# Soil Mechanics Test 2

**Number of Questions: 25** **Time: 60 min.**

***Directions for questions 1 to 25:*** Select the correct alternative from the given choices.

**1.** The intensity of radial shear stress at a point 8 m below vertically and 5 m horizontally below a point load of 3 tonnes is
(A) 1.438 t/m$^2$ (B) 1.583 t/m$^2$
(C) 1.875 t/m$^2$ (D) 2.013 t/m$^2$

**2.** The curves indicating the distribution of excess hydrostatic pressure in the soil are known as
(A) isobars (B) isochrones
(C) isotopes (D) isohyts

**3.** The soil which is compacted to the dry of optimum has
(A) low swelling
(B) low shear strength
(C) high swelling
(D) None of the above

**4.** The critical shear plane will have an angle of _____ with reference to major principle plane
(A) $45° + \frac{\Phi}{2}$ (B) $35° + \frac{\Phi}{2}$
(C) $90° + \Phi$ (D) $135° + \frac{\Phi}{2}$

**5.** Under active pressure condition the failure wedge moves
(A) towards right
(B) towards left
(C) towards upward
(D) towards downward

**6.** Westergaard's theory is applicable for which type of soils
(A) Sandy soils (B) Startified soils
(C) humus soils (D) gravel

**7.** During consolidation process
(A) effective pressure on soil decreases
(B) void ratio increases
(C) degree of saturation remains same
(D) excess hydrostatic pressure increases

**8.** The compactive effort in the modified proctor test is about _____ times than that of the standard proctor test
(A) 4.85 (B) 4.65
(C) 4.25 (D) 4.55

**9.** The sensitivity of soil indicates the
(A) moisture holding capacity of soil
(B) shear strength of the soil
(C) consolidation of soil
(D) weakening due to remolding of soil

**10.** The unsupported vertical cut of the embankment if $C = 40$ kN/m$^2$, $\gamma = 30$ kN/m$^3$ and $k_a = 1$ is
(A) 5.23 m (B) 5.33 m
(C) 5.43 m (D) 5.53 m

**11.** A retaining wall of height 10 m retains dry sand. The soil is loose and has a void ratio of 0.8, $\gamma d = 18.8$ kN/m$^3$ and $\Phi = 50°$. The backfill is compacted to a state of 0.5, $\gamma d = 20.8$ kN/m$^3$ and $\Phi = 65°$. The ratio of initial passive thrust to the final passive thrust according to Rankine's earth pressure theory is
(A) 0.35 (B) 2.9
(C) 0.33 (D) 2.7

**12.** A cohesive soil yield a maximum dry density of 1.4 g m/cc at OMC of 16% during a standard proctar test. If the value of $G = 2.65$ then degree of saturation of the soil is
(A) 1.23 (B) 1.86
(C) 1.43 (D) 1.69

**13.** A saturated clay of 6m thick takes 1.6 years for 50% primary consolidation when drained on both sides. Its coefficient of volume charge is $1.5 \times 10^{-3}$ m$^2$/kN. The coefficient of permeability of soil will be
(A) 0.013 m/yr (B) 0.016 m/yr
(C) 1.58 m/yr (D) 2.54 m/yr

**14.** A footing of 3 m × 2 m exerts uniform pressure of 150 kN/m$^2$ on soil.
Assuming a load dispersion of 2 vertical to 1 horizontal, the average vertical stress (kN/m$^2$) at 1 m below the footing is
(A) 50 (B) 80
(C) 45 (D) 100

**15.** Match the following:

| | **Compaction equipments** | | **Usage** |
|---|---|---|---|
| 1. | Tampers | i. | for cohesive and non cohesive soils |
| 2. | pneumatic tyred rollers | ii. | for clays |
| 3. | sheep foot roller | iii. | For confined trenches |
| 4. | Vibratory compactors | iv. | For granular soils |

(A) 1 – iii, 2 – i, 3 – ii, 4 – iv
(B) 1 – iv, 2 – iii, 3 – ii, 4 – i
(C) 1 – iii, 2 – ii, 3 – iv, 4 – i
(D) 1 – ii, 2 – i, 3 – iii, 4 – iv

**16.** (i) In rankine's theory the retaining wall is assumed to be smooth and vertical.
(ii) In coulomb's wedge theory the retaining wall is assume to be rough.
(A) (i) is true, (ii) is false
(B) (i) is false, (ii) is true

(C) (i) and (ii) are true
(D) (i) and (ii) are false

**Common Data for Questions 17 and 18:**
When an unconfined compression test is conducted on a cylinder of soil, it fails under axial stress of 4.3 kg/cm$^2$. The failure plane makes an angle of 60° with horizontal

**17.** The cohesion of soil is
(A) 0.58 kg/cm$^2$ (B) 0.63 kg/cm$^2$
(C) 0.68 kg/cm$^2$ (D) 1.24 kg/cm$^2$

**18.** The angle of internal friction of soil is
(A) 6.5° (B) 20°
(C) 30° (D) 10°

**19.** A 5 m thick clay has coefficient of consolidation 0.025 cm$^2$/min and final settlement 10 cm. The time required for 80% of settlement to occur is

| U | Tv |
|---|---|
| 80% | 0.567 |
| 25% | 0.078 |

(A) $5.6 \times 10^6$ minutes (B) $6.5 \times 10^6$ minutes
(C) $7.5 \times 10^6$ minutes (D) $5.8 \times 10^6$ minutes

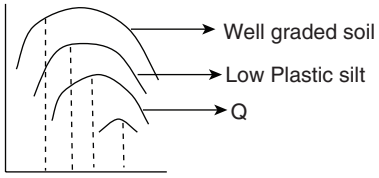
**20.** Time required for 2.5 cm settlement is
(A) $7.5 \times 10^5$ min (B) $7.8 \times 10^5$ min
(C) $7.6 \times 10^5$ min (D) $7.2 \times 10^5$ min

**21.** A 50 kN load acts on the surface of an infinite elastic medium the vertical pressure intensity in kN/m$^2$ at 10 m below and 4 m away from the load will be
(A) 0.048 kN/m$^2$ (B) 0.096 kN/m$^2$
(C) 0.049 kN/m$^2$ (D) 0.035 kN/m$^2$

**22.** With the increase of water content incompaction the maximum dry density will
(A) increase
(B) decrease
(C) first increase and then decrease
(D) first decrease and then increase

**23.** Which of the following property increases with increase in compaction
(A) permeability
(B) shear strength
(C) void ratio
(D) compressibility

**24.**




The type of soil present at $Q$ is
(A) high plastic clay
(B) high plastic silt
(C) low plastic clay
(D) poorly graded soil

**25.** When the OCR = 1 then the type of clay is known as
(A) over consolidated clay
(B) Normal consolidated clay
(C) under consolidation clay
(D) None of these

## Answer Keys

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** C | **2.** B | **3.** C | **4.** A | **5.** D | **6.** B | **7.** C | **8.** D | **9.** D | **10.** B |
| **11.** C | **12.** D | **13.** B | **14.** C | **15.** A | **16.** C | **17.** D | **18.** C | **19.** A | **20.** B |
| **21.** D | **22.** B | **23.** C | **24.** B | **25.** B | | | | | |

## Hints and Explanations

**1.** Radial shear stress $T_{rz} = \sigma_z \left(\frac{T}{z}\right)$

Given $\sigma_2 = 3$ tonnes $= 3 \times 10^3$ kg
$= 3 \times 10^4$ N

$r = 5$m
$z = 8$m

$$T_{rz} = 3 \times 10^3 \times 10 \times \left(\frac{5}{8}\right)$$

$= 18750$ N/m$^2$
$= 1.875$ t/m$^2$. Choice (C)

**10.** Unsupported vertical cut $H_C = \frac{4C}{\gamma\sqrt{k_a}}$

$$H_C = \frac{4 \times 40}{30 \times 1} = 5.33 \text{ m}$$ Choice (B)

**11.** Initial passive thrust
$P_P = K_P \times \sigma_v \qquad \sigma_v = \gamma \times z$
$\sigma_V = \gamma \times z = 18.8 \times 10 = 18.8$ kN/m

$$K_P = \frac{1+\sin(50)}{1-\sin(50)} = 7.54$$

$(P_p)_1 = 7.54 \times 188 = 1419.1$ kN/m

Final passive thrust

$\sigma_V = r \times z = 20.8 \times 10 = 208$ kN/m

$$k_p = \frac{1+\sin(65)}{1-\sin(65)} = 20.34$$

$(P_P)_2 = 208 \times 20.34 = 4232.0$ kN/m

$$\frac{(P_P)_1}{(P_P)_2} = \frac{1419.1}{4232.0} = 0.33$$ Choice (C)

**12.** $eG = Gw$

$$\gamma_d = \frac{\gamma_w G}{1+e}$$

$$\therefore \quad 0.25 \times S = 2.65 \times \frac{16}{100}$$

$$1.4 = \frac{1 \times 2.65}{1+e} \qquad S = 1.69$$

$e = 0.25$ Choice (D)

**13.** $$T_v = \frac{C_V \times t}{d^2}$$

$$d = \frac{H}{2} \rightarrow \text{double drainage}$$

$$\therefore \quad T_V = \frac{C_V \times t}{\left(H/2\right)^2} = \frac{C_v \times t \times 4}{H^2} = \frac{C_V - 3 \times 16 \times 4}{6^2}$$

$T_V$ for 50% consolidation is $= \frac{\pi}{4} \times \left(\frac{50}{100}\right)^2$

$$\therefore \quad \frac{\pi}{4} \times \left(\frac{50}{100}\right)^2 = \frac{C_V \times 3 \times 1.6 \times 4}{6^2}$$

$$\therefore \quad C_V = 1.103$$

$$C_V = \frac{k}{m_v r_w} \quad \therefore K = C_V m_v r_w$$

$= 1.103 \times 1.5 \times 10^{-3} \times 9.8$

$= 0.016$ m/year. Choice (B)

**14.** The average vertical stress

$$= \frac{Q}{(L+z)(B+z)}$$

$Q = A \times q = (3 \times 2)(150) = 900$ kN/m

$$\therefore \quad \sigma = \frac{900}{(3+2)(2+2)} = 45 \text{ KN/m}^2$$ Choice (C)

**16.** Choice (C)

**17.** Unconfined compression test $\sigma = 2 \times C_u \times \tan(45 + \Phi/2)$

$4.3 = 2 \times C_u \times \tan 60°$

$\therefore \quad C_u = 1.24$ kg/cm$^2$. Choice (D)

**18.** $45 + \frac{\phi}{2} = \alpha = 60°$ Angle of internal friction

$= 7.5°.\phi = (60 - 45) \times 2 = 30°$ Choice (C)

**19.** $C_V = T_V d^2/t$

$0.025 = T_V \times (500)^2/t$

$t = 10 \times 10^6 T_V$

when U = 80%, $T_V = 0.567$

$\therefore \quad t = 10 \times 10^6 \times 0.567$

$= 5.67 \times 10^6$ minutes. Choice (A)

**20.** $$U = \frac{2.5}{10} \times 100 = 25\%$$

When $U = 25\%$, $T_V = 0.078$

$\therefore \quad t = 10 \times 10^6 T_V$

$= 10 \times 10^6 \times 0.078$

$= 7.8 \times 10^5$ minutes. Choice (B)

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

$$r = \sqrt{10^2 + 4^2} = \sqrt{100+16} = 10.7\text{m}$$

$$= \frac{50}{100} \times \frac{3}{2\pi} \left[\frac{1}{1+\left(\frac{10.7}{10}\right)^2}\right]^{\frac{5}{2}}$$

$= 0.035$ kN/m$^2$ Choice (D)