TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
Department of BUILDING & Civil engineering
UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
TCV4324: FOUNDATION ENGINEERING

END OF SEMESTER EXAMINATION
SERIES: AUGUST 2024
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 **FIVE** printed pages.
5. **Do not write on the question paper.**

Question ONE: Earth pressures

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

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

From basic principles, derive this expression.

(12 Marks)

b) Details of a retaining wall are given in Figure 1.1. Ignoring tension cracks:

(i) Draw the active lateral earth pressure diagram on the back of the wall,

(ii) Determine the magnitude and location (above the base) of the total active thrust on the back of the wall per metre run of the wall.

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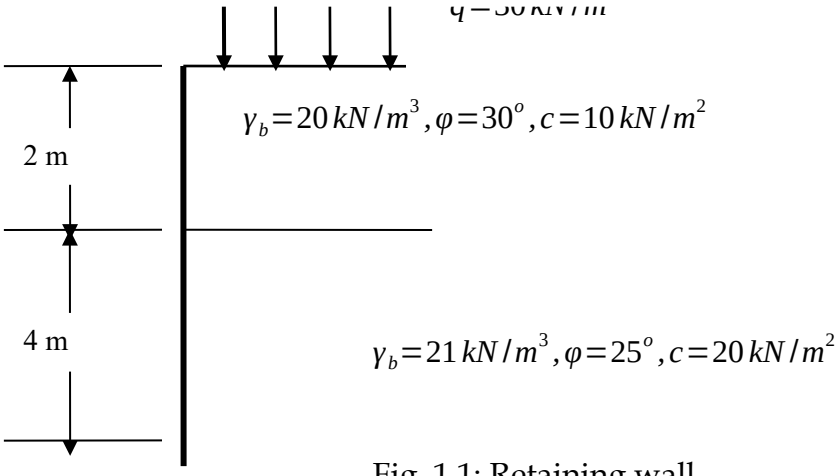

Fig. 1.1: Retaining wall

(18 Marks)

Question Two: Stability of slopes

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

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

Using a neat sketch, derive equation (2.1) from the basic principles.

(8 marks)

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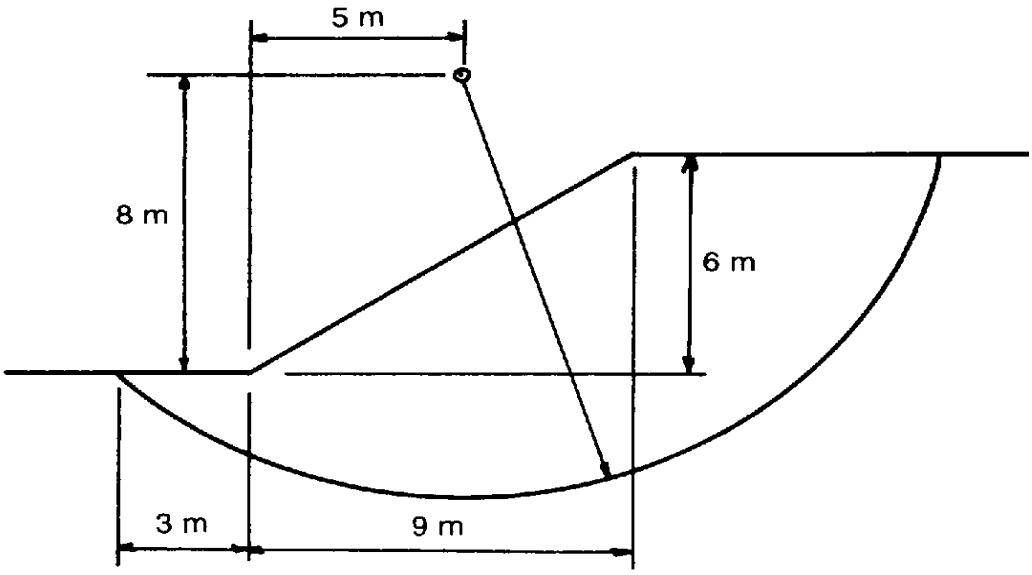

Figure: 2.1

A proposed cutting is to have the dimensions shown Figure 2.1. The soil has the following properties: $\varphi = 20^o, c = 15\,kN/m^2, \gamma = 19\,kN/m^3$. Ignoring tension cracks, determine the factor of safety against slipping for the slip circle shown.

Hint: Calculations layout:

Slice No	Area (m^2)	Weight W (kN)	Normal component N (kN)	Tangential component T (kN)
1				
2				
n				
		Totals		

(12 marks)

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Question Three

(a) Explain the following soil bearing capacity terms:

(i) Ultimate bearing capacity,

(ii) Maximum safe bearing capacity,

(iii) Allowable bearing capacity.

(4.5 marks)

(b) From first principles, derive an equation for the determination of bearing capacity of purely cohesive soils, based on slip circle analogy.

Hint:

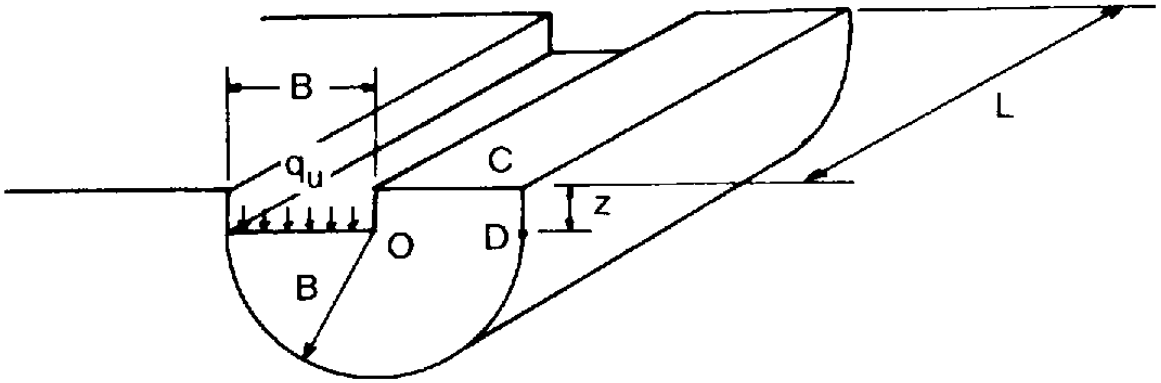

Fig. 3.1: Slip circle failure mechanism

(10 marks)

(c)A strip footing is 0.6 m wide and founded at a depth of 1.5 m in a soil of unit weight 20.0 kN/m^3, cohesion 10 kN/m^2 and angle of internal friction of 30^o. Using Terzaghi's formula and Fig. 3.2, determine the safe bearing capacity of the foundation if factor of safety is 3.

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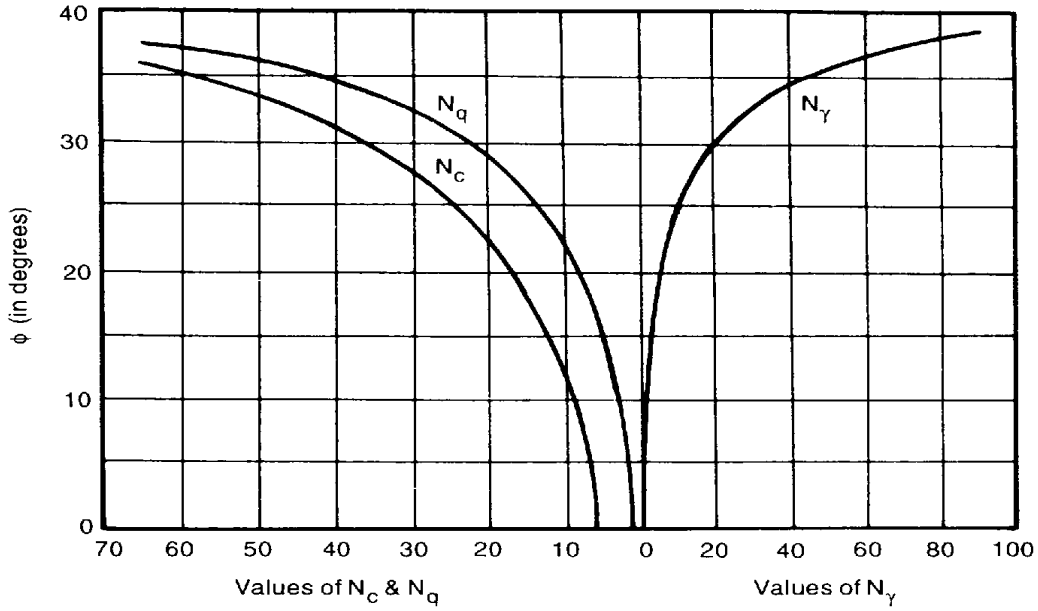

ϕ	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°
N_c	5.7	7.3	9.6	12.9	17.7	25.1	37.2	57.8	95.7	172
N_q	1.0	1.6	2.7	4.4	7.4	12.7	22.5	41.4	81.3	173
N_γ	0.0	0.5	1.2	2.5	5.0	9.7	19.7	42.4	100	298

Fig. 8.6 Terzaghi's bearing capacity coefficients.

Figure 3.2: Bearing capacity factors

(5.5 marks)

Question Four: Settlement

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

(7.5 marks)

(b) A foundation 4 m x 2 m, carrying a uniform pressure of 300 kN/m^2, is at a depth of 1.0 m in a layer of clay 5 m thick for which the value of E is 40,000 kN/m^2. The layer is underlain by a second layer 8 m thick for which the value of E is 60,000 kN/m^2. A hard stratum lies below the second layer. Determine the average immediate settlement under the foundation.

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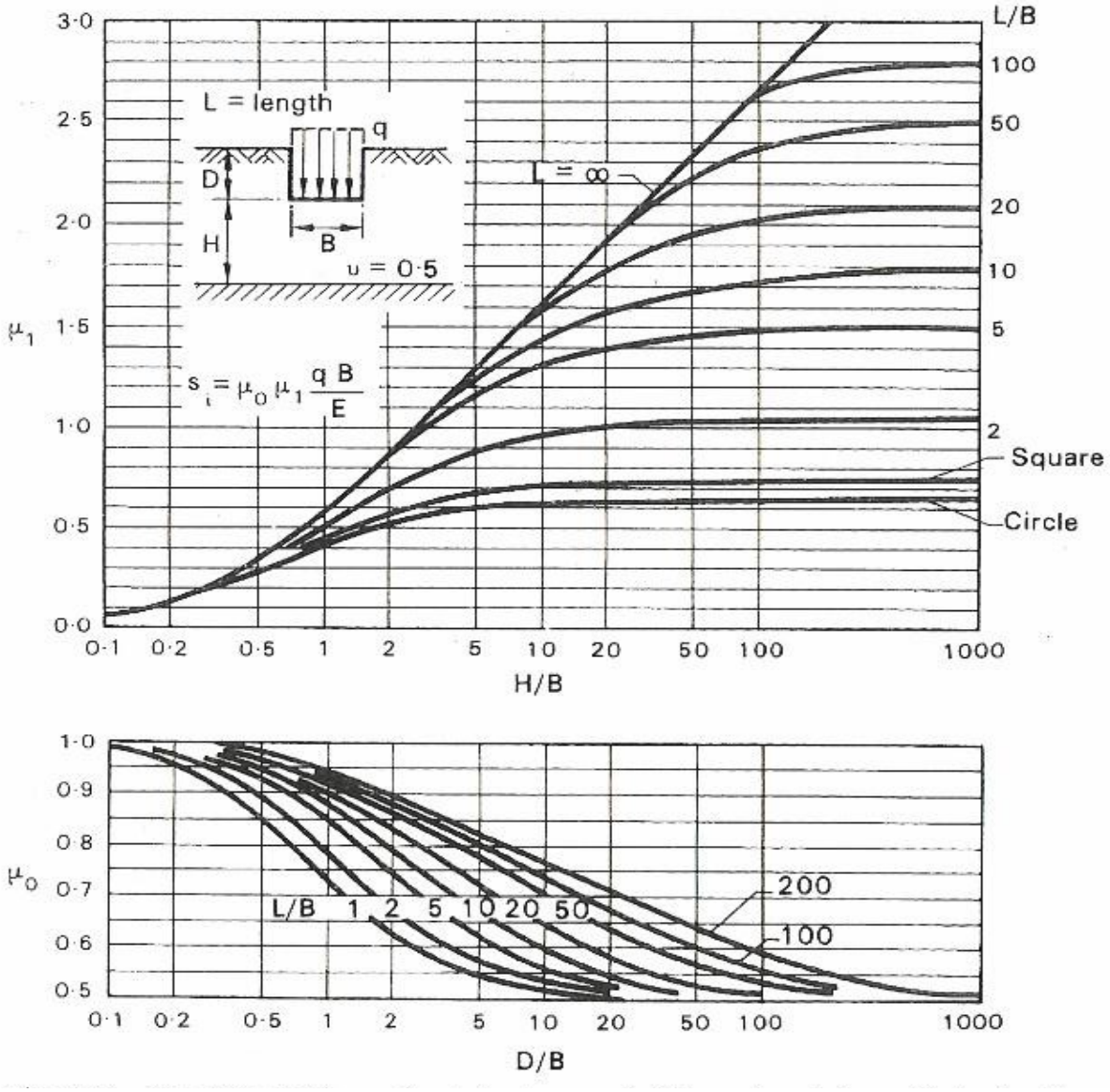

Fig. 4.1: Coefficients for vertical displacement (Janbu, Bjerrum and Kjaernsli)

(12.5 marks)

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