Ex/BESUS/CE-804/3/07

B.E. (CE) Part-IV 8th Semester Examination, 2007

Earth and Earth-retaining Structures

(CE-804/3)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.

FIRST HALF

(Answer Q.No.1 and TWO from the rest.)

1. An RCC cantilever retaining wall has the following dimensions:
   Top width of stem=300 mm
   Bottom width of stem=500 mm
   Width of base slab=3800 mm
   Toe projection=1000 mm
   Heel projection=2300 mm
   Thickness of base slab=600 mm
   Depth of foundation below GL=1200 mm

   The backfill, which has a surcharge angle of 10° to the horizontal, consists of a cohesionless backfill (γ=18.2 kN/m^3, c=0, ϕ=32°. The backface of the stem is vertical. The angle of friction between soil and concrete may be taken as 20°.

   (i) Determine the factor of safety of the wall against (a) sliding and (b) overturning.
   (ii) Plot the distribution of soil reaction on the base of wall 20

2. (a) Which earth pressure theory, Rankine's or Coulomb's, would you apply to determine the active thrust on (i) gravity retaining wall with a vertical back (ii) counterfort retaining wall with a long heel projection? Justify your answer *briefly*.
(b) A gravity retaining wall with a vertical back has to retain a homogeneous, cohesive backfill having an unconfined compressive strength of 55 kN/m^2. The average bulk density of the soil is 19 kN/m^3. A uniform surcharge of 40 kN/m^2 is placed on top of the backfill, which has a horizontal surface. Determine the total active thrust per unit width of the wall. Neglect the effect of tension cracks, if any. 5 + 10 =15

3. A cantilever sheet pile has to retain a cohesionless backfill upto a height of 5.0 m above the dredge line. The water table is at 2.2 m below ground level. The backfill has the following properties:
   bulk density = 18 kN/m^3
   saturated density = 19.5 kN/m^3
   angle of internal friction (both above and below water table) =30°

The soil below dredge line is clay having an unconfined compressive strength of 80 kN/m^2. Determine the minimum depth of embedment required with respect to a factor of safety of 1.5.
15

4. An anchored bulkhead has to retain a cohesionless backfill up to a height of 6 m above the dredge line. The average properties of soil, both above and below dredge line, are as follows:

$\gamma = 18.5$ kN/m^3, $\gamma_{sat}=20$ kN/m^3, $c=0$, $\phi=\phi'=33°$

The anchor rod is provided at 1.5 m below G.L., while the water table is at 2.5 m below G.L. Determine the minimum depth of embedment of the bulkhead and the force in the anchor rod by the *equivalent beam method*. Given, for $\phi=32°$, $x/H = 0.07$, the notations having their usual meaning. 15

5. It is required to construct a braced excavation up to a depth of 7.5 m in a stiff fissured clay having an unconfined compressive strength of 120 kN/m^2. Bracing systems consisting of struts and wales are to be installed at 1.2 m, 3.5 m and 6.0 below the G.L. Determine the strut forces and the maximum bending moment in the sheet pile walls. The maximum intensity of earth pressure may be taken as $0.35\gamma H$, the notations having their usual meaning. 15

SECOND HALF

(Answer Q.No.7 and TWO from the rest.)

Q. 6. (a) Define 'infinite slope'. Can any real life slope be called an infinite slope?

(b) Can an infinite slope have an angle of inclination greater than the angle of shearing resistance of the slope material?

(c) A slope is to be constructed in a soil for which $c'=0$ and $\Phi'=36°$. It to be assumed that the water table may occasionally reach the surface of the slope, with seepage taking place parallel to the slope. Determine the maximum slope angle for a factor of safely of 1.5, assuming a potential failure surface parallel to the slope. What would be the factor of safely of the slope, constructed at this angle, if the water table be well below the surface? The saturated unit weight of the soil is 19 kN/m^3. 15

Q. 7. (a) Is there any advantage in dividing a sliding mass into a number of slices?

(b) With a neat sketch show the complete system of forces acting on a typical slice. List the total number of unknowns and equations to find if the problem of slope stability analysis determinate. If not, what is the degree of indeterminacy? How would you tackle the indeterminacy to obtain a solution?

(c) Using the notation used in (b) above, derive a general expression for the factor of safely common to all approximate methods. Is there any assumption involved here? 20

8. (a) What are the usefulness of stability charts? Explain with reference to the Taylor's charts.

(b) Discuss the critical stages in the life of an earth dam from the point of view of stability of its upstream and downstream slopes. 15

9. (a) What are the guidelines available for the determination of the critical slip surfaces and the associated minimum factors of safely?

(b) Briefly discuss the techniques available to search for the critical slip surface. 15

10. (a) Discuss the salient features in the construction procedure of a diaphragm wall.

(b) Mention one situation in which construction of a diaphragm wall poses difficulties.

(c) A diaphragm wall is to be constructed in soil having a unit weight of 19 kN/m^3 and shear strength parameters $c'=0$ and $\Phi'=35°$. The depth of the slurry trench is 3.60 m and the water table is 1.80 m above the bottom of the trench. Determine the minimum slurry density for the factor of safely of 1.1 when the depth of slurry in the trench is 3.30 m. 15

11 (a) How do the various methods of slices differ from one another?

(b) Derive expressions for the factors of safety of the following methods:

(i) Ordinary Method of Slices

(ii) Bishop's Simplified Method 15

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