

NATIONAL EXAMINATIONS – May2019  
07-STR-B1 - GEOTECHNICAL DESIGN

3 HOURS DURATION

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- NOTES:
1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
  2. Any non-communicating calculator is permitted. This is an OPEN-BOOK exam. The candidate must indicate the type of calculator being used (i.e. write the name and model designation of the calculator, on the first inside left hand sheet of the exam workbook).
  3. Answer any FOUR questions in Section A and any THREE questions in Section B.
  4. Only the first four answers submitted in Section A and the first three answers of Section B will be marked. Extra questions answered will not be marked.
  5. Questions will have the values shown.
  6. Candidates must identify clearly the source of design charts used and where applicable the source of assumed values used in the calculations.
  7. In the absence of specific information required in the formulation of problems, the candidate is expected to exercise sound engineering judgment.
  8. Figures follow the text of the exam.
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SECTION A  
 ANSWER ANY FOUR QUESTIONS

**Question 1:**

Recommend ONE site investigation equipment that you recommend to use to obtain information that can be used in the rational design for a foundation in a sandy soil. Discuss your reasons or provide justification for selecting the equipment. Also, discuss the limitations, if any for using this equipment.

Note: Figure 1 below may be of some assistance. In this figure, various site investigation equipment that are commonly used are summarized.

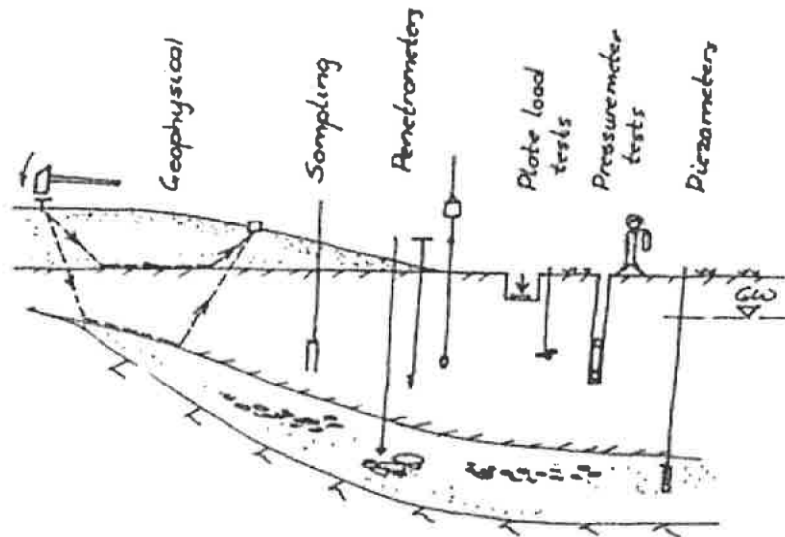


Figure 1

(Value: 7 marks)

**Question 2:**

Would you suggest recommending a higher or lower FS for the short-term stability of a slope excavated in a saturated clay? Give reasons.

(Value: 7 marks)

**Question 3:**

State the correct answer. Also, provide reasons to justify the statement along with the question number. You would **NOT** receive any marks, if you pick T or F, without providing justification.

The undrained angle of internal friction, $\phi_u$ determined from unconsolidated undrained triaxial tests for two different soils; <b>Soil A:</b> Expansive clay; and, <b>Soil B:</b> Glacial till, is equal to zero.	T	F
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(Value: 7 marks)

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**Question 4:**

State the correct answer. Also, provide reasons to justify the statement along with the question number. You would **NOT** receive any marks, if you pick T or F, without providing justification.

The safe bearing capacity, $q_s$ , is greater than the allowable bearing capacity, $q_a$ for dense sands, with an angle of internal friction, $\phi'$ greater than $40^\circ$ .	T	F
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**(Value: 7 marks)**

**Question 5:**

When do you prefer to use a mat foundation in comparison to either individual or combined footings or pile foundations?

**(Value: 7 marks)**

**SECTION B**  
**ANSWER ANY THREE OF THE FOLLOWING**  
**FOUR QUESTIONS**

**Question 6:**

**(Value: 24 marks)**

It is proposed to carry the load from a 5 story structure with an area of  $600 \text{ m}^2$  in sand using 25 square column footings. The standard penetration test results obtained from field exploration are summarized below. (i.e., corrected  $N_{60}$  results versus depth). The depth of foundation was proposed to be at 1.5 m and the tolerable settlement is 15 mm. Using a suitable empirical design method determine the size of the foundation. (Hint: Assume a load of 10 kPa per story)

Also, determine the bearing capacity of this foundation using Terzaghi's bearing capacity equation, if the GWT is at the natural ground level. Assume  $\gamma_{\text{sat}} = 20 \text{ kN/m}^3$ . What are the comments that you would offer to the owner as a consultant for this foundation?

**Note: If you need any additional information for solving this problem, make suitable assumptions providing justification).**

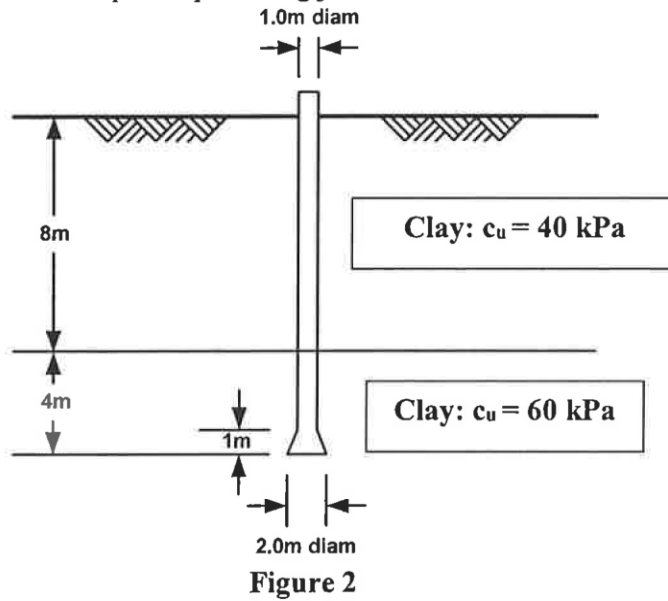
Depth (m)	<i>Corrected Results of <math>N_{60}</math></i>
1.5	10
3.0	12
4.5	14
6.0	16
7.5	16
10.0	16
12.0	16
14.0	16

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**Question 7:**

(Value: 24 marks)

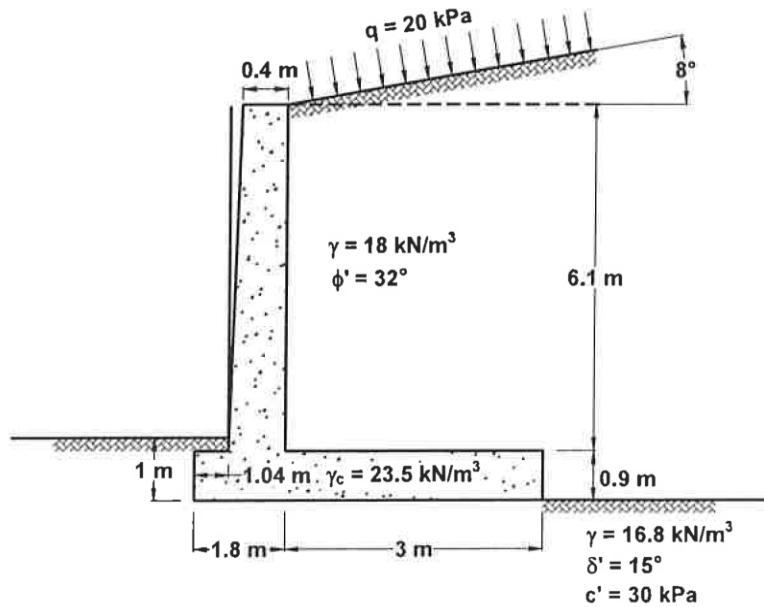
Determine the design axial capacity of the pile shown in **Figure 2**, using a factor of safety of 3. Make reasonable assumptions providing justifications.



**Question 8:**

(Value: 24 marks)

The cross section of a cantilever retaining wall is shown in **Figure 3**. The uniform load at the surface behind the wall extends far beyond the width of the base of the wall. Calculate the factors of safety with respect to overturning and sliding.



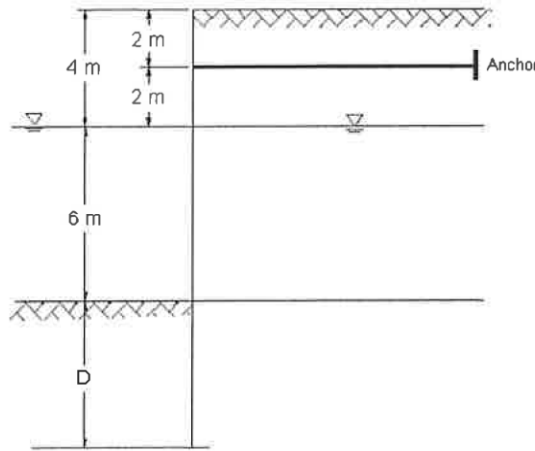
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**Question 9:**

**(Value: 24 marks)**

**Figure 4** below shows an anchored sheet pile wall penetrating a granular soil. The unit weight of the granular soil may be assumed to be  $19.5 \text{ kN/m}^3$  both above and below the ground water table and the angle of internal friction,  $\phi' = 38^\circ$ .

- (i) What is the theoretical depth of penetration  $D$  assuming free earth-support?
- (ii) Calculate the anchor force  $F$ .
- (iii) Discuss what happens, if the water level in front of the wall decreases to the dredge-line?



**Figure 4**