THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

Department of Civil Engineering

SECOND SEMESTER EXAMINATION

Final Year Bachelor of Engineering in Civil Engineering

Subject Code: **CE432**

Subject Name: **GEOTECHNICS & PAVEMENT DESIGN**

Date: **Wednesday 3rd November, 2021**

Time: **12:50 pm to 4:00 pm**

Venue: **Structures Lecture Theatre (SLT)**

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**.
4. There are six questions. Part A has three questions and Part B has three questions.
5. All questions worth 20 marks each. **ANSWER ONLY FIVE QUESTIONS.**
6. Write your answer in the answer booklet provided.
7. Do not consult your notes. Students caught cheating will be removed from the examination room and will get a zero mark.

PART A – GEOTECHNICS

QUESTION ONE

a) Describe the main functions of piles in your own words? (2 marks)

b) Piles transfer load to the ground which is referred to as the bearing of the pile. State how this is achieved. (2 marks)

c) Briefly state the advantages and disadvantages of piles that are made out of different materials. (5 marks)

d) State the differences and the similarities of displacement and non-displacement piles. (2 marks)

e) Piles can be classified as end-bearing piles cohesive or friction piles. Why? (4 marks)

f) What is the difference between a bored pile and a driven pile in terms of their methods of installation? (5 marks)

Total Marks for Q1 = 20

QUESTION TWO

The point of a pile of L = 25 m is founded into a densed medium-coarse sand deposit, which has an average N_{70} = 30 in the zone of influence of about 1.5 m above the tip to 3 m below. The pile is an HP 360 x 174 width d x b = 361 x 378 mm. The GWT is 5 m below the ground surface. Estimated overburden weight is 16.5 kN/m^3.

Estimate the point capacity P_u using the solution by Meyerhof's Equation.

For the pile point capacity – we can compute pile point capacity by using these equations;

1. $P_{pu} = A_p\,(cN'_c\,d_c + \eta\bar{q}N'_q d_q s_q + \tfrac{1}{2}\,\gamma' B_p N_\gamma s_\gamma)$ … must have θ and γ

2. $P_{pu} = A_p\,(40N)$ Lb/B $\leq A_p(380N)$ (kN) … Meyerhoff (1956, 1976)

N = statistical average of the SPT N_{55} in the zone of about 8B above to 3B below the pile point

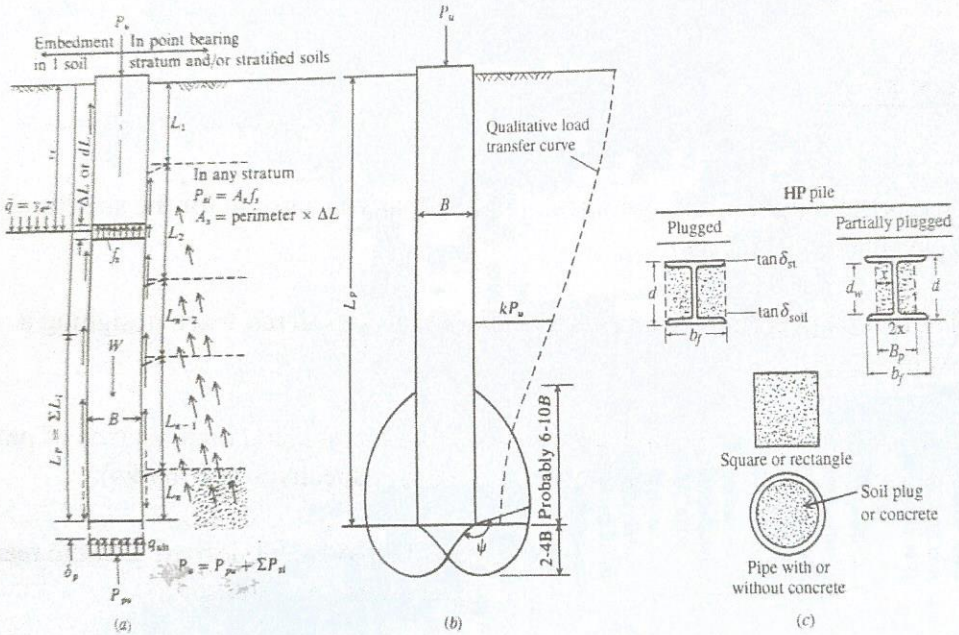

Figure 16-11 Piles in soil. Pile-to-soil friction tan δ defined for pile perimeters shown; **HP** pile has two values; all others have a single δ value.

(20 Marks)

QUESTION THREE

A precast reinforced concrete pile of diameter 350 mm is driven to a depth of 9.0 m in a medium dense sand having $\emptyset = 35°$. The horizontal subgrade modulus has been found to increase linearly with depth, and the value of the coefficient of horizontal subgrade modulus variation (η) has been found equal to 17 MN/m^3. The pile is free headed and is subjected to horizontal load at a distance 2.2 m above the ground surface. Show that this pile will behave like a long flexible unit. Determine the ultimate lateral resistance of this pile, and also determine the point of rotation/fracture from the ground surface. Take the moment of resistance (M_g) of this pile section equal to 125 kN-m. Take elastic modulus (E) of reinforced concrete equal to 26 x 10^3 MN/m^2.

(20 marks)

PART B – PAVEMENT DESIGN

QUESTION FOUR

(a) What is the minimum design traffic loading that you can use for the structural design of pavements? (2 marks)

(b) Give two engineering judgments that should be considered when designing a pavement. (2 marks)

(c) What are you trying to achieve by design, construction and maintenance of pavement? Give your thoughts about each of those factors respectively. (6 marks)

(d) Why do you recommend the use of mechanistic pavement design? List the reasons why you chose to adopt mechanistic pavement design. (10 marks)

Total marks for Q4 = 20

QUESTION FIVE

(a) City of Lae is located in the high rainfall region of PNG, and it is subjected to high ground water levels. What is the best engineering advice you can give for the design and construction of the drainage system for Lae roads, based on the Austroads 2017, Guide to Pavement Technology Part 2: Pavement Structural Design – Section 3, Construction and Maintenance Considerations? (5 marks)

(b) Why are you proposing that type of drainage system in (a)? (5 marks)

(c) What is a blanket drainage material? (2 marks)

(d) Why do you have to treat stormwater run-off from roads? (2 marks)

(e) Give three reasons why you propose the use of stabilisations? (3 marks)

(f) List three methods of construction which you can apply to improve the quality of soft subgrades. (3 marks)

Total marks for Q5 = 20

QUESTION SIX

(a) Briefly explain in your own words, the procedures for designing a "granular pavements with thin bituminous surfacings" that can sustain a 6-axles mobile crane, according to Austroads 2017, Guide to Pavement Technology Part 2: Pavement Structural Design. (5 marks)

(b) Briefly explain in your own words, the procedures for designing a "rigid pavement" that can sustain a 6-axles mobile crane, according to Austroads 2017, Guide to Pavement Technology Part 2: Pavement Structural Design. (5 marks)

(c) The previous design of the airport pavement at Nadzab Airport was based on which aircraft? What type of aircraft is the new pavement design based on? (2 marks)

(d) Explain the process of batching the asphaltic concrete and what are the constituents of an asphaltic concrete mix, used at Nadzab Airport Upgrading Project. (8 marks)

Total Marks for Q6 = 20

End of Examination