TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2406: FOUNDATION ENGINEERING I

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2HOURS

DATE: 13May2016

INSTRUCTIONS TO THE CANDIDATE:

1. You should have the following for this examination:
   - **Answer booklet.**
   - **Mathematical Table/Pocket Calculator.**
2. This paper consists of **FOUR** questions.
3. Answer question **ONE (Compulsory)** and any other **TWO** questions.
4. This paper consists of **SIX** printed pages.
5. **Do not write on the question paper.**

Question One

a) The active lateral earth pressure, at the bottom of a smooth vertical back of a retaining wall, exerted by a "c – φ"- soil, with a horizontal top surface, is given by the expression

$$p_a = \gamma z K_a - 2c\sqrt{K_a} \qquad (1.1)$$

From basic principles, derive this expression.

(12 Marks)

b) Details of a retaining wall are given in Figure 1.1.

(i) Plot the active lateral pressure distribution on the back of the wall.

(ii) Calculate the total lateral active thrust on the wall back and its position above the base.

Surcharge pressure q = 20 kN/m^2

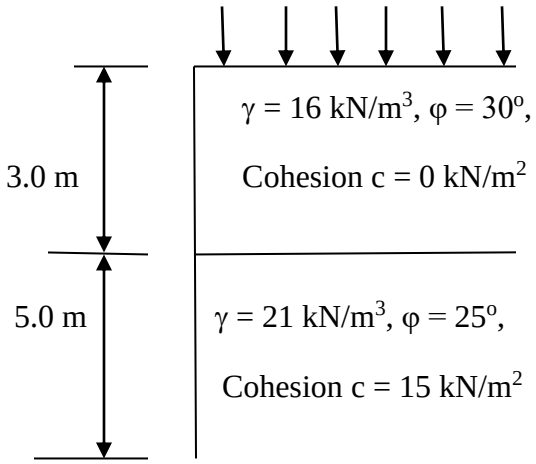


Figure 1.1: Retaining wall vertical dimensions and strength parameters of the retained soils.

(18 Marks)

Question Two

(a) For a circular-slip slope failure in a "c - φ" soil, the factor of safety against sliding is given by the expression

$$F = \frac{cr\Theta + \Sigma N tan\varphi}{\Sigma T} \qquad (2.1)$$

Using a neat sketch, derive the expression from the basic principles.

(8 marks)

(b) Ignoring tension cracks, investigate the stability of the embankment shown in Figure 2.1. Soil properties:

Soil layer 1: $\varphi = 30^o$, c = 7.2 kN/m^2 and γ = 19.3 kN/m^3,
Soil layer 2: $\varphi = 0^o$, c = 32.5 kN/m^2 and γ = 19.3 kN/m^3.

(12 marks)

Question Three

(a) Explain the following terms used in connection with bearing capacity of soils

(i) Ultimate bearing capacity,
(ii) Safe bearing capacity,
(iii) Allowable bearing capacity,

(4.5 marks)

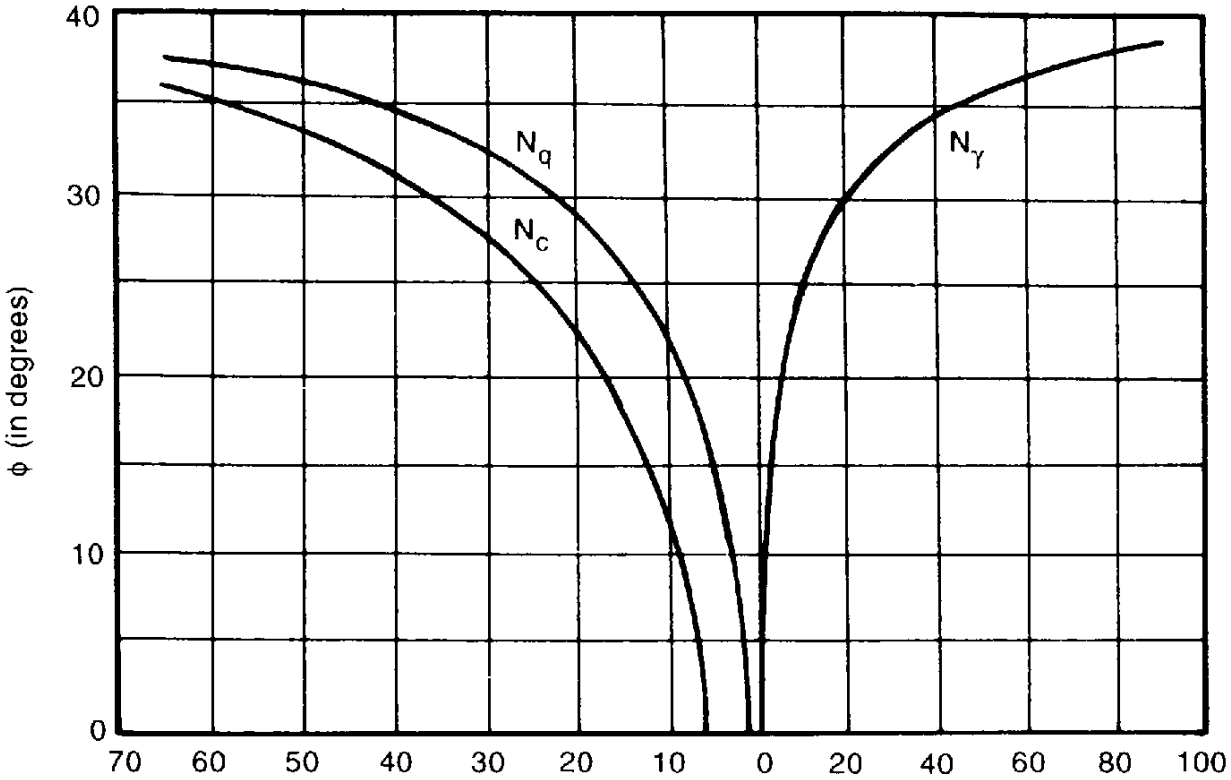
(b) Using earth pressure theory, show that ultimate bearing capacity

$$q_{ult} = \gamma z \left(\frac{1+sin\varphi}{1-sin\varphi}\right)^2 + 2c\sqrt{\left(\frac{1+sin\varphi}{1-sin\varphi}\right)^3} + 2c\sqrt{\left(\frac{1+sin\varphi}{1-sin\varphi}\right)} \qquad (3.1)$$

(10.5 marks)

(c) A strip footing is 2.5 m wide and founded at a depth of 3.0 m in a soil of unit weight 21 kN/m^3, cohesion of 15 kN/m^2 and angle of internal friction φ of 25^o. Using Terzaghi's formula and Figure 3.1, determine the ultimate bearing capacity of the foundation.

(5 marks)



ϕ	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°
N_c	5.7	7.3	9.6	12.9	17.7	25.1	37.2	57.8	95.7	172
N_q	1.0	1.6	2.7	4.4	7.4	12.7	22.5	41.4	81.3	173
N_γ	0.0	0.5	1.2	2.5	5.0	9.7	19.7	42.4	100	298

Figure 3.1: Terzaghi's bearing capacity coefficients

Question Four

(a) State and explain the stages of settlement experienced by a clay soil due to foundation loading.

(6 marks)

(b) Figure 4.1 shows a section of a rigid foundation and supporting strata. Using Figure 4.2, determine the total foundation settlement.

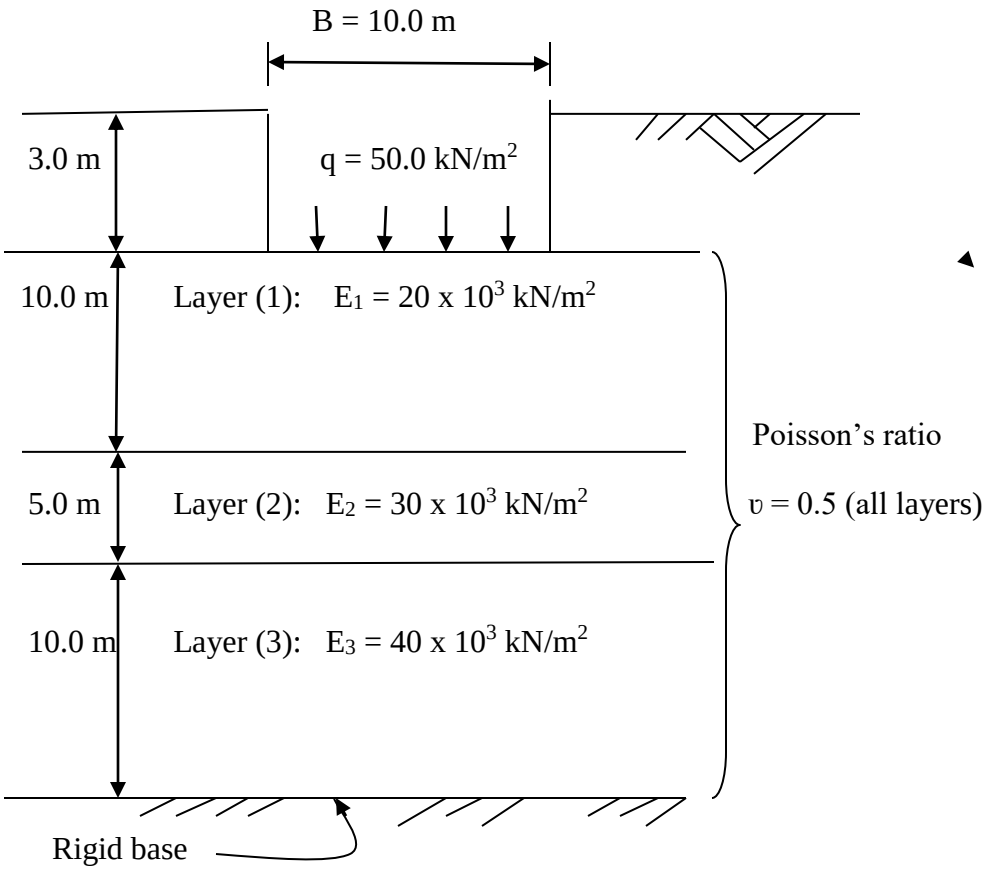


Figure 4.1: Rectangular footing **10 m x 40 m**

(14 marks)

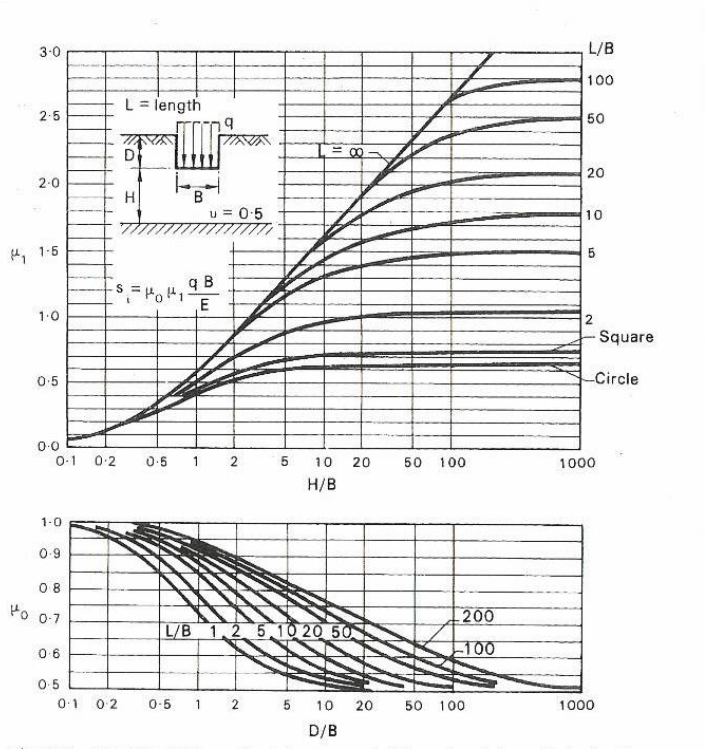


Figure 4.2: Coefficients for vertical displacement [after Bjerum et al (1956)]