

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
UNIVERSITY EXAMINATIONS FOR:
THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL ENGINEERING
(Y4 S1)

ECE 2406: FOUNDATION ENGINEERING I

END OF SEMESTER EXAMINATIONS

SERIES: APRIL/MAY 2016

TIME: 2 HOURS

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.**
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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

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

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.

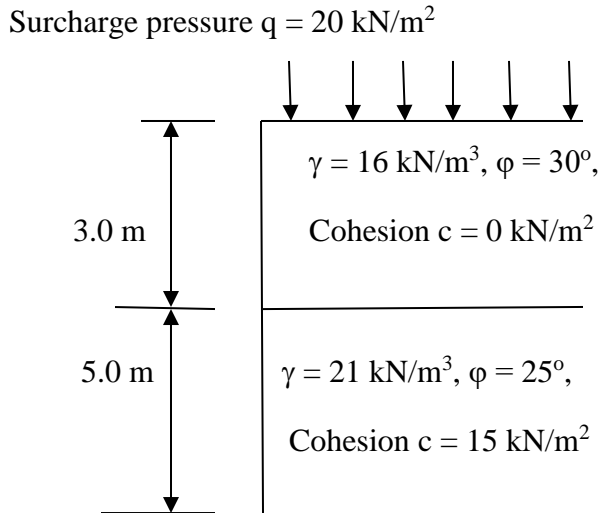


Figure 1.1: Retaining wall vertical dimensions and strength parameters of the retained soils.

(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

$$F = \frac{cr\theta + \sum N \tan \phi}{\sum T} \quad (2.1)$$

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: $\phi = 30^\circ$, $c = 7.2 \text{ kN/m}^2$ and $\gamma = 19.3 \text{ kN/m}^3$,

Soil layer 2: $\phi = 0^\circ$, $c = 32.5 \text{ kN/m}^2$ and $\gamma = 19.3 \text{ kN/m}^3$.

(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

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

(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/m³, cohesion of 15 kN/m² and angle of internal friction ϕ of 25°. Using Terzaghi's formula and Figure 3.1, determine the ultimate bearing capacity of the foundation.

(5 marks)

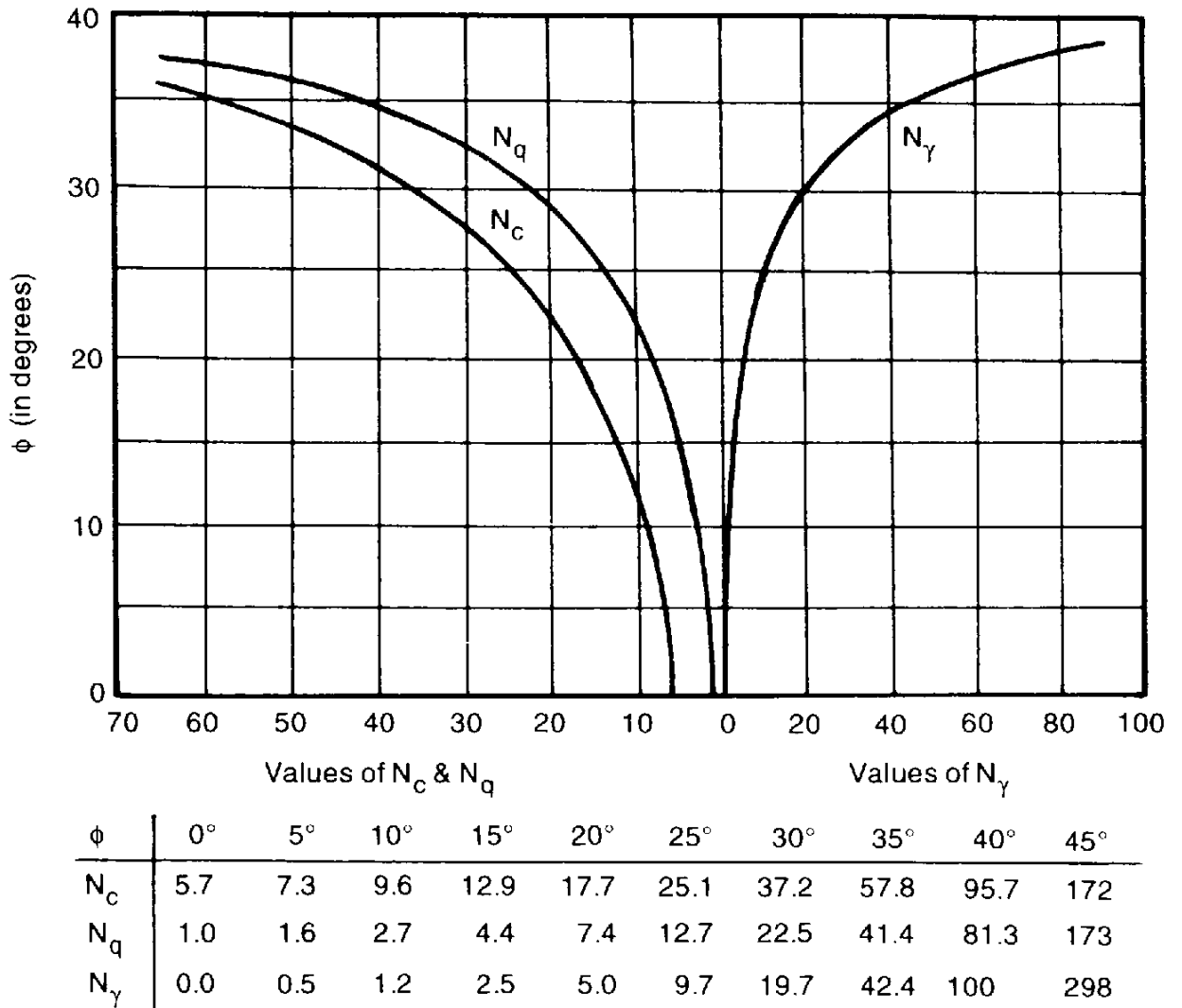


Figure 3.1: Terzaghi's bearing capacity coefficients

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.

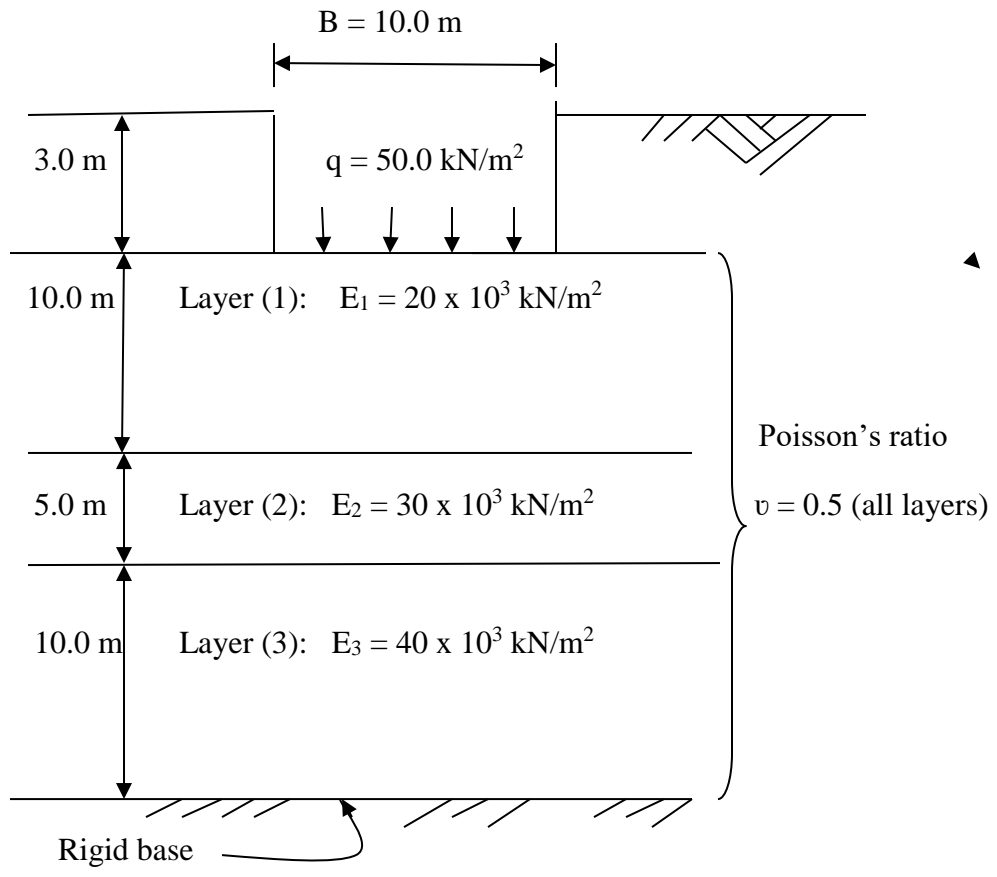


Figure 4.1: Rectangular footing 10 m x 40 m

(14 marks)

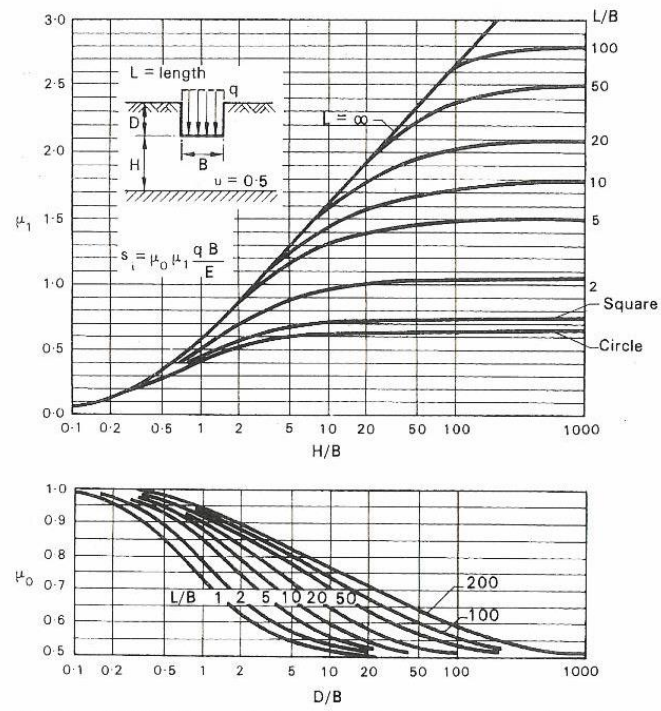


Figure 4.2: Coefficients for vertical displacement [after Bjerum et al (1956)]