SPECIAL EXAMINATION
SEMESTER I, SESSION 2014/2015

COURSE CODE	:	SKAA 2722
COURSE	:	GEOTECHNIC 1
PROGRAMME	:	SKAW
DURATION	:	2 HOURS 30 MINUTES
DATE	:	FEBRUARY, 2015

INSTRUCTION TO CANDIDATES :

1. ANSWER ALL QUESTIONS.

WARNING!

Students caught copying/cheating during the examination will be liable for disciplinary actions and the faculty may recommend the student to be expelled from the study.

This examination question consists of (10) printed pages only.

Q1. (a) Please explain the differences between the Rankine and Coulomb theory on lateral stresses acting in soil on the retaining wall. You may use a diagram to explain your answer.

(5 marks)

(b) Figure Q1(b) shows a plan view of a rectangular footing of 5 m x 4 m with a 2 x 2 m square void (through its entire thickness – white area in the footing). The void center is located at the center of the footing. It was found that increment stress, $\Delta\sigma$ at 5 m below the center of the footing, x is 100 kPa,

(i) Determine the uniform stress applied on the footing.

(ii) Determine increment stress, $\Delta\sigma$ at the point A located at right corner of footing at a depth of 5 m below the ground surface based on the applied stress determined in Q1b(i) by using Fadum's Method.

(14 marks)

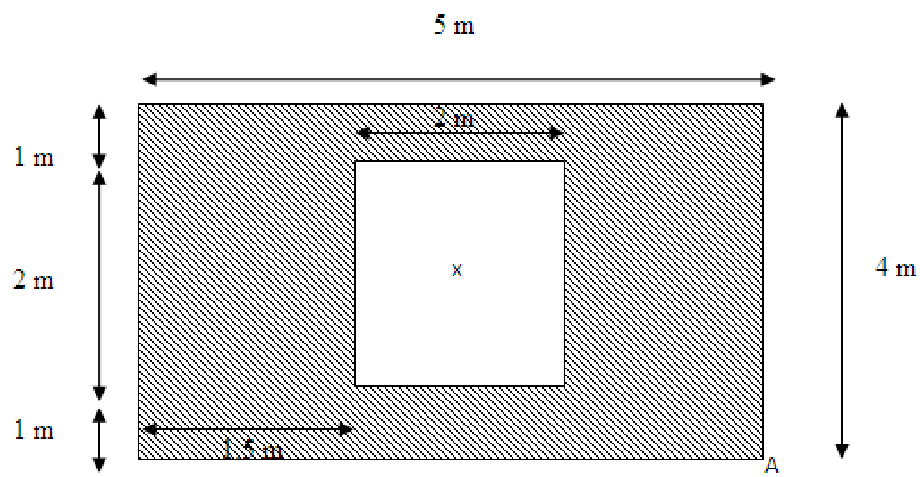
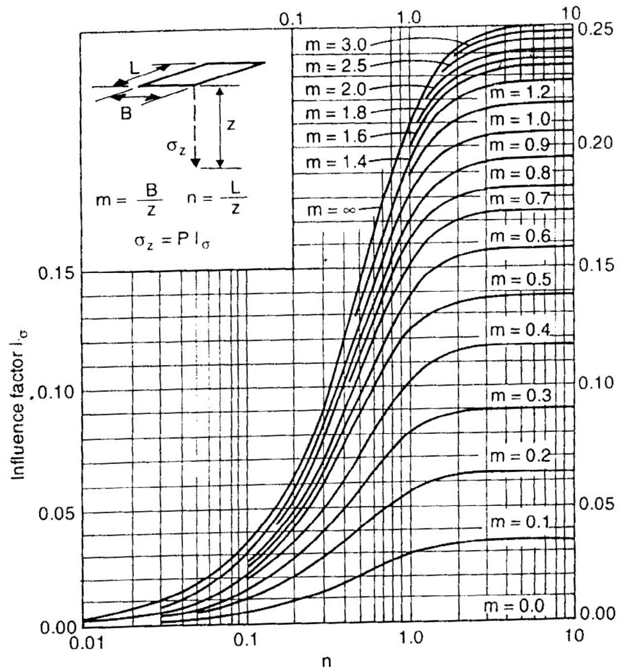


FIGURE Q1(b)



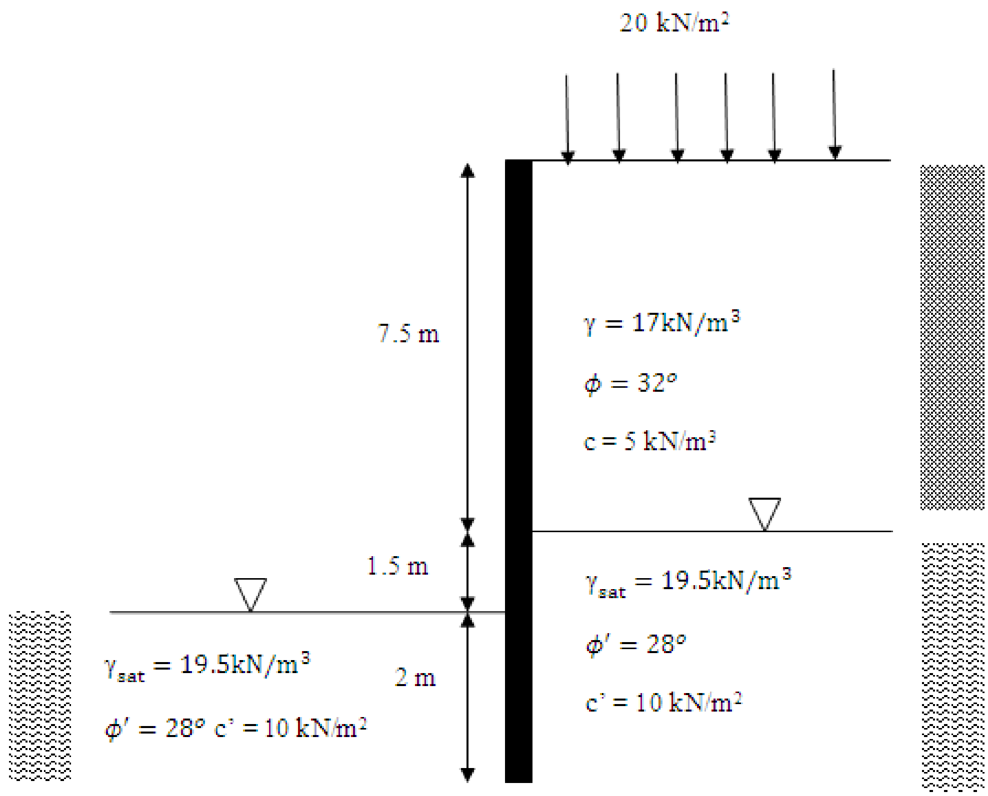
Fadum Chart

(c) Consider a proposed retaining wall as shown in Figure Q1(c) and solve the followings using Rankine's theory.

(i) Draw the distribution of active and passive pressure and calculate the total thrust behind the wall as well as the location of line of action.

(ii) If a stabilization method is required (rigid anchor sheet pile), could you suggest the best location to construct the anchor system and determine the load to be carried by each anchor if the horizontal spacing between the anchor is 2 m.

(15 marks)



20 kN/m²
7.5 m
γ = 17kN/m³
ϕ = 32°
c = 5 kN/m³
1.5 m
γsat = 19.5kN/m³
ϕ′ = 28°
c' = 10 kN/m²
2 m
γsat = 19.5kN/m³
ϕ′ = 28° c' = 10 kN/m²

FIGURE Q1(c)

Q2. (a) Explain briefly the difference(s) between compaction and consolidation. State the definitions for preconsolidation pressure, normally consolidated soil and overconsolidated soil.

(4 marks)

(b) A sample of ***normally consolidated*** clay was obtained from the midheight of a compressible clay layer in a soil profile as shown in Figure Q1b. The initial void ratio in situ, e_o is given = 1.60. A consolidation test was conducted on a portion of this sample and the pressure-void ratio relations are as follows:

p' **(kN/m^2)**	**Void ratio, *e***
80	1.50
160	1.42
320	1.30
640	1.12
1280	1.08

A footing is to be located 1.5 m below ground level, as shown in Figure Q1b. The base of the square footing is 5 m by 5 m and a total load exerted on the footing is 3500 kN.

i. Plot the e-log p curve. Find the compression index, C_c for the clay sample.

(5 marks)

ii. Determine the coefficient of volume compressibility, m_v for an effective stress range of 200 kN/m^2 to 400 kN/m^2.

(4 marks)

iii. Determine the average effective stress changes, $\Delta\sigma$ at the midheight of the clay layer under the center of the footing. Use Simple Method (1:2 load distribution) to calculate $\Delta\sigma$ in the soil profile. Repeat the calculation of $\Delta\sigma$ in the soil profile using Fadum Method. Briefly discuss the results of the two methods.

(8 marks)

iv. Compute the total expected primary consolidation settlement, S_c for the clay layer due to the load exerted by the footing as calculated by Fadum Method.

(5 marks)

v. Calculate the time it will take for the half of the expected consolidation settlement in part (iv) to take place if given the coefficient of consolidation, c_v = 0.0212 cm^2/min.

(4 marks)

vi. Determine the time it will take for 90% of the expected consolidation settlement in part (iv) to take place if the clay layer is now underlain by impermeable bedrock.

(3 marks)

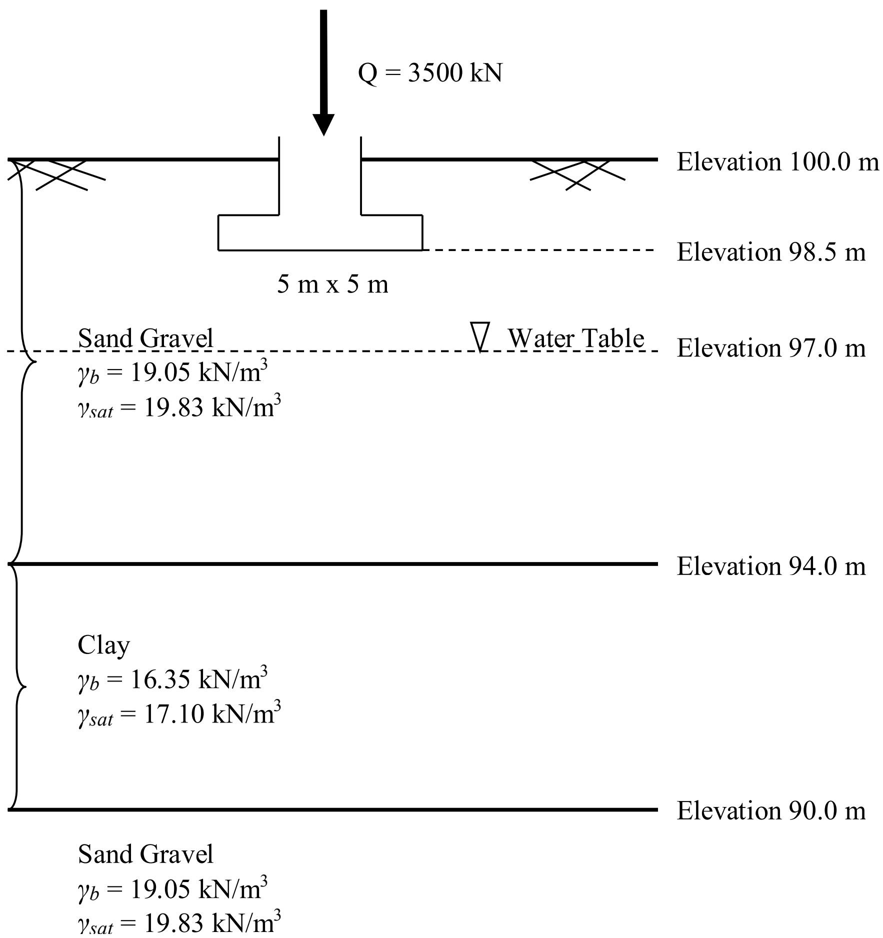


FIGURE Q2b

Q3. (a) A contractor attempts to use side slopes of 1:2 for a temporary excavation in a very soft clay. Excavation is carried out rapidly. As a consultant, you can either use short term method or long term method for slope stability analysis. What is the most suitable slope stability analysis method for this situation? State your reasons.

(5 marks)

(b) A canal is planned on a soil with shear strength parameters, c' = 18 kN/m^2 and ϕ' = 28^0. If the slope of the cut is 45^0, what is the height of the cut, if the slope in critical condition.

(6 marks)

(c) Figure Q3c shows a cutting in saturated clay is inclined at a slope of 1 vertical: 2 horizontal and has a vertical height of 10 m. The saturated unit weight, γ_{sat} of the soil is 19 kN/m^3 and its undrained cohesion, c_u is 30 kN/m^2. A failure plane is assumed with a radius of 22.83m. The weight of the moving mass is 3150 kN. Determine the factors of safety against shear failure along the slip circle as shown in Figure Q3(c) by using Moment Method for the conditions of:

(i) tension crack without water

(8 marks)

(ii) tension crack with half-full of water.

(8 marks)

(d) If you find that the slope with angle of 80^0 and has a vertical height of 20m is unsafe, then you need to plan a slope stabilization. Without altering slope geometries, what is the most suitable slope stabilization method for this situation.

(6 marks)

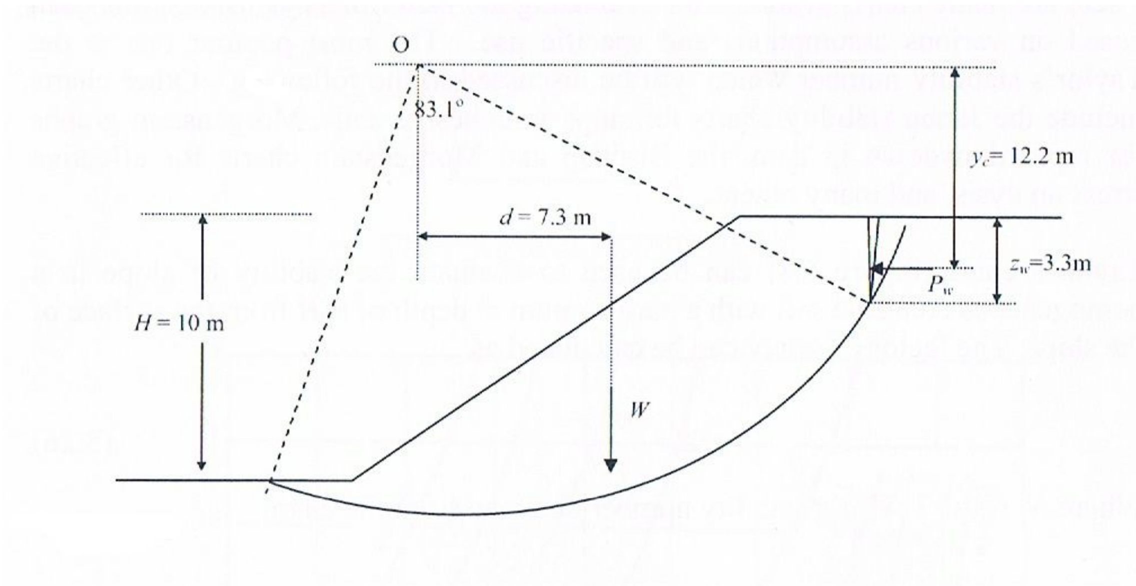


FIGURE Q3(c)

EQUATIONS

$$\Delta\sigma_z = \frac{2qz^3}{\pi(r^2 + z^2)^2}$$

$$K_a = \frac{1 - \sin\phi}{1 + \sin\phi}$$

$$\Delta H = \frac{C_c}{1 + e_0}\log(\sigma_1'/\sigma_0')H_0$$

$$\Delta H = \frac{C_r}{1 + e_0}\log(\sigma_1'/\sigma_0')H_0$$

$$\Delta H = \frac{C_r}{1 + e_0}\log(\sigma_c'/\sigma_0')H_0 + \frac{C_c}{1 + e_0}\log(\sigma_1'/\sigma_c')H_0$$

$$F_s = \frac{c\ell R^2}{Wx} = \frac{c R^2\theta}{Wd + P_w y_c}$$

$$F_s = \frac{\sum cl + \sum (W\cos\alpha)\tan\phi}{\sum W\sin\alpha}$$

$$F = \frac{1}{\sum W\sin\alpha}\sum\left[\left[c'b + W(1 - ru)\tan\phi'\right]\frac{\sec\alpha}{1 + \frac{\tan\phi\tan\alpha}{F}}\right]$$