MEASUREMENT OF SHEAR STRENGTH:

The shear strength of the soil can be determined in the lab by following four methods . (Based on the method of application of loads)

1. Direct shear test
2. Traixial shear test (or) Traixial compression test
3. Unconfined compression test (UCC)
4. Vane shear test

Based on drainage condition the shear test are classified as

1. Undrained test (UU test)→ $Unconsolidated$
2. Consolidated undrained test (CU test) → $Consolidated$
3. Drained test (CD test) → $Consolidated$

1. **DIRECT SHEAR TEST** :
   - This is a simple and commonly used test and is performance in a shear box apparatus **(60x60mm) square size** . It consists a two piece of square section . **Thickness** about **20 to 25 mm**
   - The **lower half** of the box is rigid hold in position which rest over **rulers** and driven by electric motor (or) by hand
   - The **upper half** of the box **connected with proving** ring
   - The soil sample is compacted in the shear box and in hold between metal bricks and porous stones
   - Normal load is applied on specimen through loading yoke (constant)
   - The shearing force is applied to a lower by means of geared jack
   - The **change in volume** shear displacement shear force , vertical deformation is measured by **dial gauge**
   - A number of identical specimen are tested under increasing the normal loads and maximum shear force is recorded (Until specimen fails)
   - If test continuous **beyond 20 %** Strain it is used to stop the test and defined failure point as corresponding to any desired level of strain upto **20%.**
   - A graph is plotted between normal stress in x- axis and shear stress in y- axis
   - Such a plot gives the failure envelope for the given tested soil mass.

ADVANTAGES (or) MERITS:

- The sample preparation is easy. the test is simple and convenient.
- The drainage is quick.
- It is ideally suited for cohesion less soils.
- This apparatus is relatively cheap.

DISADVANTAGES (or) DEMERITS:

- The Mohr circle cannot be drawn.
- The stress distribution is not uniform.
- The failure plane is predetermined. Therefore the specimen is not allowed to failalong it weakest plane.
- T he area under shear gradually decreases corrected area should be used in computingnormal and shear stresses.
- Measurement of pore pressure is not possible.

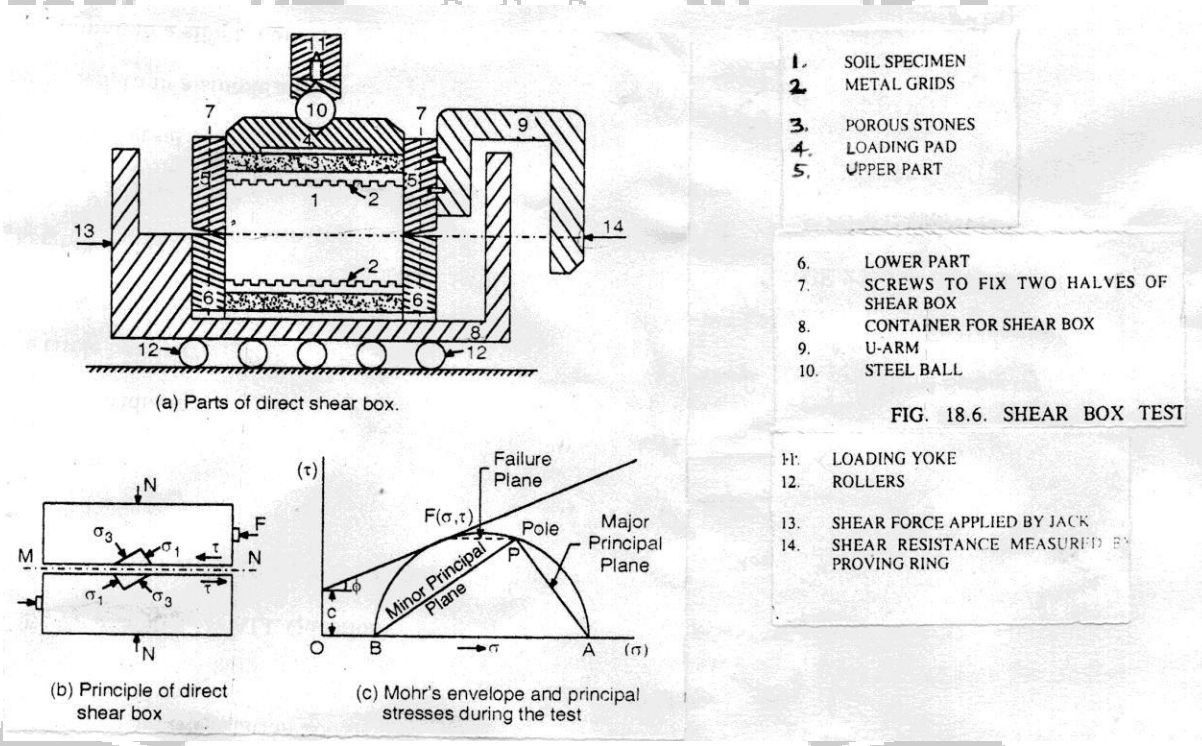


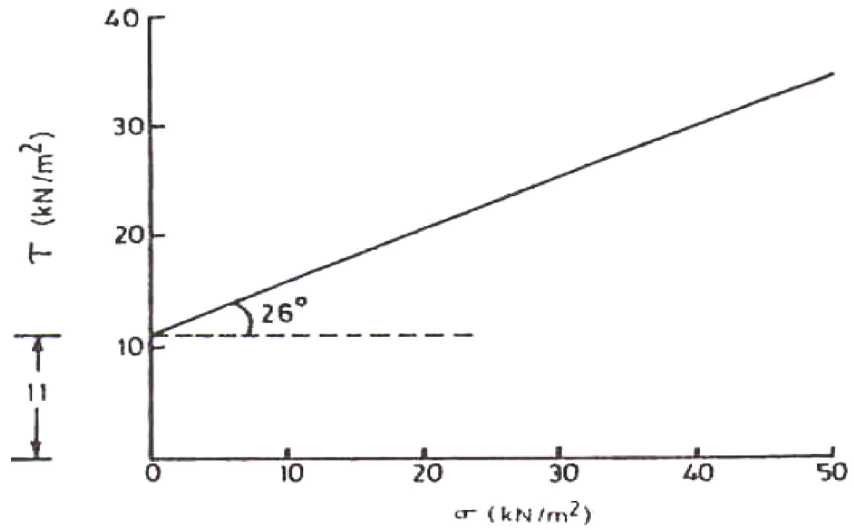
FIG. 18.6. SHEAR BOX TEST

Problems:

1) A series of direct shear test was conducted on soil each test was carried out till the samplefailed .the following results were obtained.

Sample number	Normal stress(KN/m^2)	shear stress(KN/m^2)
1	15	18
2	30	25
3	45	32

Determine the cohesion intercept and angle of shearing resistance



From the plot,

Cohesion intercept C=11 KN/m^2 ,

angle of shearing resistance φ=26^0

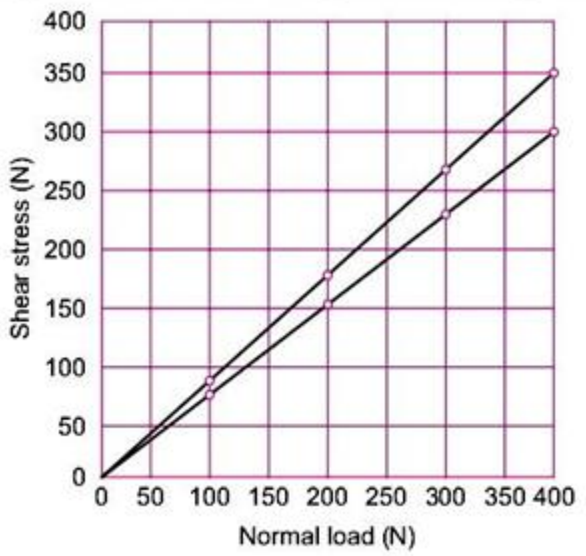
2) Samples of compacted, clean dry sand were tested in a shear box,6cm x6cm and the following results were obtained:

Normal load(N)		100	200	300	400
Peak shear load (N)	:	90	181	270	362
Ultimate shear load(N)	:	55	152	277	300

Determine the angle of shearing resistance of the sand in a)the dense, and b)the loose state.

Solution.

The value of the shearing resistance of sand, obtained from the peak stress represents the value of φ in its initial compacted state, while that obtained from the ultimate shear corresponds to the sand when loosened by the shearing action.



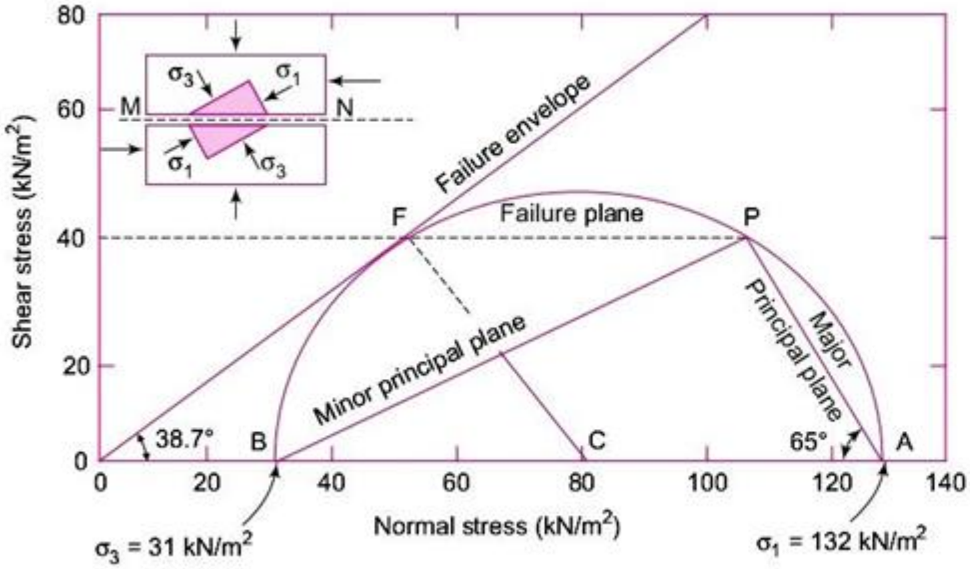
From the

a) Dense state:$\varphi=42^0$

b) Loose state :$\varphi=37^0$

3)A specimen of clean. dry, cohesion less and is tested in shear box and the soil failed at a shear stress of 40 kN/m^2.when the normal load on the specimen was 50kN/m2. Determine (a)the angle of shearing resistance, (b)the principal stress during the failure, (c)the directions of the principal planes with respect to the direction of the plane of shearing.

Solution: The failure envelope will pass through (i)origin, and (ii) a point F whose co-ordinates are : shear stress=40kN/m2(40kPa) and normal stress=50kN/m2(50kPa). The angle of shearing resistance is found to be 38.7°



The Mohr's stress circle is so drawn that it is tangential to the envelope at point F.To do this, a line FC is drawn perpendicular to the envelope. With C as the centre and CF as the radius, a circle is drawn, which intersects the normal load axis at points A and B. Point A corresponds to the major principal stress σ1 which comes out to be 132kN/m^2 and point B corresponds to the minor principal stress σ3 which Comes out to be 31 kN/ m^2 (31kPa).

To locate the position of the pole, a line FP is drawn parallel to the plane of failure in the shear box (i.e., horizontal), P is the pole.PA is the direction of the major principal plane which makes an angle of 65° in the clock wise direction with the plane of shear, while PB is the minor principal plane, making an angle of 25° in the anti-clock wise direction with the plane of shearing.

4)In a direct shear test on sand the normal stress was 2.0kg/cm^2 and shear stress at failure was 0.8 kN/cm^2. Determine the orientations of the principal planes at failure.

Solution. Figure shows the graphical solution. The failure envelope will pass through (i)the origin O and (ii)a point F whose coordinates are:

Shear stress=0.8kg/cm^2 and normal stress =2.0kg/cm^2 .Mohr circle is so drawn that **it** is tangential to the failure envelope at point F. Then PA is the direction of major principal plane which makes an angle

Of 57° in the clockwise direction with the plane of shear. Similarly, PB is the direction of minor principal plane, which makes angle of 33° in the anticlockwise direction, with the plane of shear.