NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL AND WATER ENGINEERING

GEOTECHNICAL ENGINEERING II

TCW/ECW 5105

Examination Paper

December 2024

This examination paper consists of 5 papers

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Eng K Z Mkwananzi

INSTRUCTIONS

1. Answer any four (4) questions.
2. Each question carries 25 marks.
3. Use graph paper where applicable
4. Use of calculations is permissible
5. This is a closed book examination.

MARK ALLOCATION

Total max marks achievable 100 marks

Copyright: National University of Science and Technology 2024

QUESTION 1

Bearing Capacity of Soils

(a) Explain the meaning of the term bearing capacity of a foundation soil. (5 marks)

(b) What is the ultimate bearing capacity of a soil q_r (5 marks)

(c) What is the net ultimate bearing capacity of a soil q_n (5 marks)

(d) What will be the net ultimate bearing capacity of sand having = 36 deg and γd = 19 kN/m3 for

i) 1.5 m strip foundation and (5 marks)

ii) 1.5 m X 1.5 m square footing. The footings are placed at a depth of 1.5 m below ground level. (5 marks)

Assume F = 2.5. Use Terzaghi' s equation

	Nc	Nq	N
35 deg	57.8	41.4	42.4
40 deg	95.7	81.3	100.4

(Total 25 marks)

QUESTION 2

Retaining Walls

a) Define and explain the following terms with regards to retaining walls

i) Lateral earth pressure (3 marks)
ii) Active earth pressure (3 marks)
iii) Passive earth pressure (3 marks)

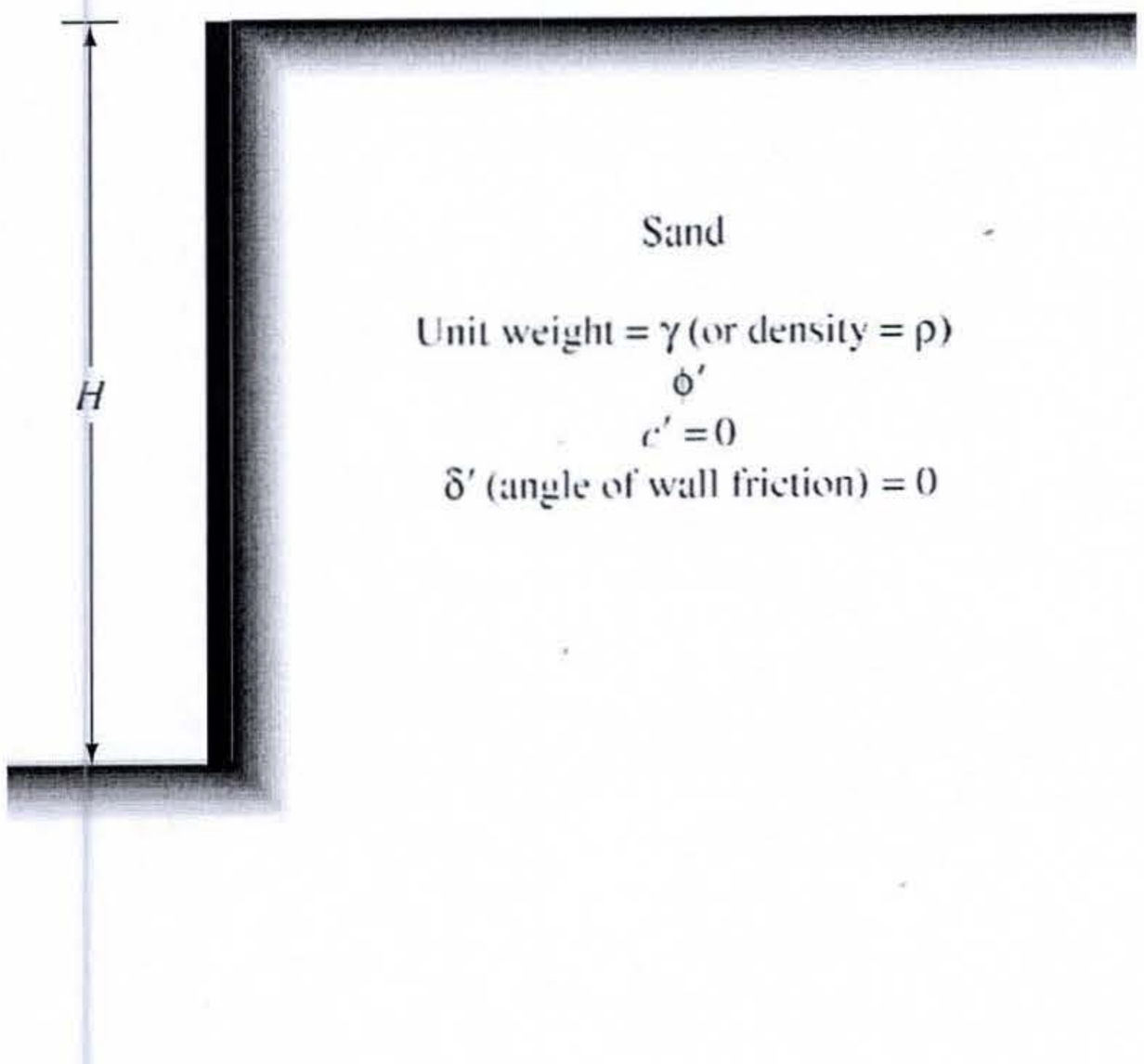
b) From Figure Q2,1 below determine the passive force, P_p, per unit length of the wall for Rankine's case. Also state Rankine's passive pressure at the bottomof the wall. Consider the following cases:

i). $H = 2.45$ m, $\gamma = 16.67$ kN/m^3, $\phi' = 33°$ (8 marks)

ii). $H = 4$ m, $p = 1800$ kg/m^3, $\phi' = 38°$ ((8 marks)

(Total 25 marks)

Figure Q2.1



QUESTION 3

Load carrying capacity of pile

a) Define and explain the **Ultimate load carrying capacity** of a pile. (5 marks)

b) Define **allowable load of a pile** and how it is obtained. (5 marks)

c) A group of 9 piles arranged in a square pattern with diameter and length of each pile as 25cm and 10m respectively, is used as a foundation in soft clay deposit. The unconfined compressive strength of clay as 120kN/m^2 and the pile spacing as 100cm c/c.

Find the load capacity of the group. Assume the bearing capacity factor as (Nc) 9 and adhesion factor (m) =0.75. Factor of safety of 3.5 may be taken. (15 marks)

(Total 25 marks)

QUESTION 4

Effective Stress Parameters

a) A square footing is to carry a column load of 650 kN with a factor of safety of 3. The foundation is to be placed 2.0m below the surface of a loose granular soil where the water table will be at foundation level. The angle of internal friction has been found to be 28^0 and the bulk unit weights above and below the water table are 16.5 and 18.3 kN/m3 respectively. Determine a suitable size for the foundation (25 marks)

(Total 25 marks)

QUESTION 5

Settlement Measurement

Settlement measurement in actual structures show that the Terzaghi and Peck method is excessively conservative

a). Explain how the Meyerhof method approach is different and preferable to above method, including what considerations are taken. (5 marks)

b) A footing 4m2 is to be located at a depth of 2m in a sand deposit, the water table being 3m below the surface. The table below gives the values of recorded standard penetration resistance,

i) Determine the allowable bearing capacity values and settlement using

a) Terzaghi and Peck suggestion (10 marks)

b) Meyerhoff's amendments (unit weight of sand is 18kN/m3) (10 marks)

(Total 25 marks)

Fig Q 5.1 Table of SPT Values

Depth (m)	N	Effective Overburden	C_n	$N' = C_nN$
1	8	18	2.5	20
2	9	36	1.8	16
3	10	54	1.4	14
4	13	62	1.3	17
5	12	70	1.2	14
6	15	79	1.0	15
7	16	87	0.8	13
8	20	95	0.7	14

END OF EXAMINATION