DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATIONS FOR:

THE DEGREE OF BACHELOR OFSCIENCE/TECHNOLOGY IN CIVIL ENGINEERING

(Y4S1)/(Y3S2)

ECV 4417: FOUNDATION ENGINEERING I, (A)

TCV 4324: FOUNDATION ENGINEERING (A)

END OF SEMESTER EXAMINATIONS

SERIES: JANUARY 2025

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

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

From basic principles, derive equation (1.1)

(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.

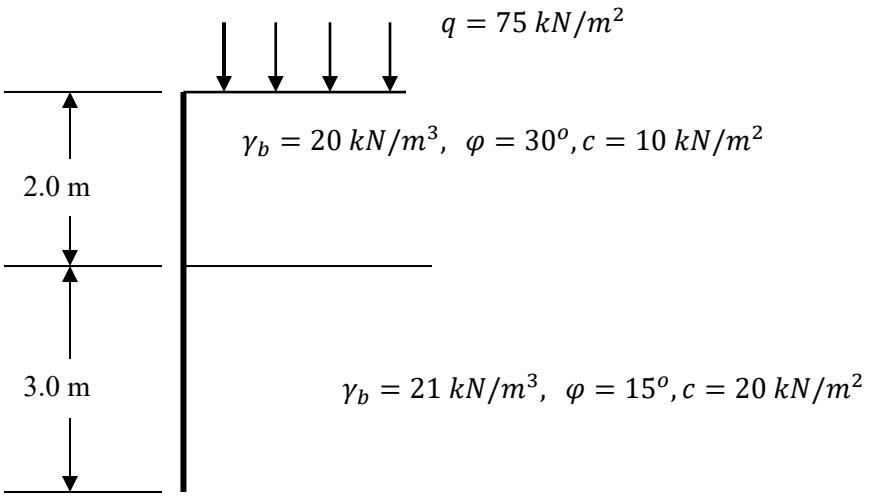


Fig. 1.1: Retaining wall

(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

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

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

(8 marks)

(b)

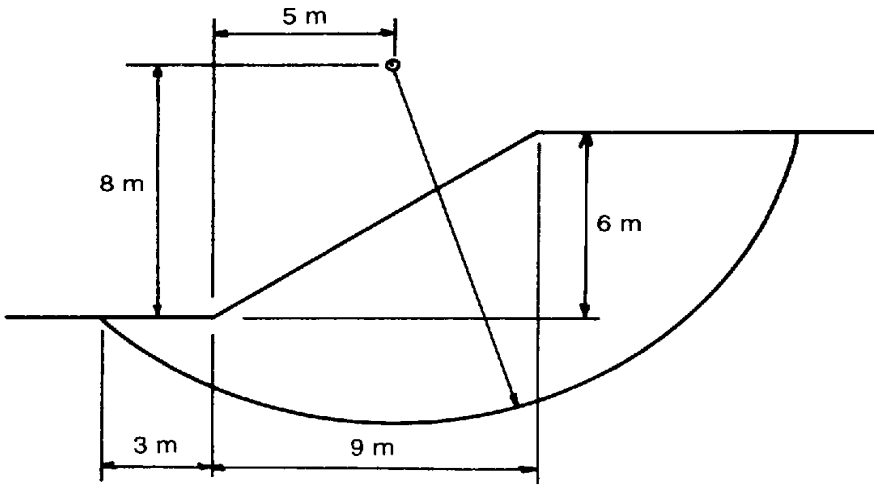


Figure: 2.1

A proposed cutting is to have the dimensions shown Figure 2.1. The soil has the following properties: $\varphi = 20^o, c = 10\ kN/m^2, \gamma = 19\ kN/m^3$. 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	$\sum N$	$\sum T$

(12 marks)

Question Three: Bearing capacity of soils

(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:

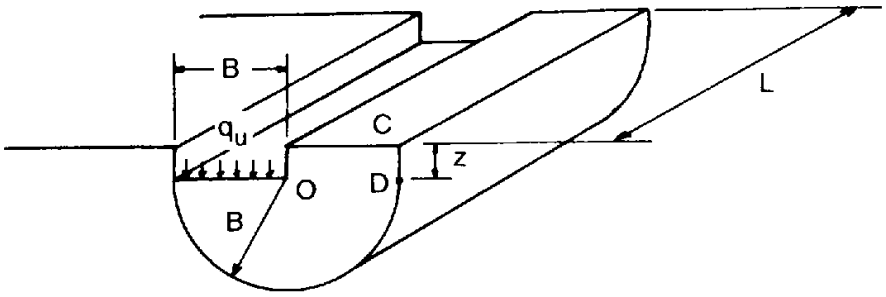
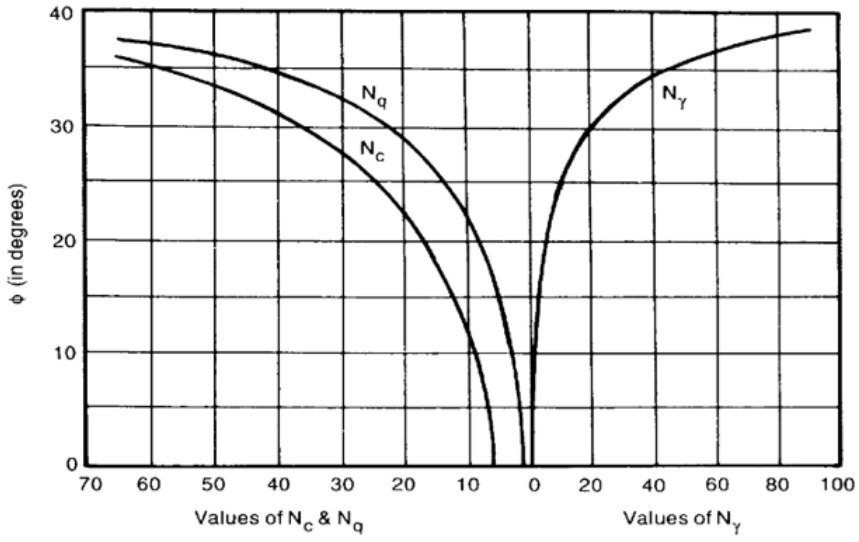


Fig. 3.1: Slip circle failure mechanism

(10 marks)

(b) A footing 2.25 m square is located at a depth of 1.5 m in a sand, the shear strength parameters being $c = o$, and $\emptyset = 40^o$. Determine the safe bearing capacity of the foundation if the factor of safety is 3. The unit weight of the soil is 18 kN/m^3.



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. 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) Results obtained from a consolidation test on a clay sample for a pressure increment of 100 - 200 kN/m^2 were:

Sample thickness(mm)	Time (min.)
12.200	0
12.141	0.25
12.108	1
12.075	2.25
12.046	4
11.985	9
11.922	16
11.865	25
11.827	36
11.809	49
11.800	64

Table 4.1: The relationship between U and T

U	10	20	30	40	50	60	70	75	80	90
T	0.008	0.032	0.070	0.125	0.197	0.290	0.410	0.485	0.570	0.848

(i) Determine the coefficient of consolidation of the soil,

(ii) How long would a layer of this clay, 10 m thick and drained on its top surface only, take to reach 80% primary consolidation?

(12.5 marks)