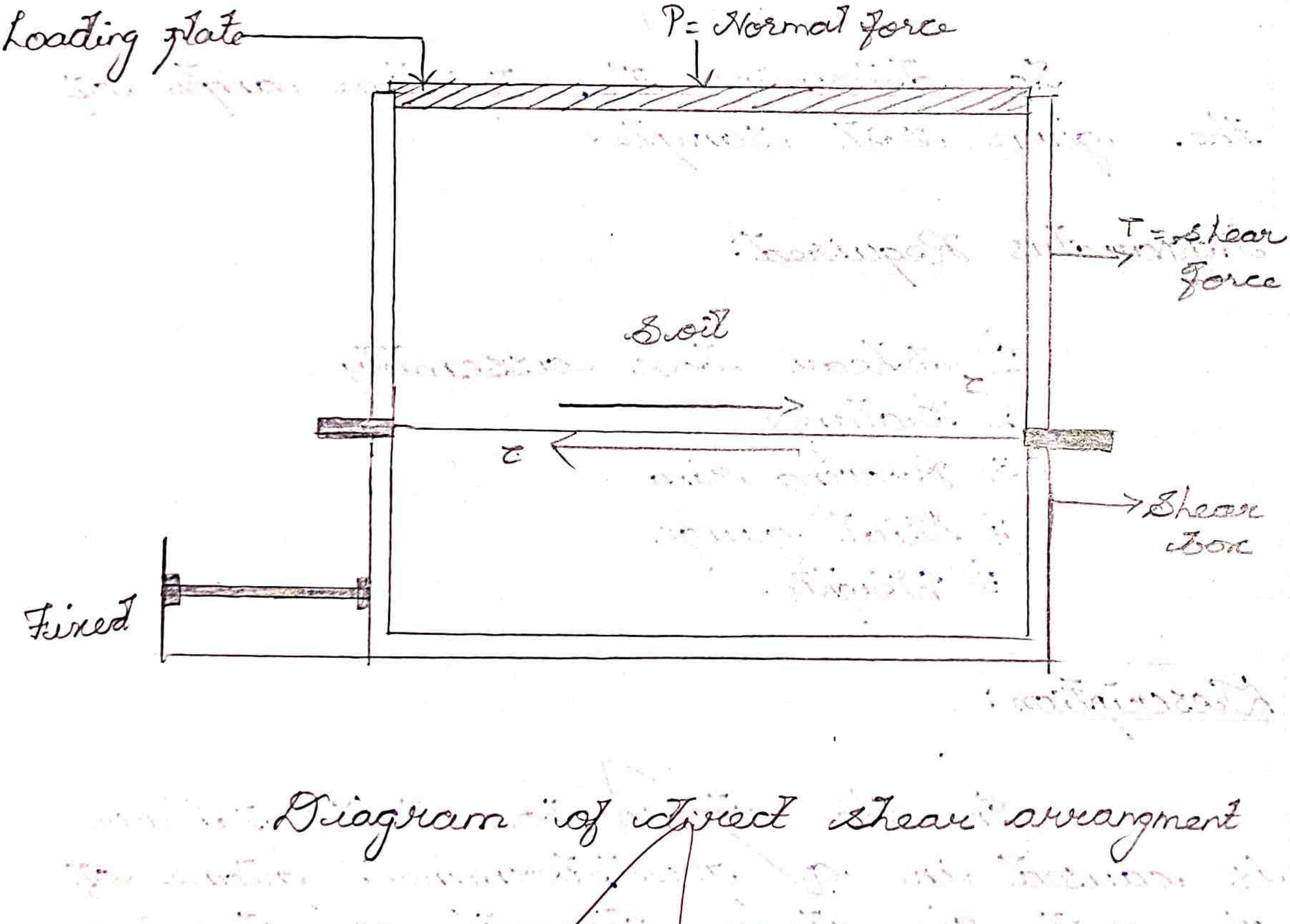


Diagram of direct shear arrangment

positioned relative to each other by two pins which can be pulled out when not required. A raised rim in the bottom half of the shear box separates it from the top half about 1mm to prevent it form riding upon any soil particles that might get between the edges.

There are two grid plates which transmit the shear to the specimen surface. The base plate is grooved and rests on pins in the sides of the lower half of the box. The top plate has an air vent and a central spherical knob, on which the vertical loading yoke rest. The outer container moves freely on ball roller strength strips parallel to the axis of the load screw and proving ring.

<u>Procedure</u>:

1) The shear box assembly is put together using the pin.

2) The bottom grid plate is placed in position, so that the groove in the grid plate should be perpendicular to the direction of shear.

Observation :

Soil Sample = Soil

Specific gravity of soil = 2.67

Sample dimensions = 6×6 cm

Area of the shear box : 36 cm^2

Load Conversion table :

Load in KN	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
Load in Kg	2	4	6	8	10	12	14	16	18	20
Dial gauge reading	80.1	160.3	240.5	320.9	408.9	481.1	561.3	641.3	641.5	801.9

3) For the given density the weight of soil sample required is calculated.

4) The calculated weight of soil sample is placed in layers; each layer is tamped to the required density.

5) The top grip plate and loading pad is placed on top of the soil sample.

6) The normal load frame is placed on the loading pad.

7) The proving ring is set to read zero.

8) The required normal load is applied.

9) The pin from shear box assembly is removed.

10) The seperating screw is turned to have a gap of 1mm between the two halves.

11) The hand wheel is rotated to apply the shear load.

Tabulation:

S.No	Normal stress kg/cm²		Proving ring reading	Load kg	Shear stress kg/cm²
1.	0.5	0.277	1	2.5	0.0694
2.	1	0.555	2	5	0.138
3.	1.5	0.833	3	7.5	0.2087
4.	2	1.111	4	10	0.277
5.	2.5	1.388	4.2	12.5	0.347

Calculation:

$$\phi = \tan^{-1}\left[\frac{dy}{dx}\right]$$

$$= \tan^{-1}\left[\frac{2.8}{2.6}\right]$$

$$= 47^\circ$$

Also ϕ can be finding out from graph.

12) The maximum deflection is recorded in the proving ring with gives the maximum shear stress.

13) The shear load is released, the normal load and the shear box is removed.

14) The test is repeated with a fresh sample of soil for other normal loads.

15) The graph between the normal stress (x axis) and the corresponding shear stress (Y axis) at failure is drawn.

16) The shear parameter ϕ is found out from the graph.

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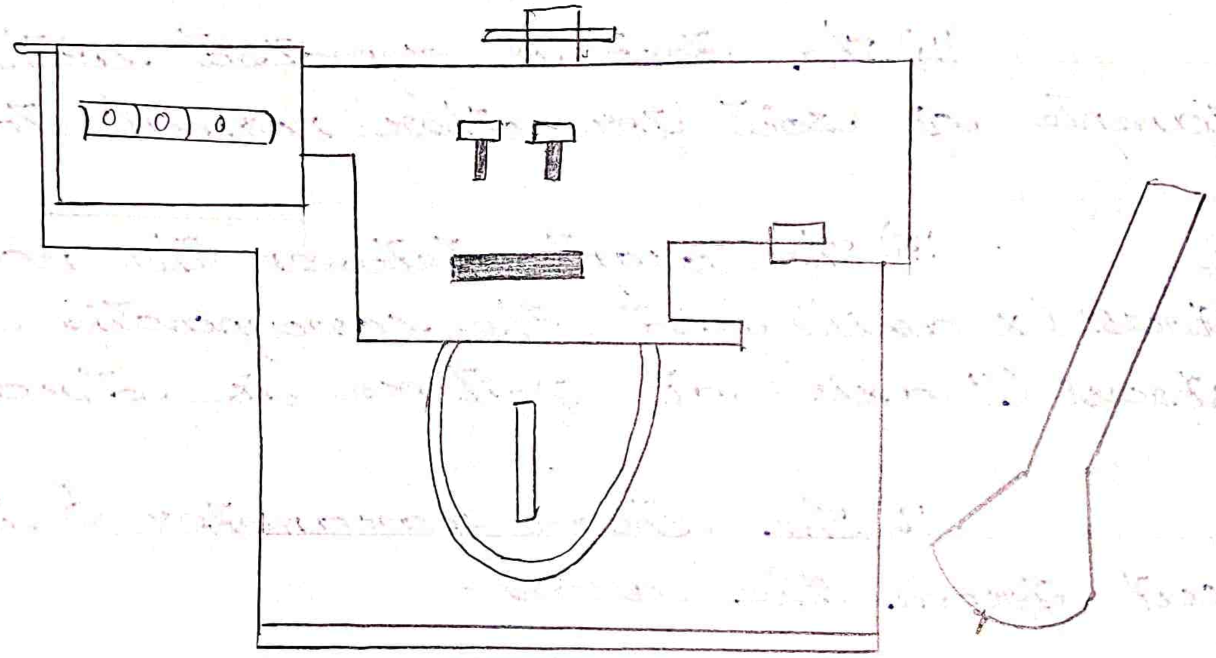
Observation	10	9
Understanding	5	4
Neatness	5	4
Viva	5	4
Total	25	21

Date of Submission 19.09.20

Result:

The friction angle from graph (ϕ) = 47°



Determination of Liquid Limit of Soil

Aim:

To determine the liquid limit of the given soil.

Description:

The liquid limit apparatus has a cup which is raised 1 cm above a flat base and then dropped by rotating handle. The grooving tool has a cutting edge of standard dimensions used to form a groove in the middle of the soil sample.

A gauge block is used to check that the cup is adjusted to give a drop of exactly one cm.

Apparatus Required:

1) Casagrande liquid limit device with grooving tool.
2) China clay dish.
3) Balance to weigh up to an accuracy of 0.01gm.

4) Spatula
5) Container to dry the sample.

Procedure:

1) Weigh about 120 gms of soil passing through 420 micron I.S. sieve.

2) The soil sample is placed on the evaporating dish and thoroughly mixed with water using spatula until the mass becomes a thick paste of putty like consistency.

3) The Casagrande's device is checked to have a correct fall of 10mm and placed a portion of the prepared paste over the brass cup.

4) A portion of the mixture is placed in the cup and leveled with the spatua to a maximum depth of 1 cm.

5) The grooving tool is used to cut a groove in the middle of the soil cake.

6) The cam is rotated at a rate of 2 blows per second and the rotations

Tabulation:

S.No	Quantity of water added in cc	Percentage of moisture content M	Number of blows N
1.	60	50	87
2.	63	53	48
3.	66	56	32
4.	69	59	24
5.	72	62	23
6.	75	65	12
7.	84	68	6
8.	88.8	71	3
9.	93.6	74	2

are counted until the groove closes over a length of 12mm.

7) A small quantity near the centre of test sample is collected in a container and weighed it.

8) The sample is kept in the oven for 24 hours and weighed.

9) The difference of the two weights will give the weight of water and from that moisture content is found out by the dry weight.

10) The experiment is repeated by adding little more water. Four trials are made so that the numbers of blows are more than 25 in two cases and less than 25 in other two cases. (25 ± 15)

11) In each trial the moisture content is determined the results of the test are plotted as a flow curve.

12) The moisture content values are plotted to a natural scale against the no of blows to a logarithmic scale.

Calculation :

Liquid limit is directly found from the graph (corresponding to 25 blows)

$$\text{Flow Index } (I_f) = \frac{(M_1 - M_2)}{\log (N_2/N_1)}$$

where, M_1, M_2 = Moisture content in % at N_2 and N_1 blows respectively.

$$I_f = \frac{59 - 56}{\log_{10}\left[\frac{32}{14}\right]}$$

$$I_f = 34.28$$

13) The moisture content corresponding to 25 no of blows will give the liquid limit for the sample (from the graph).

Graph:

A plot is made between the water content and number of blows in a semi log sheet.

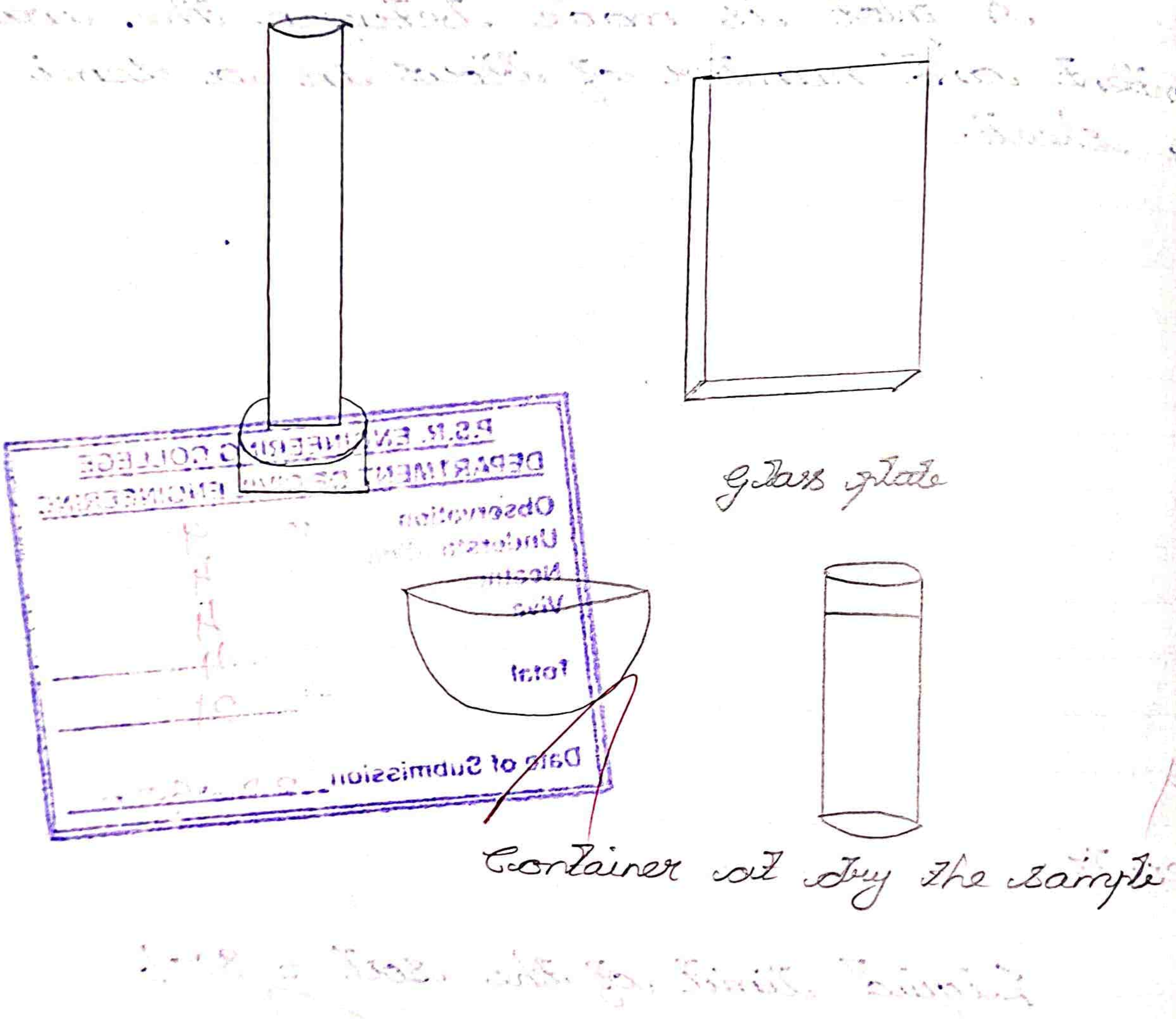
Observation	10	9
Understanding	5	4
Neatness		4
Viva		4
Total	25	21

Date of Submission 22.09.20

Result:

Liquid limit of the soil = 80%

Flow Index of the soil = 34.28


Glass plate
Container to dry the sample

Exp. No.: 8
Date : 12.10.20

Determination Of Plastic Limit Of Soil

Aim:

To determine the plastic limit of the given soil.

Apparatus Required:

1) Glass plate
2) China clay disc
3) Balance
4) Container to dry the sample in oven

Procedure:

1) A sample of about 50gms is taken from the given soil sample.

2) The sample is thoroughly mixed with water on the glass plate until it is plastic enough to be rolled into a ball.

3) The ball of soil is then rolled between the hand and the glass plate so as to form the soil mass into a

Observation:

Weight of can (W_1) (gm) = 7.5

Weight of wet soil with can (W_2) (gm) = 23.5

Weight of dried soil with can (W_3) (gm) = 19.5

Weight of water ($W_3 - W_2$) (gm) = 4

Weight of dry soil ($W_2 - W_1$) (gm) = 16

Moisture content (w) (%) = 40%

thread of 3mm diameter without breaking.

4) The soil is then kneaded together and rolled out again. The process of kneading and rolling thread is repeated until the soil just cases to be plastic and crumbles.

5) The portions of the crumbled soil are gathered together and placed in a container for moisture content determination.

6) The test is repeated twice more with fresh samples.

7) The average of the three water contents gave the plastic limit of the soil.

Calculation:

1) Determination of plastic limit

$$W = \frac{(W_2 - W_3)}{(W_3 - W_1)} \times 100$$

$$= \frac{23.5 - 19.5}{19.5 - 7.5} \times 100$$

$$W = 33\%$$

2) Plasticity index = liquid limit - plastic limit

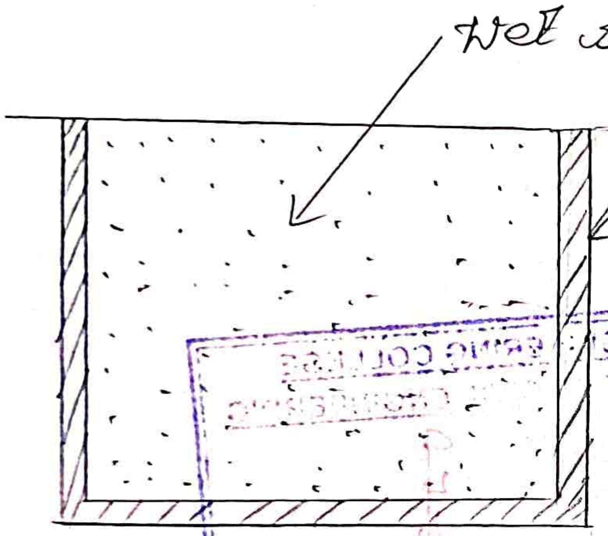
$$= 63 - 33$$

$$= 30\%$$

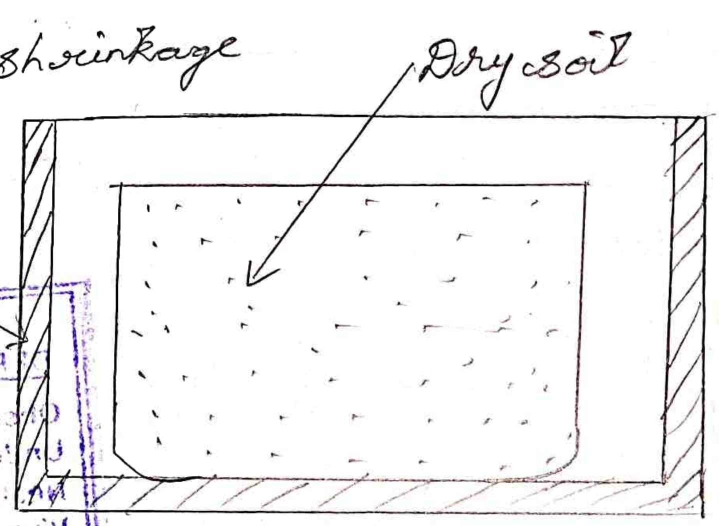
Result:

Plastic limit of the soil = 33

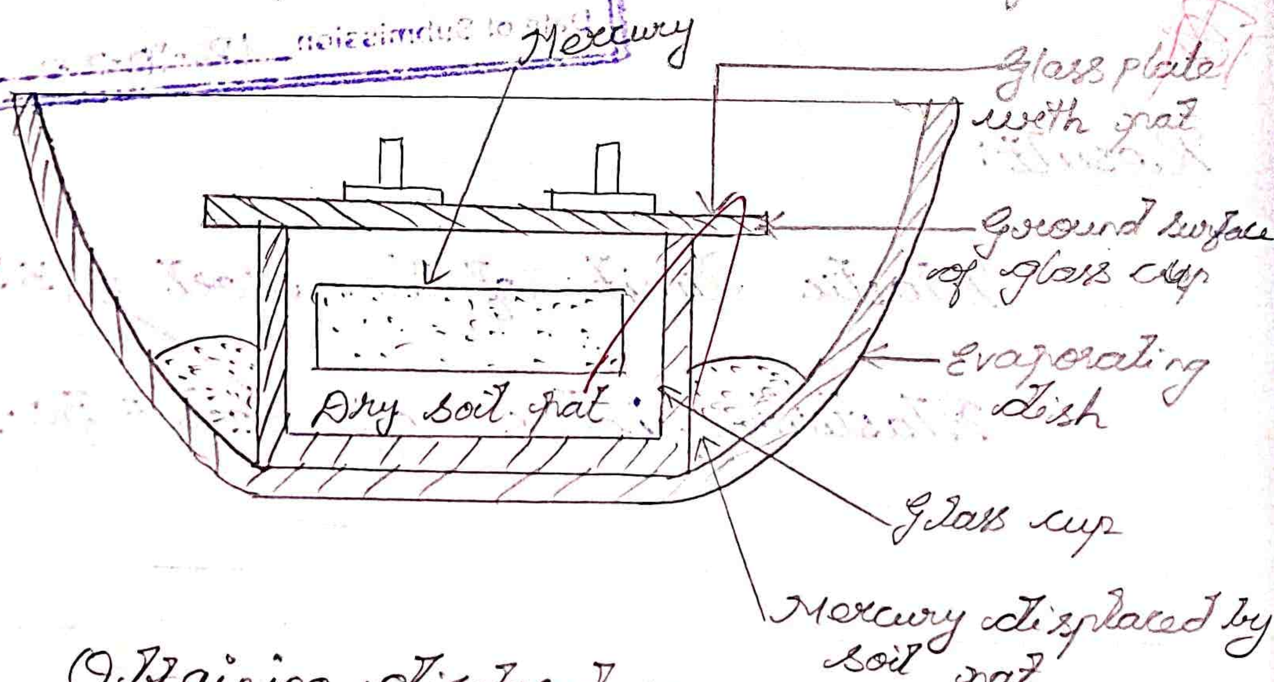
Plasticity index of soil = 30%



Before shrinkage



After shrinkage



Obtaining displaced mercury

Determination Of Shrinkage Factors

Aim :

To Determine the shrinkage limit of a soil and shrinkage factors.

Apparatus Required:

1) Shrinkage dish
2) Porcelain evaporation dish
3) Three pin pronged plate
4) Plain glass plate
5) Mercury measuring cup
6) Mercury

Procedure :

1) About 30 gms of soil passing through 425 micron sieve is mixed with distilled water. The water added should be sufficient to make the soil pasty enough to be readily worked into the shrinkage dish without intrusion of air bubbles.

2) The inside of the shrinkage dish is coated with a thin layer of vaseline.

Observation:

Weight of empty shrinkage dish (W_1) = 65

Weight of dish + wet soil (W_2) = 106

Weight of dish + dry soil (W_3) = 91.5

Soil pat diameter (d) = 4.5 cm

Height of the pat (h) = 1.5 cm

Weight of displaced mercury + Dish (W_4) = 276

Volume of dry soil pat (V_2)(cc) = 10.8

Weight of wet soil (W_w) = 41

Weight of dry soil (W_d) = 26.5

Volume of wet soil pat (V)(cc) = 23.86

The soil sample is placed in the dish by giving gentle taps. The top surface is struck off with a straight edge.

5) The shrinkage dish is weighed immediately full of water soil.

4) The dish is dried first in air and then in an oven.

5) The shrinkage dish is weighed with dry soil pat.

6) The shrinkage dish is cleaned and dried to determine its empty mass.

7) An empty porcelain dish is also weighed which will be used for weighing mercury. This dish is known as mercury weighing dish.

8) The shrinkage dish is kept in a large porcelain dish, and is filled to over flow with mercury and the excess is removed by pressing the plain glass plate firmly over the top of the dish.

9) The glass cup is placed in a large dish, and it is filled to overflowing with

Calculations:

V = Volume of wet soil pat (cc)

W = Weight of wet soil pat (gm)

V_0 = Volume of dry soil pat (cc)

W_0 = Weight of dry soil pat (gm)

a) Water content (m%) = $\frac{W - W_0}{W_0} \times 100$

$= \frac{41 - 26.5}{26.5} \times 100$

$= 54.72\%$

mercury the excess is removed by pressing the glass plate with three prongs firmly over top of the cup.

10) The outside of the glass cup is wiped to remove any adhering mercury, then it is placed in another large dish, the dry soil pat is placed on the surface of the mercury and it is submerged under the mercury by pressing with the glass plate with prongs.

11) The mercury displaced by the soil pat is transferred to the mercury weighing dish and is weighed.

12) The test is repeated thrice for each soil sample.

b) Shrinkage limit (S.L.) = $\left[m - \left(\frac{V - V_0}{W_0}\right) \times 100\right]$

$= \frac{23.86 - 10.8}{10.8} \times 100$

$= 2.45$

c) Shrinkage ratio (S.R) = $\left[\left\{(W_w - W_d) - (V_1 - V_2)\gamma_w\right\} / W_d\right] 100$

$= \frac{[41 - 26.5] - [23.86 - 10.5] \times 1}{26.5} \times 100$

S.R. = 5.434 %

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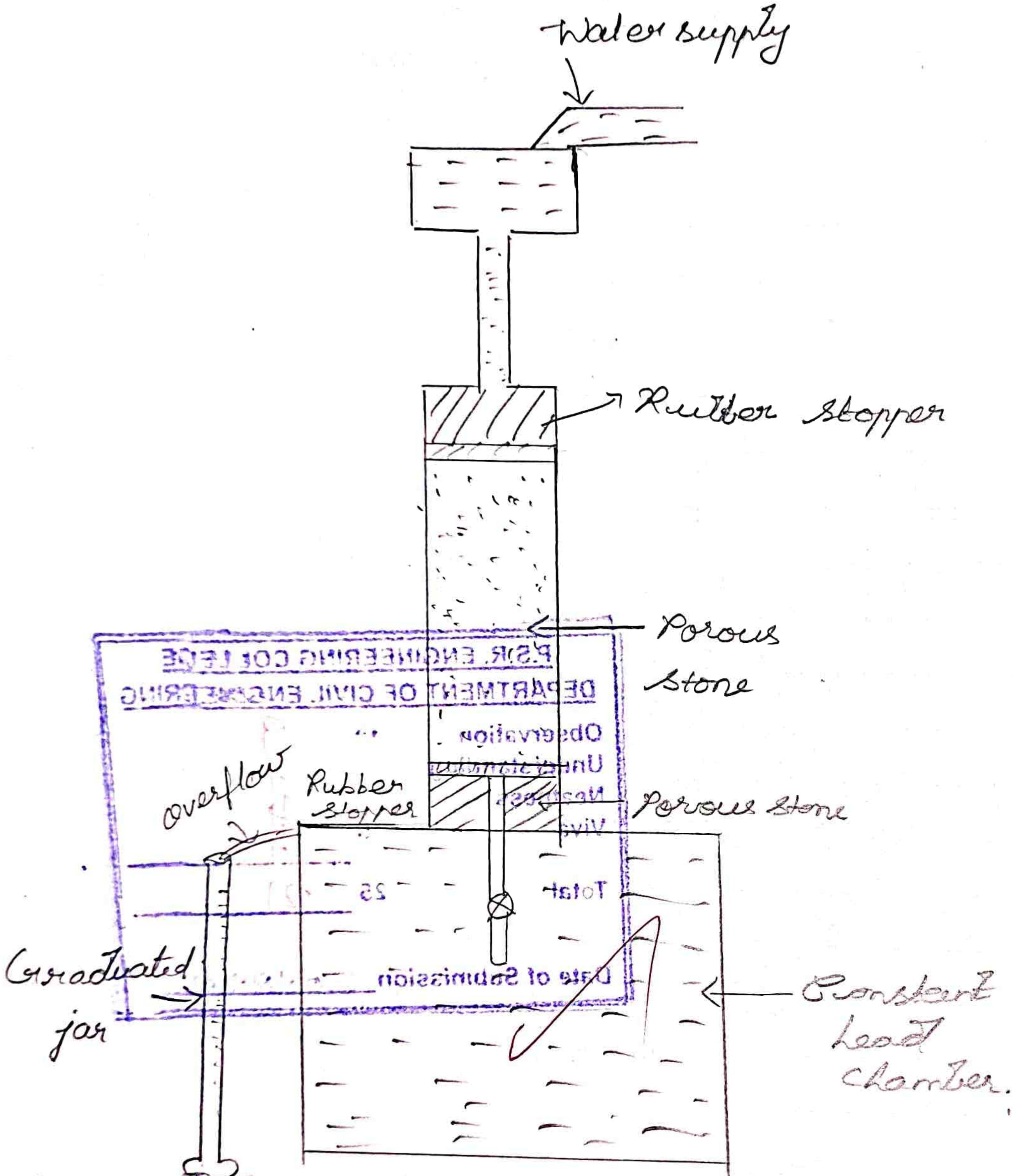
DEPARTMENT OF CIVIL ENGINEERING

Observation	10	9
Understanding	5	4
Neatness	5	4
Viva	5	4
Total	25	21

Date of Submission 20.10.20

Result:

Shrinkage limit of the soil (s) : 5.434%



Set-up of the constant head permameter

Constant Head Permeability Test

Aim :

To find out the coefficient of permeability of the assigned soil using a constant head permeameter.

Apparatus Required:

Constant head permeameter with accessories.

Procedure:

1) The permeameter mould should be filled with the assigned soil sample in a manner specified by the instructor.

2) The permeameter assembly should be assembled and kept in the bottom tank.

3) The 75mmϕ glass tube with overflow is used.

4) The water is allowed to flow into the permeameter by opening tap.

Observation:

Diameter of specimen (D) = 10cm

Area of sample (A) = 78.53 cm²

Weight of sample filling the mould (W_s) = 1400

Specific gravity of the soil (G) = 2.7

Volume of solids, $V_s = W_s / G$ = 518.87

Void ratio, $e = V_v / V_s$ = 1.032

Length of sample 'L' = 13cm

Head causing flow 'h' = 65cm

Viscosity of water at 27°C (μ_{27}) = 7.85×10^{-2} N/mm²

S.No	Hydraulic head (cm)	Time (t) sec	Quantity of flow (cm³)	Coefficient of permeability
1.	69-59 (10)	41	260	0.078
2.	70-60 (10)	58	300	0.0132
3.	71-61 (10)	69	330	0.0122

5) The air release valve on the cap of the permeameter is unscrewed.

6) The bottom outlet valve is opened and water is allowed to flow through the specimen.

7) Water is poured till it over flow in the tank.

8) Repeat the test for same time interval and determine the average quantity.

Calculation:

$$\text{Area} = \frac{\pi \times 10^2}{4} = 7853 m^2$$

$$\text{Volume} = 78.53 \times 13 = 1020.89 m^3$$

$$V_v = V - V_s$$

$$= 1020.89 - 518.87$$

$$= 502.38$$

$$V_s = 1400 / 2.7$$

$$= 518.51$$

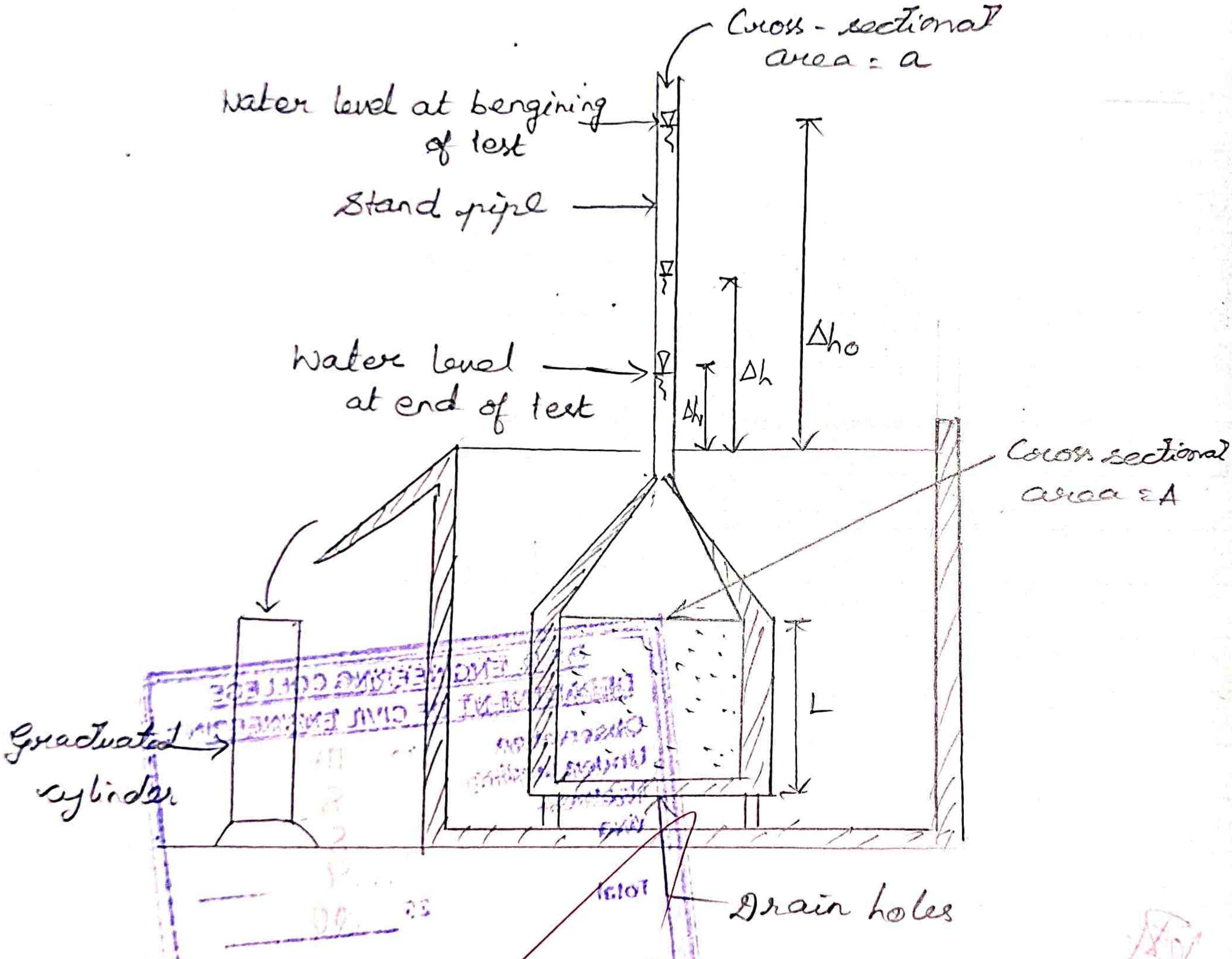
$$k = \frac{260 \times 13}{78.53 \times 41 \times 65}$$

$$K = 0.034$$

7

Result :

Co-efficient of permeability at constant head K = 0.0345 cm/sec.



Cross-sectional area = a
Water level at bengining of test
Stand pipe
Water level at end of test
Δh0
Δh
Δh1
Cross sectional area = A
L
Graduated cylinder
Drain holes

Exp. No.: 11
Date: 02.12.20

Falling Head Permeability Test.

Aim:

To find out the coefficient of permeability of the given fine grained soil using a variable head permeameter.

Apparatus Required:

Variable head permeameter with accessories.

Procedure:

1) Prepare the soil specimen in the permeameter and saturate it as explained in the constant head permeability test.

2) Keep the permeameter mould assembly in the bottom tank.

3) Connect the water inlet nozzle of the mould to the stand pipe filled with water.

Observation:

Area of sample (A) = 78.53 cm^2
Area of stand pipe (a) = 0.715 cm^2
Length of the sample (L) = 13 cm
Temperature of the Test (T°c) = Room Temperature 27°c
Depth of water in tubes = 85 cm

S.No	Initial head (h_1) cm	Final head at time h_2 (cm)	Time in sec T	Coefficient of permeability cm/sec
1.	85	75	25	0.0139
2.	70	60	31	0.0113
3.	55	45	37	0.009
4.	40	30	42	0.0095
5.	25	15	48	0.0104
			Average	0.0108

4) Note down the time interval required for the water level in the stand pipe to fall from some convenient initial value (h_1) to some final value (h_2).

5) Repeat the above step at least three times and determine the time for the water level in the stand pipe to drop from the same initial head to the same final value.

Calculation:

$$KT = 2.303 \frac{aL}{At_1} \log_{10}\left(\frac{h_1}{h_2}\right)$$

$$= 2.303 \left[\frac{0.785 \times 13}{78.53 \times 25}\right] \log_{10}\left[\frac{85}{75}\right]$$

$$= 5.072 \times 10^{-3} \times 1.16$$

$$KT = 0.0108 \text{ cm/sec}$$

Observation	10	9
Understanding		4
Neatness		4
Viva	5	4
Total	25	21

Date of Submission 02.12.20

Result:

The coefficient of permeability of the soil at variable head (k) = 0.0108 cm/sec

Unconfined Compression Test On Cohesive Soil

Aim:

To find out the unconfined compression strength and shear strength of remoulded clay samples in its normal water content.

Apparatus Required:

Unconfined compression tester, soil sample compression and gauge and proving ring.

Procedure:

1) Remoulded soil specimen (38 mm dia) was prepared and it is centrally mounted in the unconfined compression tester.

2) The proving ring is so adjusted to touch the top of the soil sample.

3) Then vertical axial load is gradually applied to the soil specimen.

Observation:

Length of Sample = 7.85 cm
Dial of sample = 3.78 cm
Initial area of sample : 11.22 cm^2
δL = 64 cm.

Tabulation:

S.No	Deflection dial reading	Proving ring reading	ΔL	Strain $E = \Delta L / L$	1-E	Load (P) kg.	Area $A_0/(1-E)$	Stress = P/A
1.	100	0.8	1	0.127	0.87	3.9	12.852	0.303
2.	200	1.2	2	0.255	0.74	7.8	15.060	0.517
3.	300	1.8	3	0.382	0.61	9.7	18.155	0.537
4.	400	2	4	0.510	0.49	15.6	22.897	0.681
5.	500	2.2	5	0.636	0.36	19.5	30.824	0.632
6.	600	2.4	6	0.764	0.23	23.4	47.542	0.492
7.	700	2.6	7	0.892	0.108	27.3	103.88	0.262

4) Readings from the proving ring and the compression dial gauge are taken.

5) During early stages of the test, take readings approximately 0.25mm of vertical deflection.

6) As the stress-strain curve begins to flatten take readings less often (ie 0.50 mm and later ever (0.75mm).

7) Compress the specimen till failure.

	Max	Marks
Observation	10	8
Understanding		4
Neatness		4
Viva		3
Total	25	19

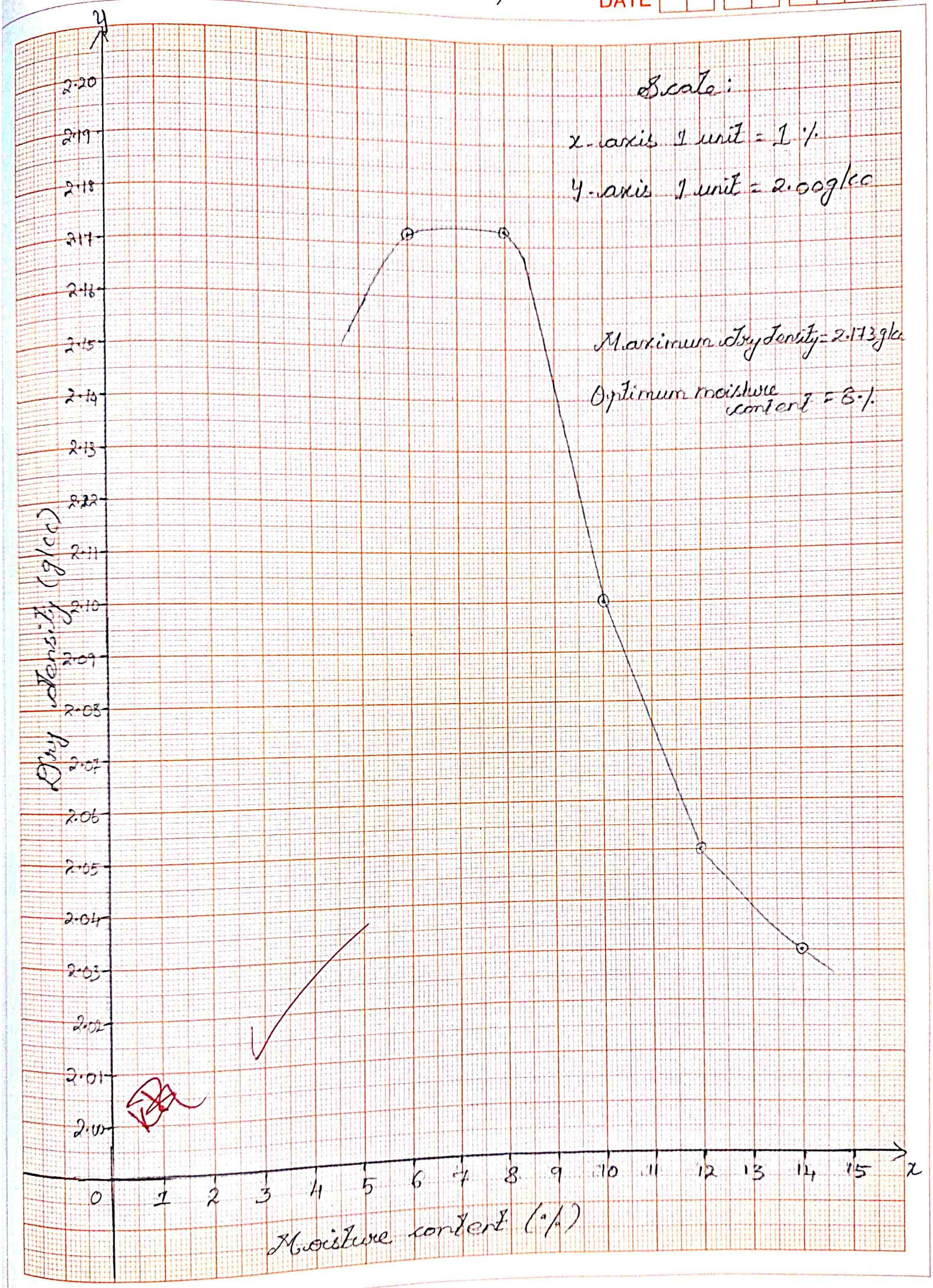
Date of Submission 10.12.20

Result:

The unconfined compression strength of given sample = 0.681 g/cm².

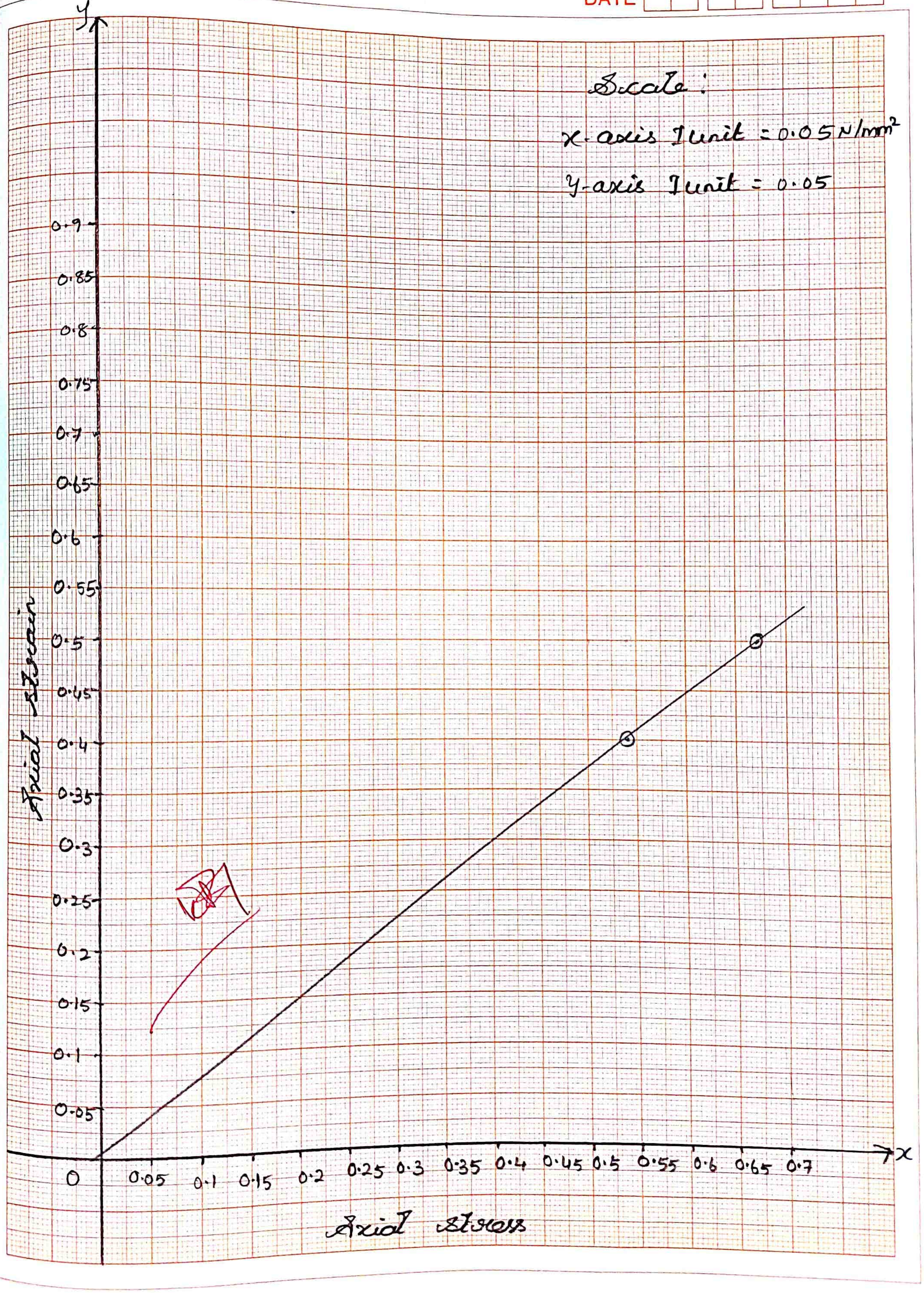
Ex NO: 4 Standard Proctor compaction Test

DATE



Ex No... Unconfined Compression strength on cohesion soil

DATE



Ex No: 2 Sieve Analysis