Exercise 1 – 19.09.2024

Processing triaxial tests

You are requested to analyze the results of a drained and an undrained triaxial compression tests. The word *drained* is used to describe the condition in which the pore water is allowed to flow freely into or out of the soil sample, and thus dissipate any excess pore pressure. In drained test, a *backpressure* is applied throughout the test in order to ensure sample saturation: the pore water pressure is kept constant and equal to a static value p_w. The word *undrained* indicates that pore water is not allowed to move into or out of the specimen, thus the pore water pressure is not constant.

1. Test conditions

Both samples are prepared in triaxial cells at following dimensions: diameter 38 mm, height 76 mm.
Conditions for tests:

a) drained triaxial test

- Initial isotropic compression up to a cell pressure σ_c = 250 kPa.
- Initial pore water pressure p_w = 50 kPa.

The sample undergoes a conventional drained triaxial compression test with cell pressure σ_c and pore water pressure p_w held constant.

b) undrained triaxial test

- Initial isotropic compression up to a cell pressure σ_c = 500 kPa.
- Initial pore water pressure p_w = 80 kPa.

An undrained conventional triaxial compression test is carried out at a constant cell pressure σ_c on the sample.

2. Experimental data

a) Drained triaxial test

After the isotropic compression, the shearing phase is performed. During the shearing phase, the following results are obtained, where F is the applied force, δ is the axial displacement (negative means that the sample height is reducing), ΔV_w is the pore water volume variation (*note*: positive ΔV_w implies that water flows out of the sample).

F (N)	δ (mm)	ΔV_w ($mm^3 \cdot 10^3$)
0	0	0
108	-0.85	1.2
240	-4.31	4.9
305	-8.72	7.1
360	-16.52	8.0
412	-24.02	8.2
443	-27.3	8.2

b) Undrained triaxial test

After the isotropic compression, the shearing phase is performed. The following results are obtained during the shearing phase, where F is the applied force, δ is the axial displacement (negative means that the sample height is reducing) and p_w is the pore water pressure.

F (N)	δ (mm)	p_w (kPa)
0	0	80
46	-1.30	112
85	-3.58	150
120	-8.39	198
135	-12.98	206
152	-18.50	211
156	-20.50	211

3. Instructions

Calculate deviatoric stress *q*, mean effective *p'* and mean total stress *p*, axial strain ε_a, and volumetric strain ε_v for each step of the test. Give the resulting values in a table. Then, plot the experimental results in the following planes (y axis - x axis):

1. q - ε_a
2. q - p (p')
3. ε_v - ε_a
4. ε_v - p'
5. p_w - ε_a

Represent both the total and effective stress paths in the plane q - p (p'), highlighting the difference between the two.

Comment on the difference between the total stress paths and the effective stress path. How is it different from the drained case?