Homework Solution
Geotechnical Engineering

Problem 9.1)

Total stress σ is $\sigma = H\gamma$.

Where, H is the height of the soil layer.
γ is the unit weight of the soil.

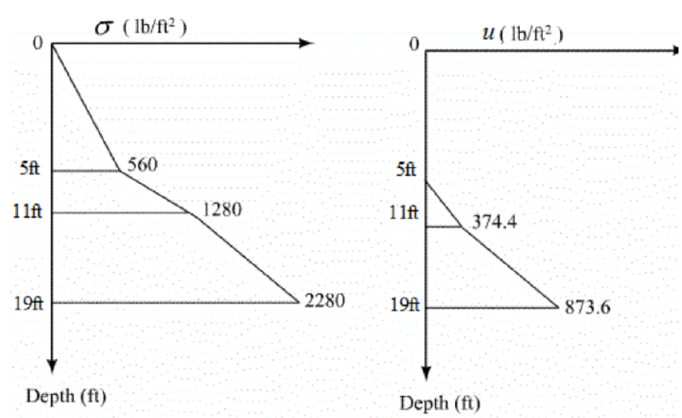
Pore water pressure is $u = H\gamma_w$.

Where, γ_w is the unit weight of water.
H is the depth of the ground water table.

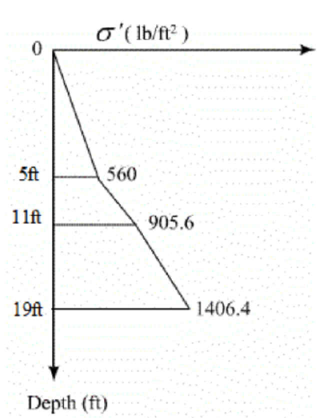
Effective stress is $\sigma' = \sigma - u$.

Point	σ (lb/ft^2)	u (lb/ft^2)	σ' (lb/ft^2)
A	0	0	0
B	560	0	560
C	1280	374.4	905.6
D	2280	873.6	1406.4

The variation of total stress and pore pressure with depth is shown in figure.

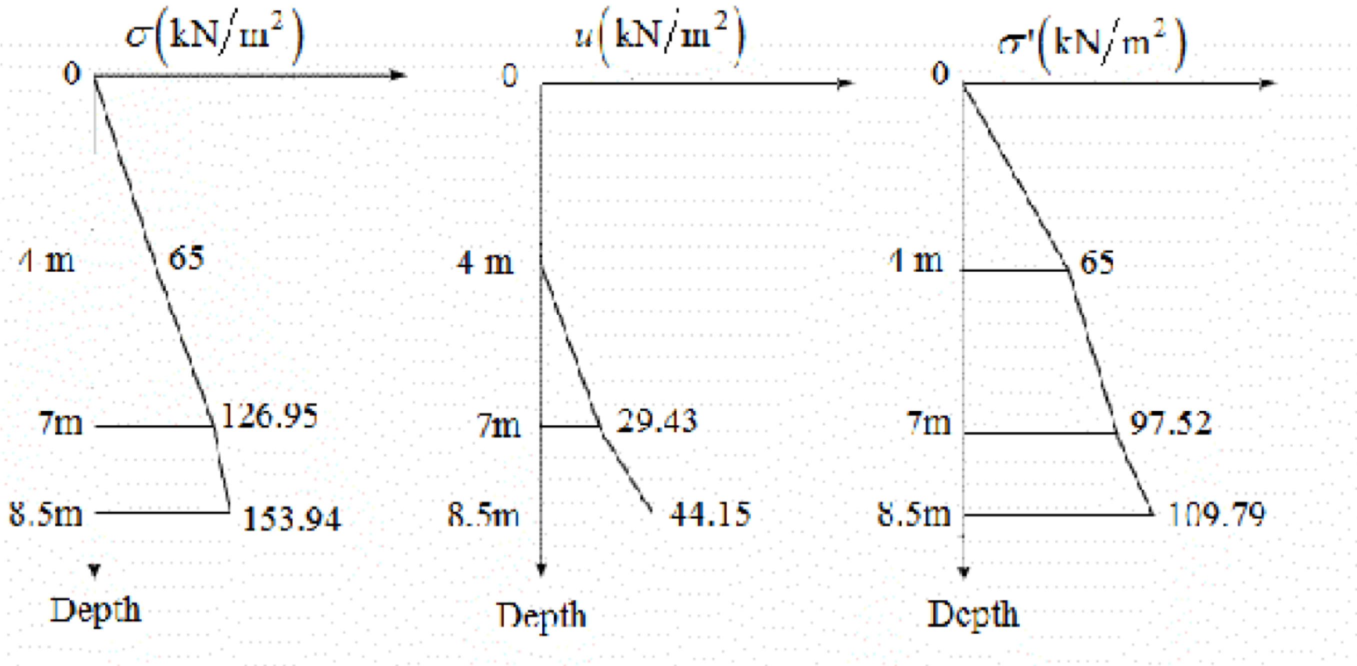


The variation of effective stress with depth is shown in figure.



Problem 9.5)

Point	$\sigma\left(\text{kN/m}^2\right)$	$u\left(\text{kN/m}^2\right)$	$\sigma'\left(\text{kN/m}^2\right)$
A	0	0	0
B	65	0	65
C	126.95	29.43	97.52
D	152.64	44.15	109.79



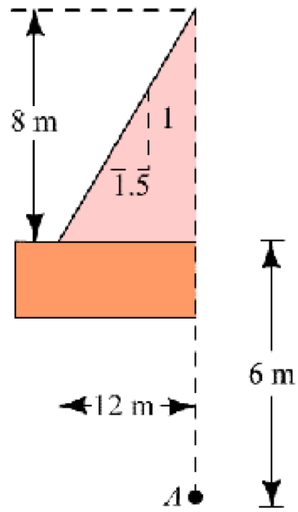
Problem 10.14)

Stress increase at point A is $\Delta\sigma_z = q_o\left(I_{2(1)} + I_{2(2)}\right)$.

Where, q_o is the total load per unit area.

$I_{2(1)}$ and $I_{2(2)}$ are functions of $\frac{B_1}{z}$ and $\frac{B_2}{z}$.

Computing $\frac{B_1}{z}$ and $\frac{B_2}{z}$ for left of point A,



Here, $B_1 = 0$, $B_2 = 12\text{ m}$ and $z = 6\text{ m}$.

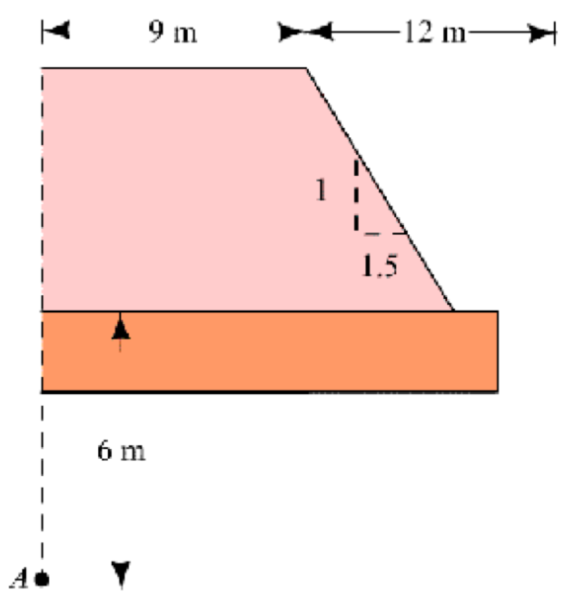
$$\frac{B_1}{z} = \frac{0}{6\text{ m}} = 0$$

$$\frac{B_2}{z} = \frac{12\text{ m}}{6\text{ m}} = 2$$

For $\frac{B_1}{z} = 0$ and $\frac{B_2}{z} = 2$,

The value of $I_{2(1)} = 0.35$

Computing $\frac{B_1}{z}$ and $\frac{B_2}{z}$ for right of point A



Here, $B_1 = 9\text{ m}$, $B_2 = 12\text{ m}$ and $z = 6\text{ m}$.

$$\frac{B_1}{z} = \frac{9\text{ m}}{6\text{ m}} = 1.5$$

$$\frac{B_2}{z} = \frac{12\text{ m}}{6\text{ m}}$$

For $\frac{B_1}{z} = 1.5$ and $\frac{B_2}{z} = 2$,

The value of $I_{2(2)} = 0.454$

Total load per unit area is $q_o = \gamma H$.

Where, γ is the unit weight of the soil layer.

H is the height of the embankment.

Substituting the values in equations,

$$q_o = \gamma H$$
$$= (16.5\ \text{kN/m}^3)(8\ \text{m})$$
$$q_o = 132\ \text{kN/m}^2$$

The stress increase at point A is

$$\Delta\sigma_z = q_o\left(I_{2(1)} + I_{2(2)}\right)$$
$$= 132\ \text{kN/m}^2\,(0.35 + 0.454)$$
$$\Delta\sigma_z = 106.13\ \text{kN/m}^2$$

Therefore, the stress increase at point A is $\boxed{\Delta\sigma_z = 106.13\ \text{kN/m}^2}$.