OCW 2020

FUNDAMENTALS OF GEOTECHNICAL ENGINEERING

ASSIGNMENTS

LESSON 6
SHEAR STRENGTH OF SOILS

Jesús Mª Hernández

Mª Helena Fernandes

Department of Mechanical Engineering

Faculty of Engineering

EXERCISE 1

In order to determine the shear strength parameters of a soil, a direct shear test will be conducted. This soil has been named as SP, poorly graded sand, according to the USCS.

Three tests have been completed, providing the maximum (peak) and ultimate shear stress values:

Test 1. τ_P = 39.93 kPa; τ_U = 34.72 kPa

Test 2. τ_P = 78.28 kPa; τ_U = 68.07 kPa

Test 3. τ_P = 110.70 kPa; τ_U = 96.26 kPa

Soil samples were put into a 60-mm square shear box, and the masses used to apply the vertical forces were 20 kg, 40 kg and 60 kg, respectively.

Determine the shear strength parameters of this soil.

On this soil, a construction is to be done that will give rise, at the most dangerous point, to a Mohr's circle having the following principal stresses σ_1 = 138.63 kPa and σ_3 = 32.15 kPa. Explain whether the soil will fail.

Answer: $\phi \cong 29.5°$.
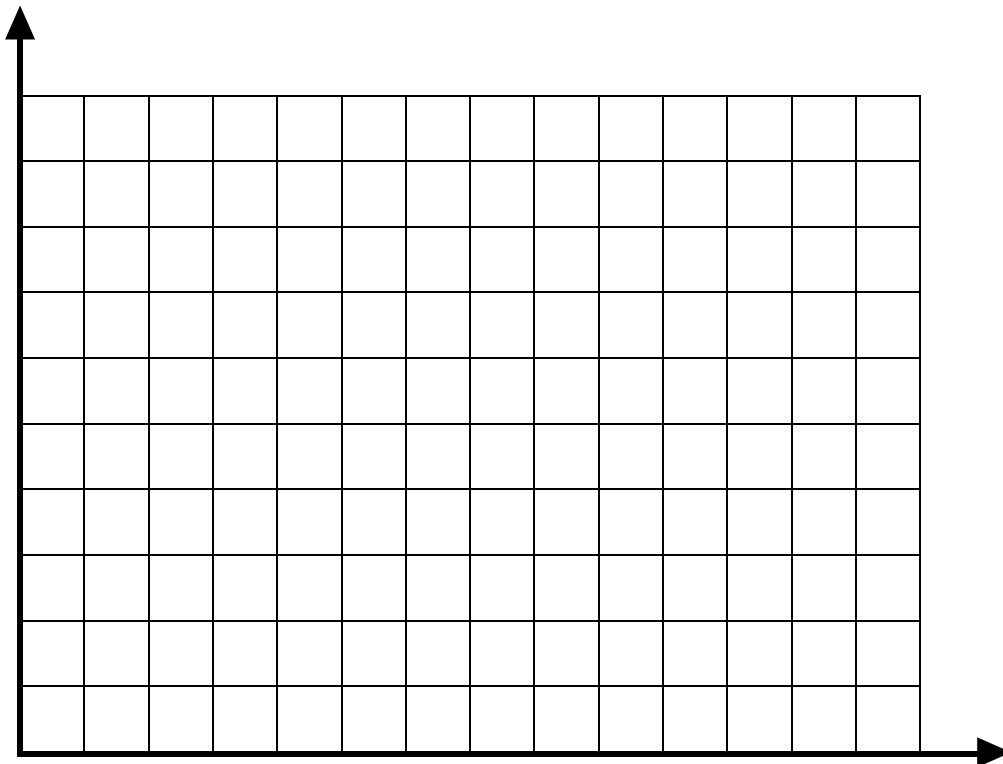
EXERCISE 2

The undrained shear strength parameter of a saturated overconsolidated clay is 48.2 kPa. On this soil, a construction is to be done that will give rise, at the most dangerous point, to a Mohr's circle having the following principal stresses σ_1 = 145.17 kPa and σ_3 = 40.45 kPa. Taking into consideration all these data, verify numerically and graphically whether this soil will fail. Also, if the soil would fail, indicate whether it will be a short-term, medium-term or long-term failure.

Answer: Short-term failure.

EXERCISE 3

An unconfined compression test has been completed on a saturated cohesive soil. The failure took place when a vertical force F = 65.3 N was applied.

The soil sample was cylindrical, having a diameter of 35 mm and a height of 100 mm. Determine the undrained shear strength of that sample in kPa.

Answer: c_U = 33.94 kPa.

EXERCISE 4

A series of UU triaxial tests have been completed on a cylindrical soil sample having a diameter of 50.8 mm and a height of 100 mm. The results of these tests were:

Test 1. All-around pressure: 50 kPa. Axial load at failure: 245.83 N.

Test 2. All-around pressure: 100 kPa. Axial load at failure: 243.21 N.

Test 3. All-around pressure: 150 kPa. Axial load at failure: 248.02 N.

On this soil, a saturated clayey soil, a construction is to be done that will give rise, at the most dangerous point, to a Mohr's circle having the following principal stresses σ_1 = 128.25 kPa and σ_3 = 62.33 kPa. At this point, the initial pore water pressure was u_0 = 19.6 kPa. Taking into consideration all these data, verify whether this soil will fail. Also, if the soil would fail, indicate whether it will be a short-term or long-term failure.

Answer: No failure.