UTM Faculty of Civil Engineering
UNIVERSITI TEKNOLOGI MALAYSIA

FINAL EXAMINATION
SEMESTER 1, SESSION 2014/2015

COURSE CODE	:	SKAA 2722
COURSE	:	GEOTECHNIC 1
PROGRAMME	:	SKAW
DURATION	:	2 HOURS 30 MINUTES
DATE	:	JANUARY, 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 type of lateral stress acting in soil on the retaining wall. You may use a diagram to explain your answer.

(6 marks)

(b) Figure Q1(b) shows a plan view of rectangular footing. If the uniform contact pressure under the footing is 50 kPa

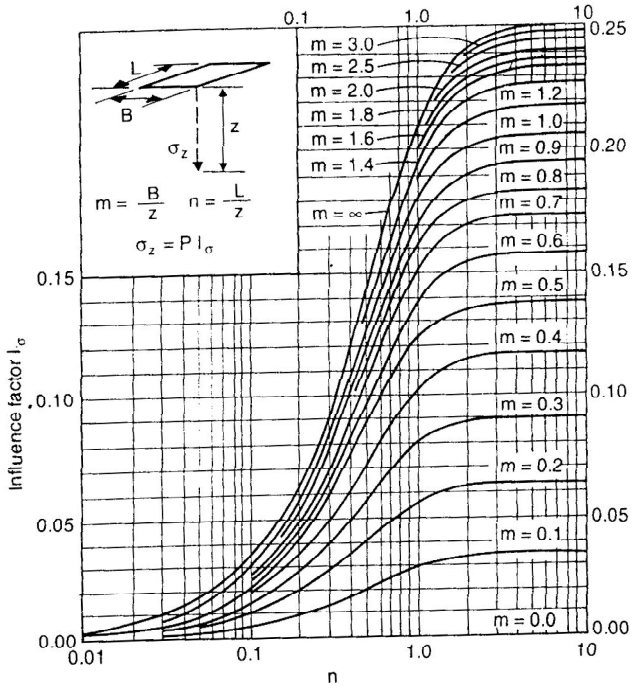
(i) Determine the increment of stress, $\Delta\sigma$ at the depth of 4 m below point A using Fadum's Method.

(5 marks)

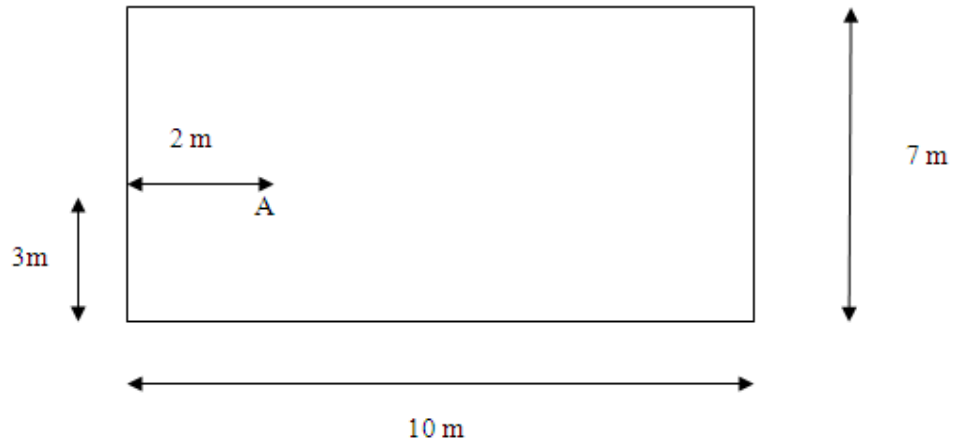
(ii) Calculate the total new effective stress at the depth of 4 m below point A due to increment of stress, $\Delta\sigma$ determined in Q1b(i).

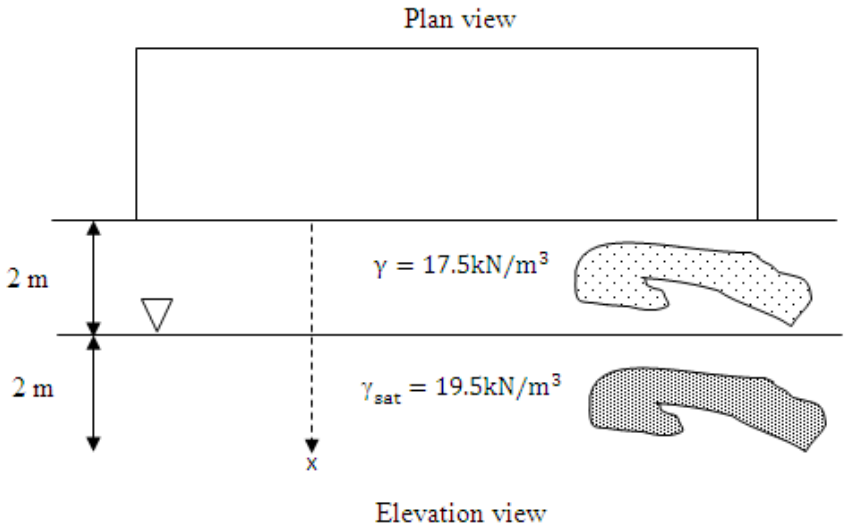
(5 marks)

Assume the excess pore water pressure dissipates relatively fast upon application of load. Use the given Fadum Chart to solve the problem.



Fadum Chart





FIQURE Q1(b)
(Figure is not scale)

(c) For a proposed rigid anchored sheet pile wall as shown in Figure Q1(c), determine the load T to be carried by each anchor if the horizontal spacing between anchors is 1 m. The materials behind the wall are sand underlain by clayey sand. There is a uniformly distributed load, q = 20 kN/m^2 on the backfill.

(18 marks)

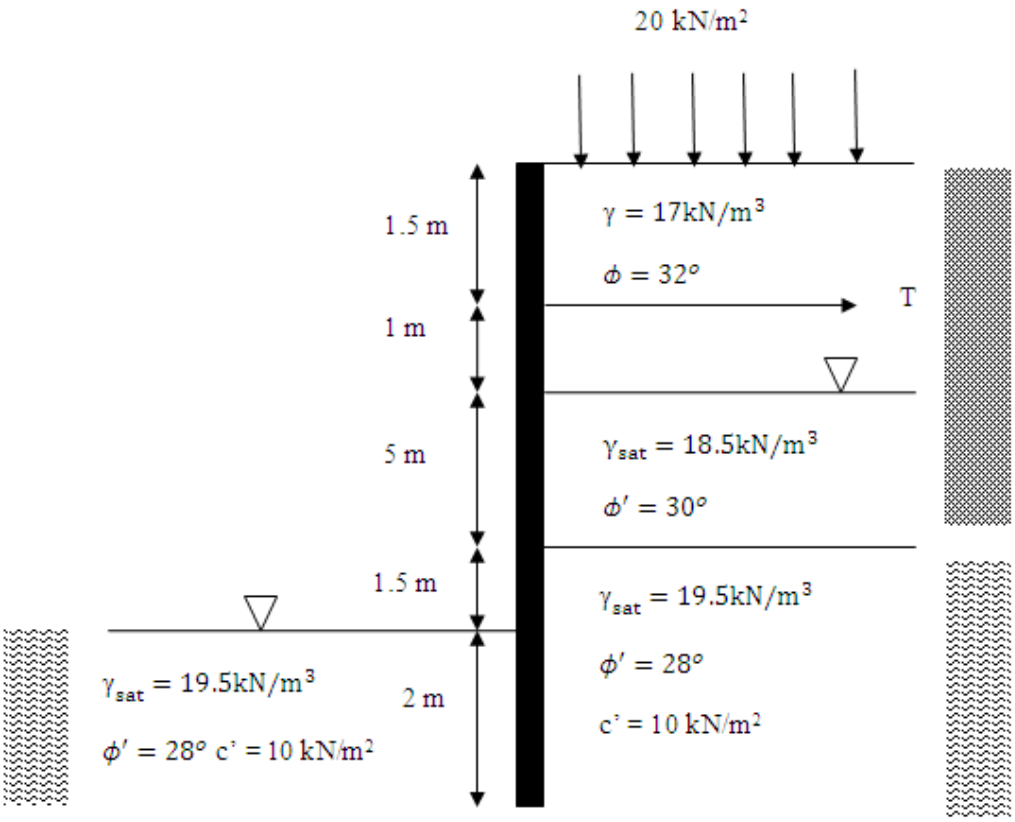

20 kN/m²
1.5 m
1 m
5 m
1.5 m
2 m
γ = 17kN/m³
ϕ = 32°
T
γsat = 18.5kN/m³
ϕ′ = 30°
γsat = 19.5kN/m³
ϕ′ = 28°
c' = 10 kN/m²
γsat = 19.5kN/m³
ϕ′ = 28° c' = 10 kN/m²

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 clay sample was obtained from the midheight of a compressible clay layer in a soil profile as shown in Figure Q2b. The initial void ratio in situ, e_o is given = 1.65. 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	1.12

A footing is to be located 1.5 m below ground level, as shown in Figure Q1b. The base of the square footing is 4.0 m by 5.0 m and a total load exerted on the footing is 2000 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 using 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)

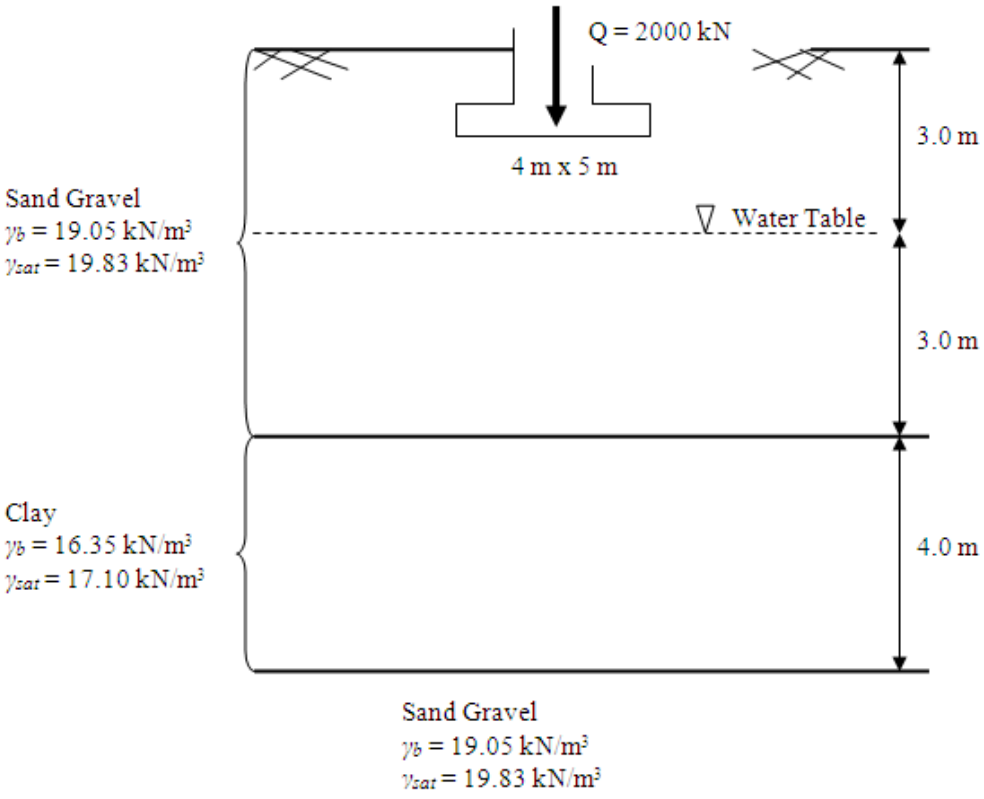
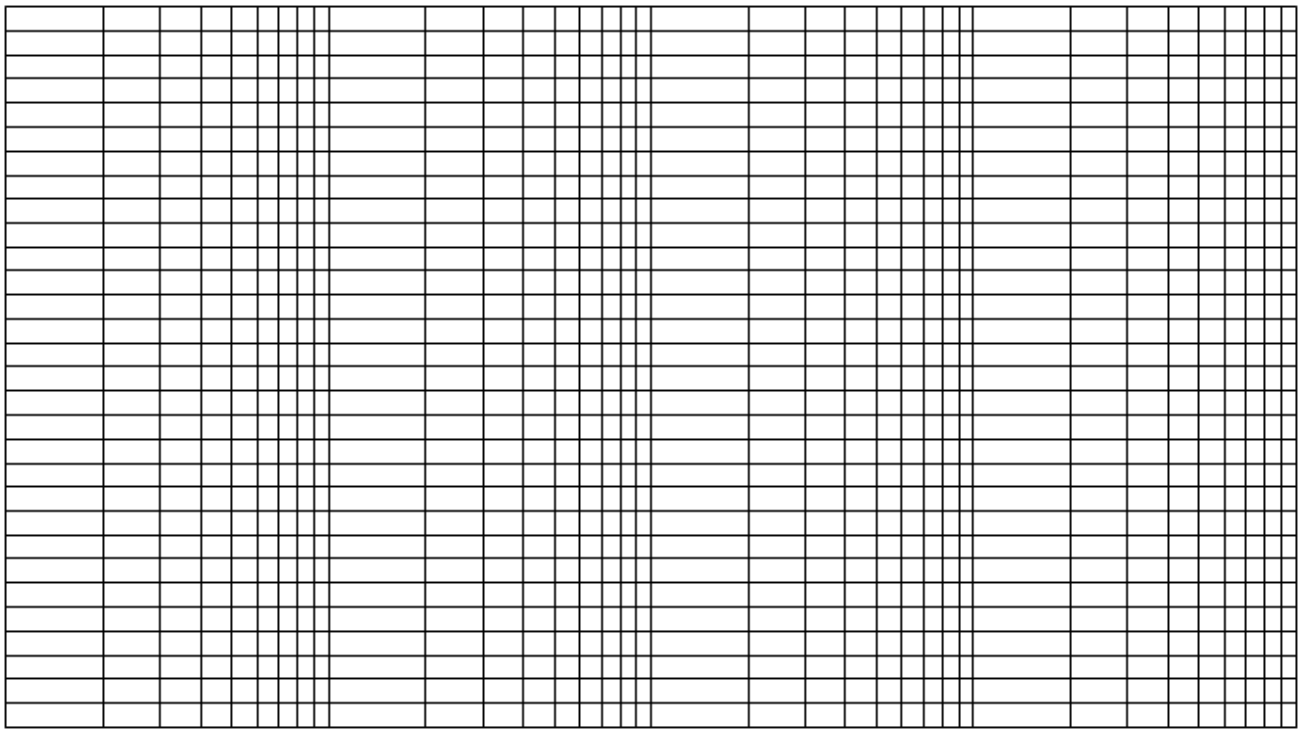


FIGURE Q2b



Q3. (a) An infinite slope is inclined at 30^o. A plane of failure has developed at depth of 10 m from the surface. Given $\gamma = 18$ kN/m^3, $c' = 15$ kN/m^2 and $\phi' = 25^o$. Calculate factor of safety, if water table exists at the surface and given $\gamma_{sat} = 20$ kN/m^3.

(8 marks)

(b) Figure Q3(b) shows a cutting in saturated clay is inclined at a slope of 1 vertical:1.5 horizontal and has a vertical height of 10 m. The saturated unit weight, γ_{sat} of the soil is 20 kN/m^3 and its undrained cohesion, c_u is 25 kN/m^2. The area of slip mass is 71.64 m^2 and θ is 67.4^0. Determine the factors of safety against shear failure along the slip circle shown in Figure Q3(b) by using Moment Method for the conditions of :

(i) tension crack with full of water

(10 marks)

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

(10 marks)

(c) It is said that the Fellenius Method gives a conservative factor of safety in comparison to results of stability analysis by Bishop Method. State the reasons for the above statement.

(5 marks)

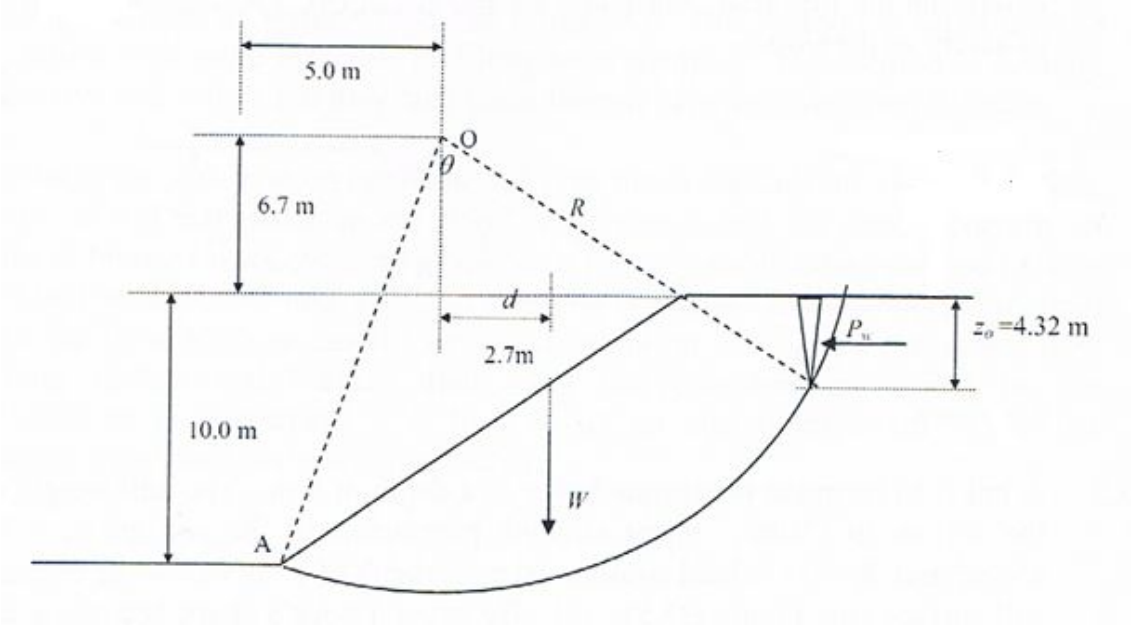


FIGURE Q3(b)

EQUATIONS

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

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

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

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

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

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

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

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

$\sigma = \{(1\text{-}m)\gamma + m\gamma_{sat}\}\ z\cos^2\beta$

$\tau_m = \{(1\text{-}m)\gamma + m\gamma_{sat}\}\ z\sin\beta\cos\beta$

$u = mz\gamma_{sat}\cos^2\beta$