

Shear Strength of Soils

Q1.

Following information is available for a direct shear test that was conducted on a dry sand with the following:

- Specimen dimensions: 65 mm (length) x 65 mm (width) x 25 mm (height)
- Normal stress: 95 kN/m²
- Shear force at failure: 250 N

- Determine the effective internal friction angle, ϕ' ;
 - What shear force is required to cause failure for a normal stress of 150 kN/m²?
 - Determine the principal stresses at failure;
 - Calculate the inclination of the major principal plane along the horizontal plane.
- (See an example problem that will help a little bit to solve this question which is available at the end of this assignment)**

Q2.

Results of direct shear test of a saturated over-consolidated clay (drained test) are given below:

- Specimen dimensions: 50 mm (length) x 50 mm (width) x 25 mm (height)

Test no.	Normal force (N)	Shear force at failure (N)	Horizontal displacement (mm)
1	145.0	157.5	5
2	230.0	199.9	7
3	330.0	257.6	9
4	540.0	363.4	11

- Determine **analytically (not graphically)** effective shear strength parameters, c' and ϕ' ;

Q3. (Triaxial Compression Test – Consolidated Drained (CD))

Results of two consolidated-drained triaxial tests on a clayey soil are as follows:

Test no.	σ_3' (kN/m ²)	σ_1' (kN/m ²)
1	93.0	305.0
2	185.0	505.0

Use the modified failure envelope equation and determine effective shear strength parameters
(This equation will be useful: $q' = m + p' \cdot \tan \alpha$,

(You don't need to plot the Mohr Circles) (Hint: see slide 52 in your notes)

Q4.

A consolidated drained triaxial test (CD) was conducted for a normally consolidated clay. The results are: $\sigma_3 = 120 \text{ kN/m}^2$; $\Delta\sigma_d = 180 \text{ kN/m}^2$. Determine

- (a) the effective internal friction angle, ϕ' ;
- (b) the failure angle that the failure plane make with the major principal stress;
- (c) the failure plane should be determined using the graphical method (see slide 11, 12 and 13 of classes notes)

Q5.

From a direct shear test, the equation of the effective stress failure envelope for a soil:

$$\tau_f = \sigma' \tan 25^\circ$$

A consolidated drained triaxial test was conducted for the same soil using a confining pressure of 100 kPa.

- (a) Calculate $\Delta\sigma_d$ at failure;
- (b) Estimate the inclination angle of the failure plane with regards to the major principal plane;