DELFT UNIVERSITY OF TECHNOLOGY

Faculty of Civil Engineering and Geosciences

Soil Mechanics I – MOCK EXAM II

CT1091

BSc EXAMINATION 2012

FOURTH PERIOD

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) At a site identified for the construction of a wide dike, from a borehole in the ground the soil is found to have the properties shown in the table below. Water is encountered at in the soil at -2 m NAP and in the borehole at -2.75 m NAP. The dike is planned to be 5 m in height and to be constructed of a sand with a dry volumetric weight of 17.5 kN/m^3.

    a. Calculate and draw based on the above information, the evolution of total stresses, effective stresses and pore water pressures in the different layers. [**10 marks**]
    b. What will be the immediate pore pressure rise in the clay layer after construction of the dike, assuming that the construction time is short? [**2 marks**]
    c. What are the total and effective stresses at the center of the 'silty clay' and 'clay' layers, both prior to construction and after construction when any excess pore pressures have dissipated? [**7 marks**]
    d. Calculate the total settlement due to the construction of the dike. [**6 marks**]
    e. A series of water extraction wells are to be installed in the coarse sand layer. It is assumed that this layer is 10 m thick and has been found to have a permeability of 5.9×10^{-6} m/s. If they are to be installed at 500 m spacing and have a 250 mm diameter, then what is the maximum pumping rate allowed so that the layer does not desaturate? [**5 marks**]
    [Hint: the pore pressure at the top of the coarse sand layer is 132.5 kPa]

Top level (m, NAP)	Base level (m, NAP)	Soil Type	Saturated volumetric weight (kN/m^3)	Dry volumetric weight (kN/m^3)	C_p
-1	-3.5	Loamy sand	20	16	0
-3.5	-7	Silty clay	16	14.5	8
-7	-16	Clay	17	15	14
-16	end	Coarse sand	20	18	0

2) A large oil tank, of 50 m diameter, is to be constructed on a saturated clay layer of 28 m thickness, underlain by a sand layer. The soil from various depths has been tested for compressibility in a laboratory with the results in the table below.

The clay has been found to have a permeability of 7.8×10^{-9} m/s. The oil tank is designed to hold 20 m depth of oil at density of 1300 kg/m^3.

Depth, m	Compressibility coefficient, m_v (kPa^{-1})
1	0.0001
4	8.0×10^{-5}
10	3.0×10^{-5}
21	2.0×10^{-6}

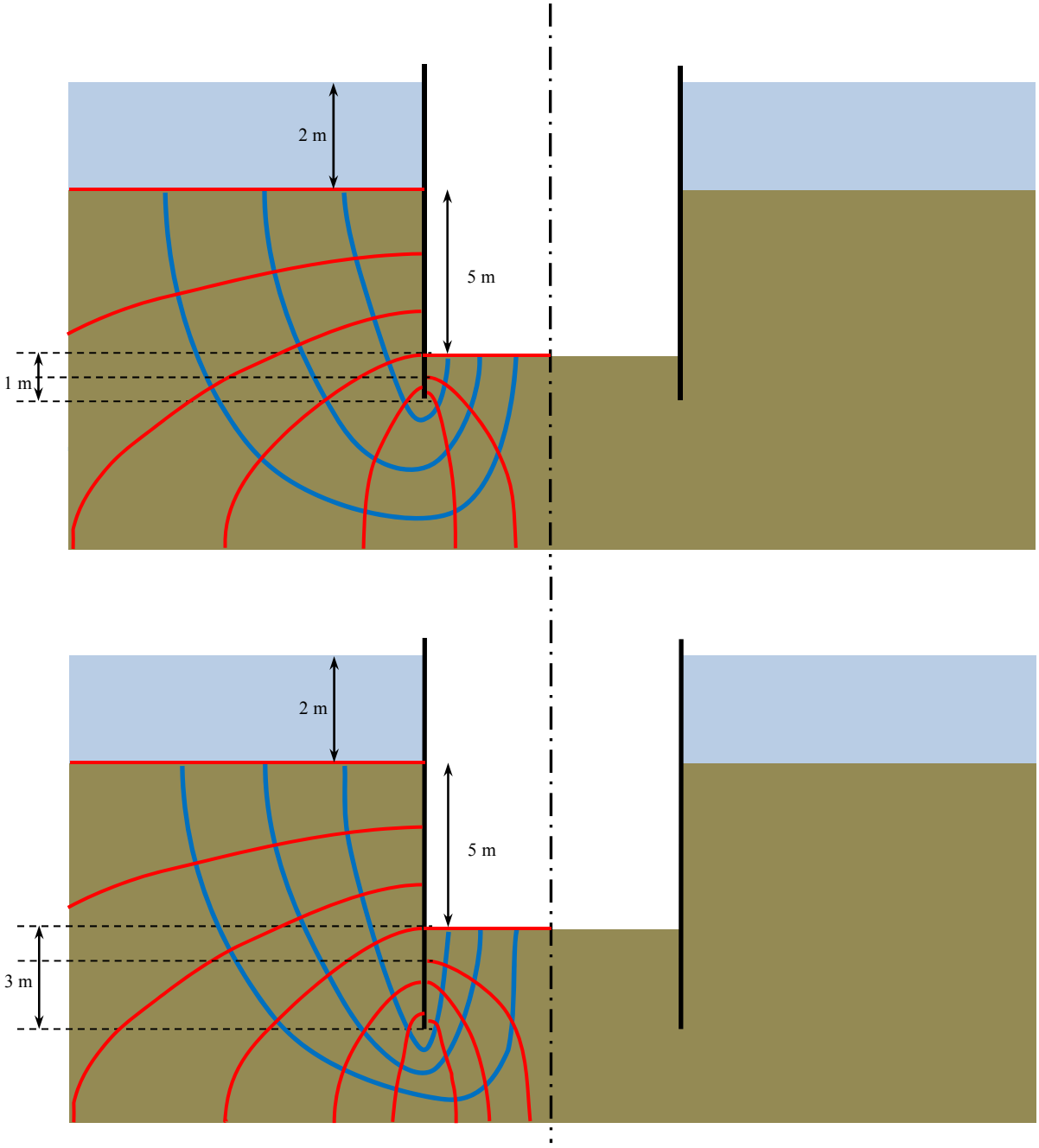
a. By dividing the soil into 4 convenient layers, determine the maximum vertical deformation due to the oil tank. [**8 marks**]
b. Assuming that the m_v value for 10 m depth is representative for the entire soil layer, calculate the consolidation coefficient. [**5 marks**]
c. At approximately which time will the consolidation be complete? [**5 marks**]
d. Another location is considered for the location of the tank, where the permeability is $3.9\text{x}10^{-9}$ m/s and the thickness of the clay layer is 14 m. Once again, the clay layer is underlain by a sand layer. If the m_v value from the table above for 10 m depth is representative for both sites, demonstrate in which location consolidation be complete first. [**7 marks**]
e. If the initial site is instead found to be underlain by an impermeable rock, prove that the consolidation process will take 4 times as long as previously calculated. [**5 marks**]

3) A excavation with sheet pile walls is being made in an estuary for a bridge pier, in a relatively permeable soil as shown below ($k=2.9\times10^{-5}$ m/s, $\gamma=19$ kN/m^3). Two options for the depth of the sheet pile walls are considered, with the flow nets drawn over half the domain.

   a. How many stream lines and potential lines are there in each option. [**3 marks**]

   b. Calculate the flow into the excavation for both options. [**12 marks**]

   c. Is either of the options at risk of liquefaction? [**10 marks**]



4) A soil is sampled by use of a sampling tube measuring 225 mm in length and 50 mm in diameter. The sample was weighed and its mass was found to be 721g. After drying in an oven at 105°C for 12 hours the soil was again weighed and found to have a mass of 612g. The dry soil was then put into a beaker of water and the water displaced was weighed and found to have a mass of 197g.

   a. What is the soil porosity? [**3 marks**]
   b. Determine the saturated and dry volumetric weights. [**4 marks**]
   c. What was the initial soil saturation? [**3 marks**]
   d. What is the density of the solid particles in the sample? [**3 marks**]
   e. What is the void ratio of the sample? [**2 marks**]

[END OF EXAM]