DELFT UNIVERSITY OF TECHNOLOGY

Faculty of Civil Engineering and Geosciences

Soil Mechanics II

CT2091

BSc EXAMINATION 2013 - RESIT

SECOND PERIOD

DATE: 22 January 2013 TIME: 09.00 – 12.00

Answer ALL Questions
(Note that the questions carry unequal marks)

Other instructions
Write your name and student number on each answer sheet

Clearly identify the answer in the answer box

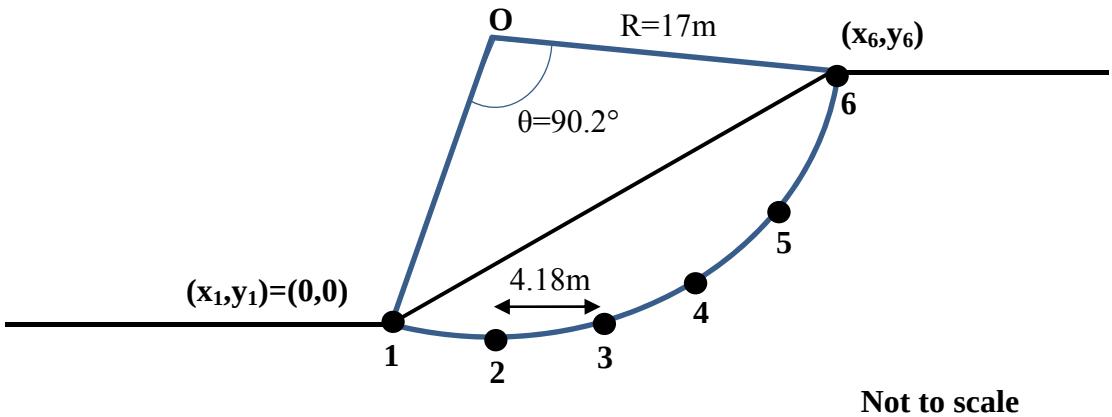
1) A slope is built for a river dike, as shown in the figure below. A circular failure surface is considered as a possible failure mode. The failure surface passes through the top and crest of the slope. The soil properties are γ = 18 kN/m^3, c = 25 kPa and ϕ = 5°.

   a. Use Fellenius' method to determine the Factor of Safety against failure. [**10 marks**]

   b. Use Bishop's method to determine the Factor of Safety against failure for the same slope. (Use only 1 iteration and a starting guess of F=1) [**10 marks**]

   c. Noting the ϕ is low and the majority of the soil strength comes from cohesion, determine the factor of safety by treating the failure volume as a whole and determining the overturning moment and resistance moment. (Hint: F = shear resistance moment / overturning moment = $c_u R^2 \theta$ / Wd) [**5 marks**]

Point	x (m)	y (m)	Angle to vertical (°)
O	4.46	16.40	-
1	0	0	-15.2
2	4.18	-0.60	-1.0
3	8.36	-0.14	13.2
4	12.54	1.44	28.3
5	16.72	4.60	46.1
6	20.90	12.00	75.0



Not to scale

2) In a consolidated undrained test on a saturated soil specimen the following procedure was adopted:

   i. Consolidate under a cell pressure of 200 kPa
   ii. Consolidate under a deviator stress of 100 kPa
   iii. Sample drain closed and cell pressure raised to 400 kPa
   iv. Sample loaded to failure

   If $A = 0.15$, B=1, $c' = 0$ and $\phi' = 20°$, calculate the compression strength. [**15 marks**]

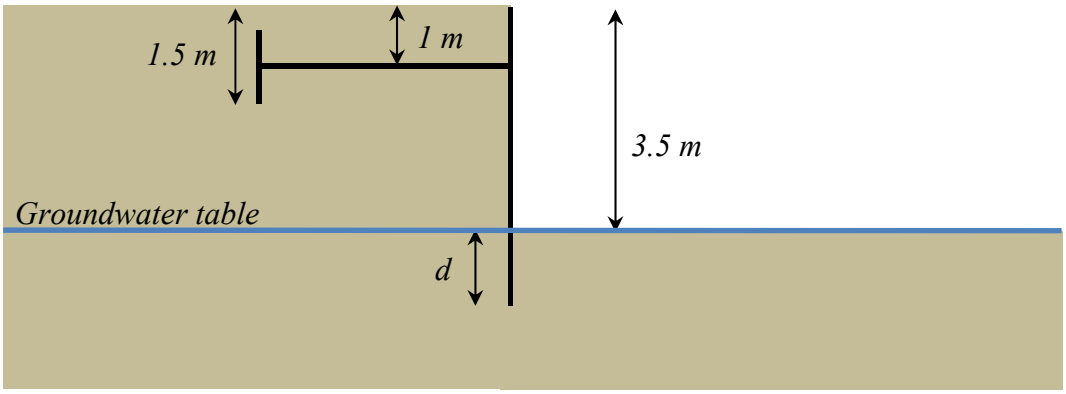
3) A sheet pile wall is designed for an excavation as shown in the figure below. The properties of the soil are: γ = 20 kN/m^3, ϕ = 30°, cohesion is c = 0 kPa. Assume that the groundwater table is at the level of the excavation ground surface throughout.

   a. Sketch the forces and location of the action on the pile. [**7 marks**]

   b. Calculate the minimum embedded depth of the pile against failure due to rotation. [**13 marks**]

   c. Calculate the force in the tension anchor. [**5 marks**]

   d. Calculate the minimum length of the tension anchor. The tension anchor end plate can act only over the first 1.5m of soil. [**5 marks**]



4) Three direct shear tests were performed on samples of a silty sand. The results obtained at failure are shown in the table below.

Test No.	Normal force, N	Shear force, N
1	400	287
2	780	508
3	1100	694

The area of the sample is 3600 mm^2.

a. Estimate the effective strength parameters c' and φ'. [**10 marks**]

b. For Test No. 2:

i. Draw the Mohr's circle at failure and the Coulomb failure line. [**5 marks**]

ii. Determine the magnitude and orientation of the principle effective stresses at failure. [**8 marks**]

iii. Determine the magnitude of the maximum shear stress and the orientation of the plane on which it acts. [**7 marks**]

[END OF EXAM]