TRIAXIAL TEST

1. Objective: To find the shear strength of soil by Unconsolidated Undrained Triaxial test. In UU test, soil specimen is not consolidated and thus drainage is not allowed either during application of cell pressure (confining pressure) or shearing. UU triaxial test is the fastest triaxial test to obtain shear strength parameters (c,Φ) of soil.

2. Apparatus Required:

A. Knowledge of Equipment

1. A constant rate of strain compression machine of which the following is a brief description of one is in common use.
   a. A loading frame in which the load is applied by a yoke acting through an elastic dynamometer, more commonly called a proving ring which used to measure the load. The frame is operated at a constant rate by a geared screw jack. It is preferable for the machine to be motor driven, by a small electric motor.
   b. A hydraulic pressure apparatus including an air compressor and water reservoir in which air under pressure acting on the water raises it to the required pressure, together with the necessary control valves and pressure dials.
2. A triaxial cell to take 3.8 cm dia and 7.6 cm long samples, in which the sample can be subjected to an all-round hydrostatic pressure, together with a vertical compression load acting through a piston. The vertical load from the piston acts on a pressure cap. The cell is usually designed with a non-ferrous metal top and base connected by tension rods and with walls formed of Perspex.

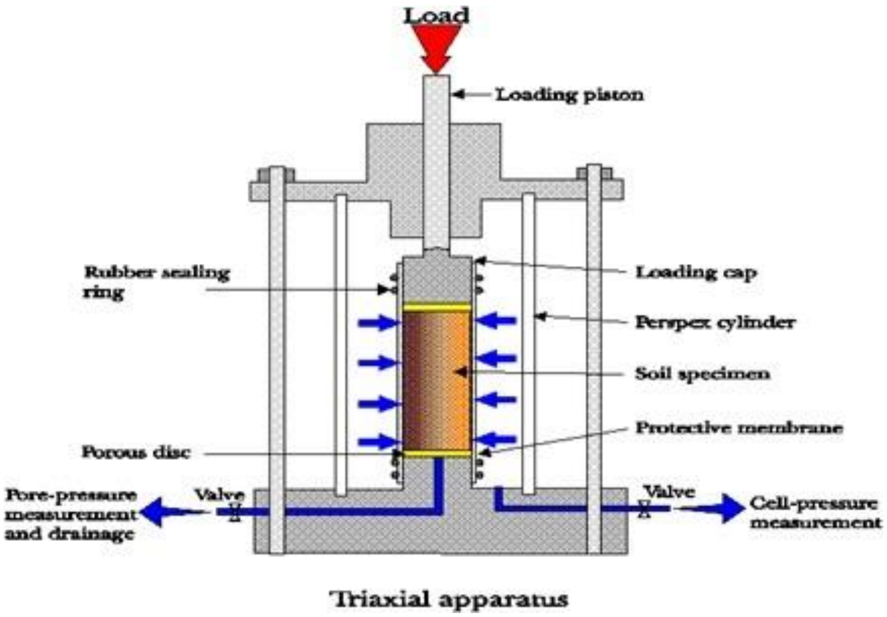

Fig. 1: Triaxial Test Apparatus

Fig. 2: Triaxial Test Setup

Fig. 3: Weighing balance

The balance to be used must be sensitive to the extent of 0.1% of total weight of sample taken

3. Reference: IS 2720(Part 11):1993 Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure (first revision). Reaffirmed- Dec 2016.

4. 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 feed 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.

5. Observation and Recording:

The machine is set in motion (or if hand operated the hand wheel is turned at a constant rate) to give a rate of strain 2% per minute. The strain dial gauge reading is then taken and the corresponding proving ring reading is taken the corresponding proving ring chart. The load applied is known. The experiment is stopped at the strain dial gauge reading for 15% length of the sample or 15% strain.

- Operator:
- Depth:
- Site:
- Bore hole No.:
- Sample No:
- Initial length of specimen:
- Initial diameter of specimen:
- Initial weight:
- Load gauge No.:
- Cell Pressure sigma_3:
- Description of sample:
- Mode of failure :
- Angle of Shear plane with vertical axis:
- Bulk density :
- Moisture content:
- Load gauge constant
- Rate of strain
- Sketch of specimen after failure

Compression Gauge Reading	Load Gauge Reading	Compression of Sample	Strain	Corrected Area	Load	Deviator Stress ($\sigma_1 - \sigma_3$)	Vertical Stress (σ_1)	- (σ_1 / σ_3)
0								
50								
100								
150								
200								
250								
300								
350								
400								
450								

Table 1: Recordings during Triaxial Test

6. Calculation:

Sample No.	**Wet bulk density gm/cc**	**Cell pressure kg/cm^2**	**Compressive stress at failure**	**Strain at failure**	**Moisture content**	**Shear strength (kg/cm2)**	**Angle of shearing resistance**
1							
2							
3							

Table 2: Triaxial Test Result

7. General Remarks:

It is assumed that the volume of the sample remains constant and that the area of the sample increases uniformly as the length decreases. The calculation of the stress is based on this new area at failure, by direct calculation, using the proving ring constant and the new area of the sample. By constructing a chart relating strain readings, from the proving ring, directly to the corresponding stress.

The strain and corresponding stress is plotted with stress abscissa and curve is drawn. The maximum compressive stress at failure and the corresponding strain and cell pressure are found out.

The stress results of the series of triaxial tests at increasing cell pressure are plotted on a Mohr stress diagram. In this diagram a semicircle is plotted with normal stress as abscissa shear stress as ordinate.

The condition of the failure of the sample is generally approximated to by a straight line drawn as a tangent to the circles, the equation of which is $\tau = c + \sigma \tan(\Phi)$. The value of cohesion, c is read of the shear stress axis, where it is cut by the tangent to the Mohr circles, and the angle of shearing resistance (Φ) is angle between the tangent and a line parallel to the shear stress.

For normally consolidated soils, $c= 0$; however, for over-consolidated soils, $c> O$.

A typical range of values of A at failure for clayey soils is given below:

Type of Soil	**A at Failure**
Clays with High sensitivity	0.75 to 1.5
Normally Consolidated Clays	0.5 to 1.0
Over Consolidated Clays	-0.5 to 0.0
Compacted Sandy Clay	0.5 to 0.75

Table 3: Triaxial Test Result