CE1305 – FOUNDATION ENGINEERING

2 MARKS QUESTIONS & ANSWERS

16 MARKS QUESTIONS

UNIT -1

1. What are components of total foundation settlement?
   elastic settlement, consolidation settlement, secondary consolidation settlement

2. What are the types of shear failure?
   general shear failure, local shear failure, punching shear failure

3. What are assumptions in Terzaghi's bearing capacity theory?
   - the base of the footing is rough
   - the load on footing is vertical and uniformly distributed
   - the footing is continuous

4. List out the methods of computing elastic settlements?
   based on the theory of elasticity, Pressure meter method,
   Janhu –Bjerram method, Schmentmann's method

5. What are the limitation of Terzaghi's analysis?
   - As the soil compresses, pi changes slight down ward movement of footing may not develop fully the plastic zones

- Error due to assumption that the resultant passive pressure consists of three components is small

6. Define ultimate bearing capacity?
gross pressure at the base of the foundation at which the soil fails in shear is called ultimate bearing capacity.

7. Define net ultimate bearing capacity ?
Net pressure increase in pressure at the base of the foundation that causes failure in shear, is called as net ultimate bearing capacity

8. Define allowable bearing capacity?
It is the net loading intensity at which neither the soil fails in shear nor there is excessive settlement detrimental to the structure

9. Write the expression for correction due to dilatancy submergence?
$N_e = 15 + (N_o - 15)$

10. What are the requirements for a stable foundation?
-must be safe from failure
-must be properly located
-must not settle or deflect sufficiently to damage the structure or impair its usefulness.

11. What are the factors which depends depth?
Type of soil, size of structure, magnitude of loads, environmental conditions, etc

12 .Define net pressure intensity ?
It is the excess pressure, of the gross pressure after the construction of the structure and the original overburden pressure.

13. What are the zones used in the Terzaghi's bearing capacity analysis for dividing the failure envelope of the soil.?
Elastic equilibrium zone, Radial Stress zone, plastic zone

14. Write the ultimate bearing capacity equation for the general shear failure of soil in Terzaghi's analysis for a strip footing.
$qu = c\,Nc + \gamma DNq + 0.5\,\gamma B\,N\gamma$

15. Define Shallow foundation.
If the depth of the foundation is less than its breadth, such foundation is known as shallow foundation.

17. Write down the equation for estimating the elastic settlement based on the theory of elasticity.?

18. When will the total settlement be completed in the case of cohesion-less soil?

Once the construction is over, the total settlement is assumed to be completed.

19. Define differential settlement

If any two points of the foundation base experiences different settlements then such settlement is known as differential settlement.

20. What type of shear failure of soil is more likely to happen in the case of very dense soil?

usually punching shear failure and local shear failure may also be possible.

21. Write the ultimate bearing capacity equation for the general shear failure of soil in Terzaghi's analysis for a square footing.

$$qu = 1.3\, cNc + \gamma D\, Nq + 0.4\, \gamma B\, N\gamma$$

22. Write down the reduction factors for water table level to be applied in the ultimate bearing capacity equation.

23. Draw the pressure distribution diagrams under a footing on cohesion less and cohesive soils.

24. When will the Consolidation settlement get completed?

In the case of cohesion-less soil, the consolidation settlement gets completed once the construction is over. But In the case of cohesive soil, the consolidation settlement takes place for several years.

25. Define Deep foundation

If the depth of the foundation is equal to or greater than the breadth of the foundation such foundation is called as deep foundation.

26. For which type of foundation, Terzaghi's bearing capacity equation is applicable. Why?

Shallow foundation only. Because the effect of the depth is not considered.

UNIT -2

1.What are the information obtained in general exploration?

preliminary selection of foundation type
depth of water,
depth, extent and composition of soil strata
engineering properties required disturbed or partly disturbed samples
approximate values of strength and compressibility

2. Define significant depth?

Exploration depth, in general it should be carried out to a depth upto which increase in the pressure due to structural loading is likely to cause shear failure, such depth is known as significant depth.

3. What are the types of soil samples?

disturbed soil sample
undisturbed soil sample

4. What is the difference between disturbed and undisturbed soil sample?

Disturbed soil sample
Natural structure of soils get partly or fully modified and destroyed
Undisturbed soil sample
Natural structure and properties remain preserved

5. What are the disadvantages of wash boring?

It is a slow process in stiff soil
It cannot be used effectively in hard soil, rocks ,etc.

6. What are design features that affect the sample disturbance?

area ratio, inside clearance, outside clearance, inside wall friction,
method of applying force

7. What are the corrections to be applied to the standard penetration number?

overburden pressure correction
dilatancy correction

8. What are various methods of site exploration?

open exacavation, borings, geophysical methods, sub-surface soundings

9. What are the methods of boring?

auger borings, shell boring, wash boring, rotary boring, percussion boring

10. Define area ratio?

Area ratio is defined as the ratio of maximum cross sectional area of the cutting edge to the area of the soil sample

11. Define liquefaction of sand?

The mass failure occurs suddenly, and the whole mass appears flow laterally as if it were a liquid such failure is referred to as liquefaction.

12. How will you reduce the area ratio of a sampler?

by increasing the size of the soil sample.

UNIT –III

1. Under what circumstances, a strap footing is adopted?

When the distance between the two columns is so great, so that trapezoidal footing is very narrow and so it is uneconomical. It transfers the heavy load of one column to other column.

2. What is a mat foundation?

It is a combined footing that covers the entire area beneath a structure and supports all the walls and columns.

3. Where mat foundation is used?

It is used when the area of isolated footing is more than fifty percentage of whole area or the soil bearing capacity is very poor.

4. Define spread footing?

It is a type of shallow foundation used to transmit the load of isolated column, or that of wall to sub soil. The base of footing is enlarged and spread to provide individual support for load.

5. What are types of foundation?

shallow foundation , deep foundation

6. What are the footings comes under shallow foundation?

spread footing or pad footings , strap footings, combined footings, raft or mat foundation

7. What are the footings comes under deep foundation?

pile, caisons(well foundation)

8. Define floating foundation?

It is defined as a foundation in which the weight of the building is approximately equal to the full weight of the soil including water excavated from the site of the building.

9. What is mean by proportioning of footing?

Footings are proportional such that the applied load including the self weight of the footing including soil .the action are not exceeding the safe bearing capacity of the soil.

10. What are the assumptions made in combined footing?

- the footing is rigid and rests on a homogenous soil to give rise to linear stress distribution on the bottom of the footing.
- the resultant of the soil pressure coincides with the resultant of the loads, then it is assumed to be uniformly distributed.

UNIT -IV

1. List out the type of pile based on material used?

timber pile, concrete pile, steel pile, composite pile

2. How is the selection of pile carried out?

The selection of the type, length and capacity is usually made from estimation based on the soil condition and magnitude of the load.

3. What is mean by group settlement ratio?

The settlement of pile group is found to be many times that of a single pile. The ratio of the settlement of the pile group to that of a single pile is known as the group settlement ratio.

4. What are the factors consider while selecting the type of pile?

-the loads
-time available for completion of the job
-availability of equipment
-the ground water conditions
-the characteristics of the soil strata involved

5. What are the type of hammer?

drop hammer, diesel hammer, double acting hammer, single acting hammer, vibratory hammer

6. What is pile driver?

Piles are commonly driven by means of a hammer supported by a crane or by a special device known as a pile driver.

7. What are methods to determine the load carrying capacity of a pile?

- dynamic formulae
- static formula
- pile load test

- penetration tests

8. What are the two types of dynamic formulae?
   - Engg. news formula
   - Hiley's formula

9. What is meant by single-under reamed pile?
   The pile has only one bulb is known as single under reamed pile

10. Write down the static formulae?
    The static formulae are based on assumption that the ultimate bearing capacity Qup of a pile is the sum of the ultimate skin friction Rf and total ultimate point or and bearing resistance Rp.

    $$Qup=Rf+Rp$$
    $$Qup=Asrf+Ap.rp$$

11. Define modulus of subgrade reaction?
    The ratio of soil reaction (p) to the deflection (y) at any point is defined as the modulus of subgrade reaction Es or soil modulus.

12. Find the group efficiency using Feld's rule for 9 piles in a group.

13. A pile group consisting of four piles is in a square pattern with equal spacing in both the directions. Find the c/c spacing in terms of the diameter of the piles, if efficiency of the group is 75% as per Converse-Labarre formula.

UNIT -V

1.Define conjugate stresses?
The stress acting on the conjugate planes is called conjugate stresses

2. How do you check the stability of retaining walls?
   - the wall should be stable against sliding
   - the wall should be stable against overturning

- the base of the wall should be stable against bearing capacity failure

3. Define angle of repose ?

Maximum natural slope at which the soil particles may rest due to their internal friction, if left unsupported for sufficient length of time

4. Define theory of plasticity?

The theory on which the condition of the stress in a state of a plastic equilibrium is called as theory of plasticity.

5. What are assumption in coulomb wedge theory?

- the backfill is dry, cohesionless, isotropic, homogenous,
- the slip surface is plane which passes through the head of the wall

6. How to prevent land sliding?

Sheet piles, retaining wall may be used to prevent the land sliding

7. Write down any two assumptions of Rankine's theory?

- semi infinite soil
- cohesion-less backfill
- homogenous soil
- the top surface is a plane which may be inclined or horizontal.

8. Distinguish Coloumb's wedge theory from Rankine's theory?

Rankine considered a soil particle at plastic equilibrium but Coulomb considered the whole soil mass.

9. Make an estimate of lateral earth pressure coefficient on a basement wall supports soil to a depth of 2 m. Unit weight and angle of shearing resistance of retained soil are 16 kN/m^3 and 32° respectively.

10. Draw the lateral earth pressure diagram of clay depend for active condition.

SIXTEEN MARK QUESTIONS

UNIT -I

1. Explain any two methods of site exploration in detail?
2. Explain wash boring method of soil exploration?
3. Explain the arrangements and operations of stationary piston sampler?
4. Explain about standard penetration test?
5. Explain any two important types of samplers
6. Explain with neat sketch auger boring method of soil exploration.
7. Explain dynamic cone penetration test.
8. Describe the salient features of a good sub-soil investigation report?

UNIT -II

1. What is shallow foundation? Explain its types?
2. What is settlement? What are the components of settlement? Distinguish between them?
3. Explain the test to be conducted for find out the bearing capacity?
4. What is bearing capacity? What are the factors affecting bearing capacity? what are improving factors of bearing capacity?
5. A Strip footing of width 3m is founded at a depth of 2m below the ground surface in a (c-φ) soil having a cohesion c = 30 kN/m^2 and angle of shearing resistance φ = 35^o. The water table is at a depth of 5m below ground level. The moist weight of soil above the water table is 17.25 kN/m^2.

   For φ = 35^o, N_c = 57.8, N_q = 41.4 and N_γ = 42.4

   Determine (i) the ultimate bearing capacity of the soil
   (ii) the net bearing capacity of soil
   (iii) the net allowable bearing pressure and the load/m length for a FS = 3.

   Use the general shear failure theory of Terzaghi.

6. Size of an isolated footing is to be limited to 1.5 metres square. Calculate the depth at which the footing should be placed to take a load of 200 kN, with a factor of safety 3. The soil is having angle of internal friction φ = 30^o. The weight of the soil is 21 kN/m^3. Bearing capacity factor for φ = 30^o, N_q=22 and N_γ = 20.

7. Calculate the settlement of a structure founded on a clay. Thickness of clay stratum is 6m at 10m below from the ground level. The overlaying layer is sand upto ground level. Water table is at 6m from the ground level. Unit weight of sand above the water table is 18 kN/m^3 and below water table it is 21 kN/m^3. Specific gravity of the clay is 2.75, natural moisture content of the clay is 40% and its liquid limit is 45%. Increase in overburden pressure at the centre of the clay structure, due to proposed construction of the building is 100 kN/m^2.

8. Explain Terzaghi's analysis of bearing capacity of soil in general shear failure.

9. A Strip footing of width 3m is founded at a depth of 2m below the ground surface in a (c-φ) soil having a cohesion c = 30 kN/m^2 and angle of shearing resistance φ = 35^o. The moist weight of soil above the water table is 17.25 kN/m^2.

For $\varphi = 35^o$, $N_c = 57.8$, $N_q = 41.4$ and $N_\gamma = 42.4$
For $\varphi = 25^o$, $N_c = 25.1$, $N_q = 12.7$ and $N_\gamma = 9.7$
The water table is at a depth of 5m below ground level. Determine
(i) the ultimate bearing capacity of the soil
(ii) the net bearing capacity of soil
(iii) the net allowable bearing pressure and the load/m length for a FS = 3.
Assume the soil fails in local shear .

10. A Strip footing of width 3m is founded at a depth of 2m below the ground surface in a (c-φ) soil having a cohesion c = 30 kN/m^2 and angle of shearing resistance $\varphi = 35^o$. The moist weight of soil above the water table is 17.25 kN/m^2.
For $\varphi = 35^o$, $N_c = 57.8$, $N_q = 41.4$ and $N_\gamma = 42.4$
For $\varphi = 25^o$, $N_c = 25.1$, $N_q = 12.7$ and $N_\gamma = 9.7$
If the water table occupies any of the positions
(i) 1.25 m below Ground Level or
(ii) 1.25 m below the base level of the foundation,
What will be the net safe bearing pressure?
Assume γ_{sat} = 18.5 kN/m^3, γ (above WT) = 17.5 kN/m^3, Factor of Safety = 3

11. Explain different types of shear failures of soil with neat sketch
12. Compute the consolidation settlement by oedometer test data method

13. A footing rests at a depth of 1m has a size of 3m x 1.5m and it causes a pressure increment of 200 kN/m^2 at its base. The soil profile at the site consists of sand for the top 3 m, which is underlined by a clay layer of 3m. Water table is at a depth of 2.5m from the ground surface. The unit weight of sand layer above and below water table are 16kN/m^3 and 18 kN/m^3 respectively. The unit weight of clay is 15 kN/m^3. The initial void ratio is 0.8 and compression index is 0.3. Determine the consolidation settlement at the middle of the clay layer. Assume 2:1 pressure distribution and consider the variation of pressure across the depth of the clay layer.

14. Compute the safe bearing capacity of a square footing 1.5 m x 1.5 m located at a depth of 1 m below the ground level in a soil of average density 20 kN/m^3. $\Phi = 20°$, Nc = 17.7, Nq = 7.4 and Nγ = 5. Assume a suitable factor of safety and that the water table is very deep. Also compute the reduction in safe bearing capacity of the footing if the water table rises to the ground level.

UNIT -III

1. What are the different types of raft foundations?
2. State the design requirement of a foundation?
3. Briefly explain about the structural design of spread footing
4. Briefly explain how proportioning and structural design of trapezoidal combined footing is done with diagram
5. Derive the relation between the dimensions of trapezoidal combined footing and unequal column loads Q1 and Q2?

6. A trapezoidal footing is to be produced to support two square columns of 30 cm and 50 cm sides respectively. Columns are 6 meters apart and the safe bearing capacity of the soil is 400 kN/m^2. The bigger column carries a load of 500 kN and the smaller carries a load of 3000kN. Design a suitable size of the footing so that if does not extend beyond the face of the columns.

UNIT -IV

1. Explain the method of determining the load carrying capacity of a pile?
2. What are the cased cast in-situ concrete piles?
3. What are the uncased cast in-situ concrete piles?
4. What are different types of piles and their functions?
5. What are group capacity by different method
6. What are the various factors influencing the selection of pile?
7. Explain briefly cyclic load test on pile.
8. A pile is driven with a single acting steam hammer of weight 15kN with a free fall of 900mm. The final set, the average of the last three blows, is 27.5mm. Find the safe load using the Engineering News formula.

9. A group of 16 piles of 50 cm diameter is arranged with a center to center spacing of 1.0 m. The piles are 9m long and are embedded in soft clay with cohesion 30kN/m. Bearing resistance may be neglected for the piles. Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group.

UNIT -V

1. Explain the active and passive states of earth pressure acting on a retaining wall.
2. Explain the Coulomb wedge theory with neat sketches
3. Explain the Rebhann's graphical method for active earth pressure calculation
4. Explain the Culmann's graphical method and the effect of line load
5. Explain the Rankine's theory for various backfill condition to calculate active state earth pressure.
6. A retaining wall is 4 metres high. Its back is vertical and it has got sandy backfill upto its top. The top of the fill is horizontal and carries a uniform surcharge of 85 kN/m^2. Determine the active earth pressure on the wall per metre length of wall. Water table is 1m below the top of the fill. Dry density of soil = 18.5 kN/m^3. Moisture content of soil above water table = 12%. Angle of internal friction of soil = 30°, specific gravity of soil particles = 2.65. Porosity of backfill = 30%. The wall friction may be neglected.