UNCONFINED COMPRESSION TEST

(IS-2720-PART-10-1991) Reaffirmed-2006

THEORY:

Unconfined compression test also known as uniaxial compression tests, is a special case of a triaxial test, where confining pressure is zero. UC test does not require the sophisticated triaxial setup and is simpler and quicker test to perform as compared to triaxial test. In this test, a cylindrical specimen of soil without lateral support is tested to failure in simple compression, at a constant rate of strain. Compressive load per unit area required to fail the specimen is called **unconfined compressive** strength of the soil.

NEED AND SCOPE:

It is not always possible to conduct the bearing capacity test in the field. Sometimes it is cheaper to take the undisturbed soil sample and test its strength in the laboratory. Also to choose the best material for the embankment, one has to conduct strength tests on the samples selected. Under these conditions it is easy to perform the unconfined compression test on undisturbed and remolded soil sample. Now we will investigate experimentally the strength of a given soil sample.

APPARATUS REQUIRED:

1) Loading frame with constant rate of movement.
2) Proving ring of 0.01 kg sensitivity for soft soils; 0.05 kg for stiff soils.
3) Soil trimmer, evaporating dish (Aluminum container).
4) Frictionless end plates (Perspex plate with silicon grease coating) of required diameter (diameter of the plate is selected according to the diameter of the sample).
5) Dial gauge (0.01 mm accuracy), Dial gauge (sensitivity 0.01mm), Vernier calipers
6) Balance of capacity 200 g and sensitivity to weigh 0.01 g.
7) Oven, thermostatically controlled with interior of non-corroding material.
8) Soil sample of required dimensions (diameter and height), Sample extractor and split sampler.

PREPARATION OF SPECIMEN:

In this test, a cylindrical specimen of soil without lateral support is tested to failure in simple compression, at a constant rate of strain. The compressive load per unit area required to fail the specimen is called unconfined compressive strength of the soil.

A. Undisturbed specimen

1. Note down the sample number, bore-hole number and the depth at which the sample was taken.
2. Remove the protective cover (paraffin wax) from the sampling tube.
3. Place the sampling tube extractor and push the plunger till a small length of sample moves out.
4. Trim the projected sample using a wire saw, and push the plunger until a 75mm long sample comes out.
5. Cutout this sample carefully and hold it on the split sampler so that it does not fall.

6. Take about 10 to 15 g of soil from the tube for water content determination.
7. Note the container number and take the net weight of the sample and the container.
8. Measure the diameter at top, middle, and bottom of the sample. Find the average and record the same.
9. Measure the length and weight of the sample and record.

B. Remolded sample

1. For the desired water content and the dry density, calculate the weight of the dry soil, W_S, required for preparing a specimen of required dimensions (diameter and height)
2. Add required quantity of water, W_W, to this soil.

   $W_W = W_S \times W/100$ gm
3. Mix the soil thoroughly with water.
4. Place the wet soil in a tight thick polythene bag in a humidity chamber.
5. Take the soil from the humidity chamber and place the soil in a constant volume mould, of required dimensions (equivalent to selected dimension of the sample).
6. Place the lubricated mould with plungers in position in the load frame.
7. Apply the compressive load till the specimen is compacted to the required height.
8. Eject the specimen from the constant volume mould.
9. Record the height, weight and diameter of the specimen.

PROCEDURE:

1. Take two frictionless bearing plates of diameter equivalent to that of the sample dimension.
2. Place the specimen on the base plate of the load frame (sandwiched between the end plates).
3. Place a hardened steel ball on the bearing plate.
4. Adjust the center line of the specimen such that the proving ring and the steel ball are in the same line.
5. Fix a dial gauge to measure the vertical compression of the specimen.
6. Adjust the gear position on the load frame to give suitable vertical displacement.
7. Start applying the load and record the readings of the proving ring dial and compression dial for every 5 mm compression.
8. Continue loading till failure or 20% axial strain (whichever is reached earlier) (IS-2720-PART-10-1991), and then draw the sketch of the failure pattern in the specimen.

OBSERVATION AND READING:

Data Sheet for Unconfined Compression Test

Project: Tested by:
Location: Boring No. :
Depth:

Sample details:

Type UD/R: soil description

Specific gravity (G_S) = _____ Bulk density = _____ g/cc

Water content (%) = _____ Degree of saturation = _____ %

Diameter (D_o) of the sample _____ cm Area of cross-section = _____ cm^2

Initial height (L_o) of the sample =_____ cm Proving ring constant = _____

Dial gauge constant = _____mm

Elapsed time (minutes)	Compression dial reading (L) (mm)	Strain (ΔL / L_o).100 (ε %)	Area A A_o /(1 - ε/100) $(cm)^2$	Proving ring reading (Divns.)	Axial load (kg)	Compressive stress (kg/cm^2)

CALCULATIONS:

1. Axial stress = (Proving ring reading x Proving ring constant) / A_{corr}

2. $A_{corr} = A_0 / (1-\varepsilon)$; A_0 is initial cross-sectional area of the soil specimen, ε is the axial strain at that point of loading.

3. Maximum axial stress is obtained, which is also considered to be the failure point of the specimen.

4. Repeat the test 3 times. Find the average value of maximum axial stress obtained in all three UC tests.

5. Unconfined compression strength of the soil, q_u = average value of maximum axial stress of three tests

6. Shear strength of the soil (cohesion, c) = $q_u/2$

7. Sensitivity = (qu for undisturbed sample)/ (qu for remoulded sample).

GENERAL REMARKS:

- Minimum three samples should be tested; correlation can be made between unconfined strength and field SPT value.
- UC test is recommended for cohesive soils, or which can stand without lateral support.