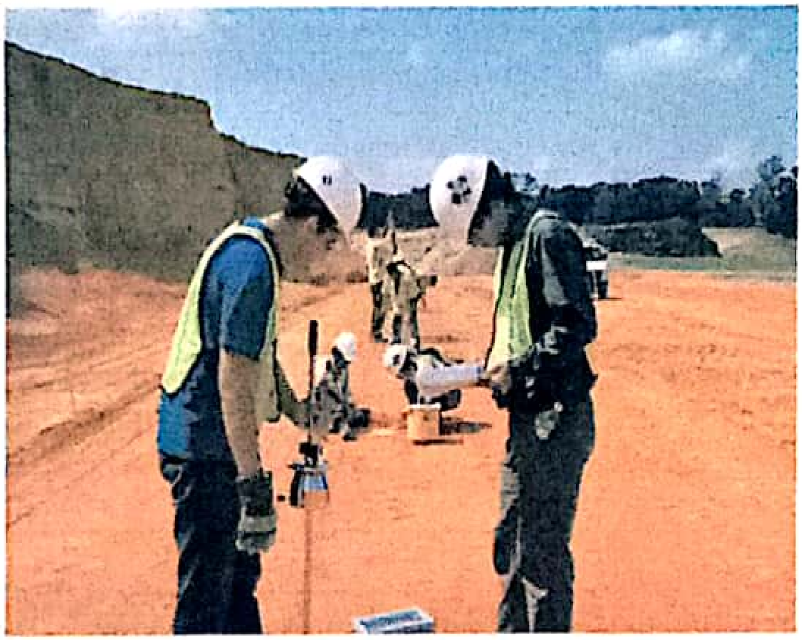
P.S.R. ENGINEERING COLLEGE

An Autonomous Institution, Affiliated to Anna University
Approved by AICTE, New Delhi, Accredited by NBA & NAAC A+
Recognized Under 12 (B) of the UGC Act, 1956 & ISO 9001:2015
Sivakasi-626 140, Virudhunagar Dt., Tamil Nadu

DEPARTMENT OF CIVIL ENGINEERING

161CE58 SOIL MECHANICS LABORATORY



LAB MANUAL

Name : ______________________

Roll No : ______________________

Semester : ______________________

Year : ______________________

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TÜV SÜD

DEPARTMENT OF CIVIL ENGINEERING

161CE58 SOIL MECHANICS LABORATORY
LAB MANUAL
ACADEMIC YEAR 2020-2021

NAME :

BRANCH & SECTION :

REGISTER NUMBER :

LAB INCHARGE
Mr. K.MAHENDRAN
Associate Professor/ Civil

3/6/20

PREPARED BY
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P.S.R. ENGINEERING COLLEGE DEPT OF CIVIL ENGG SIVAKASI

Dean (Research) & H.O.D/ Civil,
P.S.R. Engineering College,
SIVAKASI-626140

GENERAL INSTRUCTIONS

The following instructions should be strictly followed by the students in the Soil mechanics Laboratory:

1. All the students are expected to come to the laboratory with shoe, uniform and I.D.Card, whenever they come for the laboratory class.

2. For each lab. Class, all the students are expected to come with observation note book, record note book, pencil, eraser, sharpener, scale, divider, graph sheets, French curve, etc.

3. While coming to each laboratory class, students are expected to come with observation note book prepared for the class.

4. All the students are expected to complete their laboratory work including calculations and get it corrected in the laboratory class itself.

5. While coming to the next lab. Class, students are expected to submit the record note for correction.

6. All the equipments, tools and accessories are expensive. Therefore, students are expected to handle the instruments with utmost care during the lab classes.

7. The tools and accessories required for conducting the experiments can be obtained from the technician and the same should be returned after the completion of the experiments.

8. Breakage amount will be collected from the student(s) for causing damage to the instruments/equipments due to wrong operation or carelessness.

SYLLABUS (R -2016)

161CE58 SOIL MECHANICS LABORATORY L T P C

OBJECTIVE 0 0 3 2

At the end of this course, the student acquires the capacity to test the soil to assess its Engineering and Index properties.

1. Grain size distribution - Sieve analysis
2. Grain size distribution – Hydrometer analysis
3. Specific gravity of soil grains
4. Relative density of sand
5. Atterberg's limits test
6. Determination of moisture - Density relationship using standard Proctor test.
7. Permeability determination (constant head and falling head methods)

Determination of shear strength parameters by

8. Direct shear test on cohesion less soil
9. Unconfined compression test on cohesive soil
10. Triaxial compression test.
11. One dimensional consolidation test (Demo only)
12. Determination Shear Strength Of Clay Soil By Vane Shear Test
13. Consolidation Test
14. Field density test (Core cutter Method)
15. Field density test (Sand Replacement Method)
16. Determination of Standard Penetration Test.

TOTAL : 45 PERIODS

REFERENCES

1. "Soil Engineering Laboratory Instruction Manual", Published by the EngineeringCollege Co-operative Society, Chennai, 2002.
2. Head, K.H, "Manual of Soil Laboratory Testing (Vol-1 to 3)", John Wiley & Sons, Chichester, 1998.
3. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
4. "I.S.Code of Practice (2720) Relevant Parts", as amended from time to time.

Saibaba Reddy, E. and Rama Sastri, K., "Measurement of Engineering Properties of Soils", New Age International Publishers, New Delhi, 2002

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1. SIEVE ANALYSIS

Aim:

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

Description:

Soils having particles larger than 0.075 mm 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.

Apparatus required:

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

Procedure:

1. Take suitable quantity (1000 gms) of oven dried soil retained in 75sieve.
2. Sieve the soil through 4.75 mm, 2.36 mm, 1.18 mm, 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, coefficient of curvature from semi log graph.

Observations:

Sl. No.	I.S. Sieves	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						
2.	2.36mm						
3.	1.18mm						
4.	600μ						
5.	300μ						
6.	150μ						
7.	75μ						
8.	Pan						

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 (Cu) = D_{60} / D_{10}**
3. **Coefficient of curvature (Cc) = $(D_{30})^2 / (D_{10} \times D_{60})$**
4. **Fineness modulus = Total sum of the cumulative % retained / 100**

Results:

1. **Uniformity coefficient (Cu) =**
2. **Coefficient of curvature (Cc) =**

Fig: Sieve Shaker

Fig: Sieves

2. HYDROMETER ANALYSIS FOR FINE GRAINED SOIL

Aim:

1. Calibrating the Hydrometer.
2. plotting the grain size distribution curve of the given soil sample by hydrometer analysis and to determine the effective size and uniformity coefficient of the soil.

Apparatus required:

1. Balance to weigh upto 0.1 g
1. Soil stirrer
2. Hydrometer in specific gravity range from 0.995 to 1.050 and reading 1.00 at 20 c in water.
3. Graduated measuring cylinder for a volume of 1000ml (Hydrometer Jar)
4. Thermometer.
5. Beaker of 1000 cc capacity.

Calibration of hydrometer:

1. The readings on the hydrometer stem give the density of soil specimen situated at the centre of the bulb at any time.
2. When hydrometer is immersed in the jar, the water level will rise, the rise being equal to the volume Vh of the hydrometer divided by the internal area of cross section Aj of the jar.
3. So the corrected height H_R will be $H_R = H + (1/2)\ (h - (V_H / A))$
4. A graph has been drawn between hydrometer reading in x axis abscissa and height in y axis ordinate.

Procedure:

1. Mix 50 g of soil with 100ml of sodium oxalate or sodium hexametaphosphate per litre.
2. The mixture is well stirred with a glass rod and allowed to stand overnight.
3. Next day the mixer is passing through 0.075 mm sieve and washed.
4. The passing is taken for hydrometer analysis.
5. After stirring the mixture for 5 minutes the suspension is transferred to the measuring cylinder and made upto exactly 1000ml with distilled water.
6. The measuring jar is now shaken vigorously and then allowed to stand and the stop watch is started.
7. The hydrometer is carefully inserted and the first reading taken after a period of 0.5 minute.
8. It is usual for convenience, when recording the hydrometer readings to omit the one and more the decimal point three places to the right. For example the graduation of 1.014 is read as 14.
9. Further readings are taken at 1 and 2 minutes and hydrometer is removed. Insertion and withdrawal of hydrometer should be done carefully.
10. After each removal, the hydrometer should be wiped dry with a clean rag.
11. Further readings should be taken after periods of 4, 8, 15, 30 minutes and 1, 2, 3 hours. Subsequently readings may be taken at convenient intervals.
12. The readings should be taken for 24 hours.
13. The results are tabulated as in the tabular column.

Corrections to hydrometer readings:

1. Meniscus Correction: Cm

Since soil suspension is opaque the true reading of the hydrometer at the bottom of the meniscus of the liquid can not be obtained. So a meniscus correction is applied to top reading. The meniscus correction is positive and added to the hydrometer reading.

2. Temperature Correction: C_t

Hydrometers are calibrated for 20c. If the test temperature is higher than 20 correction is positive, if the test temperature is lower correction is negative. Readings are obtained from temperature correction chart.

3. Dispersion agent Correction: C_d

The standard correction of 0.8 is subtracted from the reading.

Corrected hydrometer reading R = Rh + Cm $\pm$ Ct - Cd

Calculation:

Percentage of particles smaller than corresponding equivalent particle diameter is given by the formula

$$\% \text{ Finer} = \frac{100 G_s R}{W_s (Gs - 1)}$$

Where,

Ws = Total dry weight of soil particle is 1000 ml suspension

Gs = Specific gravity of soil particles

R = Corrected Hydrometer reading

The equivalent particle diameter D in mm is obtained from the formula

$$D = 0.175 \sqrt{\frac{\eta H_R}{(G_s - 1) t}}$$

Where,

η = Viscosity of water in C.G.S. units (poises)

H_R = Effective height of fall in cms.

G_S = Specific gravity of soil particles

t = Observed time in minutes

Result:

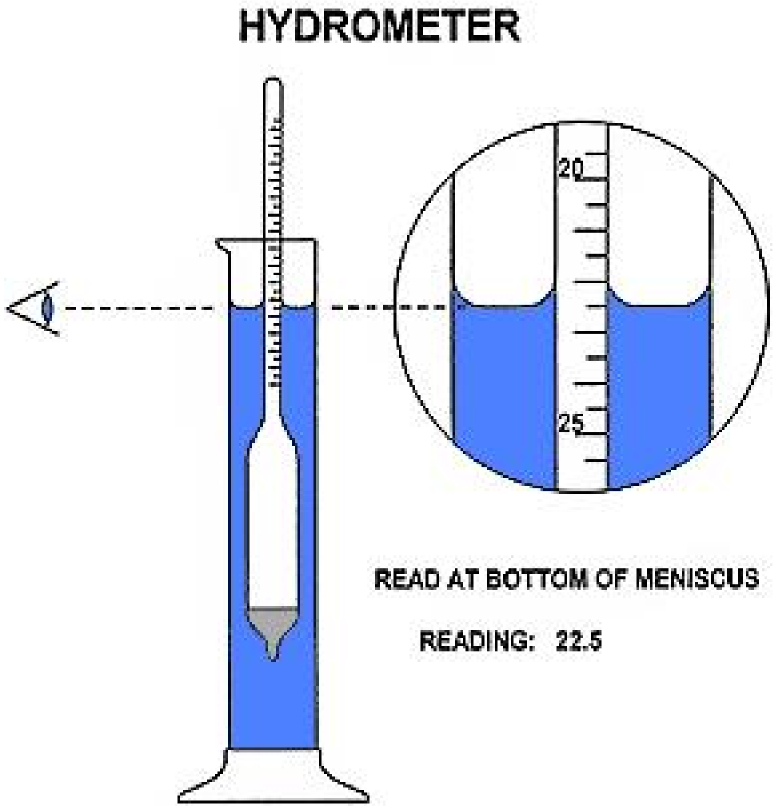
Grain size distribution curve is drawn having log. particle size in abscissa and percentage finer as ordinate. The effective size and uniformity coefficient have been determined.

Gs =　　　　Ws =　　　　Cm =

Cd =

$R = Rh + Cm \pm Ct - Cd$

Temp T	**Elapsed time 't' min**	**Hydrometer reading Rh**	**Temp. correction CT**	**Corrected hydrometer reading R**	**Viscosity (Poises)**	**Height of fall He in cms.**	**Equivalent particle diamètre 'D' mm**	**% of particles finer than the corresponding particle dia. (w%)**



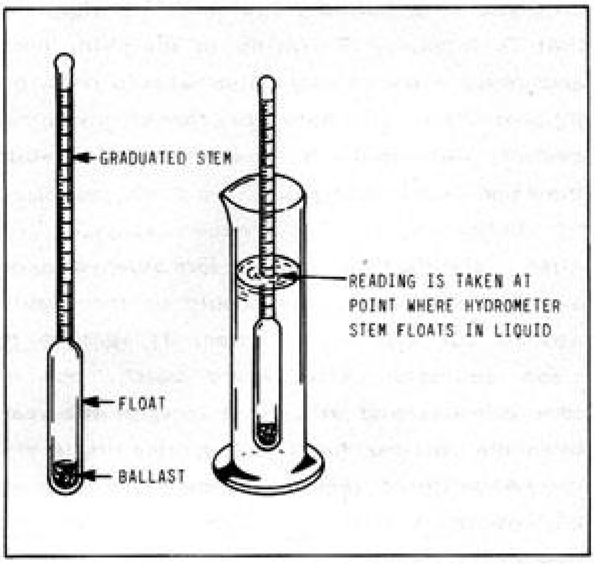


Fig: Hydrometer

3. 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 (W1) gm.
2. Take about 150g (approximately) of dry sand & put it the bottle and find its weight (W2) gm
3. The density bottle is now filled with distilled water up to the mark(marked in bottle) and weigh as (W3) gm
4. The bottle is now emptied, completely fill with only distilled water the mark and find its weight(W4)g

Observation:

Sl.No	Particulars	Weight in grams Trial 1	Weight in grams Trial 2	Weight in Grams Trial 3
1	Weight of pycnometer (W1)			
2	Weight of pycnometer + soil (W2)			
3	Weight of pycnometer + soil + water (W3)			
4	Weight of pycnometer + water (W4)			

Calculation:

Specific gravity of soil (G) = $[(W_2 - W_1)] / [(W_2 - W_1) - (W_3 - W_4)]$

Result:

Soil Specific Gravity of Soil (G) =

PYCNOMETER

4. RELATIVE DENSITY OF SAND

Aim:

This lab is performed to determine the relative density of cohesion less, free-draining soils using a vibrating table. The relative density of a soil is the ratio, expressed as a percentage, of the difference between the maximum index void ratio and the field void ratio of a cohesion less, free-draining soil; to the difference between its maximum and minimum index void ratios.

Standard References:

ASTM D 4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

ASTM D 4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

Significance:

Relative density and percent compaction are commonly used for evaluating the state of compactness of a given soil mass. The engineering properties, such as shear strength, compressibility, and permeability, of a given soil depend on the level of compaction.

Equipment:

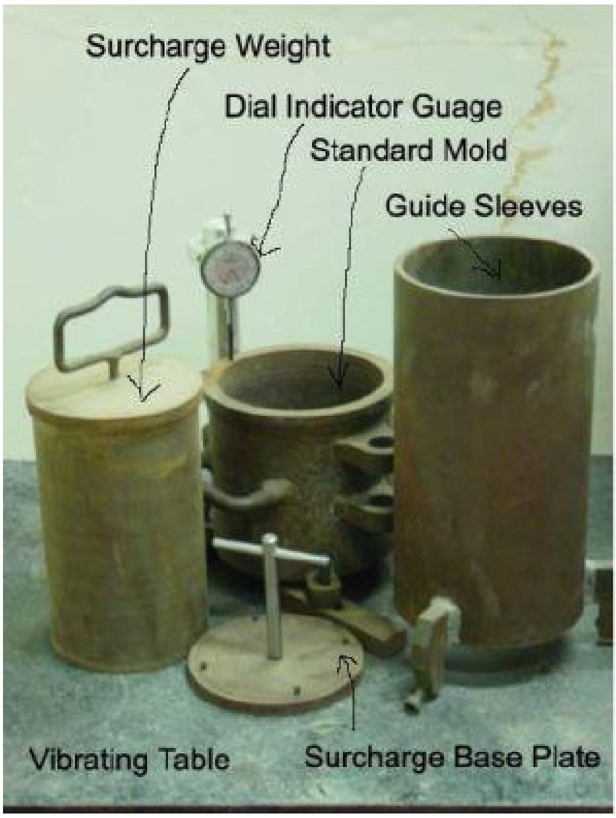
- Vibrating Table
- Mold Assembly (consisting of standard mold, guide sleeves, surcharge base-plate, surcharge weights, surcharge base-plate handle, and dial-indicator gage)
- Balance
- Scoop
- Straightedge

Test Procedure:

(1) Fill the mold with the soil (approximately 0.5 inch to 1 inch above the top of the mold) as loosely as possible by pouring the soil using a scoop or pouring device (funnel). Spiraling motion should be just sufficient to minimize particle segregation.

(2) Trim off the excess soil level with the top by carefully trimming the soil surface with a straightedge.

(3) Determine and record the mass of the mold and soil. Then empty the mold (**M_1**). See fig-1.



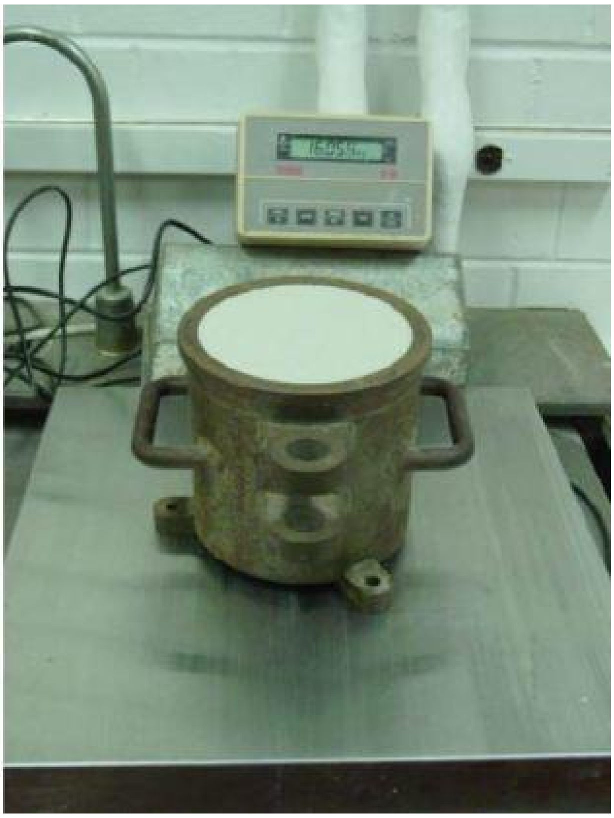


Fig-1 (Relative density test apparatus)

(4) Again fill the mold with soil (do not use the same soil used in step 1) and level the surface of the soil by using a scoop or pouring device (funnel) in order to minimize the soil segregation. The sides of the mold may be struck a few times using a metal bar or rubber hammer to settle the soil so that the surcharge base-plate can be easily placed into position and there is no surge of air from the mold when vibration is initiated.

(5) Place the surcharge base plate on the surface of the soil and twist it slightly several times so that it is placed firmly and uniformly in contact with the surface of the soil. Remove the surcharge base-plate handle.

(6) Attach the mold to the vibrating table.

(7) Determine the initial dial reading by inserting the dial indicator gauge holder in each of the guide brackets with the dial gauge stem in contact with the rim of the mold (at its center) on the both sides of the guide brackets. Obtain **six sets** of dial indicator readings, three on each side of each guide bracket. The average of these twelve readings is the initial dial gage reading, $\mathbf{R_i}$. Record Ri to the nearest 0.001 in. (0.025 mm). See fig-2.

(8) Firmly attach the guide sleeve to the mold and lower the appropriate surcharge weight onto the surcharge base-plate. See fig-2.

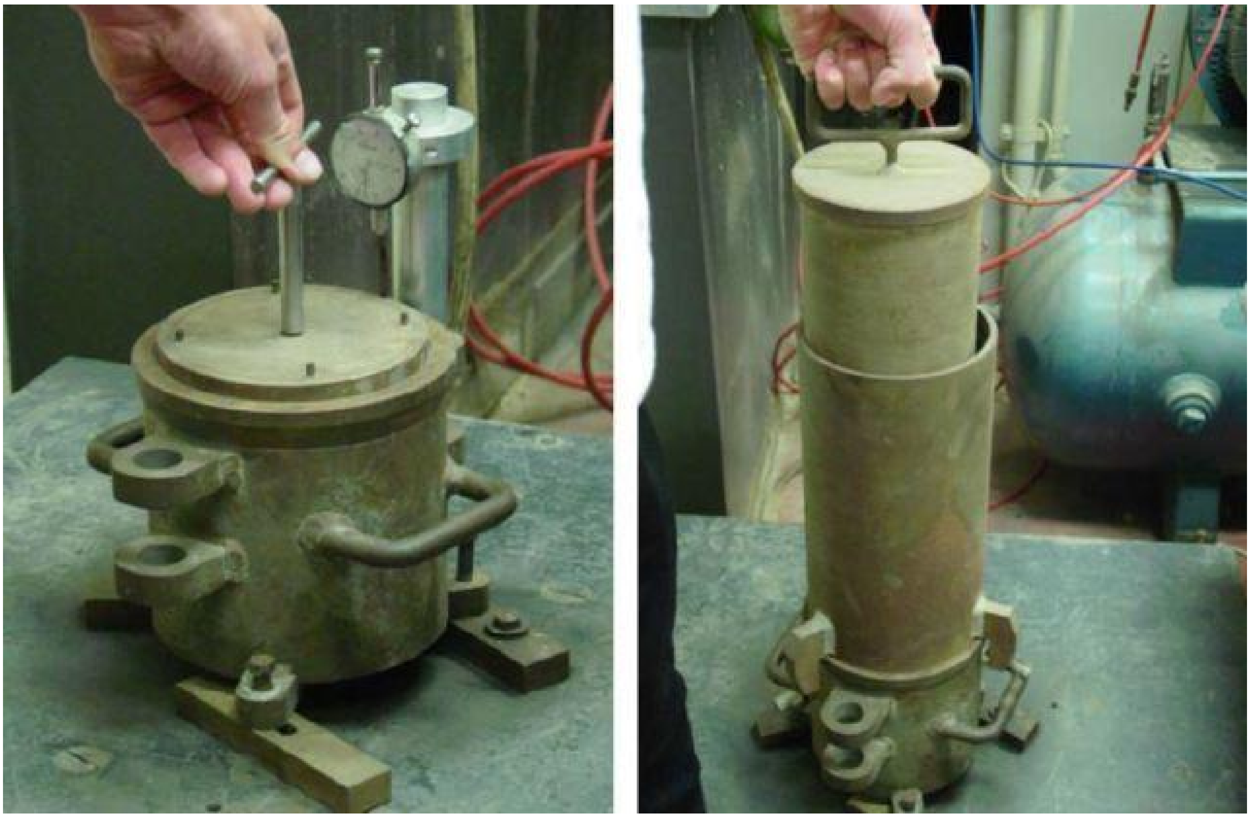


Fig-2 Relative density test of sand

(9) Vibrate the mold assembly and soil specimen for 8 min.

(10) Determine and record the dial indicator gage readings as in step (7). The average of these readings is the final dial gage reading, $\mathbf{R_f}$.

(11) Remove the surcharge base-plate from the mold and detach the mold from the vibrating table.

(12) Determine and record the mass of the mold and soil ($\mathbf{M_2}$)

(13) Empty the mold and determine the weight of the mold.

(14) Determine and record the dimensions of the mold (i.e., diameter and height) in order to calculate the calibrated volume of the mold, $\mathbf{V_c}$. Also, determine the thickness of the surcharge base-plate, $\mathbf{T_p}$.

Analysis:

(1) Calculate the minimum index density (ρ_{dmin}) as follows:

$$\rho_{dmin} = M_{S1}/V_c$$

Where

$\mathbf{M_{s1}}$= mass of tested-dry soil = Mass of mold with soil placed loose – mass of mold

$\mathbf{V_c}$= Calibrated volume of the mold

(2) Calculate the maximum index density (ρ_{dmax}) as follows:

ρ_{dmax} = M_{S2}/V

Where

M_{s2} = mass of tested-dry soil = Mass of mold with soil after vibration – Mass of mold

V = Volume of tested-dry soil = **$V_c - (A_c*H)$**

Where

A_c = the calibrated cross sectional area of the mold

H = [Rf –Ri] + Tp

(3) Calculate the maximum and the minimum-index void ratios as follows (use **G_s** value as determined from specific gravity test; **ρ_w = 1 g/cm^3**):

$e_{min} = [(\rho_w*Gs / \rho_{dmax}) - 1]$

$e_{max} = [(\rho_w*Gs / \rho_{dmin}) - 1]$

(4) Calculate the relative density as follows:

$D_d = [(e_{max} - e) / (e_{max} - e_{min})]$

To calculate the void ratio (**e**) of the natural state of the soil, first calculate density of soil (**ρ_d**) and **ρ_s=G_S*ρ_w** (use **G_s** value as determined from specific gravity test) as follows:

$e = (\rho_s / \rho_d)-1$

Result :

The relative density of sand is =

5. 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 a 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:

1. Casagrande Liquid limit device with grooving tool
2. China clay dish
3. Balance to weigh up to an accuracy of 0.01 gm
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 10 mm 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 are counted until the groove closes over a length of 12 mm
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 the 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.
13. The moisture content corresponding to 25 no of blows will give the liquid limit for the sample (from the graph)

Observations and calculations:

Sl. no.	Quantity of water added in cc	Percentage of moisture content M	Number of blows N
1.			
2.			
3.			
4.			
5.			
6.			

Graph:

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

Calculations:

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.

Results:

Liquid limit of the soil =

Flow Index of the soil =

Fig: Liquid Limit Device

6. DETERMINATION OF PLASTIC LIMIT OF SOIL

Aim:

To determine the plastic limit of the given soil.

Apparatus:

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

Procedure:

1. A sample of about 50 gms 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 thread of 3 mm 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 ceases 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.

Observations:

Soil: Specific gravity (G) :

Weight of can (w 1) (gm) :
Weight of wet soil with can (w2) (gm) :
Weight of dried soil with can (w3) (gm) :
Weight of water (w3 – w2) (gm) :
Weight of dry soil (w2 – w1) (gm) :
Moisture content (w) (%) :

Calculations:

1. Determination of plastic limit

$$W = \{(W2 - W3) / (W3 - W1)\} * 100$$

The average of the three moisture contents is taken as the plastic limit of the soil. It is expressed to the nearest whole number.

2. Plasticity index = liquid limit – plastic limit

Results:

Plastic limit of the soil =

Plasticity index of soil =

7. DETERMINATION OF SHRINKAGE FACTORS

Aim:

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

Apparatus:

1. Shrinkage dish
2. Porcelain evaporating 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. The soil sample is placed in the dish by giving gentle taps. The top surface is struck off with a straight edge.
3. The shrinkage dish is weighed immediately full of wet 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. The content of the shrinkage dish is transferred to the mercury weighing dish and is weighed.
9. The glass cup is placed in a large dish, and it is filled to overflowing with 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 dry soil pat is transferred to the mercury weighing dish and is weighed.

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

Observations:

Soil: Specific gravity:

Weight of empty shrinkage dish (w1) :

Weight of dish + wet soil (w2) :

Weight of dish + dry soil (w3) :

Volume of dry soil pat

Soil pat diameter (d) :

Height of the pat (h) :

Volume (V1) :

Weight of displaced mercury + Dish (w_h) :

Volume of dry soil pat (v2) (cc) :

Weight of wet soil (w_w) :

Weight of dry soil (w_d) :

Volumes of wet soil pat (v) (cc) :

Calculations:

V = Volume of wet soil pat (cc)

W = Weight of wet soil pat (gm)

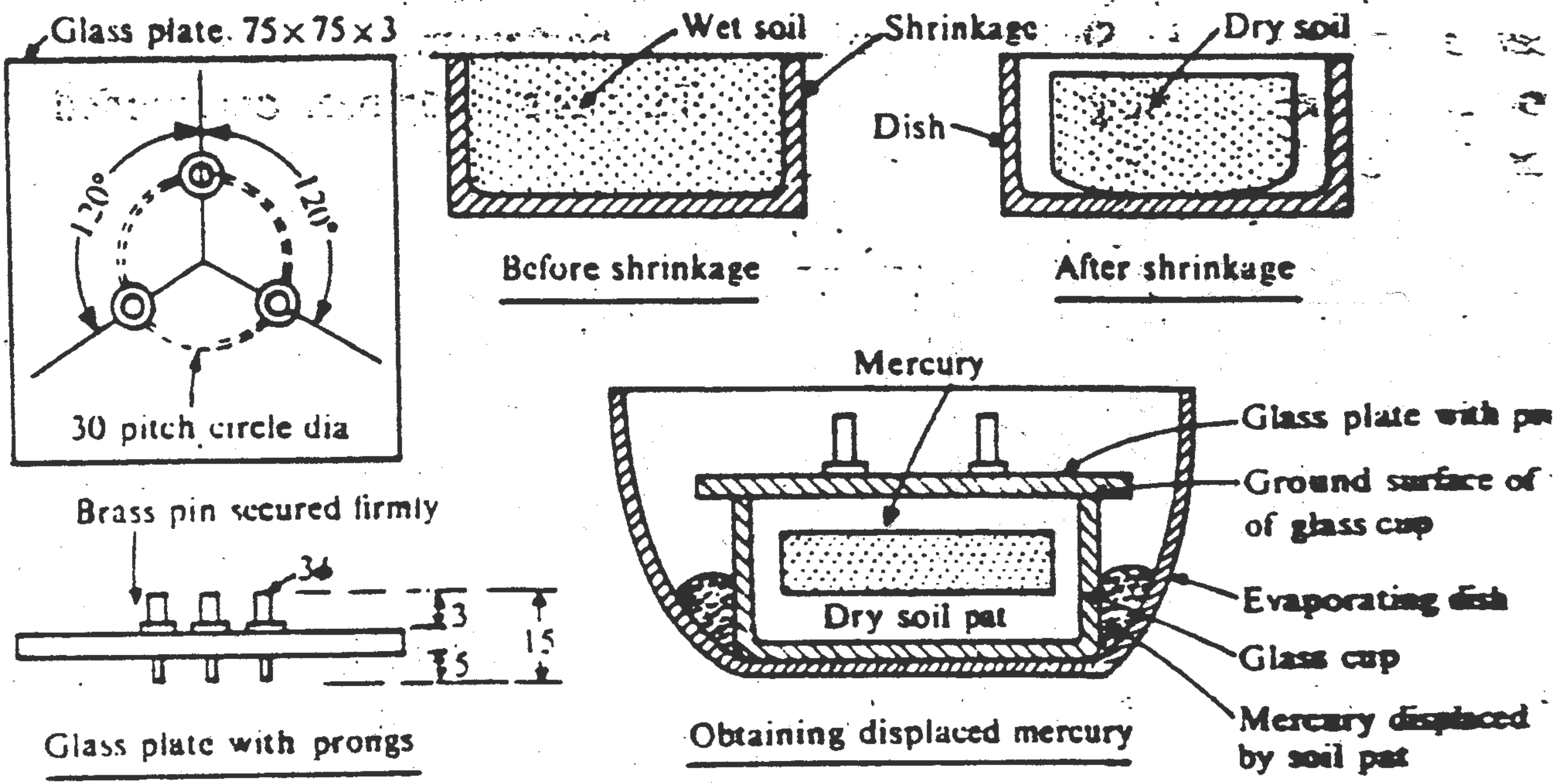
v_0 = Volume of dry soil pat (cc)

w_0 = Weight of dry soil pat (gm)

a) Water content (m %) = $(w - w_0) / w_0 \times 100$

b) Shrinkage limit (s %) = $\left[m - \left(\frac{v - v_0}{w_0}\right) x100\right]$

c) Shrinkage ratio (S.R) = $[\{(w_w - w_d) - (v_1 - v_2) * \gamma_w \} / w_d] * 100$



All dimensions are in millimetres

Results:

1. Shrinkage limit of the soil (S) =

Fig: Porcelain evaporating dish

Fig: Shrinkage dish

Fig: Mercury measuring cup

8. STANDARD PROCTOR'S COMPACTION TEST

Aim:

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

Apparatus:

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

Description:

1. The apparatus consists of diameter of 100 mm (d) and internal effective height of 127.3 mm (h). The mould is attached with detachable base plate and a removable collar. The volume of the mould is $\left(\frac{\pi d^2}{4} \text{x h}\right)$ 1000 cm^3.
2. A standard rammer has 50 mm circular base and weighs 2.6 kg. The rammer is equipped with suitable arrangements to control the height of the drop which is 310 mm.

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 4.75 mm sieve.
3. Take known quantity of water (6% by the weight of dry soil) and mix 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 310 mm.
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 there is a considerable fall in 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.

Observations and calculations:

Soil sample	:	Weight of soil taken	:
Specific gravity	:	Weight of rammer	:
Diameter of mould	:	Number of layers	:
Height of mould	:	Number of blows	:
Volume of mould	:	Weight of mould	:

Observations:

Sl. No.	Water Content(w) %	Weight of Mould + soil(w2)	Weight of Soil (w) = w2-w1	Bulk Density $\gamma = w / v$	Dry Density $\gamma_d = \frac{\gamma}{(1+w)}$	γ_d 100% Saturation g/cc

Calculations:

Wet density = $(w_2 - w_1) / v$

Dry density = Wet density / (1 + m)

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

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

Fig: Proctor Compaction Apparatus

Results:

1. Maximum dry density of the soil =

2. Optimum moisture content. =

9. CONSTANT HEAD PERMEABILITY TEST

Aim:

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

Apparatus:

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. The weight of the soil filling the mould should be determined in order to find out the void ratio.
2. The permeameter assembly should be assembled and kept in the bottom tank.
3. The 75 mm ϕ glass tube with overflow is used.
4. The water is allowed to flow into the permeameter by opening tap.
5. The air release valve on the cap of the permeameter is unscrewed.
6. Then it is closed when air ceases and only water comes out. Now the soil specimen is said to be saturated.
7. The bottom outlet valve is opened and water is allowed to flow through the specimen.
8. Water is poured till it over flow in the tank.
9. When a steady state of flow has been established collect water coming out of the overflow tube of the bottom tank.
10. Repeat the test for same time interval and determine the average quantity.

Calculations:

The coefficient of permeability of the soil (k) = Q*L / A* t * h

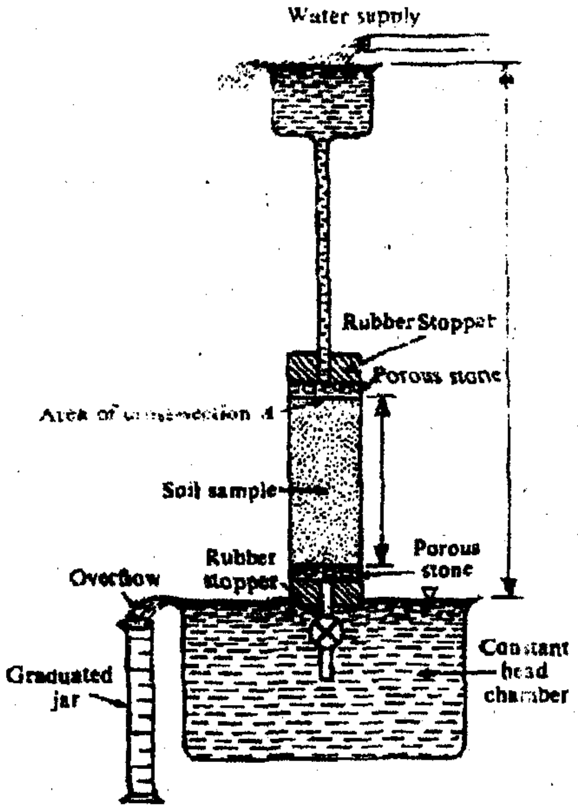
K - Coefficient of permeability of soil cm/sec

Q - Total discharge in time t cm^3/sec

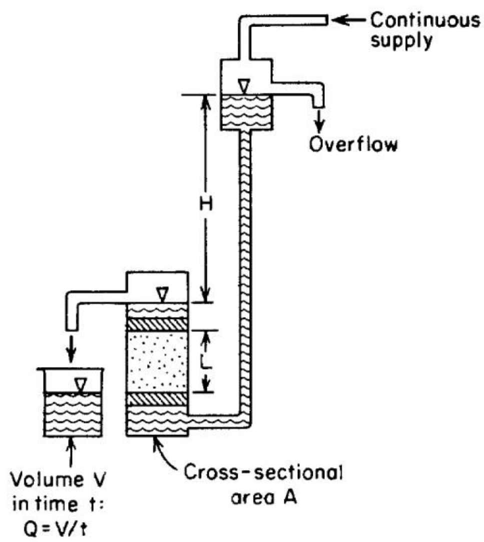
A - Area of sample perpendicular to the direction of flow of water cm2

L - Length of the sample in cm

h - Head causing the flow in cm



Set-up of the constant-head permeameter



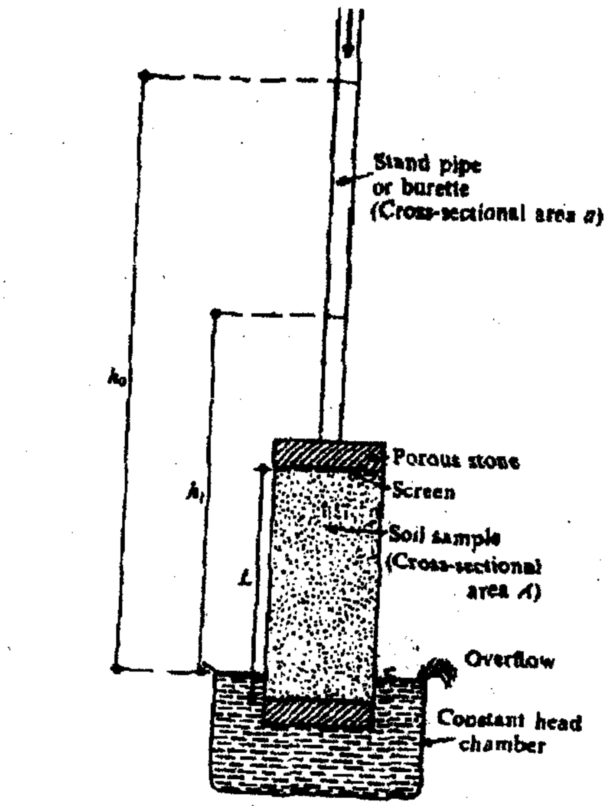
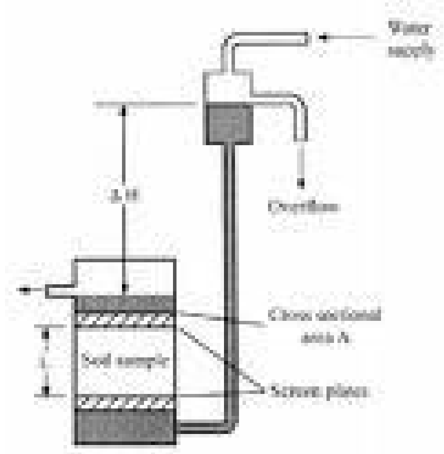


Fig. 5.5 Falling, or variable, head permeameter



Observations:

Diameter of Specimen (D) =

Area of sample (A) =

Weight of sample filling the mould w_s =

Specific gravity of the soil (G) =

Volume of solids $v_s = w_s/G$ =

Volume of voids ($v_v = v - v_s$) =

Void ratio $e = v_v / v_s$ =

Length of sample `L' =

Head causing flow `h' =

Viscosity of water at 27°C (μ27) =

Sl . No	Hydraulic head (cm)	Time (t) in Sec	Quantity of Flow (cm^3)	Coefficient of permeability cm / sec

Results:

Co-efficient of permeability at constant head (k) =

10. FALLING HEAD PERMEABILITY TEST

Aim:

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

Apparatus:

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. Permit water to flow for some time till steady state of flow is reached.
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.

Observations:

Area of the sample (A) =
Area of the stand pipe (a) =
Length of the sample (L) =
Temperature of the test (T°C) =
Depth of water in tube =
Volume of water =

Sl. No.	Initial head h_1 (cm)	Final head at time h_2 (cm)	Time in sec. T	Coefficient of permeability cm / sec

Calculations:

The coefficient of permeability of the soil can be calculated from the following relation

$$kT = 2.303 \frac{aL}{A\,t_1} \log_{10}\left(\frac{h_1}{h_2}\right)$$

Where,

a - area of the stand pipe (cm^2)

A - Cross sectional area of the specimen (cm^2)

L - Length of the specimen in cm

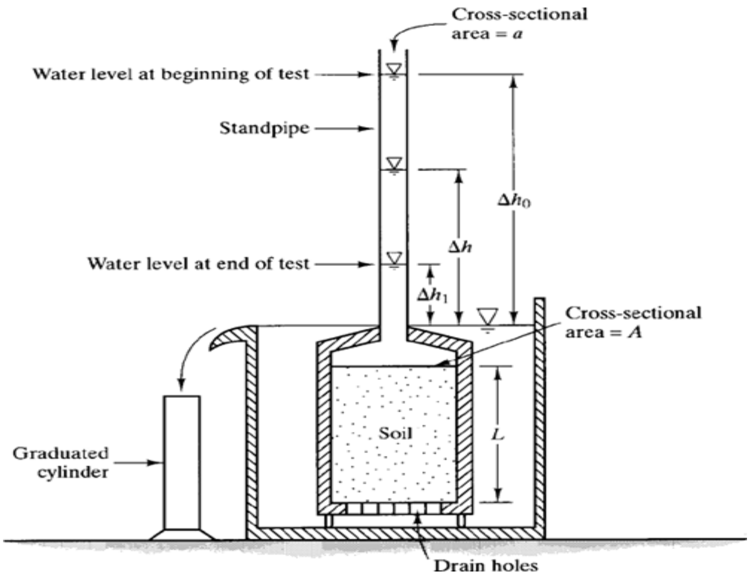
t_1 - time in sec. for the head to fall from h_1 to h_2.

h_1 - head initial

h_2 - head at time

Results:

The coefficient of permeability of the soil at variable head (k) =



11. DIRECT SHEAR TEST ON COHESIONLESS SOIL

Aim:

To determine the friction angle of the given soil sample.

Apparatus:

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 x 6 x 2 cm. The two halves of the shear box are 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 by about 1 mm to prevent it from 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.

Procedure:

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.
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. (The top of the layer does not come on the shear planes)
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 separating screw is turned to have a gap of 1 mm between the two halves.
11. The hand wheel is rotated to apply the shear load.
12. The maximum deflection is recorded in the proving ring which 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.

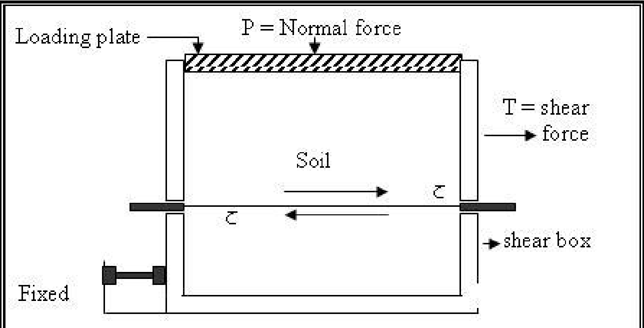


Fig. (2) : Diagram of direct shear arrangement

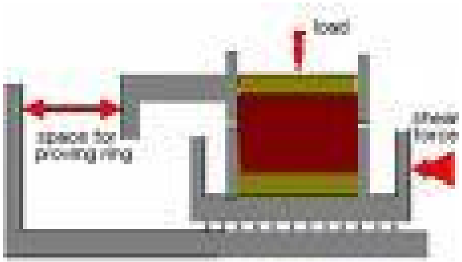


Fig: Shear Box Test Apparatus

Observations:

Soil sample =

Specific gravity of soil =

Weight of dry soil used =

Sample dimensions =

Lever arm ratio of the apparatus =

Proving ring calibration =

Area on which the loads are acting =

Area of the shear box (A) =

Proving ring dial reading at failure =

Shear force at failure (kg) =

Load conversion table:

Load in KN										
Load in Kg										
Dial gauge reading										

Tabulation:

Sl. No.	Normal stress kg/cm^2	Proving ring reading	Load kg	Shear stress kg/cm^2
1.				
2.				
3.				
4.				
5.				

Calculations:

Normal stress (σ) = $\frac{\text{Normal load applied}}{\text{Area of C.S.}}$

Ultimate Shear stress (σu) = $\frac{\text{Shear force at failure}}{\text{Area of C.S.}}$

$\tau = \sigma \tan \phi$ (for ϕ soil)

$\phi = \tan^{-1} (dy / dx)$

Also ϕ can be finding out from graph.

Results:

The friction angle from graph (ϕ) =

12. UNCONFINED COMPRESSION TEST ON COHESIVE SOIL

Introduction:

The unconfined compression is also called as U test is the special form of tri axial compression test where the lateral confining pressure is zero. This test is classified as un drained or quick test even though small amount of drainage takes place during the test. The test can be conducted on undisturbed and remolded cohesive soil samples. Normally this test is conducted in soil samples at natural water content.

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.

Description of apparatus:

Unconfined compression tester consists of a small load frame fitted with a proving ring to measure the vertical axial load applied to the soil specimen. The deformation of the sample is measured with the help of a dial gauge. The ends of the cylindrical specimen are kept flat.

Procedure:

Remolded soil specimen (38 mm dia) was prepared and it is centrally mounted in the unconfined compression tester. The proving ring is so adjusted to touch the top of the soil sample. Then vertical axial load is gradually applied to the soil specimen. Readings from the proving ring and the compression dial gauge are taken.

During early stages of the test, take readings approximately 0.25 mm of vertical deflection. As the stress -strain curve begins to flatten take readings less often (ie 0.50 mm and later ever (0.75 mm). Compress the specimen till failure.

Failure mode:

Two types of failure are possible. They are 1. Brittle failure 2. Plastic failure.
This drops rapidly with the further increases of strain. This is identically a well defined break point in the stress strain curve.

In the plastic failure no definite maximum load is indicated. In such a case the load corresponding to 20% strain is arbitrarily taken as the failure load.

Tabulation:

Length of sample =
Dia. of sample =
Initial area of the sample =

Sl. No	Deflection Dial Reading	Proving Ring Reading	ΔL	Strain E = ΔL / L	1-E	Load(P) Kg	Area(A) = A0/(1-E)	Stress = P / A

Graph:

A graph is plotted between axial stress and corresponding axial strain as in abscissa.

Results:

The unconfined compression strength of given sample =

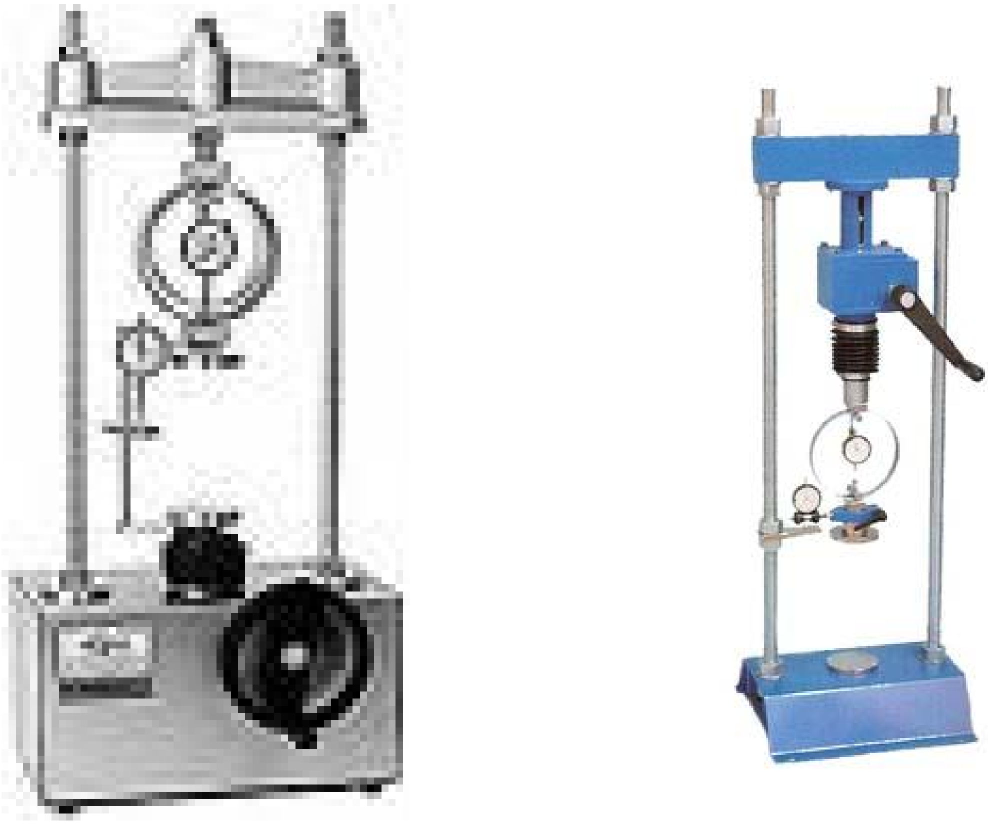


Fig: Unconfined Compression Test

Fig: Proving Ring

13. TRIAXIAL COMPRESSION TEST

Aim:

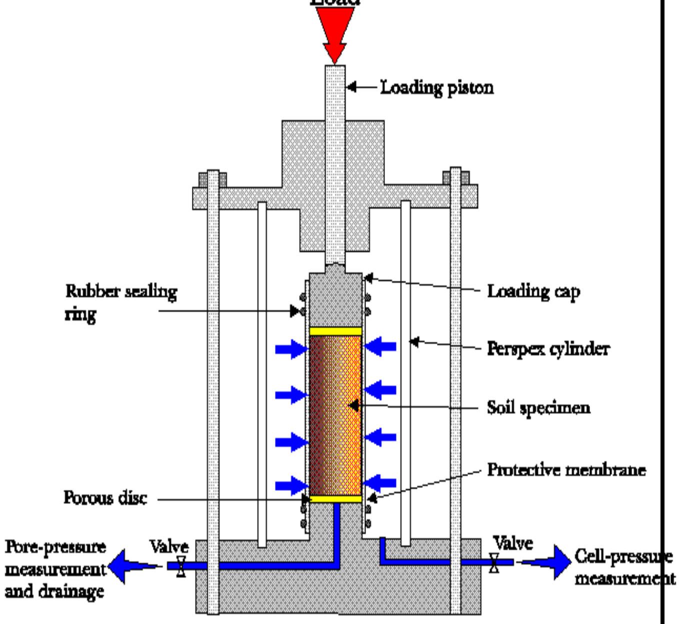
To determine the shear strength parameters of undisturbed or remolded soil specimen in the tri axial compression apparatus by un drained tri axial test.

Apparatus required:

(1) Tri axial cell
(2) Compression machine
(3) Dial gauge
(4) Split mould
(5) Seamless rubber membranes
(6) Rubber rings and apparatus for applying and maintaining the desired fluid pressure in the cell.

Preparation of Sample:

1. Remove wax sealing from field sample tube.
2. Place sample cutter tube (38 mm inner dia) on field sample tube.
3. Insert sample cutter tube in the soil with the help of hydraulic jack.
4. Take out the sample cutter tube from field sample tube by pushing soil with hydraulic jack.
5. Transfer soil sample from sample cutter tube to split mould of proper length (76 mm).
6. Take out soil specimen from split mould.
7. The ends of the specimen are trimmed flat And normal to its axis.
8. The split mould should be measured to an Accuracy enabling to the bulk density to be Calculated to an accuracy of ± 1.0 percent.



Triaxial apparatus

Loading of Sample:

1. Clean base of tri axial cell.
2. Put porous stone over bottom pedestal and filter paper of 38 mm dia over this porous stone.
3. Place soil specimen over filter paper and put another filter paper then porous stone on the top of the soil specimen.
4. Place about 8 filter paper strips vertically around soil specimen extending from top porous stone to bottom porous stone to facilitate uniform and quick saturation.
5. Put rubber membrane around the soil specimen with the help of stretcher.
6. Place "O " ring around top and bottom pedestal in the grooves.
7. Place the tri axial cell and tight the nut to the base plate.

Testing of specimen:

1. Saturate the soil sample from 24 to 48 hours, by opening drainage valve, which is

connected with burette filled with water. Water level in burette is kept little more than the top of specimen.

2. After saturation tri axial cell is filled with water and all around cell pressure ($\sigma 3$) is applied by mercury controlled device. The pore water pressure is measured the sample is saturated until it satisfies B parameter of 1 (not less than 90% of σ_3).
3. Four soil specimen of a sample are tested at 0.5, 1.0, 1.5, and 2.0 kg / cm^2 of lateral pressure ($\sigma 3$). For consolidated un-drained test (CU), the sample is to be placed for consolidation and B parameter has to be checked. The drainage reading during consolidation in the burette is to be recorded in time interval of 1, 4, 9, 16, 25, 36.....minutes up to 24 hrs.
4. On account of consolidation the length and diameter of specimen changed.
5. Changed lengths, cross sectional area and rate of strain on consolidated specimen have to be calculated.
6. Apply calculated rate of strain on consolidated specimen and note down the deformation and corresponding load on specimen un till the failure of specimen.
7. Four specimen has been tested at four confining pressure (0.5, 1, 1.5 and 2 Kg / cm2) as explained above.
8. Now from above reading plot Mohr's circle and get the shear parameters C & Φ.

Observation:

Load Applied In K.N.										
Deflection of the Dial gauge .										

Tabulation:

Sl. No	Cell pressure σ_3 Kg/cm²	Proving ring reading	Load kg	Deformation	Strain ϵ	Corrected area $A=A_o/(1-\epsilon)$ cm²	σ_d Kg/cm²	Normal stress $\sigma=\sigma_d+\sigma_3$ Kg/cm²

Result:

The shear strength of the given soil sample (C) =
The angle of internal friction (Φ) =

14.DETERMINATION SHEAR STRENGTH OF CLAY SOIL BY VANE SHEAR TEST (IS-2720-PART-30)

Aim

To determine shear strength of clay soil using laboratory vane shear apparatus.

Theory

In soil, shear strength is contributed by the two properties.

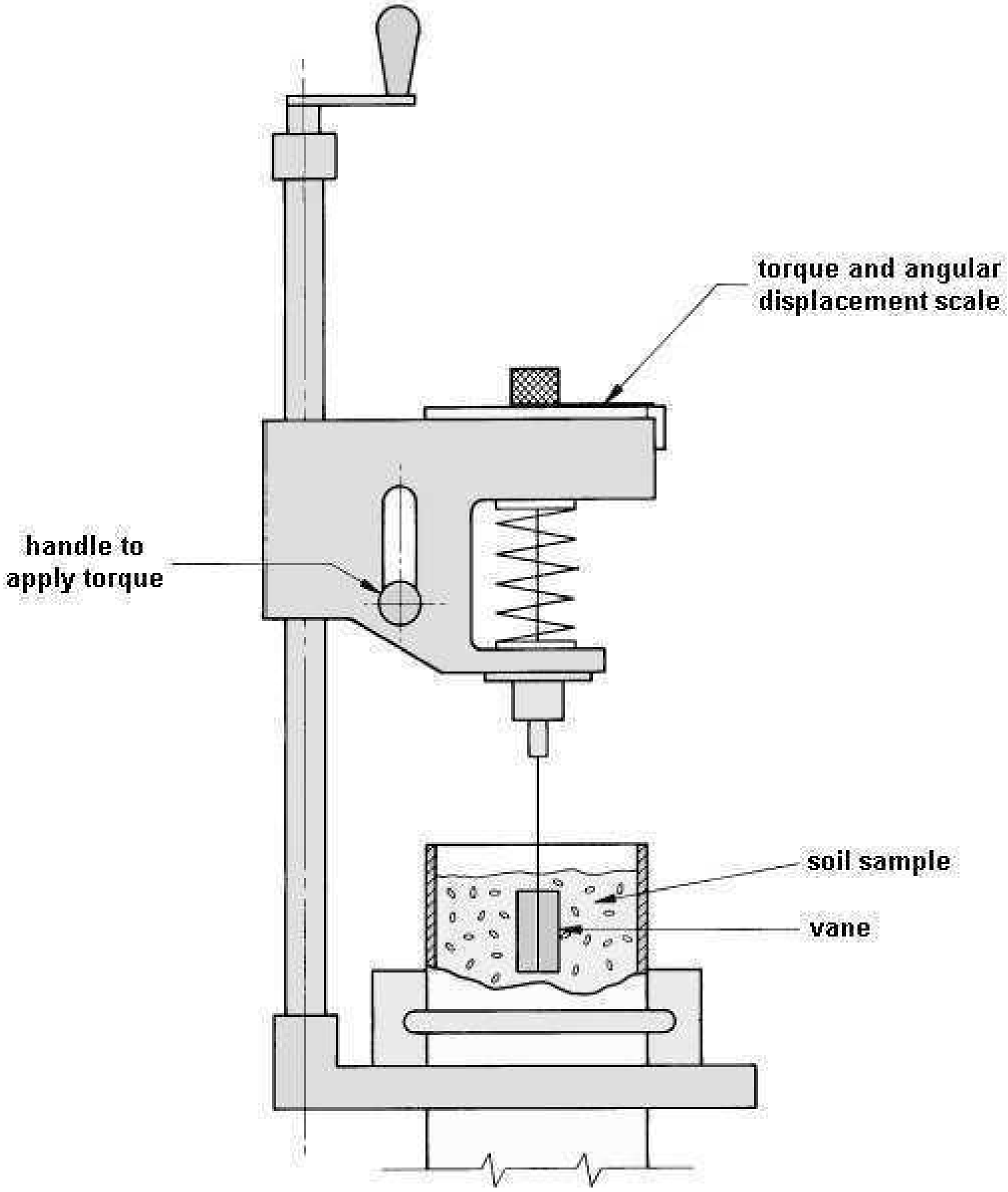
- Cohesion, and
- Angle of internal friction

In pure clays the shear resistance due to internal friction is negligible. Hence, the complete shear strength in clays is due to cohesion (**C**).

Apparatus

Vane shear test apparatus

The vane shear test apparatus consists of a torque head mounted on a bracket. Four shear vanes are fixed on a shaft and the shaft is fixed in the lower end of a circular disk graduated in degrees. A torsion spring is fixed between torque head and the circular disk. A maximum pointer is provided to facilitate reading the angle of torque. As the strain indicating pointer rotates when the torque is applied, it moves the maximum pointer, leaving it in position when the torque gets released at failure and the vane returns to its initial position. Turning the torque applicator handles effects rotation of the vane.



VANE SHEAR TEST

Procedure

1. Clean the apparatus thoroughly. Apply grease to the lead screw.
2. Fill-up the sampling mould with remoulded soil at required density and moisture content or the undisturbed soil sample. Level the surface of the sample with the mould.
3. Mount the sampling tube with sample under the base of the unit and clamp it in position.
4. Bring the maximum pointer into contact with the strain indicating pointer. Note down the initial reading of these pointers on the circular graduated scale.

5. Lower the bracket until the shear vanes go into the soil sample to their full length.
6. Operate the torque applicator handle until the specimen fails, which is indicated by the return of the strain-indicating pointer or rotation of drum.
7. Note down the readings of the maximum pointer.
8. The difference between the two readings (initial & final) gives the angle of torque.
9. Repeat steps 3 to 8, on a number of test specimens to obtain the average shear strength of the sample.

Observations and Calculations

Calculate Torque

Calculate torque using following formula:

T = Ø * K/180

Where,

T = Torque

Ø = Difference of angle (angle of torque)

K = Spring factor

Calculate Shear Strength

Shear strength of the soil, C is computed using the following formula:

$$\mathbf{T = C\pi * [(d^2h/2) + (d^3/6)]}$$

Where,

D = Diameter of vane (cm)

H = Height of the vane (cm)

C = Shear strength (kg/cm^2)

T = Torque applied (kg-cm)

Result :

The vane shear test value is =

15. CONSOLIDATION TEST

Aim:

To determine the following:

Co-efficient of compressibility (a_v)
Co-efficient of volume change (m_v)
Compression index (C_c)
Co-efficient of consolidation (C_v)

Apparatus:

1. Consolidometer with loading device
2. Specimen ring, made of a non-corroding material
3. Water reservoir to saturate the sample.
4. Porous stones
5. Soil trimming tool, like knife, spatula
6. Dial gauge, accuracy 0.002 mm
7. Pressure pad.
8. Weighing balance, accuracy 0.01g.
9. Oven
10. Ball.

Formula:

Height of solids Hs $= Md / (a * \gamma_w * A)$

Coefficient of compressibility $a_v = d_e / d_p$

Co-efficient of volume compressibility $M_v = a_v / 1+e_0$

Compression Index $C_c = d_e / \log_{10} (P_2/P_1)$

Co-efficient Consolidation $c_v = 0.197 (h*a*v^2) / t_{50}$

(or)

Co-efficient Consolidation $C_v = 0.848 (h*a*v^2) / t_{90}$

Where

γ_w = Density of water in gm/cc

G_s = Specific Gravity of Soil

A = Area of the specimen in Cm^2

P_1 & P_2 = Initial & Final Pressure

e_0 = Initial Void Ratio

d_e = Change in Voids Ratio

d_p = Change in Pressure

Introduction:

(1) Preparation of the specimen for undisturbed soil samples:

The undisturbed sample from the field may be circular or a block sample. Clean the specimen ring and weight is empty. Cutt off about 3 to 5cm of the soil specimen from one end of the field sample. Place vertically the specimen ring with cutting edge downwards on the undisturbed soil sample disc or block. Using the ring gently downwards with minimum of disturbance until the soil protrudes in to the extension collar by about 5mm above the specimen ring. Remove the extension collar and trim off excess soil flush with the top end. Cut the at the level of the cutting edge of the cutter. Remove the cutter and trim of the excess soil. Cover this face of specimen also with the second glass plate.

(2) Preparation of Remolded Specimen:

(i) Saturated Specimen: By the specimen ring along with the two glass plates. Place the specimen ring on one of the glass plates .Press remolded saturated soil in to the specimen ring with a spatula, care being taken to avoid trapping air during the process. Finish flush with the top end of the ring and cover with the second glass plate. Weigh the ring eith specimen and glass plates.

(ii) Statically Compacted Soil: Mix an appropriate quantity of water about 350gms of pulverized soil to bring its water content to the desired value. Mature of soil for a suitable time. Keep a sample water content determination.

Procedure:

1. Saturated the porous stone either by boiling in distilled water for about 15minus or by keeping them submerged in distilled water for 4 to 8hrs. Wipe away excess water. Moisten all surfaces of the consolidometer which are to be enclosed.
2. Assemble the consolidometer with the soil specimen and porous stone at top & bottom of the specimen, providing a filter paper between the soil specimen and the porous stone. Position the pressure pad centrally on the top of the porous stone.
3. Mount the mould assembly on the loading frame and center it such that the load applied is axial.
4. Position the dial gauge to measure vertical compression of the specimen. The dial gauge holder should be so set that the dial gauge is near the beginning of its release run, allowing sufficient margin for the swelling of the soil, if any.
5. Connect the mould assembly to water reservoir, and the sample is allowed to saturate. The level of water inside should be at about the same level as the soil specimen.
6. Apply the initial seating load to the assembly. The magnitude of this load should be chosen by trial such as that there is no swelling. It should not less 5kN/m^2 for ordinary soils. The load should be allowed to stand until there is no change in dial gauge reading for 2 consecutive hours, or for max. 24hrs.

Consolidation Test:

(1) Note the final dial reading under the initial setting load. Apply first load of intensity 1kN/m2 and start the stop watch simultaneously with loading. Record the dial gauge reading at various time intervals indicated in table. The dial gauge rearing are taken until 90% of consolidation is reached. Primary consolidation is generally reached within 24hrs.

(2) At the end of the period specified above, take the dial gauge reading and time rearing. Double the load intensity and take dial readings at various time intervals. Repeat this

Procedure for successive load increments. The usual loading intensities are as follows 10, 20, 50, 100, 200, 400 & 800kN/m^2

(3) After the last loading is completed reduce the load to half of the value of the last load and allow it to stand for 24hrs.Reduce the load further in steps of ¼ of previous intensity till an intensity of 10kN/m2 is reached. Take the final reading of the dial gauge.

(4) Reduce the load to the initial setting load, keep it for 24hrs & note the final dial readings.

(5) Quickly dismantle the specimen assembly and the remove excess surface water on the soil specimen. Weigh the ring with consolidation specimen. Dry the soil specimen in oven and determine its dry weight.

Observation:

Sl. No	Time (sec)	Time (min)	√ t	log t	Reading in divisions
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					

Sl. No	Applied Pressure Kg/cm^2	Final Dial Reading	Compression	Specimen Height	$C = (H/H_s) - 1$	d_e	d_p	$a_v = d_e / d_p$ cm^2 / kg	$Mv = a_v / 1+e_0$ cm^2 / kg	Compression Index (Cc)

Result:

Co-efficient of compressibility (a_v) =
Co-efficient of volume change (m_v) =
Compression index (C_c) =
Co-efficient of consolidation (Cv):
(A) LOG TIME FITTING METHOD =
(B) SQUARE ROOT OF TIME METHOD =

16. FIELD DENSITY TEST – Core Cutter Method

Aim:

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

Apparatus:

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 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 (W2)

Observation:

Height of core cutter (h) =

Internal dia. of core cutter (d) =

Volume (V) = $(\Pi d^2 / 4) \times h$ cm^3

Empty weight of core cutter (w1) =

Weight of core cutter with filed soil (w2) =

Trial	**W2(gm)**	**Weight of soil alone (w)= (w2-w1) gm**	**Density of soil, ρ= w / V g/cc**
I			
II			
III			
		Average	

Calculation:

Field Density = Weight of Soil / Volume of the Core Cutter

Result:

The field density of soil mass by core cutter method = $\qquad$ g/cm^3

Fig. Cylinder Cutter

17. FIELD DENSITY TEST – Sand Replacement Method

Aim:

To determine the field density of soil sample by Sand Replacement Method

Apparatus:

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).
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 (W1).
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 come apparatus weighted(W6)
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 valve and take the weight of sand cone apparatus (W2) from their weight. The weight of sand filling the excavated pit can the determined for density cylinder, following procedure is adopted.
8. Place the sand fill up in cone apparatus again with the sand is weighted (W4).
9. Place the apparatus on a standard cylinder and open he valve. Now, find the weight of sand cone apparatus (W3) and Find the weight of standard cylinder and find its volume.

Observation:

1. Weight of sand pouring cylinder with full sand (W_1) = gm
2. Weight of sand in cone (W_2) = gm
3. Weight of cylinder and sand after filling the calibrating container (W_3) = gm
4. Weight of sand filling calibrating container and cone (W_a)=(W_1-W_2-W_3) = gm
5. Weight of sand cone apparatus after refilling with full of sand (W_4) = gm
6. Weight of soil taken from the field (W_5) = gm
7. Weight of sand cone apparatus after filling the field hole (W_6) = gm
8. Weight of sand in the excavated hole (W_b) = (W_4 – W_2 – W_6) = gm
9. Volume of sand filling the excavated hole (V_h) = W_b / γ_s = cm^3
10. Diameter of standard cylinder (D) = cm
11. Height of standard cylinder (H) = cm

Calculation:

1. Volume of standard cylinder(V_c) = $[(\Pi D^2) / 4] \times H$
2. Bulk density of sand(γ s) = Weight of sand (W_a) / Volume of standard cylinder.(V_c)
3. Field density of soil (γ f) = W_5 / V_h

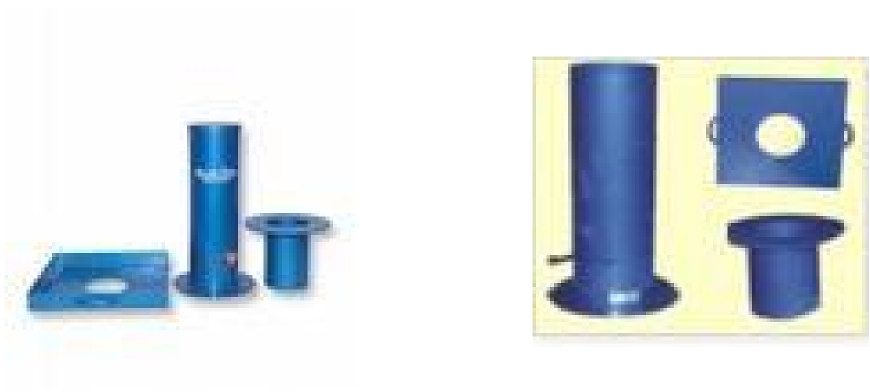


Fig: Sand pouring cylinder

Result:

The Field Density of Soil Mass by Sand Replacement Method = g/cm^3

18. STANDARD PENETRATION TEST.

AIM:

To find the standard penetration value of the given soil sample.

Apparatus required:

1.A thick-walled sample tube, with an outside diameter of 50.8 mm and an inside diameter of 35 mm, and a length of around 650 mm

2. hammer with a mass of 63.5 kg

3. Falling height = 75 cm

4. Lifting bail, Tongs, ropes, screw jack, etc.

PROCEDURE :

1. The bore hole is advanced to desired depth and bottom is cleaned.
2. Split spoon sampler is attached to a drill rod and rested on bore hole bottom.
3. Driving mass is dropped onto the drill rod repeatedly and thev sampler is driven into soil for a distance of 450 mm.
4.The number of blow for each 150 mm penetration are recorded.
5. N-value of First 150 mm penetration is considered as seating penetration. The number of blows for the last two 150 mm penetration are added together and reported as N-value for the depth of bore hole.
6. The split spoon sampler is recovered, and sample is collected from split barrel so as to preserve moisture content and sent to the laboratory for further analysis.
7. SPT is repeated at every 750 mm or 1500 mm intervalv for larger depths. Under the following conditions the penetration is referred to as refusal and test is halted
 a) 50 blows are required for any 150 mm penetration
 b)100 blows are required for last 300 mm penetration
 c) 10 successive blows produce no advancement.
8. The height of free fall Must be 750 mm. The fall of hammer must be free, frictionless and vertical Cutting shoe of the sampler must be free from wear & tear .
9. The bottom of the bore hole must be cleaned to collect undisturbed sample.
10. When SPT is done in a sandy soil below water table , the water level in the bore hole MUST be maintained higher than the ground water level.

The corrected N values given by in which corrected value of observed

N’’ = correction factor for overburden pressure.

Correction for dilatancy Di1atancy correction is to be applied when obtained after overburden correction, exceeds 15 in saturated fine sands and silts.

IS: 2131-1981 incorporates the Terzaghi and Peck recommended dilatancy correction (when N’> 15) using the equation N’’ =15+0.5 (N’ — 15)

Where N’’ = final corrected value to be used in design charts.

If N’= >15 is an indication of a dense sand. In such a soil, the fast rate of application of shear through the blows of a drop hammer, is likely to induce negative pore water pressure in a saturated fine sand under undrained condition of loading.

Consequently, a transient increase in shear resistance will occur, leading to a SPT value higher than the actual one.

OBSERVATION:

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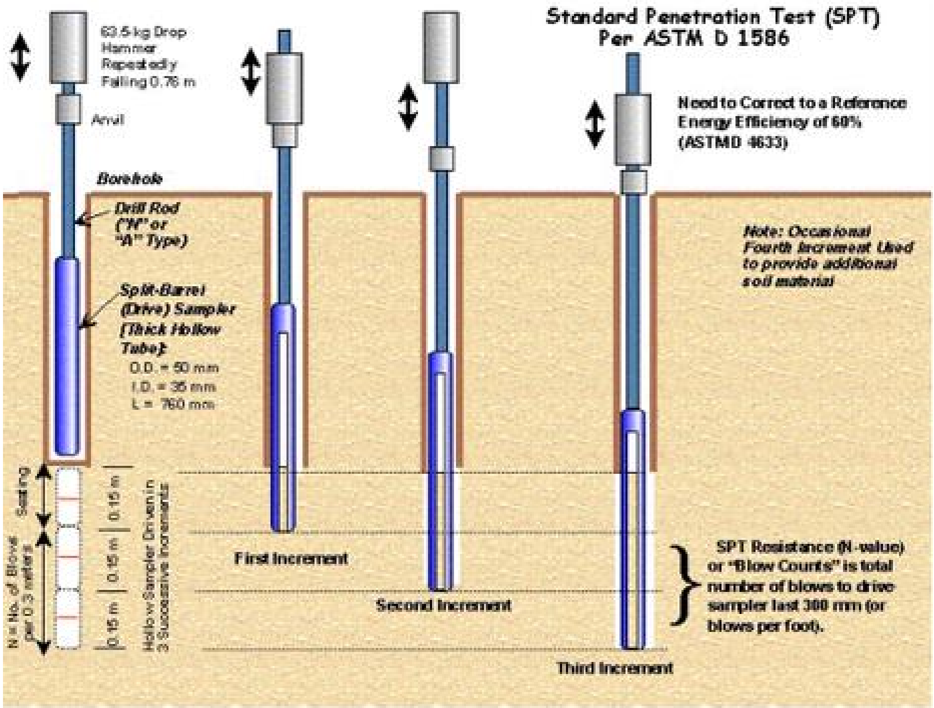
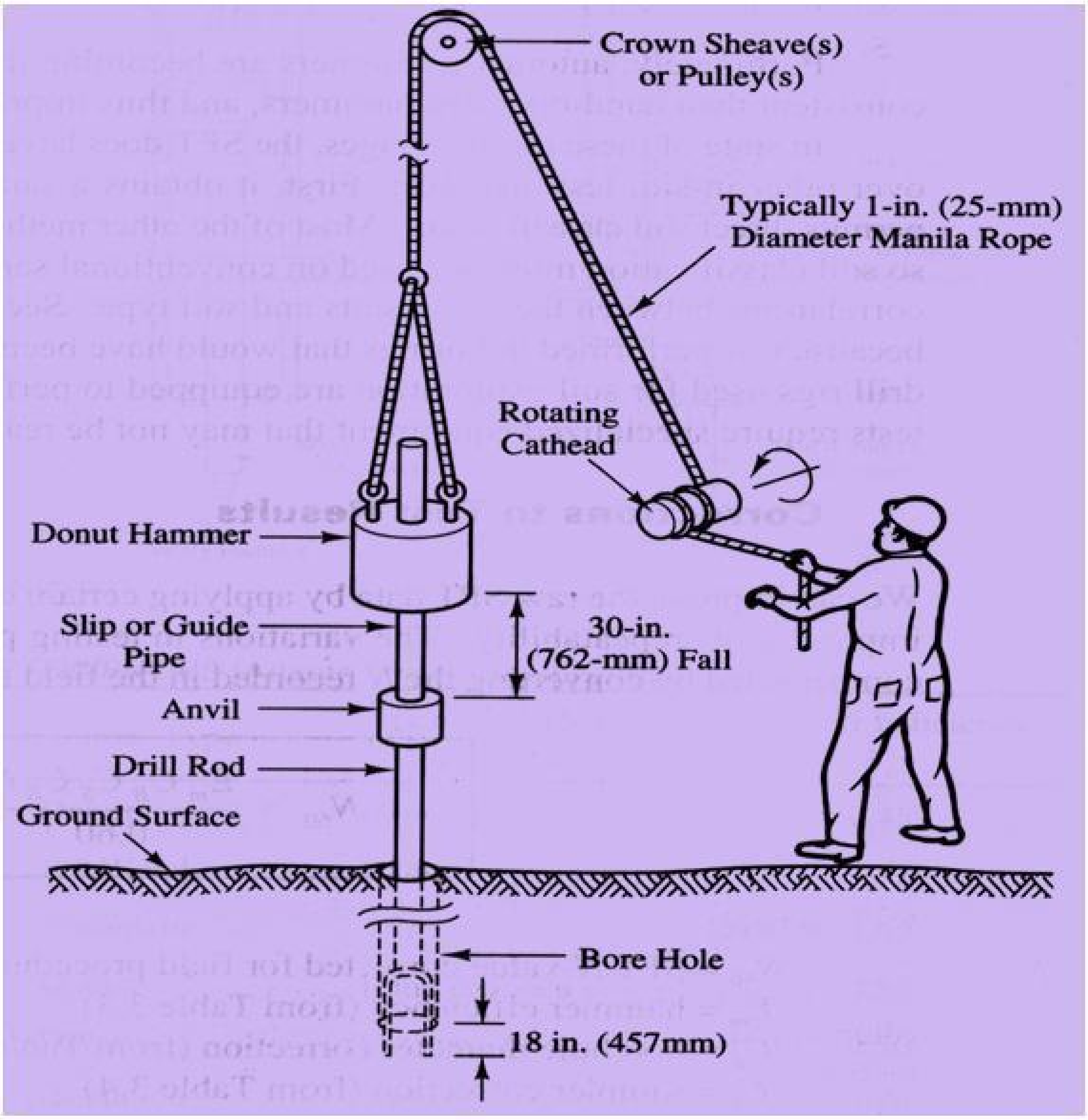
SL.NO.	OBSERVED N VALUE	CORRECTED N VALUE	CONDITION

RESULT :

The corrected N Value of the soil sample =


Standard Penetration Test (SPT)
Per ASTM D 1586
63.5-kg Drop Hammer Repeatedly Falling 0.76 m
Anvil
Borehole
Drill Rod ("N" or "A" Type)
Split-Barrel (Drive) Sampler (Thick Hollow Tube):
O.D. = 50 mm
I.D. = 35 mm
L = 760 mm
Need to Correct to a Reference Energy Efficiency of 60% (ASTMD 4633)
Note: Occasional Fourth Increment Used to provide additional soil material
Seating
N = No. of Blows per 0.3 meters
0.15 m
0.15 m
0.15 m
Hollow Sampler Driven in 3 Successive Increments
First Increment
Second Increment
Third Increment
SPT Resistance (N-value) or "Blow Counts" is total number of blows to drive sampler last 300 mm (or blows per foot).


Crown Sheave(s) or Pulley(s)
Typically 1-in. (25-mm) Diameter Manila Rope
Rotating Cathead
Donut Hammer
Slip or Guide Pipe
30-in. (762-mm) Fall
Anvil
Drill Rod
Ground Surface
Bore Hole
18 in. (457mm)