DIRECT SHEAR TEST

1. Objective: 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. Direct shear test is used to predict these parameters quickly. The laboratory report cover the laboratory procedures for determining these values for cohesionless soils.

2. Apparatus Required:

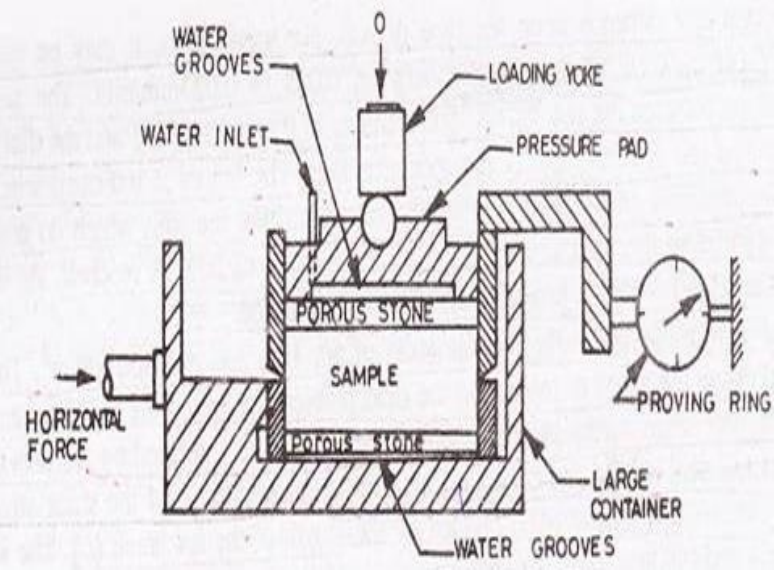

Fig. 1: Direct Shear Test Apparatus

Direct shear test apparatus consisting of:

(a) Loading frame (motor attached)

(b) Dial gauge

(c) Proving ring.

Fig. 2: 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 13):1986 Methods of test for soils: Direct shear test. Reaffirmed- 2016.

4. Procedure:

1. Calculate the volume of the container. Weigh the container.
2. Place the soil in smooth layers (approximately 10 mm thick). If a dense sample is desired, tamp the soil.
3. Weigh the soil container, the difference of these two is the weight of the soil. Calculate the density of the soil.
4. Put the upper grating on stone and loading block on top of soil.
5. Measure the thickness of soil specimen and apply the desired normal load.
6. Record the initial reading of the dial gauge and calibration values.
7. Before proceeding to test check all adjustments to see that there is no connection between two parts except sand/soil.
8. Start the motor. Take the reading of the shear force and record the reading.
9. Take volume change readings till failure.
10. Add 5 kg normal stress 0.5 kg/cm2 and continue the experiment till failure.
11. Record carefully all the readings. Set the dial gauges zero, before starting the experiment
12. Take next readings at 1.0 kg/cm^2 & then at subsequent increment of 0.5 kg/cm^2

5. Observation and Recording:

Normal stress 0.5 kg/cm^2/ 1.0 kg/cm^2/ 1.5 kg/cm^2

L.C=..... P.R.C=.....

Horizontal Gauge Reading (1)	Vertical Dial gauge Reading (2)	Proving ring Reading (3)	Hori. Dial gauge Reading Initial reading div. gauge (4)	Shear deformation Col.(4) x Least count of dial (5)	Vertical gauge reading Initial Reading (6)	Vertical deformation= div.in col.6 x L.C of dial gauge (7)	Proving reading Initial reading (8)	Shear stress = div. col.(8) x proving ring constant Area of the specimen (kg/cm2) (9)
0								
25								
50								
75								
100								
125								
150								

175								
200								
250								
300								
350								
400								
500								
600								
700								
800								
900								

Table 1: Data Collection Sheet for Direct Shear Test

6. Calculation:

S. No.	Normal load (kg)	Normal stress(kg/cm^2) = load x leverage/Area	Shear stress = Proving Ring reading x calibration / Area of container
1			
2			
3			

Table 2: Direct Shear Test

7. General Remarks

In the shear box test, the specimen is not failing along its weakest plane but along a predetermined or induced failure plane i.e. horizontal plane separating the two halves of the shear box. This is the main drawback of this test. Moreover, during loading, the state of stress cannot be evaluated. It can be evaluated only at failure condition i.e. Mohr's circle can be drawn at the failure condition only. Also failure is progressive.

Direct shear test is simple and faster to operate. As thinner specimens are used in shear box, they facilitate drainage of pore water from a saturated sample in less time. This test is also useful to study friction between two materials, one material in lower half of box and another material in the upper half of box.

The angle of shearing resistance of sands depends on state of compaction, coarseness of grains, particle shape and roughness of grain surface and grading. It varies between 28^0(uniformly graded sands with round grains in very loose state) to 46^o (well graded sand with angular grains in dense state).

The volume change in sandy soil is a complex phenomenon depending on gradation, particle shape, state and type of packing, orientation of principal planes, principal stress ratio, stress history, magnitude of minor principal stress, type of apparatus, test procedure, method of preparing specimen etc. In general loose sands expand and dense sands contract in volume on shearing. There is a void ratio at which either expansion contraction in volume takes place. This void ratio is called critical void ratio. Expansion or contraction can be inferred from the movement of vertical dial gauge during shearing.

The friction between sand particles is due to sliding and rolling friction and interlocking action.The ultimate values of shear parameter for both loose sand and dense sand approximately attain the same value so, if angle of friction value is calculated at ultimate stage, slight disturbance in density during sampling and preparation of test specimens will not have much effect.