4.4.UNCONFINED COMPRESSION TEST (UCC)

- The object of the experiment is to determine the unconfined compressive strength of the clayey soil.
- The purpose of the test is to obtain the value of compressive and shearing strength of the soils.
- The split mould is oiled lightly from inside, the mould is pushed into the soil. The split mould is opened carefully and sample is taken out after taken from the soil man.
- Measure the initial length and diameter of specimen place the specimen on the bottom plate of the loading device, adjust the upper plate to make contact with the specimen.
- Set the loading dial gauge and the strain dial gauge to zero.
- The cracks are formed on the soil specimen due to compression and take dial gauge readings and draw the failure envelope.
- This test is simple test and used to determine the sensitivity of the clay soils.

$$\text{Sensitivity} = \frac{Q_u \text{ (undisturbed)}}{Q_u \text{ (remoulded (or) disturbed)}}$$

- It is a special case of triaxial compression test in which $\sigma 2 = \sigma 3 = 0$ due to the absence of such confining pressure, the uniaxial test is called as UnConfined Compression test.
- This test is applicable for saturated clay soil ($\phi = 0$)

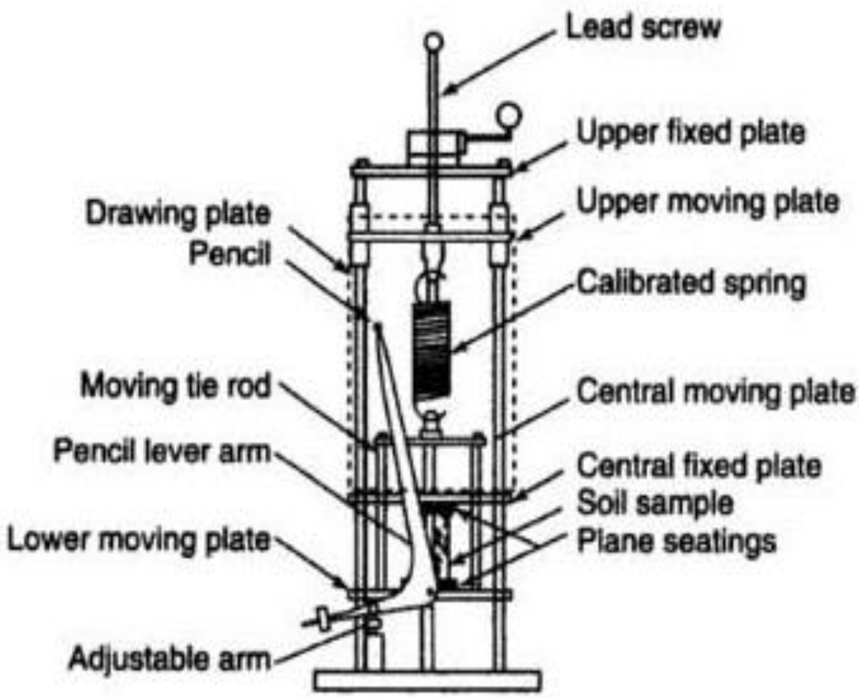


fig 4.4.1 UCC

We Know that,

$\sigma 1 = \sigma 3 \ \tan^2 \alpha + 2c \tan \alpha$

$\sigma 3 = 0$

$\sigma 1 = 2c \tan \alpha$;

$$\alpha = 45 + \frac{\varphi}{2}$$

$$\sigma_1 = 2Ctan\left[45 + \frac{\varphi}{2}\right]$$

$$\sigma 1 = 2c \tan 45° \ [\varphi = 0]$$

$$\sigma 1 = 2c$$

$$C = \frac{\sigma_1}{2}$$

but, $\tau = c + \sigma \tan \phi$

$$\tau = C = \frac{\sigma_1}{2}$$

$$\tau = C = \frac{\sigma_1}{2} = \frac{q_u}{2}$$

(Ref.fig.4.4.1) q_u = Unconfined Compressive strength

$$\varepsilon = \frac{\Delta L}{L} = 0.1$$

$$A_f = \frac{A}{1 - \frac{\Delta L}{L}}$$

$$q_u = \frac{P_f}{A_f}$$

MERITS:

1. The test is simple and quick
2. It is used for determining the unconfined compressive strength of clayey soil.
3. The sensitivity of soil is also determined from the test results.

DEMERITS:

- The test cannot be conducted on hard clay
- The test cannot be used for friction soils.

Problem:

1)In an unconfined compression test ,a sample of clay 100 mm long and 50mm in diameter fails under a load of 150 N at 10% strain. calculate the shearing resistance taking into account theeffectof changein cross section of the sample.

Solution:

$$\varepsilon = \frac{\Delta L}{L} = 0.1$$

$$A_f = \frac{A}{1 - \frac{\Delta L}{L}}$$

$$A = \frac{\pi x d^2}{4} = \frac{\pi(50^2)}{4}$$

$$A_f = \frac{\frac{\pi(50^2)}{4}}{1 - 0.1} = 2181.7mm^2$$

$$q_u = \frac{P_f}{A_f} = \frac{150}{2181.7}$$

$=0.06875$ N/mm^2

Shear resistance$= \frac{q_u}{2} = \frac{68.75}{2} = 34.38\ KN/m^2$

2)A shear vane of 7.5 cm diameter and 11 cm length was used to measure the shear strength of soft clay. If torque of 600 Kg-cm was requires to shear the soil, Calculate the shear strength .The vane was then rotated rapidly to cause remoulding of the soil. The torque required in the remoulded state was200kg/m. Determine the sensitivity of the soil

Solution:

$$\tau_f = \frac{T}{\pi d^2 \left[\frac{H}{2} + \frac{d}{6}\right]}$$

$$\tau_f = \frac{600}{\pi(7.5)^2 \left[\frac{11}{2} + \frac{7.5}{6}\right]}$$

$C = \tau_f = 0.503$ Kg/cm^2

For remoulded state: The shear strength will be in direct proportion to the torque

$$Sensitivity = \frac{C\ in\ undisturbed\ condition}{C\ in\ disturbed\ condition} = \frac{T\ in\ undisturbed\ condition}{T\ in\ disturbed\ condition}$$

$$= \frac{600}{200} = 3$$

3)A cylindrical specimen of saturated clay,4cm in diameter and 9cm in overall length is tested in an unconfined compression tester. The specimen has coned end and its length between the apices of cone is 8cm.Find the unconfined compressive strength of clay, if the specimen fails under an axial load of 46.5N.The change in the length of specimen at failure is 1cm.

Solution:

Original length of specimen=9cm overall & 8cm apices of cone

Length of cylinder of the same volume and diameter(avg length) L_1=8.66cm.

$$A_1 = \frac{\pi x d^2}{4} = \frac{\pi(4^2)}{4} = 12.57\ cm^2$$

Change in length ,ΔL=1cm

$$A_2 = \frac{A_1}{1-\frac{\Delta L}{L}}$$

$$A_2 = \frac{12.57}{1-\frac{1}{8.66}} = 14.2\ cm^2$$

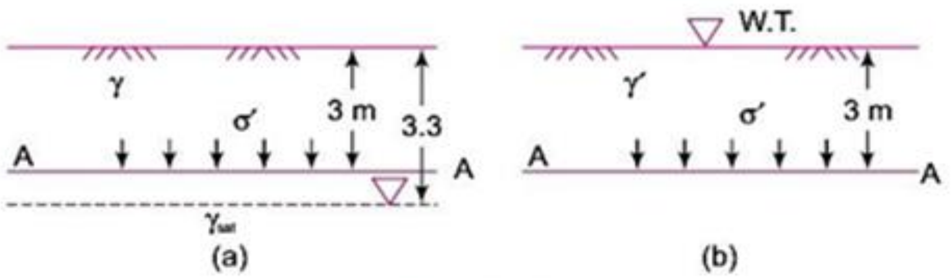
$$unconfined\ compression\ test\ q_u = \frac{failure\ load}{A_2}$$

$$= \frac{465}{14.2} = 32.8 KN/cm^2$$

=328KN/m^2

Shear strength $C_u = \frac{q_u}{2} = \frac{328}{2} = 164\ KN/m^2$

4) Calculate the potential shear strength on a horizontal plane at a depth of 3m below the surface in a formation of cohesionless soil when the water table is at a depth of 3.3 m.The degree of saturation may be taken as 0.5 on the average ,void ratio=0.5,grain specific gravity=2.7, angle of internal friction=30^0.what will be the modified values of shear strength if water table reaches the ground surface?



Solution:

a)water table at 3.3m depth

$$w = \frac{eS}{G} = \frac{0.5x0.5}{2.7} = 0.0926$$

$$\gamma = \frac{G\gamma_w}{1+e}(1+w)$$

$$= \frac{G\gamma_w}{1+e}(1+w)$$

$$= \frac{2.7x9.81}{1+0.5}(1+0.0926)$$

$$= 19.293\ KN/m^3$$

σ' at AA,at 3m depth=γH

=19.293x3

=57.879 KN/m^2

τ_f=C+σ'tanφ

=0+57.879 tan 30^0

=33.42 KN/m^2

b)water table at GL

$$w_{sat} = \frac{eS}{G} = \frac{0.5x1}{2.7} = 0.1852$$

$$\gamma_{sat} = \frac{G\gamma_w}{1+e}(1+w_{sat})$$

$$= \frac{G\gamma_w}{1+e}(1+w_{sat})$$

$$= \frac{2.7x9.81}{1+0.5}(1+0.1852)$$

$$= 20.928\ KN/m^3$$

γ'=20.928-9.81=11.118 KN/m^2

σ' at AA =γ'H

=11.118x3=33.354 KN/m^2

τ_f=C+σ'tanφ

=0+33.354 tan 30^0

=19.26 KN/m^2