Code No: RR420101 **Set No. 1**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
ADVANCED FOUNDATION ENGINEERING
(Civil Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain how to estimate the bearing capacity of shallow foundation when it is subjected to
   i. Eccentric loads and
   ii. Inclined loads
   (b) A square footing has to carry a gross allowable load of 155 kN. The depth of foundation is 0.7m. The properties of the soil are: c= 0, $\emptyset$= 30^0, γ= 18 kN/m^3. The load is inclined at an angle of 20^0 to the vertical. Determine the width of footing by taking F.S= 3.0. For $\emptyset$= 30^0, N_q= 18.4, N_γ= 22.4. [8+8]

2. Explain in detail how the settlement of footings is estimated embedded in different soils of infinite thickness. [16]

3. A friction pile group (4 × 3) consists of square piles having sides of 450 mm. The piles are 18 m long and are embedded in a normally consolidated clay deposit 26 m thick, followed by shale. The clay has an average c_u value of 30 kN/m^2. The c_u value at the pile base is 40 kN/m^2. The piles are spaced at 1.22 m centre-t-centre. Determine the load carrying capacity of the group using a factor of safety of 4. Assume the water table to be at the ground surface. What would be the settlement of the group, given that the saturated unit weight of clay as 19 kN/m^3, initial void ratio is 1.12 and the slope of the e- logp curve in the virgin compression portion is 0.24? [16]

4. (a) What do you understand by negative skin friction in pile foundation? Explain the situation which causes negative skin friction and explain how do you account for it in pile design.
   (b) A single under-reamed pile is installed in a deep deposit of stiff fissured clay. The diameter of the stem is 1.0 m and that of under-ream is 2.5 m. The length of the pile is 16 m. the unconfined compressive strength of clay is 140 kN/m^2. Estimate the allowable load carrying capacity of the pile for a factor of safety of 3.0. [8+8]

5. (a) What is meant by grip length? What is its importance in well foundations?
   (b) How will you determine the ultimate and safe load carrying capacity of a foundation well in different soils?
   (c) Briefly discuss the techniques of well sinking in relation to the well foundations. [4+6+6]

6. (a) Describe the equivalent beam method for the analysis of an anchored sheet pile wall.

   (b) An anchored bulkhead of total height 10.0 m retains cohesionless soil on either side of it. The upper ground surface is horizontal and is in level with the top of the bulkhead. The dredge level is 8.0 m below the top. The free water level is at 2.0 m below the top ground surface. Anchors are provided at 1.0 m below top. The saturated and submerged unit weights of the soil are 18.5 kN/m^3 and 9 kN/m^3 respectively. The angle of internal friction of the soil is 30^0. Determine

      i. depth of embedment,

      ii. anchor pull and

      iii. maximum moment in the sheet pile. [10+6]

7. (a) What are the factors influencing the heave and how to predict the heave of soil?

   (b) What are the basic approaches used to reduce or prevent the effects of swelling on structures? [8+8]

8. (a) What are the foundation techniques available for different structures to be constructed in expansive soils? Describe any one of them in detail.

   (b) What are the chemical reactions that take place when lime is added to soil? What are the resulting physical changes? [8+8]

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Code No: RR420101 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Draw the bearing pressure diagram for an isolated footing under
   i. Direct axial load
   ii. Eccentric axial load
   iii. Inclined and eccentric axial load
   iv. Axial load and moment
   v. Axial load with moments in two directions.

   (b) An isolated footing of dimensions L and B metres is subjected to a load P at e_x and e_y from its center of gravity. If the allowable bearing capacity of the soil below is q kN/m^2 find P for e_x= 0 and e_y= 0.2B. [10+6]

2. (a) Discuss the estimation of settlement of footing embedded in sand by Schmertmann's method.

   (b) Determine the settlement of a 10 m square area loaded at 100 kN/m^2, placed at 1 m below the ground level in a bed of sand. Ground water level is just below the footing. The SPT values are as follows.

Depth	Average SPT
1m to 5m	20
5m to 10m	25
10m to 20m	30

[8+8]

3. (a) Discuss the settlement of pile groups in sandy soils.

   (b) Design a pile group consisting of RCC piles for a column of size 650mm × 650 mm carrying a load of 5000 kN. The exploration data reveal that the sub-soil consists of deposit of soft clay extending to a greater depth. The other data of the deposit are:
   Compression index = 0.10, Initial void ratio = 0.9, Saturated unit weight = 19 kN/m^3, Unconfined compressive strength= 40kN/m^2. Also proportion the pile group for the permissible settlement of 50 mm. [8+8]

4. (a) Discuss the situations under which under-reamed pile foundations are used. When do you recommend the multi under-reamed piles? Discuss.

   (b) What are the preventive measures do you recommend for the negative skin friction? How to estimate the negative skin friction for a group of piles? [10+6]

5. (a) Under what situations a well foundation is preferred over a pile foundation?

(b) What are the different shapes of foundation wells, and what are their comparative merits and demerits?

(c) Enumerate the various forces which act on a foundation well. [4+6+6]

6. (a) What are the differences between free-earth support method and fixed-earth support method?

(b) Draw the pressure diagrams for braced cuts suggested by Peck in

i. dry or moist sand

ii. firm clay and

iii. soft or medium clay.

Explain how to find out the forces in struts? [8+8]

7. (a) What is the cause of swelling in expansive soils? What are the tests available to identify expansive soils? Give the relative values.

(b) Distinguish between differential free swell and swell potential. Discuss briefly the methods available to reduce swelling in soils. [8+8]

8. What is soil stabilization? What are the different methods of soil stabilization? Explain them clearly. [16]

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1. (a) What are the differences between Terzaghi, Meyerhof and Hansen bearing capacity theories? Discuss in detail.
   (b) A wall footing has width and depth of 1.2m and 0.8m respectively, while the surrounding soil has $\gamma = 19kN/m^3$, $c_u = 48kN/m^2$ and $\emptyset = 20^0$. Determine the ultimate bearing capacity of the footing by Meyerhof's method. Given N_c= 14, N_q= 6.7 and N_γ= 2.8. [10+6]

2. (a) How does the settlement of a footing influence its design and how can a designer take into consideration the settlement of a footing?
   (b) A footing 1.5m square is located 1.5m below the surface of a uniform soil deposit of density 20 kN/m^3. The void ratio of the soil is 0.8 and its compression index is 0.07. If the total thickness of the deposit, which is underlain by rock strata, is 3.5m, compute the primary consolidation settlement of the footing when it carries a load of 225 kN. Use 2:1 ratio stress distribution method and consider four layers. [8+8]

3. (a) Discuss the elastic settlement of pile groups in sandy soils.
   (b) What inputs are required for the estimation of settlement of a group of friction piles in clay? Mention the assumptions made. [8+8]

4. (a) What is downward drag force? How to determine the downward drag force of piles?
   (b) A bored pile with enlarged base is to be installed in a stiff clay, the undrained shear strength at base level being 220 kN/m^2. The saturated unit weight of the clay is 21 kN/m^3. The diameters of the pile shaft and base are 1.0m and 3.0m respectively. The pile extends from a depth of 4m to a depth of 22m, the top of the under-ream being at a depth of 20m. Past experience indicates that a skin friction coefficient of 0.70 is appropriate for the clay. Compute the allowable load on the pile to ensure
      i. an overall load factor of 2, and
      ii. a load factor of 3 under the base, when shaft resistance is fully mobilized. [6+10]

5. (a) Explain the design principles, with neat sketches showing typical reinforcement in design of
      i. Well cap
      ii. Well steining

iii. Well curb
iv. Bottom plug

(b) Briefly explain the sinking operation of a well foundation. [10+6]

6. Discuss the method of designing a cantilever sheet pile wall in cohesive soils. [16]

7. (a) What are the factors influencing the swell pressure of soil?
   (b) What are the tests available to determine the swell pressure of an expansive soil and explain any one of them very clearly? [8+8]

8. (a) Explain the concept of CNS layer used in the foundations of black cotton soils.
   (b) How to fix the number of bulbs in under-reamed piles? Discuss. [8+8]

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1. (a) Discuss critically and in a comparative manner, the bearing capacity theories of Terzaghi and Meyerhof with special reference to
   i. the suitability of the theories to different foundation conditions
   ii. the rupture surfaces and the failure planes
   iii. the assumptions made
   iv. the bearing capacity equations and the charts provided and
   v. the procedure to find the bearing capacity of soils.

   (b) What is the ultimate load carrying capacity of a square footing of size 2.0m×2.0m with an eccentricity of 0.4 m? The depth of the footing is 0.6m. The soil properties are: γ= 20 kN/m^3, c= 12 kN/m^2 and $\emptyset$= 30^0. For $\emptyset$= 30^0, N$_c$= 30, N$_q$= 18 and Nγ= 15. [10+6]

2. Explain in detail how the settlement of footings is estimated embedded in different soils of infinite thickness. [16]

3. (a) Discuss the settlement of a pile group in sand with the help of settlement of an individual test pile data.

   (b) Discuss the settlement of pile groups in cohesive soils. [8+8]

4. (a) What is down drag force on a pile? How to determine the down drag force in single piles and also in a group of piles?

   (b) A square pile group of 16 piles pass through a filled up soil of 3 m depth. The pile diameter is 250 mm and pile spacing is 750 mm. If unit cohesion of the material is 18 kN/m^2 and unit weight is 15 kN/m^3, compute the negative skin friction on the group. [10+6]

5. Briefly discuss the simple stability analysis method of foundation wells, which are heavy enough to rotate about the base, and are rectangular in shape. Write down the equations which will help in determining the maximum and minimum base pressure as well as the maximum horizontal thrust from the bridge deck from a height 'H' above the maximum scour level. The grip length may be taken as 'D', and allowable deflection of well at maximum scour level= δ. Suitable notations may be adopted for indicating the soil and well parameters. [16]

6. (a) Describe the equivalent beam method for the analysis of an anchored sheet pile wall.

(b) An anchored bulkhead of total height 10.0 m retains cohesionless soil on either side of it. The upper ground surface is horizontal and is in level with the top of the bulkhead. The dredge level is 8.0 m below the top. The free water level is at 2.0 m below the top ground surface. Anchors are provided at 1.0 m below top. The saturated and submerged unit weights of the soil are 18.5 kN/m^3 and 9 kN/m^3 respectively. The angle of internal friction of the soil is 30^0. Determine

i. depth of embedment,

ii. anchor pull and

iii. maximum moment in the sheet pile. [10+6]

7. (a) What are the factors affecting swelling characteristics of soil? Discuss them.

(b) Discuss the various direct methods of determining the swelling pressure of soil. [8+8]

8. (a) Explain the engineering benefits of soil stabilization with lime and cement?

(b) Explain the role of additives in soil stabilization. [8+8]

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