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UNIVERSITY OF TWENTE.

Exam Soil Mechanics

Bachelor 2nd year, CiT/CTW

Module/course code: 202000065-1A: Safety and Risk in Delta's – Soil Mechanics

Date: 19 October 2023

Time: 13.45-15.45 (+25% for students who may use extra time)

Module-coordinator: Maarten Krol

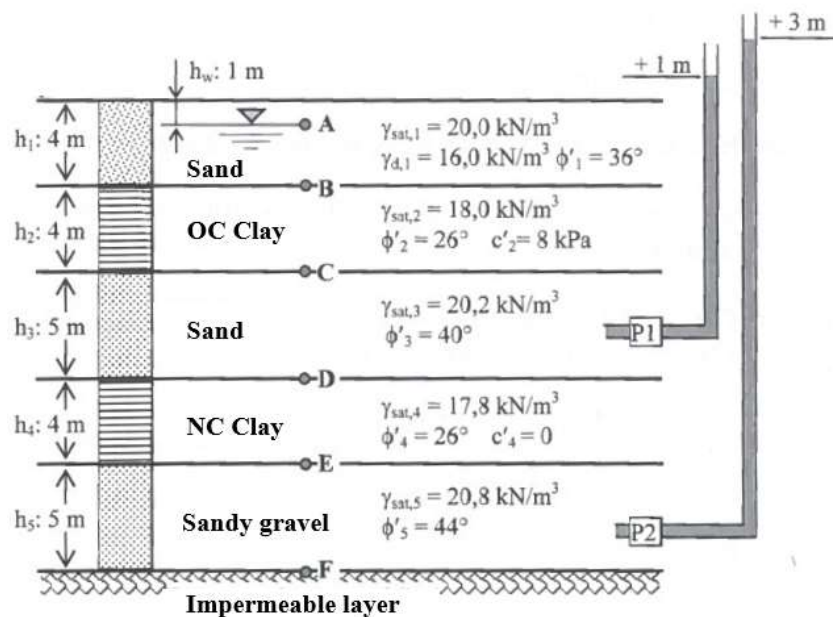
Instructors: Hongyang Cheng and Floriana Anselmucci

Type of test: Exercises, Open questions.

Allowed aids: Scientific calculator, formula sheet, English-Dutch dictionary.

Attachments: Formula sheet.

Exercise 1



Given the stratigraphy in the Figure above:

- 1.1 Calculate the total stress σ , the interstitial pressure u , the effective stress σ' in the points A,B,C,D,E,F.
- 1.2 Draw the profiles of the stresses σ , u , σ' .

Exercise 2

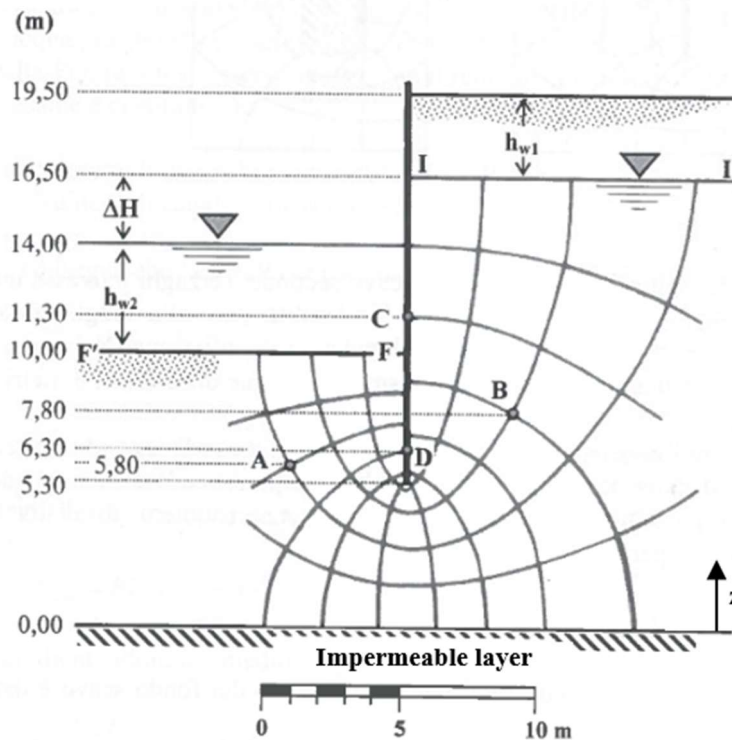
Consider the 2D flow net underneath the retaining wall, as represented in the figure below. The retaining wall is perfectly impermeable and installed in a saturated and homogeneous sand with the unit weights: $\gamma_{dry}^{sand} = 16 \frac{kN}{m^3}$; $\gamma_{sat}^{sand} = 19,8 \frac{kN}{m^3}$ and a permeability coefficient of: $k = 10^{-5} \frac{m}{s}$.

- 2.1 Assuming we place two piezometers in A and B, what would be the water level?
- 2.2 Measure the equipotential drop between A and B.
- 2.3 Sketch the piezometers in A and B and indicate their water level.
- 2.4 Calculate the vertical effective stress in A and B.
- 2.5 Calculate the total flow rate q .

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2.6 Finally explain the difference between the two piezometers levels.



Exercise 3

Assuming to have a layer of clay of 2 meters underneath a 3 meters layer of sand, and the water table is placed in the middle of the sand layer.

The physical properties of the soils are:

$$\gamma_{dry}^{clay} = 15 \frac{kN}{m^3}; \gamma_{sat}^{clay} = 18 \frac{kN}{m^3}; \gamma_{dry}^{sand} = 16 \frac{kN}{m^3}; \gamma_{sat}^{sand} = 20 \frac{kN}{m^3}$$

The mechanical properties of the soils are:

$$c^{clay} = 8 \text{ kPa}; \varphi^{sand} = 35^\circ; \varphi^{clay} = 25^\circ$$

- 3.1 Sketch the stratigraphy explained above.
- 3.2 Calculate the vertical effective stress of the point A situated at the middle of the clay layer (4m from the top surface). If the constant of lateral earth pressure K_0 is 0.4, determine the horizontal total and effective stresses in the same point. Draw the soil element with the corresponding stresses and the Mohr circle representing such stress state.
- 3.3 In a soil sample around point A, the stress state on a horizontal plane is (σ_v, τ_{xy}) , and on a vertical plane $(\sigma_h, -\tau_{xy})$. Considering σ_v and σ_h as the total stresses calculated in the previous point and $\tau_{xy} = 20 \text{ kPa}$. Draw the soil element with the corresponding stresses and the Mohr circle representing such stress state.
- 3.4 Determine the maximum and minimum principal stresses along with the maximum shear stress. Represent them on the Mohr circle.
- 3.5 Finally, determine normal and shear stresses on a plane that makes an angle of 28 degrees with respect to the horizontal face of the soil element. Detect them graphically by using Mohr circle to check your results.