7 CHAPTER

Stress Distribution of Soil

Q.1 Westergaard's analysis for stress distribution beneath loaded areas is applicable to
(a) Sandy soils
(b) Clayey soils
(c) Stratified soils
(d) Silty soils

Q.2 Consider the following characteristics of soil layer
1. Poisson's ratio
2. Young's modulus
3. Finite nature of soil layer
4. Effect of water table
5. Rigidity of footing
Westergaard's analysis for pressure distribution in soil utilizes
(a) 1, 3, 4 and 5 (b) 2, 3, 4 and 5
(c) 3, 4 and 5 (d) 1 and 2

Q.3 An isobar is a curve which joins points of
(a) equal horizontal stress
(b) equal vertical stress
(c) zero vertical stress
(d) maximum vertical stress

Q.4 The vertical stress on a vertical line at a constant radial distance from the axis of a vertical load in a soil mass
(a) is the same at all depth
(b) increases with depth
(c) first increases, attains a maximum value and then decreases
(d) first decreases, attains a maximum value and then increases

Q.5 **Assertion (A):** Bossinesq's equation is not suitable for sedimentary deposits.
Reason (R): Sedimentary deposits do not represent an isotropic and homogeneous system.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.6 **Assertion (A):** Stresses obtained from Boussinesq's theory are considered reasonably satisfactory in foundation engineering.
Reason (R): They consider elastic soil medium and intensity of allowable stresses below foundation in most cases are quite small and justify elastic solution.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.7 Influence factor 'I' depends on
(a) applied vertical load
(b) type of soil
(c) location of point with respect to load
(d) soil modulus

Q.8 Match List-I with List-II and select the correct answer using the codes given below the lists:
List-I
A. Stress distribution due to point load in homogeneous isotropic medium
B. Stress distribution due to point load in an anisotropic soil medium
C. Influence chart for stress distribution in a rectangular area
D. Influence chart for stress distribution in irregularly shaped areas.

List-II

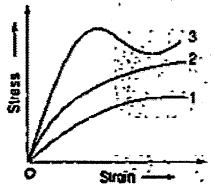
1. Stein Brenner
2. Newmark
3. Boussinesq
4. Westergaard

Codes:

	A	B	C	D
(a)	4	3	2	1
(b)	3	4	2	1
(c)	3	4	1	2
(d)	4	3	1	2

Q.9 For any applied stress, zone of influence refers to isobar corresponding to
(a) 20% (b) 15%
(c) 10% (d) 5%

Q.10 Curve 1, 2 and 3 shown below represents the stress-strain relationship, respectively for



(a) clay, loose sand, dense sand
(b) loose sand, clay, dense sand
(c) clay, dense sand, loose sand
(d) dense sand, loose sand, clay

Q.11 Consider the following statements:
1. An isobar is a curve or contour connecting all points below the ground surface of equal vertical pressure.
2. An isobar is a spatial curved surface of the shape of the bulb.
3. The vertical pressure at every point on the surface of the pressure bulb is same.

Which of these statements are correct?
(a) both 1 and 2 (b) both 2 and 3
(c) both 1 and 3 (d) 1, 2 and 3

Q.12 Study the following statements
1. Equivalent point load method is an approximate method of determining the vertical stress at any point due to any loaded area
2. Newmark's influence chart method is more accurate method of determining the vertical stress at any point
3. The vertical pressure on an infinite strip of width 'B' loaded with uniformly distributed load intensity 'q' per unit area is $q/\pi(\alpha + \sin\alpha)$

Which of the statements is/are correct?
(a) only 3 (b) only 2
(c) both 1 and 3 (d) 1, 2 and 3

Q.13 The depth of the stressed zone below a footing of width b is
(a) b (b) 0.5 b
(c) 2 b (d) 1.5 b

Q.14 An elevated structure with a total load of 1024 kN is supported on a tower with 4 legs. The legs rest on piers located at the corner of a square $2\sqrt{6}$ m on a side. The vertical stress increment due to this loading at a point 4 m beneath the centre of structure will be
(a) 3 kN/m² (b) 6 kN/m²
(c) 9 kN/m² (d) 12 kN/m²

Q.15 The stress distribution at a depth beneath a loaded area is determined using Newmark's influence chart which indicate an influence value of 0.005. The number of the segments covered by the loaded area in the chart is 20 and the intensity of loading on the area is 10 T/m². The intensity of stress distribution at that depth is
(a) 1 T/m² (b) 2 T/m²
(c) 5 T/m² (d) 10 T/m²

Q.16 A point load of 400 kN is applied on the surface of a thick layer of clay. Using Boussinesq's elastic analysis, what is the approximate value of estimated vertical stress (in kN/m²) at a depth 2 m below the point of application of load?
(a) 191.00 (b) 95.50
(c) 382.00 (d) 47.75

Q.17 A raft of size 4 m square carries a load of 200 kN/m². The vertical stress increment at a point 4.0 m below the centre of loaded area using Boussinesq's theory will be
(a) 200 kN/m² (b) 150 kN/m²
(c) 95.5 kN/m² (d) None of these

Q.18 A concentrated load acting on the surface of a soil produces a stress of 19.1 kPa at a depth of 1 m below it. Using Boussinesq's expression, the stress at 2 m depth is
(a) 9.55 kPa (b) 6.37 kPa
(c) 4.77 kPa (d) 4.37 kPa

Q.19 The value of influence factor for 10 concentric circles and 20 radial lines is _____

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Answers Stress Distribution of Soil

1. (c)	2. (d)	3. (b)	4. (c)	5. (a)	6. (a)	7. (c)	8. (c)	9. (a)	10. (a)
11. (d)	12. (d)	13. (d)	14. (a)	15. (a)	16. (d)	17. (c)	18. (c)	19. (0.005)	

Explanations Stress Distribution of Soil

2. (d)
$\mu \to 0$ and $\frac{E_h}{E_v} \to \infty$

7. (c)
Influence factor $= I = \dfrac{1}{\left[1+\left(\frac{r}{z}\right)^2\right]^{5/2}}$

9. (a)
Stress isobars are the lines joining points with equal vertical stress generally effect of vertical stress is neglected beyond the zone of 20% isobar, the approximate depth of 20% isobar is 1.5 B, where B is the size of footing.

14. (a)

$$r = \sqrt{(2\sqrt{6})^2 + (2\sqrt{6})^2} = \sqrt{48}$$

$$r = 4\sqrt{3}\text{m}$$

$$\sigma_z = \frac{3Q}{2\pi z^2}\left[\frac{1}{1+(r/z)^2}\right]^{5/2}$$

Load on each pier

$$Q = \frac{1024\pi}{4} = 256\pi$$

$$\sigma_z = \frac{3\times 256\pi}{2\pi\times 16}\left[\frac{1}{32}\right] = 0.75$$

Stress increment at centre due to total load
$= 4 \times 0.75 = 3\ \text{kN/m}^2$

15. (a)
$\sigma_z = NI_f q = 20 \times 0.005 \times 10 = 1\ \text{T/m}^2$

16. (d)
According to Boussinesq's theory,

$$\sigma_z = 0.4775\frac{Q}{z^2} = 0.4775 \times \frac{400}{(2)^2} = 47.75\text{kN/m}^2$$

17. (c)
Total load at the centre of footing (Q)
$= 200 \times 4 \times 4 = 3200$ kN

$$\sigma_z = \frac{3Q}{2\pi z^2}\left[\frac{1}{1+(r/z)^2}\right]^{5/2}$$

$r = 0$ for stress at a point directly below the load
$z = 4$ m

$$\therefore \sigma_z = \frac{3Q}{2\pi z^2}\left(\frac{1}{1}\right)^{5/2} = 95.49\ \text{kN/m}^2 \simeq 95.5\ \text{kN/m}^2$$

18. (c)

$$\sigma_z = \frac{3}{2\pi}\left[\frac{1}{1+\left(\frac{r}{z}\right)^2}\right]^{5/2}\frac{Q}{Z^2}$$

Just below the load $r = 0$

$$\therefore \quad \sigma_z = \frac{Q}{Z^2}\times\frac{3}{2\pi}$$

$$\sigma_z \propto \frac{1}{Z^2}$$

$$\frac{\sigma_1}{\sigma_2} = \frac{Z_2^2}{Z_1^2}$$

$$\frac{19.1}{\sigma_2} = \frac{4}{1}$$

$$\Rightarrow \quad \sigma_2 = 4.775\ \text{kPa}$$

19. (0.005)

$$IF = \frac{1}{mn} = \frac{1}{20\times 10} = 0.005$$

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