

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
UNIVERSITY EXAMINATIONS FOR:
THE DEGREE OF BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
(Y3S2)

TCV4324: FOUNDATION ENGINEERING

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: NOVEMBER 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.**
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Question ONE: Earth pressures

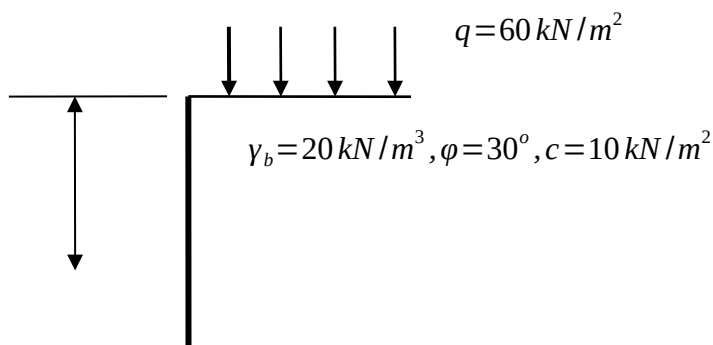
- a) The active lateral earth pressure, at the bottom of a smooth vertical back of a retaining wall, exerted by a “c – ϕ ”- soil, with a horizontal top surface, is given by the expression

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

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.



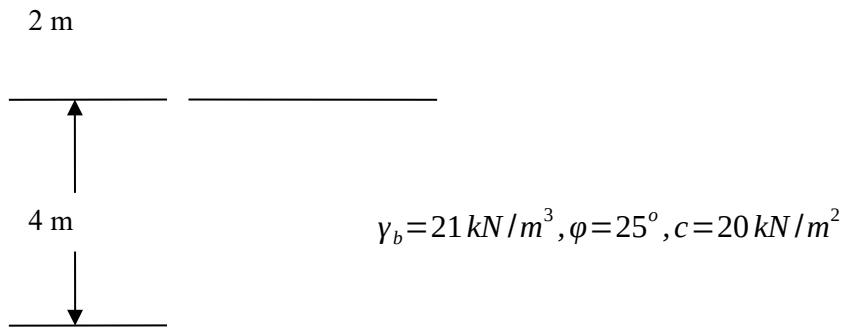


Fig. 1.1: Retaining wall

(18 Marks)

Question Two: Stability of slopes

An embankment has a slope of 1 vertical to 2 horizontal. The properties of the soil are: $c = 25 \text{ kN/m}^2$, $\phi = 20^\circ$, $\gamma = 16 \text{ kN/m}^3$, $H = 31 \text{ m}$.

Using Tylor's charts (**Fig.2. 1**), determine the factor of safety, F value for the slope

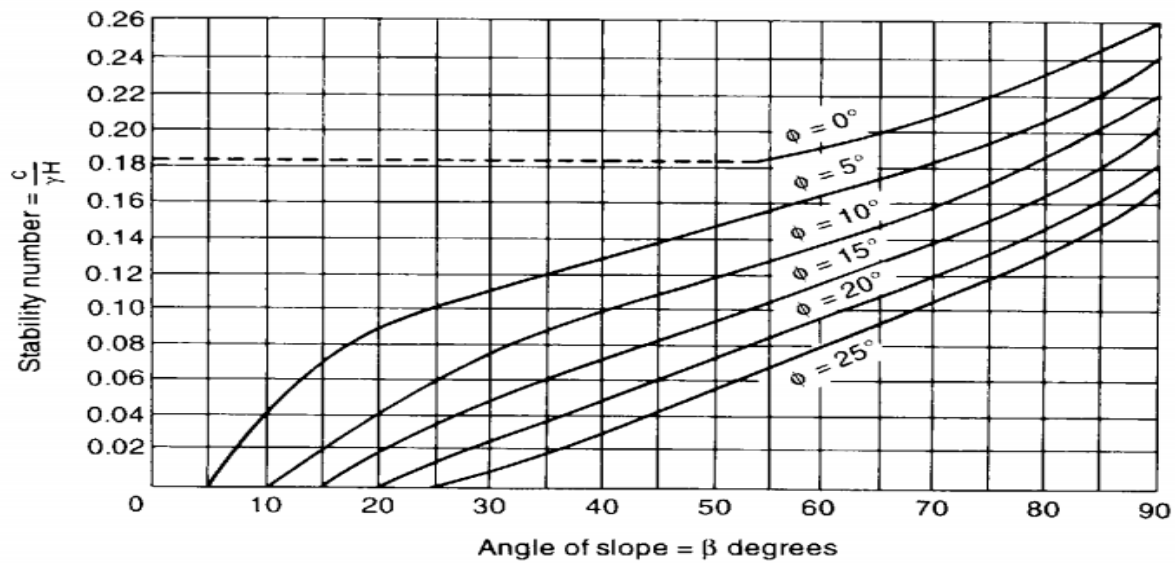


Fig.2. 1: Curves for total stress analysis (Taylor 1948)

(20 Marks)

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:

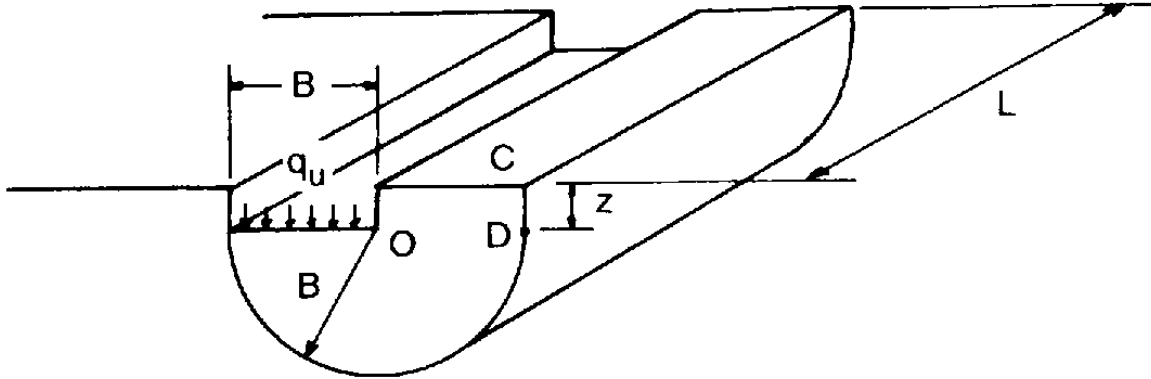


Fig. 3.1: Slip circle failure mechanism

(10 marks)

(c) A strip footing is 0.6 m wide and founded at a depth of 2.0 m in a soil of unit weight 21.0 kN/m^3 , cohesion 20 kN/m^2 and angle of internal friction of 25° . Using Terzaghi's formula and Fig. 3.2, determine the safe bearing capacity of the foundation if factor of safety is 3.

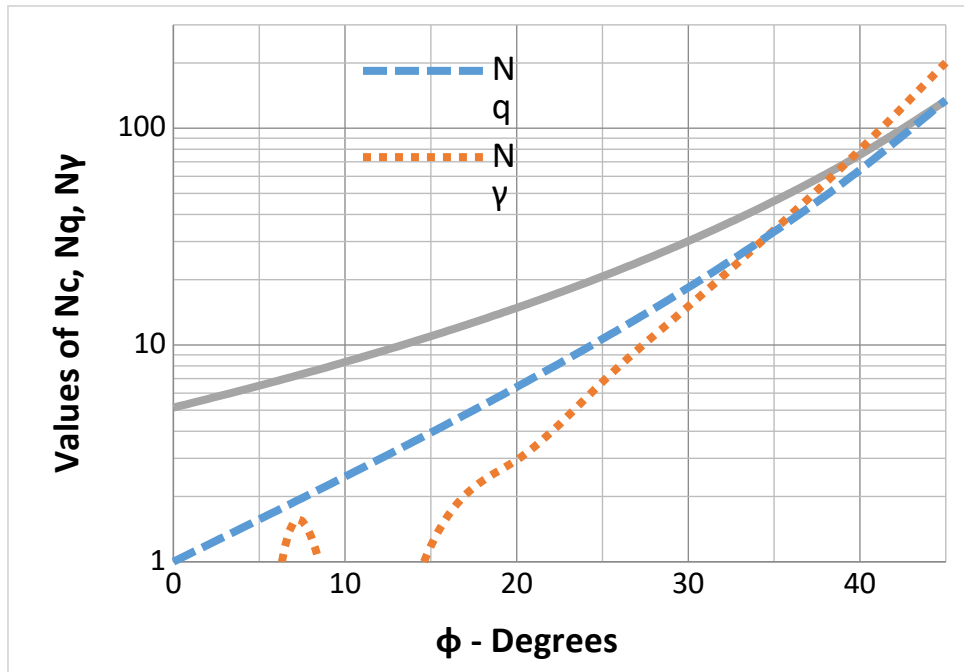


Figure 3.2: Bearing capacity factors

(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 400 kN/m², is at a depth of 1.0 m in a layer of clay 6 m thick for which the value of E is 40,000 kN/m². The layer is underlain by a second layer 10 m thick for which the value of E is 60,000 kN/m². A hard stratum lies below the second layer. Determine the average immediate settlement under the foundation.

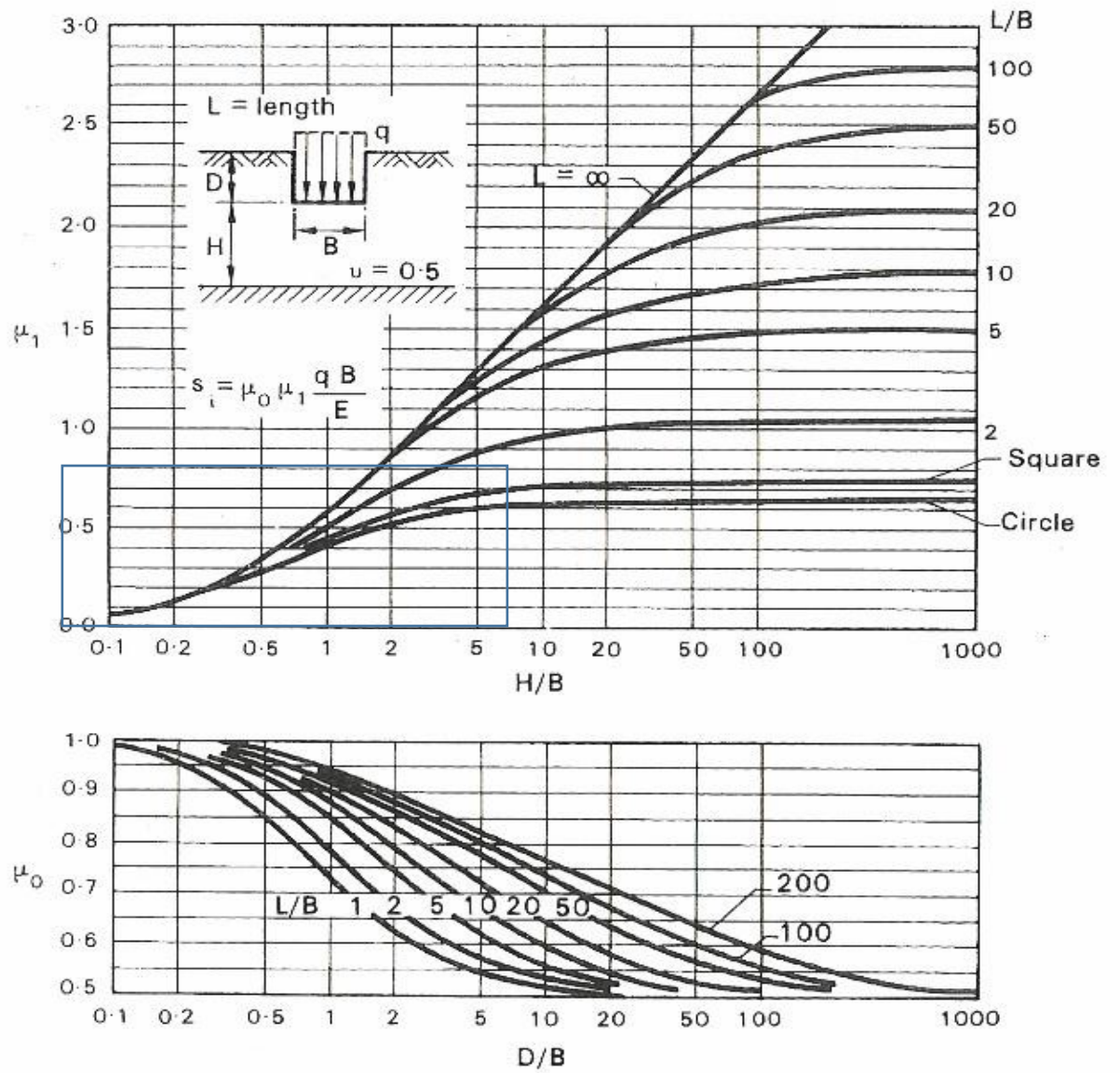


Fig. 4.1: Coefficients for vertical displacement (Janbu, Bjerrum and Kjaernsli)

(12.5 marks)