VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**UNDRAINED COMPRESSION TEST**
Purpose	To find the shear of the soil by Undrained Triaxial Test.
Scope	The standard consolidated undrained test is compression test, in which the soil specimen is first consolidated under all round pressure in the triaxial cell before failure is brought about by increasing the major principal stress.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. The sample is placed in the compression machine and a pressure plate is placed on the top. Care must be taken to prevent any part of the machine or cell from jogging the sample while it is being setup, for example, by knocking against this bottom of the loading piston. The probable strength of the sample is estimated and a suitable proving ring selected and fitted to the machine.
2. The cell must be properly set up and uniformly clamped down to prevent leakage of pressure during the test, making sure first that the sample is properly sealed with its end caps and rings (rubber) in position and that the sealing rings for the cell are also correctly placed.
3. When the sample is setup water is admitted and the cell is fitted under water escapes from the beed valve, at the top, which is closed. If the sample is to be tested at zero lateral pressure water is not required.
4. The air pressure in the reservoir is then increased to raise the hydrostatic pressure in the required amount. The pressure gauge must be watched during the test and any necessary adjustments must be made to keep the pressure constant.
5. The handle wheel of the screw jack is rotated until the underside of the hemispherical seating of the proving ring, through which the loading is applied, just touches the cell piston.
6. The piston is then removed down by handle until it is just in touch with the pressure plate on the top of the sample, and the proving ring seating is again brought into contact for the begging of the test.

PRECAUTIONS TO BE FOLLOWED

- Dial gauge dial reading should be noted properly
- Horizontal strain should be noted from proving

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**DIRECT SHEAR TEST**
Purpose	To determine the shearing strength of the soil using the direct shear apparatus.
Scope	In many engineering problems such as design of foundation, retaining walls, slab bridges, pipes, sheet piling, the value of the angle of internal friction and cohesion of the soil involved are required for the design.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. Check the inner dimension of the soil container.
2. Put the parts of the soil container together.
3. Calculate the volume of the container. Weigh the container.
4. Place the soil in smooth layers (approximately 10 mm thick). If a dense sample is desired tamp the soil.
5. Weigh the soil container, the difference of these two is the weight of the soil. Calculate the density of the soil.
6. Put the upper grating on stone and loading block on top of soil.
8. Measure the thickness of soil specimen.
9. Remove the shear pin.
10. Attach the dial gauge which measures the change of volume.
11. Record the initial reading of the dial gauge and calibration values.
12. Before proceeding to test check all adjustments to see that there is no connection between two parts except sand/soil.
13. Start the motor. Take the reading of the shear force and record the reading.
14. Take volume change readings till failure.
15. Add 5 kg normal stress 0.5 kg/cm^2 and continue the experiment till failure
16. Record carefully all the readings. Set the dial gauges zero, before starting the experiment

PRECAUTIONS TO BE FOLLOWED

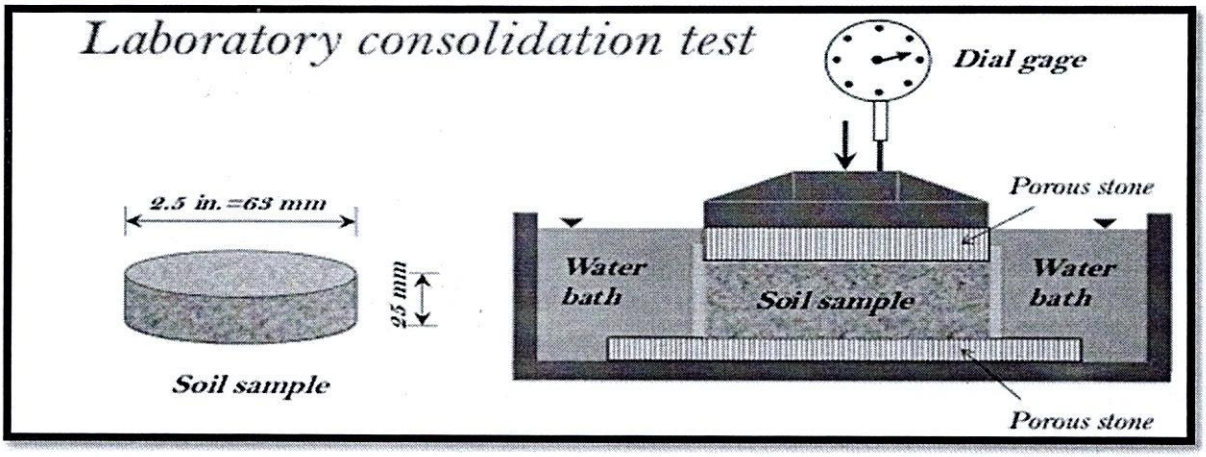
- Dial gauge dial reading should be noted properly
- Horizontal strain should be noted from proving ring

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

CONSOLIDATION TEST

Consolidation of a saturated soil occurs due to expulsion of water under static, sustained load. The consolidation characteristics of soils are required to predict the magnitude and the rate of settlement.



Coefficient of compressibility,

$$a_v = -\frac{\Delta e}{\Delta \sigma}$$

Coefficient of volume change

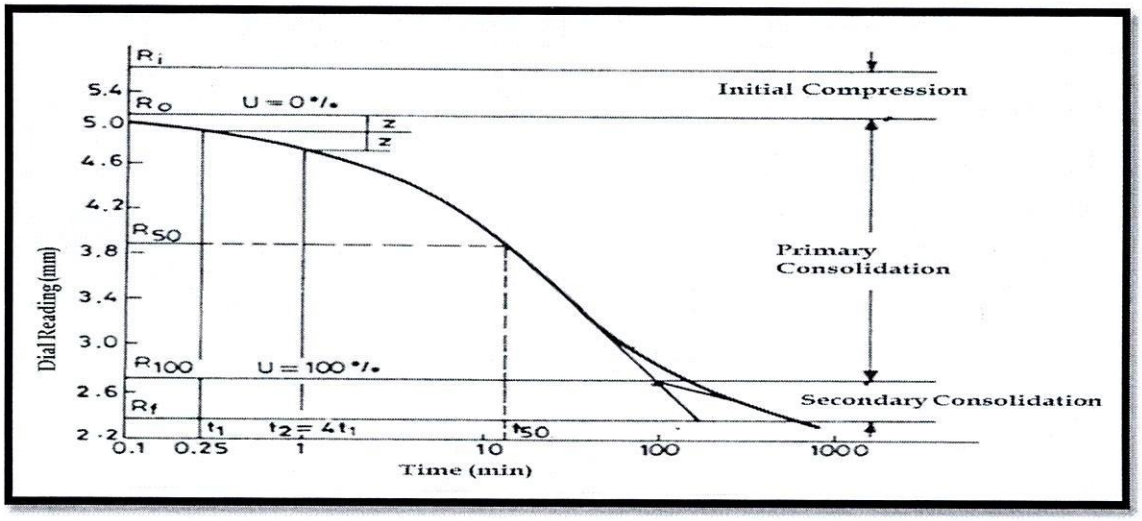
$$m_v = \frac{-\Delta e}{1+e}\left(\frac{1}{\Delta \bar{\sigma}}\right)$$

Compression Index

$$C_c = \frac{-\Delta e}{\log \frac{(\sigma_o + \Delta \sigma)}{\bar{\sigma}_o}}$$

Coefficient of consolidation

$$C_v = T_v \frac{d^2}{t}$$



VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**TRIAXIAL SHEAR TEST**
Purpose	To find the shear of the soil by Triaxial shear Test.
Scope	The soil specimen is first consolidated under all round pressure in the triaxial cell before failure is brought about by increasing the major principal stress.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. The sample is placed in the compression machine and a pressure plate is placed on the top. Care must be taken to prevent any part of the machine or cell from jogging the sample while it is being setup, for example, by knocking against this bottom of the loading piston. The probable strength of the sample is estimated and a suitable proving ring selected and fitted to the machine.
2. The cell must be properly set up and uniformly clamped down to prevent leakage of pressure during the test, making sure first that the sample is properly sealed with its end caps and rings (rubber) in position and that the sealing rings for the cell are also correctly placed.
3. When the sample is setup water is admitted and the cell is fitted under water escapes from the beed valve, at the top, which is closed. If the sample is to be tested at zero lateral pressure water is not required.
4. The air pressure in the reservoir is then increased to raise the hydrostatic pressure in the required amount. The pressure gauge must be watched during the test and any necessary adjustments must be made to keep the pressure constant.
5. The handle wheel of the screw jack is rotated until the underside of the hemispherical seating of the proving ring, through which the loading is applied, just touches the cell piston.
6. The piston is then removed down by handle until it is just in touch with the pressure plate on the top of the sample, and the proving ring seating is again brought into contact for the begging of the test.

PRECAUTIONS TO BE FOLLOWED

- Preparation of soil sample should be smooth and trimmed properly
- Dial gauge dial reading should be noted properly

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**GRAIN SIZE DISTRIBUTION**
Purpose	The grain size analysis is widely used in classification of soils.
Scope	The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction, air field etc.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

(a) The proportion of soil sample retained on 75 micron I.S sieve is weighed and recorded weight of soil sample is as per I.S 2720.

(b) I.S sieves are selected and arranged in the order as shown in the table.

(c) The soil sample is separated into various fractions by sieving through above sieves placed in the above mentioned order.

(d) The weight of soil retained on each sieve is recorded.

(e) The moisture content of soil if above 5% it is to be measured and recorded.

PRECAUTIONS TO BE FOLLOWED

- Carefully reading should be noted from the each sieve, without splitting the soil particles

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**CALIFORNIA BEARING RATIO TEST**
Purpose	The california bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements.
Scope	This is the most widely used method for the design of flexible pavement.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

- Place the mould assembly with the surcharge weights on the penetration test machine.
- Seat the penetration piston at the center of the specimen with the smallest possible load, but in no case in excess of 4 kg so that full contact of the piston on the sample is established.
- Set the stress and strain dial gauge to read zero. Apply the load on the piston so that the penetration rate is about 1.25 mm/min.
- Record the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10 and 12.5 mm. Note the maximum load and corresponding penetration if it occurs for a penetration less than 12.5 mm.
- Detach the mould from the loading equipment. Take about 20 to 50 g of soil from the top 3 cm layer and determine the moisture content.

PRECAUTIONS TO BE FOLLOWED

- Dial guage dial reading should bs noted properly
- Soaked and unsoaked values should determine through definite time interval

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**STANDARD PROCTOR TEST**
Purpose	To determined the maximum dry density and optimum moisture content
Scope	This method covers the determination of the relationship between the moisture content and density of soils compacted in a mould
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. Take a representative oven-dried sample, approximately 5 kg in the given pan. Thoroughly mix the sample with sufficient water to dampen it to approximately four to six percentage points below optimum moisture content.
2. Weigh the proctor mould without base plate and collar. Fix the collar and base plate. Place the soil in the Proctor mould and compact it in 3 layers giving 25 blows per layer with the 2.5 kg rammer falling through.
3. Remove the collar, trim the compacted soil even with the top of the mould by means of the straight edge and weigh
4. Remove the sample from the mould and slice vertically through and obtain a small sample for moisture determination.
5. Thoroughly break up the remainder of the material until it will pass a no.4 sieve as judged by the eye. Add water in sufficient amounts to increase the moisture content of the soil sample by one or two percentage points and repeat the above procedure for each increment of water added. Continue this series of determination until there is either a decrease or no change in the wet unit weight of the compacted soil.

PRECAUTIONS TO BE FOLLOWED

- Wear shoes and gloves when executing the experiment

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**LIQUID LIMIT TEST**
Purpose	Preparesoilspecimenasperspecification.Findthe relationship betweenwatercontentandnumberofblows.Draw low curve. Find out liquid limit.
Scope	Liquid limit is significant to know the stress history and general properties of the soil met with construction..
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. About 120 gm of air-dried soil from thoroughly mixed portion of material passing 425 micron I.S sieve is to be obtained.
2. Distilled water is mixed to the soil thus obtained in a mixing disc to form uniform paste. The paste shall have a consistency that would require 30 to 35 drops of cup to cause closer of standard groove for sufficient length.
3. A portion of the paste is placed in the cup of LIQUID LIMIT device and spread into portion with few strokes of spatula.
4. Trim it to a depth of 1cm at the point of maximum thickness and return excess of soil to the dish.
5. The soil in the cup shall be divided by the firm strokes of the grooving tool along thediameter through the centre line of the follower so that clean sharp groove of proper dimension is formed.
6. Lift and drop the cup by turning crank at the rate of two revolutions per second until the two halves of soil cake come in contact with each other for a length of about 1 cm by flow only.
7. The number of blows required to cause the groove close for about 1 cm shall be recorded.
8. A representative portion of soil is taken from the cup for water content determination.
9. Repeat the test with different moisture contents at least three more times for blows between 10 and 40.

PRECAUTIONS TO BE FOLLOWED

- Carefully reading should be noted for the each trial

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**PLASTIC LIMIT TEST**
Purpose	To determine the Plastic limit and calculate the Plastic Limit ratio for the given soil.
Scope	Soil is used for making bricks, tiles, and soil cement blocks in addition to its use as foundation for structures.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. Take about 20gm of thoroughly mixed portion of the material passing through 425 micron I.S. sieve obtained in accordance with I.S. 2720 (part
2. Mix it thoroughly with distilled water in the evaporating dish till the soil mass becomes plastic enough to be easily molded with fingers.
3. Allow it to season for sufficient time (for 24 hrs) to allow water to permeate throughout the soil mass
4. Take about 10gms of this plastic soil mass and roll it between fingers and glass plate with just sufficient pressure to roll the mass into a threaded of uniform diameter throughout its length. The rate of rolling shall be between 60 and 90 strokes per minute.
5. Continue rolling till you get a threaded of 3 mm diameter.
6. Kneed the soil together to a uniform mass and re-roll.
7. Continue the process until the thread crumbles when the diameter is 3 mm.
8. Collect the pieces of the crumbled thread in air tight container for moisture content determination.
9. Repeat the test to atleast 3 times and take the average of the results calculated to the nearest whole number.

PRECAUTIONS TO BE FOLLOWED

- Carefully reading should be noted for the each trial

RECORD TO BE MAINTAINED

- Maintenance observation readings and record

VINAYAKA MISSION'S RESEARCH FOUNDATION

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

SOIL MECHANICS LABORATORY

STANDARD OPERATING PROCEDURE

Name of the Experiment	**SHRINKAGE LIMIT TEST**
Purpose	To determine the shrinkage limit and calculate the shrinkage ratio for the given soil.
Scope	Soils which undergo large volume changes with change in water content may be troublesome. Volume changes may not and usually will not be equal.
Responsibility	Faculty i/c of the facility, HOD/CIVIL

PROCEDURE

1. Take about 100 gm of soil sample from a thoroughly mixed portion of the material passing through 425-micron I.S. sieve.
2. Place about 30 gm the above soil sample in the evaporating dish and thoroughly mixed with distilled water and make a creamy paste.
3. Coat the inside of the shrinkage dish with a thin layer of Vaseline to prevent the soil sticking to the dish.
4. Fill the dish in three layers by placing approximately 1/3 rd of the amount of wet soil with the help of spatula. Tap the dish gently on a firm base until the soil flows over the edges and no apparent air bubbles exist. Repeat this process for 2nd and 3rd layers also till the dish is completely filled with the wet soil. Strike off the excess soil and make the top of the dish smooth. Wipe off all the soil adhering to the outside of the dish.
5. Weigh immediately, the dish with wet soil and record the weight.
6. Remove the dried disk of the soil from oven. Cool it in a desiccator. Then obtain the weight of the dish with dry sample.

7. Determine the weight of the empty dish and record.
8. Determine the volume of shrinkage dish which is evidently equal to volume of the wet soil as follows. Place the shrinkage dish in an evaporating dish and fill the dish with mercury till it overflows slightly. Press it with plain glass plate firmly on its top to remove excess mercury. Pour the mercury from the shrinkage dish into a measuring jar and find the volume of the shrinkage dish directly. Record this volume as the volume of the wet soil pat.

PRECAUTIONS TO BE FOLLOWED

- Carefully reading should be noted for the each trial

RECORD TO BE MAINTAINED

- Maintenance observation readings and record
- Laboratory Manual containing the experiments that can be performed with the equipment