BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
I Semester 2022-2023
Course: CE F313 Foundation Engineering
Comprehensive Examination
Duration: 180 MINUTES Dated: 17-12-2022 Weightage:40% Max. Marks: 80

Answer Part A and B in separate sheets. You can START Part B (open book) after submitting Part A answer sheet.
PARTA (CLOSED BOOK)

Select most appropriate alternative for Q1 to 40 and answer at same page(EACH 0.5 marks)

Q1. Main advantage of Auger cast in-situ piles is
A) No casing required for bore hole stabilization
B) Good quality control
C) no limitation on pile length
D) no limitation on pile diameter

Q2. Lateral Load capacity of single under-reamed pile is to be increased by …… percent by providing an additional bulb
A) 5 B) 10 C) 20 D)50 E) 100

Q3. As per IS 2911(2010) excessive whipping during handling precast piles may generally be avoided by limiting the length of the pile to a maximum of _____ times the least width.
A)100 B) 25 C) 30 D) 40 E) 50

Q4. Consider following statements for precast driven *piles*
1. Piles can be installed without much noise, vibration
2. Being non-displacement pile, no risk of heave
3. Good quality control.

A) only 3 & 2 are correct , B) only 3 is correct, C) only 2 is correct
D) only 1 and 3 are correct E) All statements are wrong

Q5. As per IS 2911(2010), the minimum grade of concrete to be used for piling is _____.
(A) M40 (B) M20 (C) M25 (D) M30

Q6. In bored cast in-situ under-reamed piles the bulb diameter shall normally be ….. times stem diameter
A)1.5 B) 2.5 C) 3.25 D) 3.5 E) 3.75

Q7. For a large building total 2200 precast concrete piles to be used. Find minimum number of initial test piles for initial load tests. Use IS2911 guidelines. [2 marks]
A)22 B) 2 C) 3 D) 4 E) 11

Q8. In under-reamed piles the top most bulb should be at a minimum depth of ….. time bulb diameter
A)1 B) 2 C) 3 D) 4 E) 5

Q9. Consider following statements for *bored and cast-in situ piles*
1. Piles can be installed without much noise, vibration
2.. Being displacement pile, no risk of loosening of sandy soil.
3. Feasible in strata with cobbles and boulders.

A) 1&2 both are correct B) only 1 is correct C) only 2 is correct
D) only 1 and 3 are correct E) All statements are correct

Q10. For checking stability of footing just after construction resting on saturated clay which test you will suggest for shear strength parameters
A) UU test B) CU test C) CD test D) direct shear test

Q11. Consider following statements
1. The ***deeper the new foundation*** and the ***nearer to the existing*** it is located, the greater the damage is likely to be.
2. The shallower ***the new foundation*** and the ***nearer to the existing*** it is located, the greater the damage is likely to be.
3. The ***deeper the new foundation*** and the far ***to the existing*** it is located, the greater the damage is likely to be.

Out of these statements,
A) 1&2 both are correct B) only 1 is correct C)only 2 is correct
D) only3 is correct E) only 1 and 3 are correct

Q12. Consider following statements for Geosynthetics
1.MARV stands for minimum average roll value
2. MARV stands for maximum average roll value
3.MARV means only 5% test results fall below desired value
Out of these statements,
A) 1&2 are correct B) only 1 is correct C)1 and 3 are correct D) only3 is correct

Q13. A strap footing is provided when
A. a footing of a column near property line is heavily eccentrically loaded and its distance with nearest interior column is so large that a combined footing becomes excessively long & narrow.
B. space restriction on the interior column footing which cannot be placed centrally under the interior column.
C. Footing near to property line is less loaded compare to interior footing
D. Two footings are very close say less than 5m.

Q14. It is found wind load is 50 percent of that due to dead and live loads, as per IS1904, foundations may be so proportioned that the pressure due to combination of load (that is, dead + live + wind load) does not exceed the allowable bearing pressure by more than
A) 10% (B) 25% (C) 33.33% (D)50% E) No increase allowed

Q15. When water table rises to ground level from a great depth, the ultimate bearing capacity of a strip footing in pure sandy soil decreases approximately by ---------- of original value.
A: 30% B: 50% C: 70% D: 20% E: 33.33%

Q16. The bearing capacity factors N_c, N_q and N_t are functions of
A. Width and depth of footing
B.Density of soil
C.Cohesion of soil
D.Angle of internal friction of soil
E.Both cohesion and angle of internal friction of soil
F. NONE OF THESE

Q17. Which is most suitable anti-liquefaction measures for new industry away from existing habitation?

A) Gravel drains B) Vibroflotation C) Dynamic compaction D) Compaction grouting

Q18. Which technique is most suitable for a new multi-storey building in urban environment with environment protection?
A) Vibrocompaction by wet top feed method B) Vibrocompaction by dry bottom feed method C) Dynamic compaction D) Compaction grouting

Q19. In soft clays settlements are best accelerated by
A)geotextile B) preloading C)densification D) pre fabricated vertical drains

Q20. As per IS2911 minimum centre to centre spacing of friction piles is …..times diameter of piles.
A)2 B) 2.5 C) 3 D) 5 E) 2.25

Q21. Which the following can serve function of drainage
A) Geogrid B) Geonet C)Non-woven Geotextile D) Geomembrane E) Geocell

Q.22. When stone columns are made in soft clays using vibrofloat this technique is called as
A) Vibrocompaction B) Vibroreplacement C) Insitu densification D) vibrocolumn

Q23. Which the most important property for drainage function
A) High Transmissivity B) High permeability C) High tensile strength D) Low elongation

Q.24. Which of the following is lowest cost method for in-situ densification of deep deposits of loose sands
A) Compaction piles B) Vibroflotation C) Dynamic compaction D) Jet grouting

Q25. As per IS:1904-2021, **w**ind or seismic load may be neglected in design of foundations when it is
A: less than 10% of dead load and live loads B: less than two third of dead load and live loads
C: less than 50% of dead load and live loads D: less than 25% of dead load and live loads

Q26. Consider following statements, as per IS:1904-2021
1.It is good to have big trees near buildings on expansive soils
2.No tree which grow to a large size shall be planted within 6 m of foundations of buildings in expansive soils.
3.It is good to have trees large size trees within 3 to 4 m of foundations of buildings in expansive soil.
Out of these statements,
A) 1&2 both are correct B) only 1 is correct C) only 2 is correct
D) only3 is correct E) only 1 and 3 are correct

Q27. When a footing is resting on sloping ground, horizontal distance from the lower edge of the footing to the sloping surface shall be at least --------.
A) 50mm B) 50 cm C) 70cm D) 90 cm E) 70 mm

Q28. The minimum horizontal spacing between existing and new footings shall be
A: equal to twice width of smaller footing B: equal to width of smaller footing
C: equal to width of wider footing D: equal to twice width of wider footing
E: equal to 1.5 times the width of smaller footing

Q29. The wall friction of retaining wall
A. Decreases active earth pressure but increases passive earth pressure
B. Decreases passive earth pressure but increases active earth pressure
C. Decreases both active and passive earth pressures
D. Increases both active and passive earth pressures

Q30. What is the lowest cost testing procedure for finding safe bearing capacity and settlement of shallow foundation/ combine footings with width ranging from 2 m to 5 m resting on dry deep deposit of loose to medium dense sand?
A) Direct shear test B) Triaxial test C) SPT D) Plate load test E) Consolidation test

Q31. In a plate load test, how is the ultimate load estimated from the load settlement curve on a log-log graph?
A. by intersection point of two straight lines
B. By drawing tangents to the curve at the initial and final points
C. By the secant method
D. At 0.2 % of the maximum settlement

Q. 32. Study the statements listed below
1. Negative skin friction is developed when the pile is driven through a recently deposited clay layer
2. Negative skin friction is developed when the pile is driven through a layer of dense sand
3. Negative skin friction is developed due to a sudden drawdown of the water table
Of these statements
A: 1 alone is correct
B: 2 alone is correct
C: 2 & 3 are correct
D: 1 & 3 are correct

Q33. Uplift Load capacity of single under-reamed pile in uplift is to be increased by …… percent by providing an additional bulb
A) 5 B) 10 C) 20 D)50 E) 100

Q34. Which one of the following different types of submerged soil is most susceptible to liquefaction under earthquake?
A. Dense well graded sand
B. Soft clay
C. Loose non-plastic silt
D. Loose sandy clay with high plasticity of clay particles

Q35. For a bored concrete pile estimated safe load is 200 kN. Upto what load (kN) initial load test should be conducted for initial test pile. Use IS2911-part4 guidelines. [1mark]
A)200 B) 100 C) 150 D) 500 E) 2000

Q.36. Consider the following statements

1. Coulomb earth pressure theory does not take the roughness of wall into consideration
2. Active earth pressure on a retaining wall decreases due to increase in wall friction
3. Rankine theory of earth pressure assumes that back of wall is vertical and smooth

Of these statements
A: 1 and 2 are correct
B: 3 and 1 are correct
C: 2 and 3 are correct
D: 1, 2 and 3 are correct

Q37. Which of the following statements are correct?

1. All soils can experience liquefaction under strong vibrations.
2. Liquefaction is generally associated with saturated sandy soils.
3. Liquefaction is not possible in normal clays.
4. Highly sensitive clays may undergo phenomenon *similar* to liquefaction under vibrations.

A. 1 and 3,
B. 2 and 4
C. 2 and 3
D. 2, 3 and 4

Q38. As per IRC 6-2017, active earth pressure due to dry backfill act at a height of .... from base of wall. H is height of wall.
A)0.42 H B) 0.66H C) 0.3 H D) 0.5 H

Q39. Active earth pressure due to surcharge act at a height of ..... from base of wall. H is height of wall.
A)0.66 H B) 0.33H C) 0.5 H D) 0.25 H

Q40. Which the following can serve function of reinforcement, separation, filter and drainage
A) Geogrid B) Geonet C)Geotextile D) Geomembrane E) Geocell

PART B (OPEN BOOK) CE F313 Foundation Engineering, Comprehensive Examination, Part B, Dated: 17-12-2022
Note: You are allowed to do Part B open book after submitting Part A answer sheets.

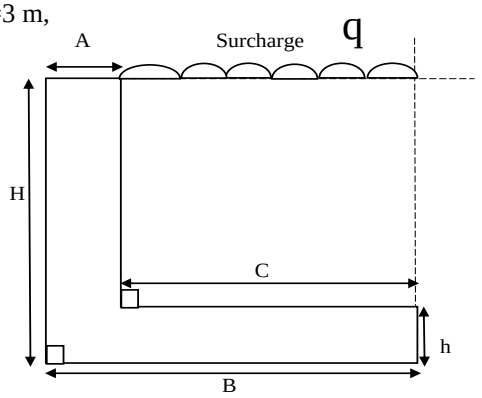
Q1. Find the net safe bearing capacity of 2 m square footing placed at a depth of 1.5 m. Observed SPT N_{60} values of the sandy soil (having good permeability) are given below. Water table is at a depth of 1m from GL. Above and below water table unit weight of soil is 18 kN/m^3 and Poisson's ratio is 0.3. Use IS 6403-1981 provisions. [10 marks]

Depth (m) from GL	0.75	1.5	2.25	3	3.75	4.5	5.5	7.0	8.5	10
N_{60}	8	7	8	10	10	25	18	34	36	37

Q2. Find the length of 1 m diameter bored concrete pile into clay stratum as given below. Safe load to be carried by pile is 1100 kN. Use IS 2911-2010 recommendations. **[5 marks]**

Depth from GL	Soil type	properties
0-4m	Clay	γ =17kN/m^3 c_u=40 kPa
4-10m	Clay	γ =18kN/m^3 c_u=60 kPa
10 m onward deep deposit	Clay	γ =20kN/m^3 c_u=110kPa

Q3. A L shape reinforced concrete retaining wall is having dimensions H=7m, A=0.3 m, B=3 m, h=0.4m. Surcharge q=18 kPa imposed due to traffic load. Calculate the factor of safety with respect to sliding and overturning. Backfill soil is dry sand, unit weight γ = 18 kN/m^3, Φ' = 38. Soil below retaining wall base is same as backfill. Draw pressure distribution at the base of wall and is it safe? Allowable bearing pressure = 250 kPa. Use IRC 6-2017.



[15 marks]

Q4. A hospital is to be constructed near a river in Zone IV. Site is loose sandy soil (having 15% fines) with $N_1)_{60}$ value of 9 only. It is proposed to improve soil to ensure safety against liquefaction. Find value of $N_1)_{60}$ after soil improvement for no liquefaction as per IS 1893-part1-2016 (Youd et al. approach) at a depth of 3 m from ground level. Expected moment magnitude (Mw) is 7 Assume water table at 1 m from ground level and unit weight of saturated sandy soil is 18 kN/m^3. Assume soil is saturated above water table also. Is this value matching with screening criterion given in IS 1893-part1-2016? Comment on adequacy of screening criterion given in IS 1893-part1-2016 based on similarity (or discrepancy) of results. What are most appropriate liquefaction screening guidelines as per Indian code of practices. [10Marks]

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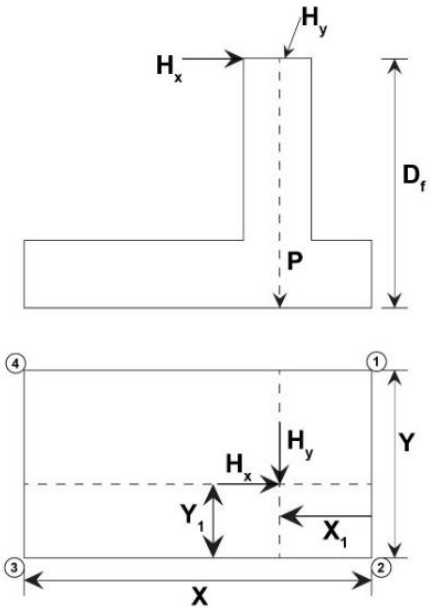
Q5. An isolated footing 4 m x 6 m is designed for the column whose centre coincides with the centre of footing (X=2 X_1 and Y= 2Y_1) is subjected to horizontal forces at height of D_f = 2m from base of footing as shown in figure (not to the scale) Hx = 1190 kN and H_y = 250 kN, as well as vertical load P = 2225 kN. Allowable bearing pressure for sandy soil is 250 kPa and uplifting of footing is not allowed. Is footing safe? If not, what should be the revised dimension (increase only one side X or Y) to make it safe for minimum area of footing? Also find pressure at all corners (1,2,3,4) of footing base after safe design. Draw the properly dimensioned plan of the foundation and pressure distribution at the base. **[10 marks]**



Q6. A block vibration test was conducted on a concrete block of size 1.5 m x 0.75 m x 0.7 m high using vertical excitation. Assume weight of oscillator and motor 2 kN. The results are as follows.

Frequency (rpm)	600	700	800	900	950	1100
Amplitude(mm)	0.6	0.8	0.9	2.4	1.7	1.3

Find shear modulus and coefficient of elastic uniform compression applicable for foundation block having base dimension 3m x 5m. Poisson' ratio of soil = 0.3. **[5 Marks]**

Q7. A fixed head reinforced concrete (M35 grade) bored pile 1m diameter is constructed into a submerged sand to a depth of 7m for a highway bridge. given: design SPT value 16. The submerged unit weight of the soil is 8.75 kN/m3. A lateral load of 100kN and a moment of 30 kN-m applied on the pile head at ground level. Compute the lateral deflection at ground level under applied loads. Is it safe for computed deflection? If not, make it safe without changing dimension? **[5 marks]**

-PAPER ENDS-