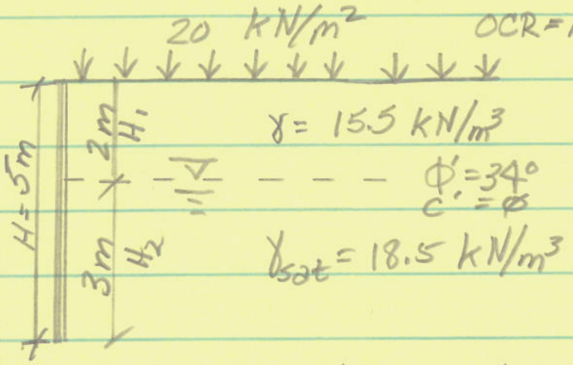
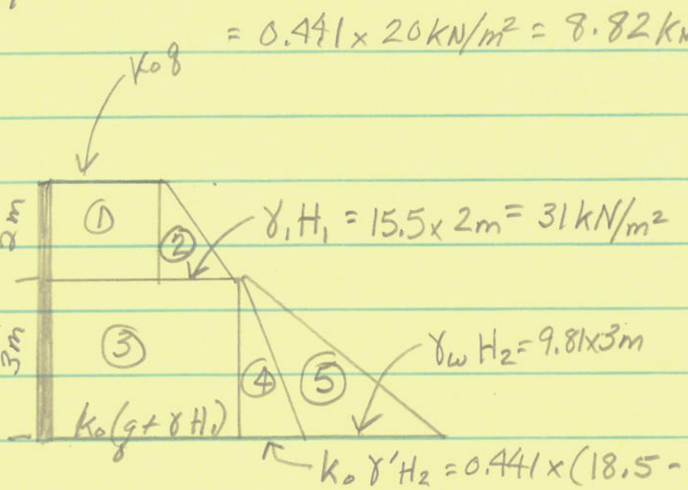
Chap 7 Practice Problems

David Dammon

#7.2

Use Eq 7.3 & Fig below, determine the at-rest lateral earth force per unit length of the wall. Find the resultant force.





$k_o = 1 - \sin\phi' (OCR^{\sin\phi})$

$K_o = 1 - \sin 34° (1^{\sin 34°})$

$K_o = 0.441$

$K_o(q + \gamma_1 H_1) = 0.441(20 + 31)$

$= 22.491\ kN/m^2$

① $= H_1 \times K_o q = 2m \times 8.82\ kN/m^2 = 17.63\ kN/m$

② $= \frac{1}{2}(H_1 \times \gamma_1 H_1) = \frac{1}{2}\, 2m \times 31 kN/m^2 = 31.0\ kN/m$

③ $= K_o(q + \gamma_1 H_1) \times H_2 = 3m \times 22.49 kN/m^2 = 67.47\ kN/m$

④ $= \frac{1}{2}(H_2 \times K_o \gamma' H_2) = \frac{1}{2}(11.50 \times 3m) = 17.24\ kN/m$

⑤ $= \frac{1}{2}(H_2 \times \gamma_w H_2) = \frac{1}{2}(3m \times 29.43) = 44.14\ kN/m$

$P_o =$ ① + ② + ③ + ④ + ⑤

$P_o = (17.63 + 31 + 67.47 + 17.24 + 44.14)\ kN/m$

$\boxed{P_o = 177.48\ kN/m}$

next ↴

#7.2 continued

The location of the centroid of pressure, take moment about the bottom

$$\bar{z} = \frac{\left[A_1 \times \left(H_2 + \frac{1}{2}H_1\right)\right] + \left[A_2 \times \left(H_2 + \frac{1}{3}H_1\right)\right] + \left[A_3 \left(\frac{1}{2}H_2\right)\right] + \left(A_4 \times \frac{1}{3}H_2\right) + \left[A_5 \times \frac{1}{3}H_2\right]}{P_0}$$

$$\bar{z} = \frac{\left[17.63 \times \left(3 + \frac{2}{2}\right)\right] + \left[31\left(3 + \frac{2}{3}\right)\right] + \left[67.47\left(\frac{3}{2}\right)\right] + \left[17.24\left(\frac{3}{3}\right)\right] + \left[44.14\left(\frac{3}{3}\right)\right]}{177.48}$$

$$\bar{z} = \frac{70.52 + 113.67 + 101.20 + 17.24 + 44.14}{177.48}$$

$\bar{z} = 1.95$ m from bottom

resultant = $\boxed{177.48 \text{ kN/m } @ 3.05 \text{ m from top}}$

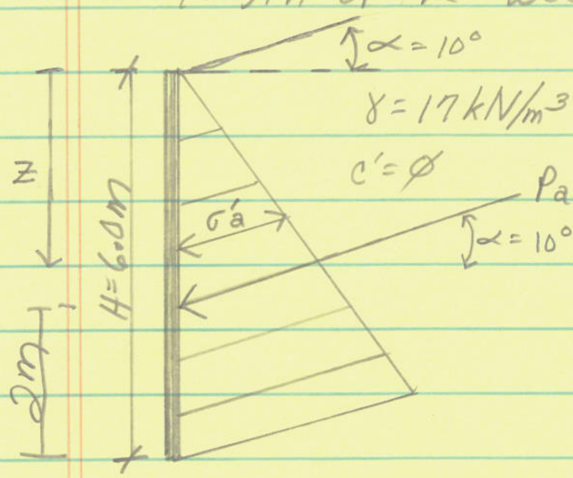
7.6 (pg 372) David Dammon

For the retaining wall $H = 6.0\,m$

$\phi' = 34°$, $\alpha = 10°$, $\gamma = 17\,kN/m^3$ & $c' = \phi$

a) determine the intensity of the Rankine active force @ $z = 2m, 4m,$ & $6m$

b) determine the Rankine active force per meter length of the wall & the location & direction of resultant.



Tbl 7.1 (pg 337)

$\alpha = 10°$, $\phi' = 34°$

$K_a = 0.2944$

a) [7.20] $\sigma_a' = \gamma z k_a$

$z = 2m \quad \sigma_a' = 17\,kN/m^3 (2m)\, 0.2944 = 10.01\,kN/m^2$

$z = 4m \quad \sigma_a' = 17\,kN/m^3 (4m)\, 0.2944 = 20.02\,kN/m^2$

$z = 6m \quad \sigma_a' = 17\,kN/m^3 (6m)\, 0.2944 = 30.03\,kN/m^2$

b) [7.21] $P_a = \frac{1}{2}\gamma H^2 K_a = \frac{1}{2}(17\,kN/m^3)(6m)^2\, 0.2944$

$\boxed{P_a = 160.15\,kN/m}$

Location of $P_a = H/3 = 6/3 = 2m$ from bottom @ 10° from horizontal

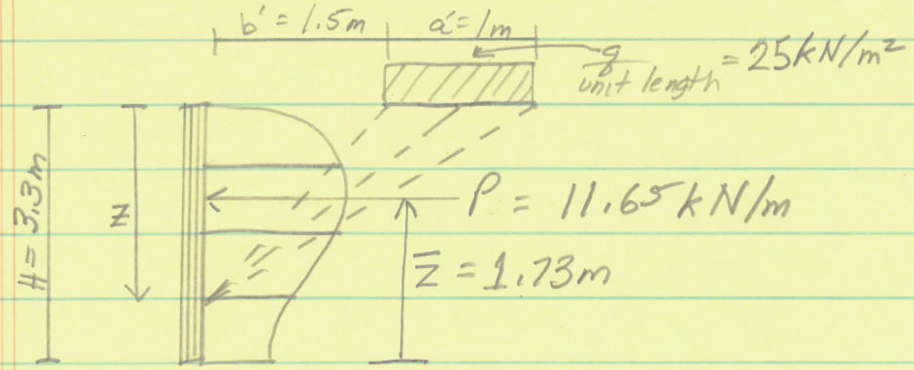
David Dammon

7.10

Refer to Fig below (7.14b)

Given $H = 3.3\,m$, $a' = 1\,m$, $b' = 1.5\,m$ & $q = 25\,kN/m^2$

Determine the lateral force per unit length of the un-yielding wall caused by the surcharge load only.



$$[7.35]\quad \theta_1 = \tan^{-1}\left(\frac{b'}{H}\right)(\deg) = \tan^{-1}\left(\frac{1.5}{3.3}\right)^\circ = 24.44$$

$$[7.36]\quad \theta_2 = \tan^{-1}\left(\frac{a'+b'}{H}\right)(\deg) = \tan^{-1}\left(\frac{1+1.5}{3.3}\right)^\circ = 37.15$$

$$[7.34]\quad P = \frac{q}{90}\left[H\left(\theta_2 - \theta_1\right)\right]$$

$$P = \frac{25\,kN/m^2}{90}\left[3.3m\left(37.15 - 24.44\right)\right]$$

$$\boxed{P = 11.65\ kN/m}$$

$$\bar{z} = H - \left[\frac{H^2(\theta_2 - \theta_1) + (R - Q) - 57.3a'H}{2H(\theta_2 - \theta_1)}\right]$$

$$[7.38]\quad R = (a'+b')^2 \times (90 - \theta_2)$$

$$R = (1+1.5)^2 \times (90 - 37.15)$$

$$R = 330.3$$

$$[7.39]\quad Q = b'^2(90 - \theta_1)$$

$$Q = 1.5^2(90 - 24.44)$$

$$Q = 147.51$$

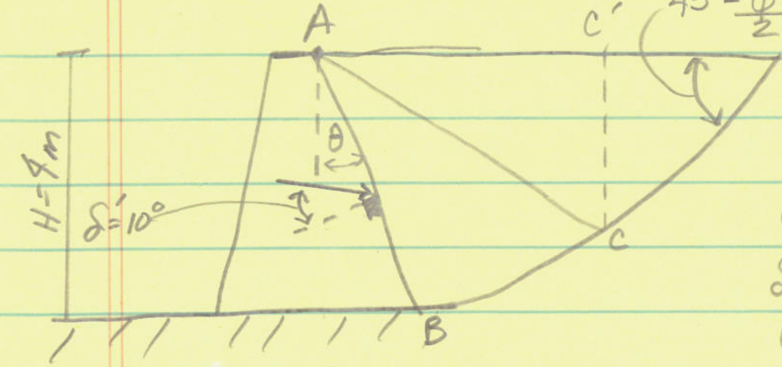
$$\bar{z} = 3.3 - \left[\frac{3.3^2(37.15 - 24.44) + (330.3 - 147.5) - 57.3(1)(3.3)}{2(3.3)(37.15 - 24.44)}\right]$$

$$\boxed{\bar{z} = 1.73\ m}$$

7.15 In Fig below (7.28) — David Dammon

which shows a vertical retaining wall with a horizontal backfill; $H = 4\,m$, $\theta = 25°$, $\gamma = 16.5\,kN/m^3$, $\phi' = 35°$ & $\delta' = 10°$; Based on Zhu & Qian's work, what would be the passive force per meter length of the wall?

$45 - \frac{\phi'}{2} = 45 - \frac{35}{2} = 27.5$



$\gamma = 16.5\,kN/m^3$
$\phi' = 35°$
$\delta' = 10°$
$\theta = 25°$

[7.73] $K_p = K_{p(\delta'=0)}\,R$

$K_{p(\delta'=0)} = 2.37$

$R \quad \frac{\delta'}{\phi'} = \frac{10}{35} = 0.286$

$R = 1.25$

$K_p = 2.37 \times 1.25$

$K_p = 2.96$

[7.72] $P_p = \frac{1}{2} K_p \gamma H^2$

$= \frac{2.96}{2}(16.5\,kN/m^3)(4m)^2$

$\boxed{P_p = 391\,kN/m}$