CLASS TEST

S.No.: 02SK_CE_EFGHI_04082025

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SOIL MECHANICS

CIVIL ENGINEERING

Date of Test : 04/08/2025

ANSWER KEY

1.	(a)	7.	(b)	13.	(c)	19.	(c)	25.	(c)
2.	(b)	8.	(b)	14.	(b)	20.	(b)	26.	(d)
3.	(c)	9.	(a)	15.	(c)	21.	(d)	27.	(a)
4.	(d)	10.	(b)	16.	(a)	22.	(c)	28.	(b)
5.	(b)	11.	(a)	17.	(d)	23.	(b)	29.	(a)
6.	(a)	12.	(d)	18.	(c)	24.	(d)	30.	(a)

DETAILED EXPLANATIONS

1. (a)

$$(V_w)_{\text{displaced}} = V_{\text{soil}} + V_{\text{wax}}$$

$$\Rightarrow \quad (V_w)_{\text{displaced}} = V_{soil} + \frac{W_{wax}}{G_{wax}\gamma_w}$$

$$\Rightarrow \quad 345 = V_{soil} + \frac{7}{0.9\times 1}$$

$$\Rightarrow \quad V_{\text{soil}} = 337.2 \text{ cc}$$

Now, $$\gamma_d = \frac{W_{\text{solid}}}{V_{\text{soil}}}$$

$$\Rightarrow \quad \gamma_d = \frac{550}{337.2} = 1.63 \text{ g/cc}$$

2. (b)

$P = 32\%$; $W_L = 47\%$; $W_p = 35\%$

$$a = P - 35 = 32 - 35 = -3 = 0$$

$$b = P - 15 = 32 - 15 = 17$$

$$c = W_L - 40 = 47 - 40 = 7$$

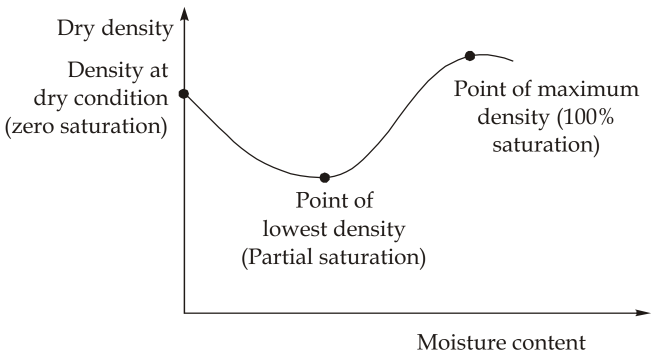
$$d = I_P - 10 = (W_L - W_P) - 10 = (47 - 35) - 10 = 2$$

$$GI = 0.2a + 0.005ac + 0.01\,bd$$

$$\Rightarrow \quad GI = 0.2(0) + 0.005(0\times 7) + 0.01\,(17\times 2)$$

$$\Rightarrow \quad GI = 0.34$$

3. (c)



4. (d)

$$\sigma_1 = 150 \text{ kN/m}^2;\ \theta_c = 52°$$

We know $$\theta_c = 45° + \frac{\phi}{2} = 52°$$

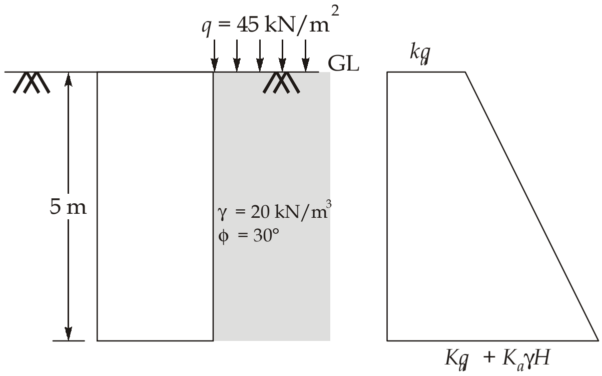
$$\therefore \quad \phi = 14°$$

$$\therefore \quad \sigma_1 = \sigma_3 \tan^2\left(45° + \frac{\phi}{2}\right) + 2c\tan\left(45° + \frac{\phi}{2}\right)$$

$$\Rightarrow \quad 150 = 0 + 2c\tan\left(45 + \frac{14}{2}\right) \qquad \{\sigma_3 = 0, \text{ as tensile unconfined}\}$$

$$\therefore \quad c = 58.6 \text{ kPa}$$

5. **(b)**



Active earth pressure at base

$$= K_a q + K_a \gamma H \qquad \text{where } K_a = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1-\sin 30°}{1+\sin 30°} = \frac{1}{3}$$

$$= \frac{1}{3}(45) + \frac{1}{3}(20)(5) = 48.33 \text{ kN/m}^2$$

6. **(a)**

As per allen Hazen's equation

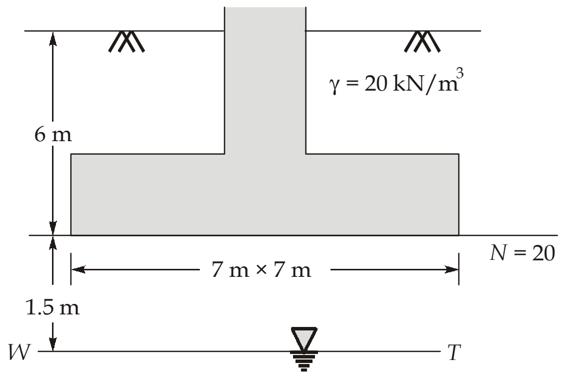
$$k = 100D_{10}^2$$

Here, k is in cm/s, D_{10} is in cm

$$\therefore \quad k = 100 \times (0.15)^2$$

$$= 2.25 \text{ cm/s}$$

7. **(b)**



After overburden correction, corrected SPT value

$$N_1 = \frac{350}{(\sigma' + 70)} \times N = \frac{350}{(20 \times 6) + 70} \times 20 = 36.84$$

8. **(b)**

Given:
W = Weight of hammer = 3 tonne ≃ 30 kN
Q_{ap} = 25 tonne ≃ 250 kN
FOS = 6 (for engineering news record formula if allowable)
C = Combined temporary correction i.e., 0.25 cm for steam hammer
H = Height of all = 100 cm

$$Q_{up} = \frac{WH}{S+C}$$

$$\Rightarrow \quad Q_{ap} = \frac{WH}{(S+C)FOS}$$

$$\therefore \quad 250 = \frac{30\times100}{(S+0.25)6}$$

$$S = 1.75 \text{ cm}$$

9. (a)

$$Q_u = CN_cA_b + \alpha\bar{C}A_s$$

$$\Rightarrow \quad 900 = 40(9)[0.4^2] + \alpha\bar{c}(4\times0.4\times10)$$

$$\Rightarrow \quad \alpha\bar{C} = 52.65$$

So for pile of cross-section 250 mm × 250 mm, ultimate load carrying capacity is

$$Q_u = CN_cA_b + \alpha\bar{C}A_s$$

$$\Rightarrow \quad Q_u = 40(9)(0.25^2) + 52.65(4\times0.25\times18)$$

$$\Rightarrow \quad Q_u = 970.2 \text{ kN} \simeq 970 \text{ kN}$$

10. (b)

$$U = \frac{\Delta h}{\Delta H}$$

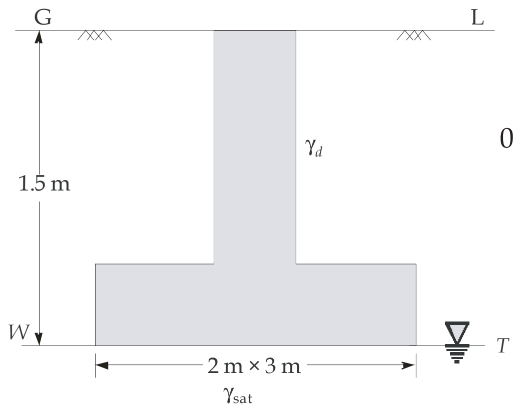
$$\Rightarrow \quad U = \frac{120}{300} = 0.4 < 0.6$$

$$\therefore \quad T_V = \frac{\pi}{4}U^2$$

$$\Rightarrow \quad T_V = \frac{\pi}{4}(0.4)^2$$

$$\Rightarrow \quad T_V = 0.126$$

11. (a)



For sand, C =

$$e = \frac{n}{1-n} = \frac{0.4}{1-0.4} = \frac{2}{3}$$

$$G = 2.7$$

$$\therefore \quad \gamma_d = \frac{G\gamma_w}{1+e} = \frac{2.7\times9.81}{1+\frac{2}{3}}$$

$$\Rightarrow \quad \gamma_d = 15.90 \text{ kN/m}^3$$

$$\gamma_{sat} = \frac{G+e}{1+e}\gamma_w = \frac{\left(2.7+\frac{2}{3}\right)}{\left(1+\frac{2}{3}\right)}\times9.81$$

$$\Rightarrow \quad \gamma_{sat} = 19.81 \text{ kN/m}^3$$

$$q_{nu} = S_q d_q i_q \gamma_d D_f + \frac{1}{2} S_\gamma d_\gamma i_\gamma N_\gamma \gamma' B$$

$$\Rightarrow \quad q_{nu} = (1.33 \times 1.263 \times 1 \times 18.4 \times 15.90 \times 1.5) + \frac{1}{2}(0.733)(1)(1)(18.08)(19.81 - 9381)(2)$$

$$\Rightarrow \quad q_{nu} = 869.68 \text{ kN/m}^2$$

$$q_{nu} = q_u - \gamma_d D_f = 845.83 \text{ kN/m}^2$$

$$\therefore \quad Q_{nu} = 845.83 \times (2 \times 3) = 5075 \text{ kN}$$

12. (d)

$$Q_{up} = 9c\frac{\pi}{4}D^2 + \alpha\bar{c}\pi DL$$

$$= 9(58)\left(\frac{\pi}{4} \times 0.8^2\right) + (0.6 \times 58 \times \pi \times 0.8 \times 9) = 1049.5 \text{ kN}$$

For 16 piles, $nQ_{up} = 16 \times 1049.5 = 16792 \text{ kN}$

$$Q_{ug} = 9CB^2 + \alpha\bar{c}(4BL)$$

$$= 9(58)(6.2)^2 + (1)(58)(4 \times 6.2 \times 9)$$

$$= 33011.28 \text{ kN}$$

where $B = 3S + D = 3(1.8) + 0.8 = 6.2 \text{ m}$

$\alpha = 1$ for pile group

$$\therefore \quad Q_{ag} = \frac{\min\{Q_{ug} \text{ and } n \times Q_{up}\}}{FOS} = \frac{16792}{2.5}$$

$$Q_{ag} = 6716.8 \text{ kN} \simeq 6717 \text{ kN}$$

13. (c)

$$q_u = CN_c + \gamma D_f N_q + \frac{1}{2}\gamma B N_\gamma$$

For local shear failure, $C' = \frac{2}{3}C = \frac{2}{3} \times 36 = 24 \text{ kPa}$

$$\tan\phi' = \frac{2}{3}\tan\phi$$

$$\Rightarrow \quad \phi' = \tan^{-1}\left[\frac{2}{3}\tan\phi\right]$$

$$= \tan^{-1}\left[\frac{2}{3}\tan 20°\right] = 13.64°$$

$$\therefore \quad N_c = 11, \; N_q = 4 \quad N_\gamma = 1.6$$

$$q_u = 24(11) + 20(2)(4) + \frac{1}{2}(20)(2)(1.6)$$

$$\Rightarrow \quad q_u = 456 \text{ kN/m}^2$$

$$\therefore \quad q_{safe} = \frac{q_u - \gamma D_f}{FOS} + \gamma D_f$$

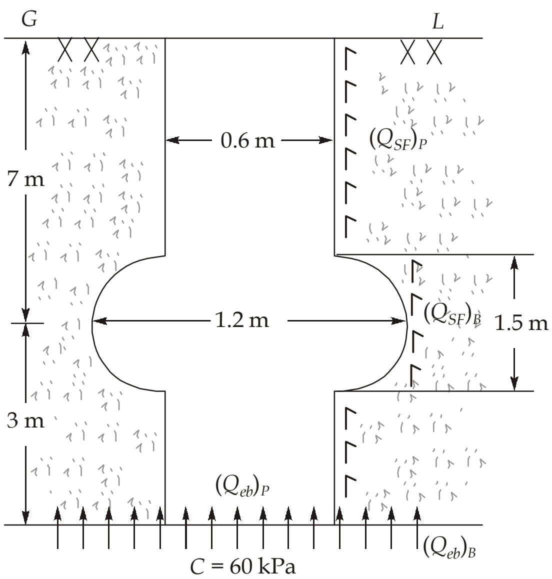
$$\Rightarrow \quad q_{safe} = \frac{456 - 20(2)}{2.5} + 20(2)$$

$\Rightarrow \quad q_{safe} = 206.4 \text{ kN/m}^2$

$\therefore \quad Q_{safe} = 206.4 \times (2 \times 1)$

$\Rightarrow \quad Q_{safe} = 412.8 \text{ kN} \simeq 413 \text{ kN}$

14. (b)



$$Q_{up} = (Q_{eb})_{\text{Pile without bulb}} + (Q_{sf})_{\text{Pile without bulb}} + (Q_{eb})_{\text{Bulb}} + (Q_{sf})_{\text{Bulb}}$$

$$\Rightarrow \quad Q_{up} = 9C\frac{\pi}{4}D^2 + \alpha\bar{c}\pi D(L - L_b) + 9c\frac{\pi}{4}\left(D_b^2 - D^2\right) + \alpha\bar{c}\pi D_b L_b$$

$$\Rightarrow \quad Q_{up} = 9(60)\frac{\pi}{4}(0.6)^2 + 0.6(40)(\pi \times 0.6) \times (10 - 1.5)$$

$$+9(40)\frac{\pi}{4}\left(1.2^2 - 0.6^2\right) + 1(40)(\pi \times 1.2 \times 1.5)$$

$\Rightarrow \quad Q_{up} = 1070 \text{ kN}$

15. (c)

$$\text{FOS} = \frac{c' + \gamma' H \cos^2\beta \tan\phi}{\gamma_{sat} H \cos\beta \sin\beta}$$

For $\quad \text{FOS} = 1, \text{ at } H = H_C$

$$\therefore \quad H_C = \frac{C'}{\cos^2\beta[\gamma_{sat}\tan\beta - \gamma'\tan\phi']}$$

$$\Rightarrow \quad H_C = \frac{12}{\cos^2(18°)[19\tan 18° - (19 - 9.81)\tan 15°]}$$

$\Rightarrow \quad H_C = 3.57 \text{ m}$

16. (a)

$\sigma_3 = 1000$ kPa, $\sigma_3' = \sigma_3 - u$; $\sigma_d = 1600$ kPa; $\sigma_1' = \sigma_1 - u$; $\sigma_1 = 2600$ kPa; as $(\sigma_1 = \sigma_3 + \sigma_d)$

We know,

$$\sigma_1' = \sigma_3' \tan^2\left(45 + \frac{\phi'}{2}\right) + 2c'\tan\left(45 + \frac{\phi'}{2}\right)$$

$$(\sigma_1 - u) = (\sigma_3 - u)\tan^2\left(45+\frac{\phi'}{2}\right) + 2c'\tan\left(45+\frac{\phi'}{2}\right)$$

$$\Rightarrow \quad (2600 - u) = (1000-u)\tan^2\left(45+\frac{25}{2}\right) + 2(220)\tan\left(45+\frac{25}{2}\right)$$

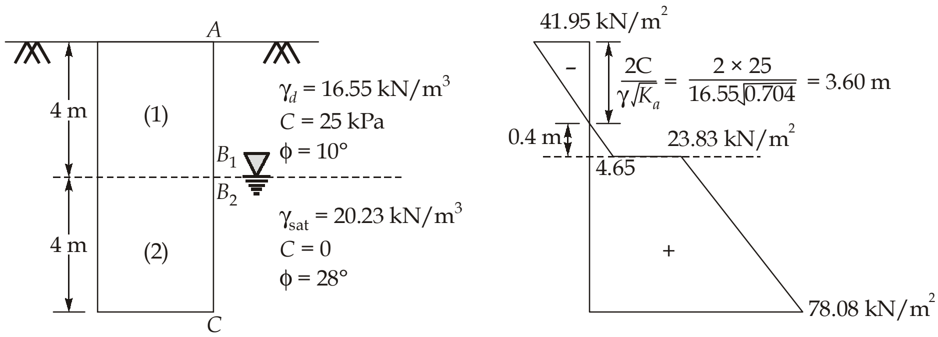
$$\Rightarrow \quad (2600 - u) = (1000 - u)(2.463) + 691$$

$$\Rightarrow \quad 2600 - u = 2463 - 2.463u + 691$$

$$\Rightarrow \quad 1.463u = 2463 + 691 - 2600$$

$$\Rightarrow \quad u = 378.67 \text{ kPa} \simeq 378 \text{ kPa (say)}$$

17. (d)



$$K_{a_1} = \frac{1-\sin 10}{1+\sin 10°} = \frac{0.826}{1.174} = 0.704$$

$$K_{a_2} = \frac{1-\sin 28}{1+\sin 28} = 0.36$$

$$(\gamma_d)_{clay} = \frac{G\gamma_w}{1+e} = \frac{2.7\times 9.81}{1+0.6} = 16.55 \text{ kN/m}^3$$

$$(\gamma_{sat})_{sand} = \frac{G+e}{1+e}\gamma_w = \frac{2.7+0.6}{1+0.6}\times 9.81 = 20.23 \text{ kN/m}^3$$

$$(P_a)_A = -2C\sqrt{K_a} = -2(25)\sqrt{0.704} - 41.95 \text{ kPa}$$

$$(P_A)_{B_1} = -2C\sqrt{K_{a_1}} + \gamma z_1 K_{a_1}$$

$$= -41.95 + 16.55(4)(0.704) = 4.65 \text{ kPa}$$

$$(P_a)_{B_2} = \gamma_d z_1 K_{a_2} = 16.55(4)(0.36) = 23.832 \text{ kPa}$$

$$(P_a)_C = \gamma_d z_1 K_{a_2} + \gamma' z_2 K_{a_2} + \gamma_w z_2$$

$$= 23.832 + (20.23 - 9.81)(4)(0.36) + 9.81(4)$$

$$= 78.08 \text{ kPa}$$

Total active earth pressure on wall = Area of positive portion in earth pressure variation.

$$= \frac{1}{2}(0.4)(4.65) + \frac{1}{2}(23.83+78.08)(4)$$

$$= 204.75 \text{ kN/m} \simeq 205 \text{ kN/m (say)}$$

18. (c)

When slope is dry

$$\gamma_d = \frac{G\gamma_w}{1+e} = \frac{2.75\times 9.81}{1+0.52} = 17.75 \text{ kN/m}^3$$

$$\text{FOS} = \frac{C+\left(\gamma_d H\cos^2 i\right)\tan\phi'}{\gamma H\cos i\,\sin i}$$

$$= \frac{25+\left(17.756\times\cos^2 26°\right)\tan 16°}{17.75(6)\cos 26°\sin 26°}$$

$$= 1.184$$

When slope is subjected to seepage

$$\text{FOS} = \frac{C}{\gamma_{sat}H\sin i\cos i} + \left(\frac{\gamma'}{\gamma_{sat}}\right)\frac{\tan\phi}{\tan i}$$

$$\gamma_{sat} = \frac{G+e}{1+e}\gamma_w = \frac{2.75+0.52}{1.52}\times 9.81 = 21.10 \text{ kN/m}^3$$

$$\therefore \quad \text{FOS} = \frac{25}{21.10(6)\sin 26°\cos 26°} + \left(\frac{21.10-9.81}{21.10}\right)\frac{\tan 16°}{\tan 26°}$$

$$\Rightarrow \quad \text{FOS} = 0.816$$

19. (c)

Volume of cure cutter mould, $V = \frac{\pi}{4}D^2H$

$$\Rightarrow \quad V = \frac{\pi}{4}\times 0.12^2\times 0.14 \text{ m}^3$$

$$\Rightarrow \quad V = 1583.36 \text{ cm}^3$$

Mass of soil sample, M = Mass of (soil + Core cutter) – Mass of core cutter

M = 2840 – 1160 = 1680 gm

Bulk density, $\rho_b = \frac{M}{V}$

$$\Rightarrow \quad \rho_b = \frac{1680}{1583.36} = 1.061 \text{ gm/cc}$$

Dry density, $\rho_d = \frac{\rho_b}{1+w}$

$$\Rightarrow \quad \rho_d = \frac{1.061}{1.05} = 1.01 \text{ gm/cc}$$

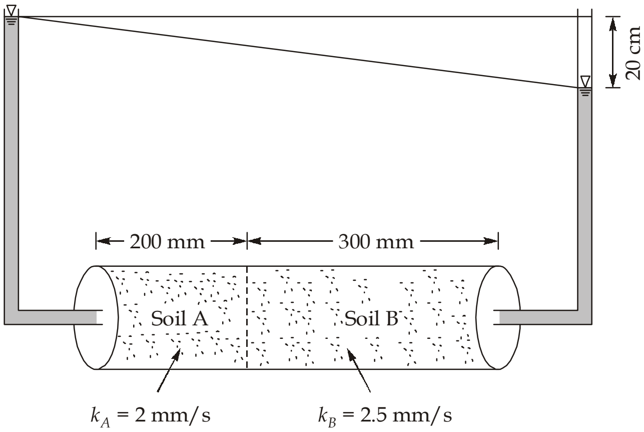
Also, $\rho_d = \frac{G\rho_w}{1+e}$

$$\Rightarrow \quad 1.01 = \frac{2.73\times 1}{1+e}$$

$$\Rightarrow \quad 1+e = 2.70$$

$$\Rightarrow \quad e = 1.7$$

20. **(b)**



∵ This is a case of series arrangement.
∴ Discharge is same in both A and B.

$$k_{eq} = \frac{\Sigma Z}{\Sigma \frac{Z}{k}} = \frac{200+300}{\frac{200}{2}+\frac{300}{2.5}} = \frac{500}{100+120} = 2.27 \text{ mm/s}$$

$$q_A = q_{avg}$$
$$q_A = k_{eq}\, iA$$
$$\Rightarrow \quad q_A = \frac{2.27}{10} \times \frac{20 \times 10}{500} \times 50$$
$$\Rightarrow \quad q_A = 4.54 \text{ cm}^3\text{/s}$$

21. **(d)**

As per result of falling head permeability test

$$K = 2.303 \frac{al}{At} \log \frac{h_o}{h_1}$$

$$a = \frac{\pi}{4} d^2 = \frac{\pi}{4} \times (2 \times 10^{-2})^2 = 3.14 \times 10^{-4} \text{ m}^2$$

$$A = \frac{\pi}{4} D^2 = \frac{\pi}{4} \times (6 \times 10^{-2})^2 = 2.83 \times 10^{-3} \text{ m}^2$$

L = 0.15 m; h_o = 0.45 m; h_1 = 0.30 m; t = 120 sec

$$K = 2.303 \times \frac{3.14 \times 10^{-4}}{2.83 \times 10^{-3}} \times \frac{0.15}{120} \times \log\left(\frac{0.45}{0.30}\right)$$

$$\Rightarrow \quad K = 5.62 \times 10^{-5} \text{ m/s} = 5.62 \times 10^{-5} \times (24 \times 60 \times 60) \text{ m/day}$$
$$\Rightarrow \quad K = 4.86 \text{ m/day}$$

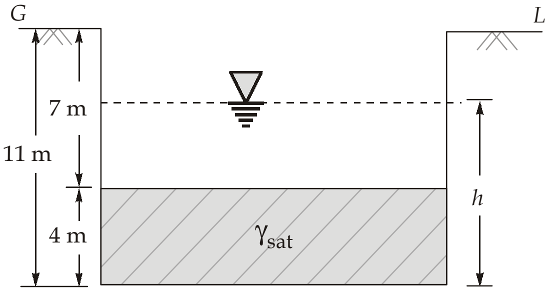
22. **(c)**

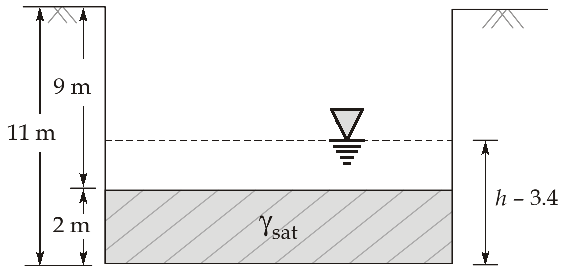
As percentage particles finer than 4.75 mm is 100% it means it is sand.

Dot C_u = 1.40 < 6 → poorly graded

∴ Soil can classified as SP.

23. (b)





$$\gamma_{sat}(4) = \gamma_w(h) \qquad\qquad \gamma_{sat}(2) = \gamma_w(h - 3.4)$$

$$\Rightarrow \gamma_{sat} = \frac{10h}{4} \quad ...(i) \qquad \Rightarrow \gamma_{sat} = \frac{10(h-3.4)}{2} \quad ...(ii)$$

Equate both equation (i) and equation (ii)

$$\frac{10h}{4} = \frac{10(h-3.4)}{2}$$

$$\Rightarrow 2h = 4h - 13.6$$

$$\Rightarrow h = 6.8 \text{ m}$$

$$\therefore \gamma_{sat} = \frac{10\times 6.8}{4} = 17 \text{ kN/m}^3$$

$$\because \gamma' = \gamma_{sat} - \gamma_w$$

$$\therefore \gamma' = 17 - 10 = 7 \text{ kN/m}^3$$

24. (d)

$$\gamma_d = \frac{G\gamma_w}{1+\left(\frac{wG}{S}\right)}$$

$$\Rightarrow 17 = \frac{2.6\times 10}{1+\frac{0.10\times 2.6}{S}}$$

$$\Rightarrow S = 0.4911$$

$$\therefore e = \frac{wG}{S} = \frac{0.10\times 2.6}{0.4911} = 0.5294$$

$$\therefore n = 0.346$$

At full compilation (S = 1)

$$\therefore e = wG$$

$$\therefore e_{min} = 0.10 \times 2.6 = 0.26$$

$$n_{min} = \frac{e}{1+e} = 0.206$$

$$\%\Delta n = \frac{0.346 - 0.206}{0.346}\times 100$$

$$\Rightarrow \%\Delta n = 40.46\%$$

25. (c)

q_u for circular footing

$$q_u = 1.3\,CN_c + \gamma D_f N_q + 0.3\,\gamma\, N_\gamma$$

$\because \quad C = 0$ and $D_f = 0$

{footing is at surface of cohesionless soil}

$\therefore \quad (q_u)_{circular} = 0.3\,\gamma D\, N_\gamma$ {D = diameter of circular footing}

Now, q_u for strip footing

$$q_u = CN_c + \gamma D_f N_q + 0.5\,\gamma\, BN_\gamma$$

$\because \quad C = 0$ and $D_f = 0$

{footing is at surface and soil is cohesionless}

$\therefore \quad (q_u)_{strip} = 0.5\,\gamma D\, N_r$

$$\therefore \quad \frac{(q_u)_{circular}}{(q_u)_{strip}} = \frac{0.3\gamma DN_\gamma}{0.5\gamma BN_\gamma}$$

$\because \quad D = 2B$ (given)

$$\frac{(q_u)_{circular}}{(q_u)_{strip}} = \frac{3}{5}\times\frac{2B}{B} = \frac{6}{5} = 1.2$$

26. (d)

Given, $w_p = 35\%$, $I_p = w_L - w_p = 10\%$, $w_L = (I_p + w_p = 10 + 35) = 45\%$

We know that, $\dfrac{V_L - V_P}{w_L - w_P} = \dfrac{V_P - V_d}{w_P - w_s}$

Given, $V_d = (1 - 0.25)V_p = 0.75\, V_p$

$V_d = (1 - 0.32)V_L = 0.68\, V_L$

$$\therefore \quad w_p - w_s = \frac{(w_L - w_p)(V_p - V_d)}{(V_L - V_p)} = \frac{10\left(\frac{1}{0.75} - 1\right)V_d}{\left(\frac{1}{0.68} - \frac{1}{0.75}\right)V_d}$$

$\Rightarrow \quad w_p - w_s = 24.28$

$\Rightarrow \quad w_s = 35 - 24.28 = 10.72\%$

$$\text{Shrinkage ratio, } R = \frac{(V_1 - V_2)/V_d}{w_1 - w_2}\times 100 = \frac{(V_L - V_d)/V_d}{w_L - w_s}\times 100$$

$$= \frac{\left(\frac{1}{0.68} - 1\right)}{45 - 10.72}\times 100 = 1.372 \approx 1.37$$

27. (a)

As the load is gradually applied from Jan 2007 to Dec 2008, the load is assumed to be instantaneously applied at middle of loading period i.e. in Jan 2008.

Now,

$\Delta h = 100$ mm, $\quad t = 4$ years (from Jan 2008 to Jan 2012)

$\Delta H = 250$ mm

$$\therefore \quad U = \frac{\Delta h}{\Delta H} = 0.4$$

$$\therefore \quad T_V = \frac{C_V t}{d^2}$$

Now there is no change in permeability, coefficient of volume compressibility and drainage depth

$\therefore$ C_V and d will not change

$$\therefore \quad T_V \propto t \begin{Bmatrix} T_{V1} = \frac{\pi}{4}U^2 = \frac{\pi}{4}(0.4)^2 = 0.1256 \\ t_1 = 4 \text{ years} \\ t_2 = 12 \text{ years \{Jan 2008 to Jan 2020\}} \end{Bmatrix}$$

$$\therefore \quad \frac{T_{V1}}{T_{V2}} = \frac{t_1}{t_2}$$

$$\Rightarrow \quad \frac{0.1256}{T_{V2}} = \frac{4}{12}$$

$$\Rightarrow \quad T_{V2} = 0.377 > 0.28 \text{ i.e. } U > 60\%$$

$$\therefore \quad T_{V2} = -0.9332 \log (1 - U_2) - 0.0851$$

$$\Rightarrow \quad 0.377 = -0.9332 \log (1 - U_2) - 0.0851$$

$$\Rightarrow \quad U_2 = 0.68 \text{ i.e. } U_2 = \frac{\Delta h}{\Delta H}$$

$$\therefore \quad 0.68 = \frac{\Delta h}{250}$$

$$\Rightarrow \quad \Delta h = 170 \text{ mm}$$

28. (b)

As the flow is in upward direction.

$\therefore$ $P_H = H_1 + Z + iZ$

Where, H_1 = Height of water above soil surface = 2 m

Z = Vertical depth of section = 1 m

i = Hydraulic gradient = $\frac{\Delta h}{L} = \frac{2}{4} = 0.5$

$\therefore$ $P_H = 2 + 1 + 0.5\ (1)$

$\Rightarrow$ $P_H = 3.5$ m

Datum head = 3 m

$\therefore$ Total head = 3 + 3.5 = 6.5 m

Head loss = Total available head – Total head at P

= (4 + 2 + 2) – (7.5) = 1.5 m

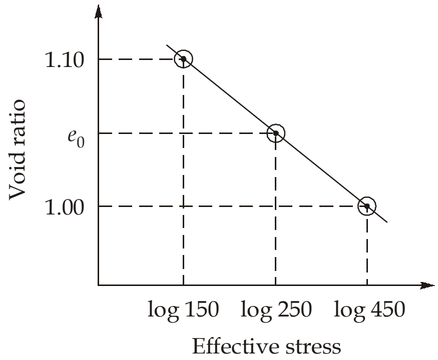
29. (a)

Test result $e_1 = 1.10$, $e_2 = 1.00$

$p_1 = 150$ kN/m^2, $p_2 = 450$ kN/m^2

$$\therefore \quad C_c = \frac{e_1 - e_2}{\log_{10} p_2 - \log_{10} p_1} = \frac{1.10 - 1.00}{\log_{10} 450 - \log_{10} 150} = 0.2096$$

Now clay layer in field



H_o = 5 m

σ_0 = Initial overburden pressure = 250 kN/m²

$\Delta\sigma'$ = Additional pressure = 150 kN/m²

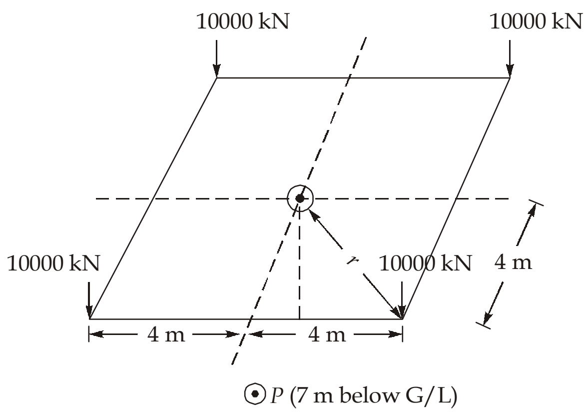
As per result of lab, initial void ratio of clay in field under initial overburden pressure can be calculated as

$$\frac{1.10-1.00}{\log_{10}450-\log_{10}150} = \frac{1.10-e}{\log_{10}250-\log_{10}150}$$

$\Rightarrow$ $e_0 = 1.054$

$$\therefore \quad \Delta H = \frac{C_c H_o}{1+e_o}\log\left[\frac{\sigma_0' + \Delta\sigma'}{\sigma_0'}\right] = \frac{0.2096\times 5}{1+1.054}\log\left[\frac{250+150}{250}\right] = 104.15 \text{ mm}$$

30. (a)



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

$$r = \sqrt{4^2+4^2} = 5.657 \text{ m}$$

Z = 7 m

Q = 4 × 10000 = 40000 kN

$$\therefore \quad \sigma_z = \frac{3}{2\pi}\left[\frac{1}{1+\left(\frac{5.657}{7}\right)^2}\right]^{5/2}\times\frac{40000}{(7)^2}$$

σ_z = 110.93 kN/m²

■■■■