

BUILDING STRUCTURES AND GEOMECHANICS 2
SEMESTER 1, 2000

Time Allowed: 3 hours

Instructions: Attempt all questions
Marks for all components of all questions are shown in brackets
Open Book Examination

Questions:

1. A multi-storey building is proposed to be constructed in the city area. The soil conditions comprise very stiff clay to 10m depth, over variable strength weathered sandstone rock. Groundwater is expected to be encountered within the sandstone. Three underground car park levels will form the lower part of the proposed building.
 - a) Discuss the advantages and disadvantages of a stiffened raft footing versus a piled footing for the proposed building (6 marks)
 - b) If piled footings are adopted, discuss the relevant merits of driven and cast in place concrete piles and bored and cast in place concrete piles for the site and building conditions described (6 marks)
 - c) Why must the sides of the excavation for the below ground part of the building be adequately supported at all times during construction (4 marks)
 - d) What beneficial effect can the concrete floor slabs of the below ground car park levels have on the performance of the perimeter car park retaining walls? (4 marks)

2. Compaction is an important part of any building project involving earthworks.
 - a) list any three engineering properties of soil that are improved by compaction, and explain how they are improved (6 marks)
 - b) Describe one method of shallow compaction and one method of deep compaction. Explain what soil types and/or site conditions each method is suited to and why (6 marks).
 - c) Why is moisture conditioning of soil often required prior to compaction? (4 marks)
 - d) For a method specification for compaction control, describe the inputs that need to be defined in order to finalise the proposed compaction regime (4marks).

3. Slope stability is an important engineering consideration for both artificial and natural shapes.
 - a) Explain why the presence of bedding and jointing discontinuities in a rock mass often has an important influence of the slope stability of the rock mass (4 marks).
 - b) Why is a slope instability in a soil mass that has previously slipped more likely than in a soil mass that has not yet slipped, for the same slope geometry and soil type? (4 marks).
 - c) Discuss any four factors that may influence whether a slope instability develops in a soil mass (8 marks).
 - d) What effect does the presence of a thin weak seam in an otherwise homogeneous, sloping soil mass have on the stability of the slope? (4 marks)

4. A house with masonry walls is constructed on an expansive soil profile. Explain what effect the following factors have on the performance of the structure as a result of expansive soil movements.

- the magnitude of characteristic surface movement of the soil profile
- the depth of the footing beams
- the amount of reinforcement in the footing beams
- the presence of the control joints in the masonry walls
- the presence of a nearby tree
- a stiffened raft footing versus a grid of strip footings with the same beam depth and reinforcement
- a leaking sewage pipe
- a dry soil profile versus a wet soil profile at the time of footing construction
- injecting lime slurry into the subsurface soil profile prior to footing construction
- a lack of watering of the garden areas surrounding the house during summer

(20 marks)

5. It is important for engineers to understand the behaviour of footings and foundation soils under applied loads.

- a) Pad footings, strip footings and raft footings are the three main types of shallow footing systems. Explain in what situations each is likely to be used, and the advantages and disadvantages of each system (6 marks)
- b) Explain the difference between an end bearing pile and a friction pile. Are the pile alternatives in Question 1b) likely to behave as end bearing piles or friction piles? (4 marks)
- c) When a saturated clay soil is subjected to an increase in applied load, initially all of the additional stress is carried by the pore water. As the soil then begins to drain, explain what happens to the effective stress in the soil mass. What changes in engineering behaviour of the soil will result from drainage of the excess pore water pressure in the soil (6 marks).
- d) Explain why the effective stress of the soil controls the bearing capacity of the soil in Question 5c) above, rather than the total stress (4 marks)