

Ref. No. : Ex/CE/PE/B/T/421C/2024(S)

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER  
SUPPLEMENTARY EXAMINATION -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. Draw a neat sketch of braced excavation 10m deep x 25m wide to be constructed with diaphragm wall along with waler beams and struts. Discuss the design criteria required for analysis and design of a typical braced excavation. 5+5 =10

C.O.5

Q 2. A steel storage tank 50m diameter x 12m high is to be founded on subsoil deposit given below.

**Stratum I** : Soft clay of thickness 14.0m with undrained cohesion  $C_u = 23\text{kPa}$ ,  $\gamma_{\text{sat}}=17\text{kN/m}^3$ ,  $C_c/1+e_0 = 0.15$ .

**Stratum II** : Stiff over-consolidated clay with undrained cohesion  $C_u = 70\text{kPa}$ ,  $\gamma_{\text{sat}}=19\text{kN/m}^3$ ,  $C_c/1+e_0=0.08$  down to 20.0m below ground level.

**Stratum III**: A deep deposit of sand (below 20.0m) of angle of shearing resistance  $34^\circ$  and bulk density  $19.5\text{kN/m}^3$ .

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 0.85m diameter and 15m long stone column placed at a spacing of 1600mm 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  $10\text{ t/m}^2$  due to consolidation of both reinforced and unreinforced layers separately.

10+7+8=25

C.O.5

Q 3. What is band drain? Discuss the basic principle of ground improvement of soft clay deposit using Band drain with the help of neat sketches. 2+8=10

C.O.2

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

[ Turn over

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SECOND SEMESTER SUPPLEMENTARY EXAM 2024  
SUBJECT: ADVANCED FOUNDATION ENGINEERING  
(Name in full)**

**PAPER ××××**

**Time: Three hours**

**Full Marks =100  
(50 Marks for part II)**

No. of  
Question

**Part-II**

**CO      Marks**

- 1) Answer all questions from Section A and any five MCQs from the available 10 MCQs in Section B.  
2) Assume reasonable values of data if it is not supplied,  
3) In the cases where excess number of questions will be answered exceeding the required number of question/s, the first required number of question/s will be evaluated only.

**Section A**

Sl. No.

**Answer from 1(a), 1(b).**

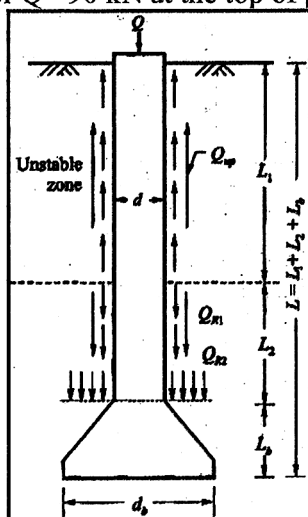
- 1 (a) Write down the equation for uplift force  $Q_{up}$  for pier as per Chen (1988)? [CO1] [1+8]

Here the figure shows a drilled pier [refer to Fig. shown] with a belled bottom in expansive soil. The water table is not encountered. The details of the pier and soil are:

$L_1 = 2.7$  m,  $L_2 = 3.3$  m,  $L_b = 0.760$  m,  $d = 0.305$  m,  $d_b = 0.9$  m,  $p_s = 480$  kN/m<sup>2</sup>,  $c_u = 96$  kN/m<sup>2</sup>,  $\square = 17.3$  kN/m<sup>3</sup>,

**Calculate:**

- (a) total uplift force  $Q_{up}$ ,  
(b) total resisting force  $Q_R$ ,  
(c) factor of safety for  $Q = 0$  at the top of pier,  
(d) factor of safety for  $Q = 90$  kN at the top of pier (assume  $\alpha = 0.51$ )



- (b) When is the soil considered to be metastable? Which soil types are examples of metastable soils? [CO1] [2+4]

Or

What does "free swell" mean? Why are foundations not considered safe if the surrounding soil has the tendency to swell? [CO1] [3+3]

**Answer from 2(a), 2(b), 2(c).**

- 2 (a) What should belong in a report on a pumping test? [CO4] [5]

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- (b) When are tests for pumping required? [CO4] [5]  
 Or  
 Who interprets data from pumping tests?
- (c) Do the groundwater levels fluctuate naturally? When is the best time of year to conduct a pumping test? [CO4] [3+2]
- Answer from 3(a), 3(b), 3(c).*
- 3 (a) Explain about the basics of ground improvement. [CO5] [5]  
 Or  
 Which objectives does the ground improvement aim to achieve?
- (b) What does the term "groutability ratio" mean? [CO5] [5]  
 (c) Discuss about any two of the following threes: [CO5] [5]  
 (a) Cement grouts,  
 (b) Chemical grouts,  
 (c) Soil grouts.

**Section B**

**Choose the correct alternative/ alternatives for any five MCQs from the following 10 MCQs (if more than 5 MCQs will be answered, then only the first 5 answered MCQs will be evaluated and the rest answered MCQs will be ignored):**

- MCQ (1) 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.
- MCQ (2) The collapse of the soil is associated with [CO1] 1  
 (a) Localized shear failure of the soil mass,  
 (b) Overall shear failure of the soil mass,  
 (c) Both (a) and (b),  
 (d) None of the above.
- MCQ (3) Pretreatment technique of soil is being applied for [CO1] 1  
 (a) Stabilizing the soil only,  
 (b) Collapsing the soil deposit to some degree,  
 (c) Both (a) and (b),  
 (d) None of the above.
- MCQ (4) 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),

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(e) Both (b) and (c).

- MCQ (5) 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.
- MCQ (6) An open, unsaturated and partly unstable fabric of soil helps in [CO1] 1  
 (a) Making the soil metastable,  
 (b) Making the soil to be collapsible,  
 (c) Both (a) and (b),  
 (d) None of the above.
- MCQ (7) 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.
- MCQ (8) 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.
- MCQ (9) (vii) There are two types of soils that exhibit: [CO1] 1  
 (a) Typical consolidated state,  
 (b) Volume changes under constant loads with changes in water content,  
 (c) Both (a) and (b),  
 (d) None of the above.
- MCQ (10) “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

*End of Questions*