THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

Department of Civil Engineering

FIRST SEMESTER

EXAMINATION

Final Year Bachelor of Engineering in Civil Engineering

Subject Code: **CE411**

Subject Name: **GEOTECHNICAL ENGINEERING**

Date: **Wednesday 07th June, 2023**

Time: **8:30 am to 11:30 am**

Venue: **Hydraulics Lecture Theatre (HLT)**

Examination Instructions

1. **NO MOBILE PHONE** is allowed in the examination room.
2. You have 10 minutes to read the paper.
3. Fill-in the attendance slip. **DO IT NOW.** Tear off the attendance slip and give it to the invigilator.
4. There are six questions. **Do Any FIVE QUESTIONS ONLY.**
5. Same marks are allocated for each question.
6. Write your answer in the answer booklet provided.
7. You must not consult your notes.

Question 1

A soil sample was extracted 15 m (Point A) below the saturated clay layer. Above the clay layer was water to a depth of 25 m below the water surface. Point A is a submerged clay layer and it was determined that it had a moisture content of 54% and Specific gravity Gs of 2.78. What is the effective vertical stress at A? Illustrate with a diagram and solve the question.

(10 marks)

Question 2

(a) A newly built spread footing has the following dimension of 3 m by 4 m. It was placed on the ground surface and carried a columnar axial load of P = 2,000 kN. Determine the vertical stress increase in a point at a depth 6 m below the centre of the invert. (5 marks)

(b) Refer to the diagram below (Figure Q2(b)) of the rectangular footing below and determine the average stress increase below the centre of the loaded area, between z = 3 m and z = 5 m. (5 marks)

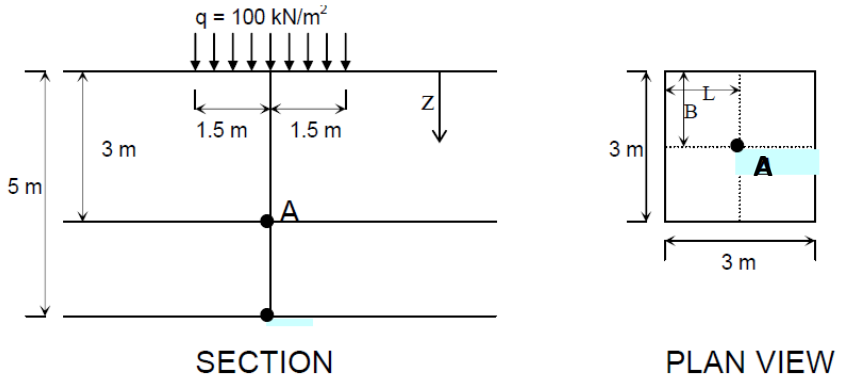


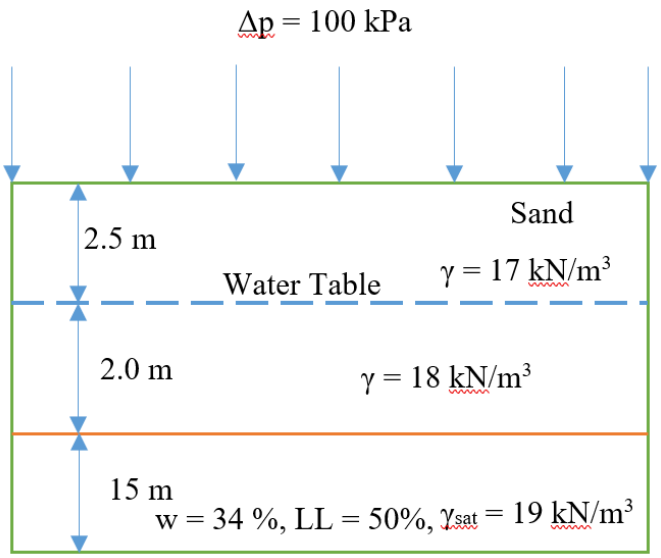
Figure Q2(b)

(10 marks)

Question 3

(a) A uniform pressure of 200 kPa was exerted on a semi-infinite saturated soil layer next the Lae Main Wharf. The elastic modulus of the soil layer was 50 MPa. The foundation that exerted the uniform pressure was made of reinforce concrete, and it was placed outside the entrance of KK Kingston Warehouse at Erica Street in Lae City. The dimension of the concrete foundation was 20 m x 40 m. Determine the value of immediate settlement under the foundation. (5 marks)

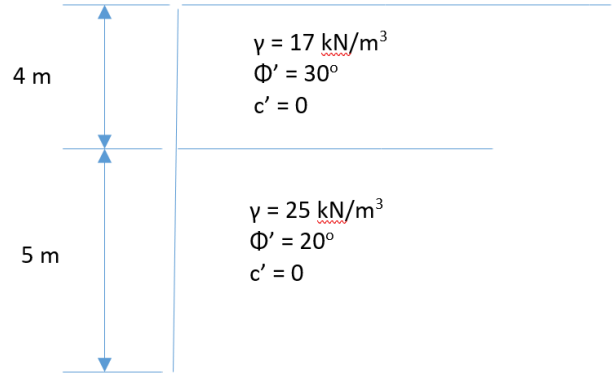
(b) A new administration building site for Lae District was planned as shown below. After the Geotech tests, it was found that the clay soil particles have a specific gravity of 2.67. You are assigned to determine the primary consolidation settlement if the clay is normally consolidated. (5 marks).



(10 marks)

Question 4

The soil retained behind a smooth wall is shown below. You are required to draw the diagram of the pressure distribution on the back of the wall and determine the total horizontal active thrust acting on the back of the wall by the Rankine Theory.



(Total marks = 10)

Question 5

(a) What types of soil exhibits planar slope failures? Give your reasons why this type of failure occurs. Also, indicate which types of soils exhibits circular slope failures and state your reasons why this type of failure occurs. (5 marks).

(b) There are three types of plastic failures under the foundation of mega civil engineering structure. Name these plastic failures and explain each of these failures in detail. (5 marks)

(Total marks = 10)

Question 6

Discuss the following in-situ test for determining the soil bearing capacities, giving particular attention to the method of conducting the test, type of soil in which the test is appropriate, design information that is collected and problems (if any) encountered during the test.

(i) Standard Penetration Test (2.5 marks)

(ii) Dynamic Cone Penetration Test (2.5 marks)

(b) State two disadvantages and advantages for the following ground boring methods:

(i) Wash Boring (2.5 marks)

(ii) Augering (2.5 marks)

(Total marks = 10)

TOTAL MARKS FOR THE EXAMINATION = 50

Formula:

$$\gamma' = \left[\frac{(G_S + e)\gamma_W}{1+e}\right] - \gamma_W$$

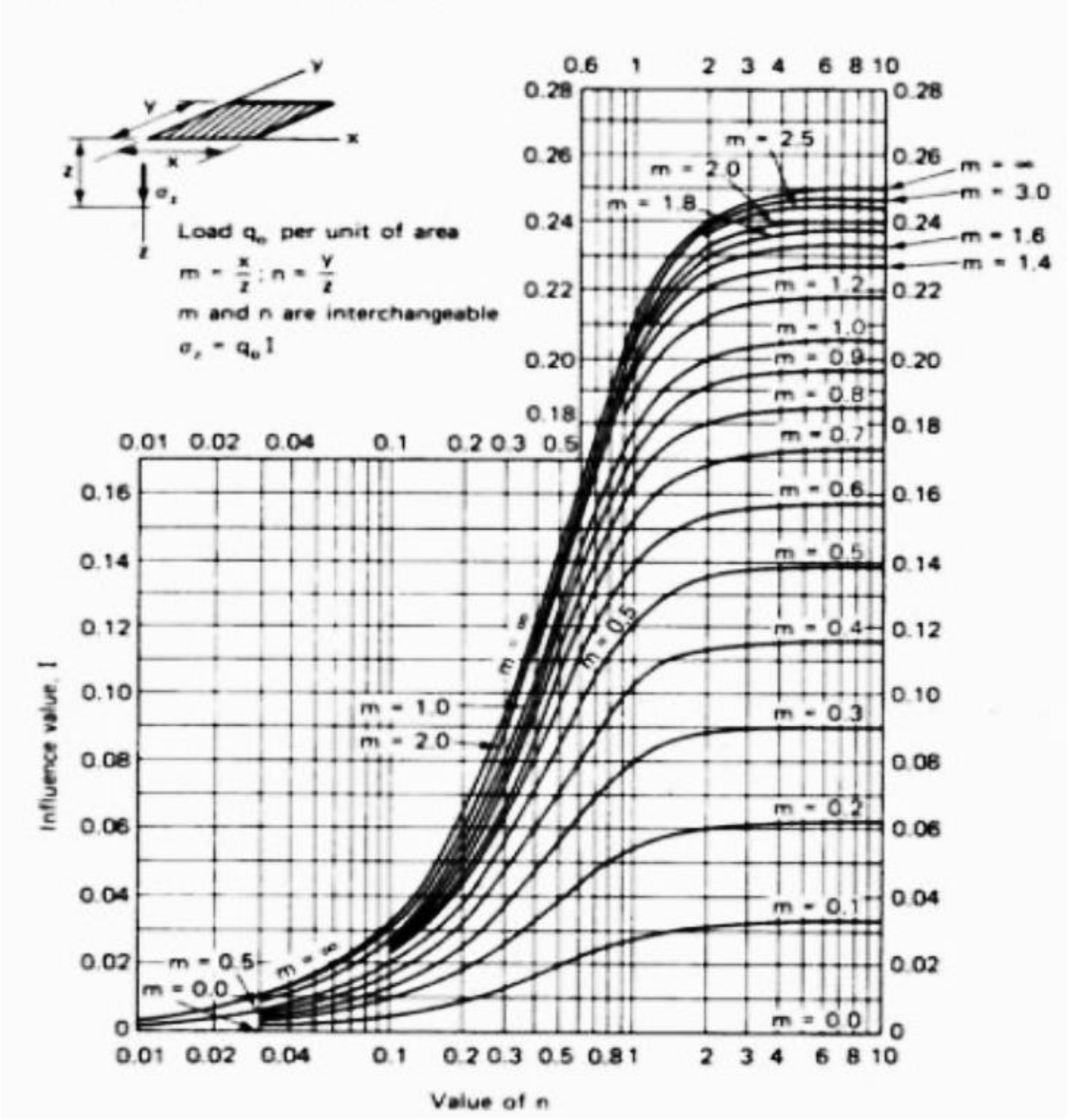
$$Se = wG_S$$

$$\Delta p_{avg(H_2/H_1)} = q\left[\frac{(H_2)(I_{4(H_2)}) - (H_1)(I_{4(H_1)})}{H_2 - H_1}\right]$$

Table 11.2 Values of I_p.

L/B	I_p
circle	0.73
1	0.82
2	1.00
5	1.22
10	1.26

$$\Delta H = \frac{HC_c}{1+e_o}\log_{10}\frac{p_o + \Delta p}{p_o}$$ consolidation settlement



END OF EXAMINATION