DELFT UNIVERSITY OF TECHNOLOGY

Faculty of Civil Engineering and Geosciences

Soil Mechanics II

CT2091

BSc EXAMINATION 2012

MOCK EXAM I

DATE: 2012 TIME: 3 hours

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

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

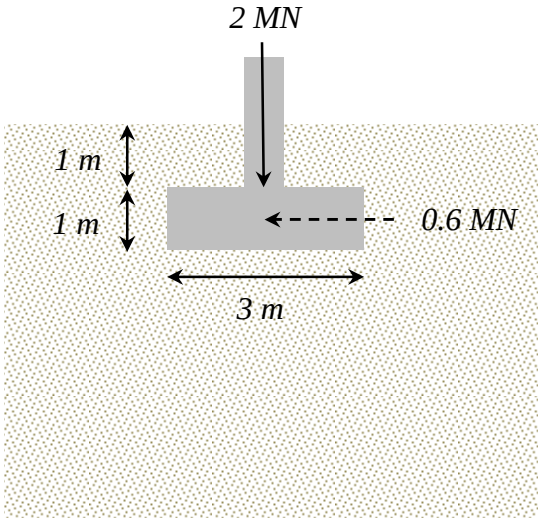
Clearly identify the answer in the answer box

1) A reinforced concrete raft foundation has plan dimensions 3m by 5m and is 1m thick (γ_{conc} = 25kN/m^3). The foundation is to support a central column and the formation level for the foundation is 2m below ground level. The foundation soil consists of a firm lightly over-consolidated clay to a considerable depth, with the following properties: γ = 20.5kN/m^3, c' = 5 kPa and ϕ' =25°. The groundwater table is 1m below ground level, the soil is saturated throughout and the excavation is backfilled above the foundation to the original ground level. For the following load cases calculate the Factor of Safety against bearing failure:

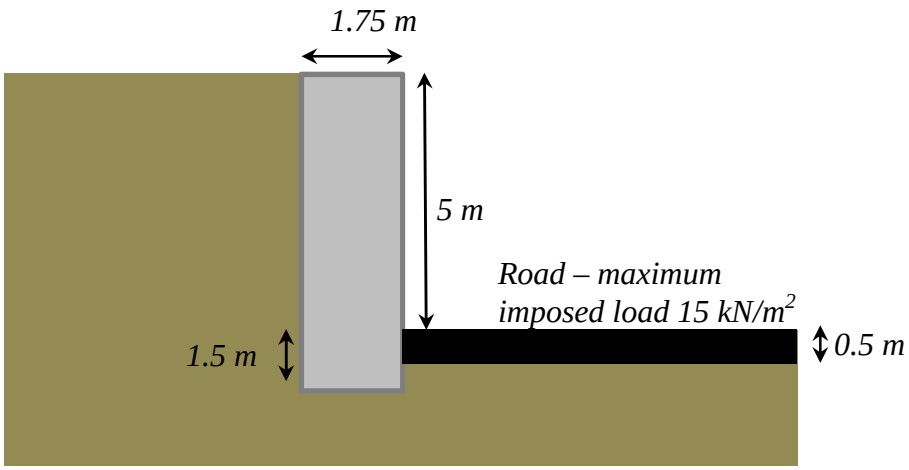
   a. Calculate the coefficients, N_c, N_q and N_γ. [**5 marks**]

   b. A central vertical load of 2 MN applied at foundation level. [**12 marks**]

   c. A vertical load of 2 MN and a horizontal load of 0.6MN along the major axis, i.e. towards a 5m side. Once again, the load is applied via ground level. [**8 marks**]



2) A concrete retaining wall is to be built to retain the soil for a new road. The wall is depicted below. The height of the wall is 5m relative to the road surface and the wall is designed to be embedded 1m into soil relative to the road surface. The road construction is 0.5m thick and the maximum load imposed on the road is 15 kN/m^2.



Assume that the wall is perfectly vertical for the calculation of lateral forces. The volumetric weight of the concrete is 25 kN/m^3, for the soil it is 18.5 kN/m^3 and for the road construction material it is 20 kN/m^3 and the water table is 5m below the base of the wall. The angle of friction of the soil is ϕ=25°, the cohesion is c= 0 kPa and the frictional resistance between the soil and the concrete is δ=22.5°. Assume the same shear strength properties for the road construction materials to be conservative in design.

a. Determine the forces that will be imposed on the wall in the critical condition for sliding. [**8 marks**]

b. Determine the Factor of Safety against sliding. [**7 marks**]

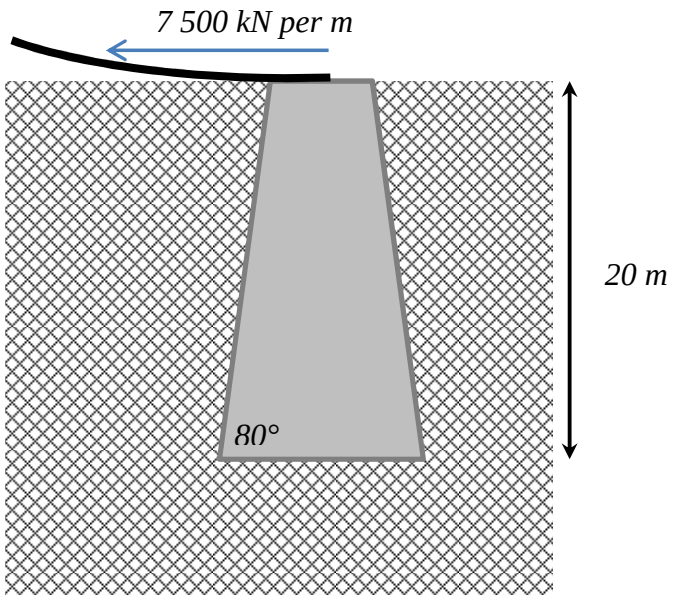
c. A blocked drain during a heavy rainfall means that the water table is at ground level at both sides of the wall. Calculate the new Factor of Safety. [**10 marks**]

3) A ground anchor for a suspension bridge is constructed as shown below. It is designed to resist a lateral force of 7 500 kN per metre. The water table is found to be at the ground surface and the soil properties have been determined via laboratory tests to be in the ranges of: γ = 19 to 21 kN/m^3, ϕ = 30 to 32°, cohesion is c = 0 to 5 kPa. The concrete is: γ = 25 kN/m^3 and the friction angle between the soil and the concrete, δ, is assumed to be between ϕ and 2/3 ϕ.

a. Sketch the forces on the ground anchor including the appropriate material properties to ensure a conservative design. [**7 marks**]

b. Calculate the lateral forces on the ground anchor. [**15 marks**]

c. Determine the volume of concrete required in the ground anchor to give a Factor of Safety of 2. [**8 marks**]



4) A sand has been consolidated in a triaxial cell under a cell pressure of 100 kPa. The drain was then closed and the cell pressure raised, in four equal stages of 100 kPa, to a cell pressure of 500 kPa. At the end of each stage the pore pressure was recorded as follows:

Cell pressure, kPa	Pore water pressure, kPa
100	0
200	82
300	177
400	277
500	377

a. Calculate the pore pressure parameter *B* for each of the four stages. [**6 marks**]

Next the drain was opened and the specimen was allowed to consolidate under the cell pressure of 500 kPa. The following test procedure was then adopted:

i. Consolidation under a deviator stress of 150 kPa
ii. Sample drain closed and cell pressure raised to 700 kPa, with the deviator stress remaining constant.
iii. Sample loaded to failure.

b. If $A = -0.2$, $c' = 0$ *kPa* and $\phi' = 35°$, calculate the compression strength. [**14 marks**]

[END OF EXAM]