

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER-2024
SUBJECT: ADVANCED FOUNDATION ENGINEERING

Time: 3 HOURS Full Marks : 100

(PART I – 50 MARKS)

Use separate Answerscript for each part
Assume reasonable values of data not supplied

C.O.3

Q 1. Discuss under which situation Braced Excavation technique is adopted for underground construction. Draw a neat sketch of braced excavation 10m deep x 25m wide to be constructed with diaphragm wall along with waler beams and struts. 3+7 =10

C.O.5

Q 2. A steel storage tank 50m diameter x 10m high is to be founded on subsoil deposit given below.

Stratum I : Soft clay of thickness 15.0m with undrained cohesion $C_u = 25\text{kPa}$, $\gamma_{\text{sat}}=17\text{kN/m}^3$, $C_c/1+e_0 = 0.14$.

Stratum II : Stiff over-consolidated clay with undrained cohesion $C_u = 75\text{kPa}$, $\gamma_{\text{sat}}=19\text{kN/m}^3$, $C_c/1+e_0=0.07$ down to 20.0m below ground level.

Stratum III: A deep deposit of sand (below 20.0m) of angle of shearing resistance 34° and bulk density 19.5kN/m^3 .

GWT is at the ground level.

The formation level of the ground is to be raised by 1m sand fill prior to construction. The soil is proposed to be treated by 0.80m diameter and 15m long stone column placed at a spacing of 1700mm c/c.

- a. Write the expression for bearing capacity of a single stone column and determine the safe bearing capacity of the foundation soil reinforced with stone column with appropriate magnitude of factor of safety.
- b. Derive the expression of consolidation settlement of a soil deposit reinforced with stone column.
- c. Estimate the corresponding settlement of the tank if the average pressure below the tank is 10 t/m^2 due to consolidation of both reinforced and unreinforced layers separately.

10+7+8=25

C.O.5

Q 3. What is radial consolidation? Discuss with the help of neat sketches how this technique is practised with stage construction and / or preloading for ground improvement of soft clay deposit. 2+8=10

C.O.2

Q 4. Draw a neat sketch of a well foundation showing its different components. 5

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PAPER ××××

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Full Marks -50

(50 marks for part I and 50 Marks for part II)

Use a same Answer-Script for each part

No. of
Question

Part -II

CO Marks

- 1) Answer question number 1, question number 2, question number 3 and question number 4.
2) Assume reasonable values of data if it is not supplied.
3) Answer the Part I and Part 2 separately.
4) There is no need of any code etc. for answering Part- II.

Sl. No.

Question

1

What is the equation for uplift force Q_{up} for pier as per Chen (1988)? [CO1] [1+7]

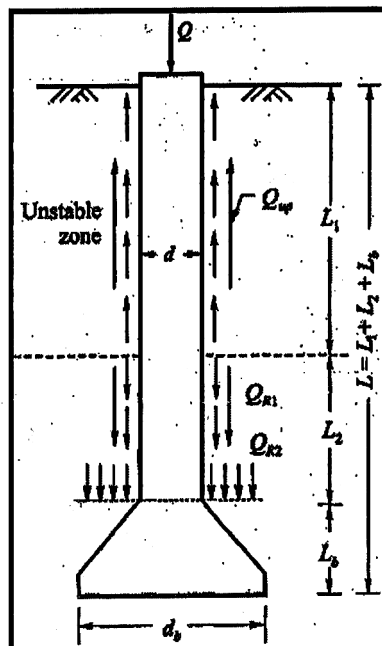
This picture depicts a drilled pier on expanding soil that has a belled bottom (see Fig. shown). There is no interaction with the water table.

The pier and soil's specifics are as follows:

$L_1 = 3.05$ m, $L_2 = 3.05$ m, $L_b = 0.760$ m, $d = 0.305$ m, $d_b = 0.9$ m, $p_s = 480$ kN/m², $c_u = 95$ kN/m², $\gamma = 17.5$ kN/m³,

Required:

- total uplift force Q_{up} ,
- total resisting force Q_R ,
- factor of safety for $Q = 0$ at the top of pier,
- factor of safety for $Q = 90$ kN at the top of pier (assume $\alpha = 0.54$)



2

- Answer any twelve MCQ from the given fourteen MCQ.
- Some MCQ question may have more than one correct alternative, so examine each alternative of each MCQ before giving your choice of the concerned MCQ.
- Giving all alternatives of any MCQ as your choices as correct answers of the concerned MCQ, will lead to zero marks for the concerned MCQ.

[12]

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Use a same Answer-Script for each part

- If anyone attempts more than 12 MCQ, then the first 12 MCQ will be evaluated and considered only and the other extra MCQ will not be evaluated and will not be considered.

✓ Instructions (with examples) for giving answers to MCQ in this part:

Suppose you have to answer following MCQ in your answer script:

MCQ 1) Name of the present prime minister of the India

- a) Jawaharlal Nehru,
- b) Narendra Modi,
- c) Manmohan Singh,
- d) None of the above.

MCQ 2) Virat Kohli is

- a) Captain of the Indian Cricket team,
- b) Player of Royal Challengers Bengaluru,
- c) President of the BCCI,
- d) All of the above.

MCQ 3) Within the last ten months

- a) Iran attacked Israel,
- b) IIC World Cup has been started,
- c) China attacked India,
- d) All of the above.

.....

Then during giving answer in your answer scripts, you have to give the answers of the above MCQ in the following style only:

Part –II

Answer to MCQ 1) : b) Narendra Modi,

Answer to MCQ 2) : b) Player of Royal Challengers Bengaluru,

Answer to MCQ 3) : a) Iran attacked Israel,

b) IIC World Cup has been started,

Note:

(A) In MCQ 2, if anyone give alternative "a)" as one of the correct alternative, he/ she is wrong as Virat Kohli was (not "is") Captain of the Indian Cricket team. So, read each word of the alternatives very carefully before giving your answer.

(B) In MCQ 3, if anybody either alternative "a)" or alternative "b)" as the correct alternative, he/ she will get 0.5 marks as there were two correct alternatives.

(C) There is no negative marking for choosing wrong alternative as your choice in any MCQ.

(i) Collapsible soil can withstand a large applied vertical pressure with small compression, but then show much larger settlement upon wetting, with no increase in: [CO1] [1]

Sru Bishnu 15/05/24

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- (a) Vertical stress,
(b) Horizontal stress,
(c) Both (a) and (b),
(d) Principal stresses.
- (ii) Most economical method of dewatering is: [CO4] [1]
(a) Open sump method,
(b) Deep Well method,
(c) Well point method,
(d) Both (a) and (b),
(e) Both (b) and (c).
- (iii) The Well theory comprises of: [CO4] [1]
(a) Draw down,
(b) Discharge quantity,
(c) Number of wells,
(d) Both (a) and (b),
(e) Both (b) and (c).
- (iv) When well yield is low, then more reliable test is: [CO4] [1]
(a) Well yield test,
(b) Pumping test,
(c) Both (a) and (b),
(d) None of the above.
- (v) Variations in water levels during pumping and recovery (which influence water levels), are naturally caused by: [CO4] [1]
(a) Tidal factor,
(b) River factor,
(c) Barometric factor,
(d) Both (a) and (b),
(e) Both (a) and (c),
(f) Both (a), (b) and (c),
(g) None of the above.
- (vi) In metastable soils: [CO1] [1]
(a) Large loss of shear strength occurs at small changes in stress,
(b) Large loss of shear strength occurs at small changes in deformation,
(c) Great increase in compressibility occurs at small changes in stress,
(d) Great increase in compressibility occurs at small changes in deformation,
(e) Both (a) and (b),
(f) Both (c) and (d),
(g) All from the (a) to (d),
(h) None of the above.
- (vii) There are two types of soils that exhibit: [CO1] [1]
(a) Typical consolidated state,

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- (b) *Volume changes under constant loads with changes in water content,*
 (c) *Both (a) and (b),*
 (d) *None of the above.*
- (viii) *According to Holtz and Hilf, soils have not generally been observed to collapse when:* [CO1] [1]
 (a) *The soil has specific gravity equal to 2.6 and dry unit weight equal to 70 lb/cube ft and liquid limit as 15,*
 (b) *The soil has specific gravity equal to 2.7 and dry unit weight equal to 80 lb/cube ft and liquid limit as 25,*
 (c) *The soil has specific gravity equal to 2.7 and dry unit weight equal to 80 lb/cube ft and liquid limit as 15,*
 (d) *None of the above.*
- (ix) *Under Triaxial stress-state, the magnitude of volumetric strain originating from a change in stress state depends on:* [CO1] [1]
 (a) *Principal stress ratio,*
 (b) *Mean normal total stress,*
 (c) *Both (a) and (b),*
 (d) *None of the above.*
- (x) *To maximize the amount of drawdown for the pumping test, the pump is normally placed:* [CO4] [1]
 (a) *Below the well screen,*
 (b) *At the level of the well screen,*
 (c) *Above the well screen,*
 (d) *All the above.*
- (xi) *“Any type of soil compacted at _____ of optimum conditions and at a _____ dry density may develop a collapsible fabric.” – in this statement the blank spaces should be filled by the following two words:* [CO1] [1]
 (a) *“wet” and “low”,*
 (b) *“dry” and “high”,*
 (c) *“dry” and “low”,*
 (d) *“wet” and “high”.*
- (xii) *“A compacted and metastable soil structure is supported by _____ of the shear strength that is _____, which are highly dependent upon capillary action.” – in this statement the blank spaces should be filled by the following two words:* [CO1] [1]
 (a) *“macro-forces ” and “bonds”,*
 (b) *“micro-forces ” and “bonds”,*
 (c) *“micro-forces ” and “attraction”,*
 (d) *“macro-forces” and “attraction”.*
- (xiii) *“The collapse of a soil is associated with _____ shear failure rather than a/ an _____ shear failure of the soil mass.” – in this* [CO1] [1]

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statement the blank spaces should be filled by the following two words:

- (a) "localized" and "overall",
- (b) "localized" and "general",
- (c) "punching" and "overall",
- (d) "punching" and "general".

(xiv) "On the basis of the crystalline arrangement, clays are divided in to _____ general groups." – in this statement the blank space should be filled by the following word: [CO1] [1]

- (a) two,
- (b) three,
- (c) four,
- (d) five

Answer any three from 3(a), 3(b), 3(c) and 3(d).

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|--------------|--|-----------|
| 3 (a) | What are the key things to consider when designing and planning a pumping test? | [CO4] [5] |
| 3 (b) | How is the pumping rate selected? | [CO4] [5] |
| 3 (c) | How is the pumped water discharged? | [CO4] [5] |
| 3 (d) | A well is located in a 30 m thick confined aquifer of permeability 35 m/day and storage coefficient of 0.004. If the well is pumped at the rate of 1500 liters per minute, calculate the drawdown at a distance of 40 m from the well after 20 hours of pumping. | [CO4] [5] |
| 4 (a) | What is meant by the term "ground improvement"? | [CO5] [3] |
| 4 (b) | Discuss about the principles of the ground improvement.
or
Explain the term "groutability ratio". | [CO5] [5] |
| 4 (c) | What is meant by the term "grouting"? | [CO5] [3] |
| 4 (d) | Discuss about any two of the following threes:
(a) soil grouts,
(b) cement grouts
(c) Chemical grouts. | [CO5] [4] |

End of Questions