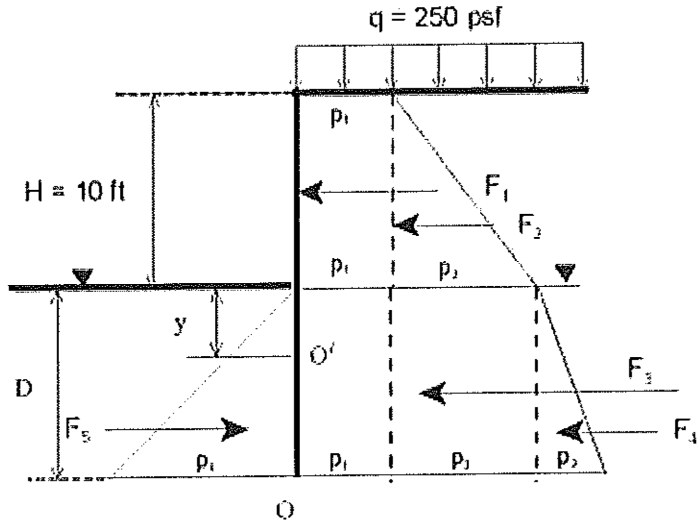
EXAMPLE - CANTILEVERED SHEETING WALL *(US CUSTOMARY UNITS)*

Step 1: Using the Simplified Method, determine the depth of embedment and required section modulus for the following situation (permanent sheeting).

Given:
γ = 115 pcf
γ_s = 52.6 pcf
ϕ = 32°



Step 2: Rankine Theory for a level backfill:

$K_a = \frac{1 - \sin\varphi}{1 + \sin\varphi} = 0.31$

$K_p = \frac{1 + \sin\varphi}{1 - \sin\varphi} = 3.25$ $\quad K_p' = \frac{K_p}{1.5} = 2.18$

Step 3: Compute the pressures:

$p_1 = (K_a)(q) = (0.31)(250)$ = 77.5 psf
$p_2 = (K_a)(\gamma)(H) = (0.31)(115)(10)$ = 356.5 psf
$p_3 = (K_a)(\gamma_s)(D) = (0.31)(115\text{-}62.4)(D)$ = 16.31 D psf
$p_4 = (K_p')((\gamma_s)(D)) = (2.18)(115\text{-}62.4)(D)$ = 114.67 D psf

Compute the forces:

$F_1 = (p_1)(H) = (0.31)(250)(10)$ = 775.0 lbs/ft.
$F_2 = (½)(p_2)(H) = (½)(356.5)(10)$ = 1782.5 lbs/ft.
$F_3 = (p_1+p_2)(D) = (77.5+356.5)(D)$ = 434.0 D lbs/ft.
$F_4 = (½)(p_3)(D) = (½)(16.31\ D)(D)$ = 8.16 D^2 lbs/ft.
$F_5 = (½)(p_4)(D) = (½)(114.67\ D)(D)$ = 57.34 D^2 lbs/ft.

Step 4: Determine depth of embedment (D). (To compute: $\Sigma M_{@o} = 0$ and solve for D).

$$\Sigma M_{@o} = (1/3)(D)(F_4)+(½)(D)(F_3)+(D + 1/3\ H)(F_2) + (D + ½H)(F_1) - (1/3)(D)(F_5) = 0$$

$$-16.39\ D^3 + 217\ D^2 + 2557.5\ D + 9816.7 = 0$$

$$D = 21.7\ ft.$$

The depth of embedment is increased by 20% to account for the differences which exist between using the Simplified vs. Conventional Method of analysis.

$$D = (D)(1.2) = 26\ ft.$$

Step 5: Find the point of zero shear (y):

$$\Sigma F_H = 0 = F_1 + F_2 + F_3 + F_4 - F_5$$

$$0 = y^2 - 8.83\ y - 52.0$$

$$y = \frac{8.83 \pm \sqrt{8.83^2 - (4)(1)(-52.0)}}{(2)(1)} \qquad \text{(quadratic equation)}$$

$$y = 12.87\ ft.$$

Step 6: Find the maximum moment which occurs at the point of zero shear:

$$\Sigma M_{@o'} = M_{max} = -16.39\ y^3 + 217\ y^2 + 2557.5\ y + 9816.7$$

$$= 43.7\ kip\text{-}ft.$$

Step 7: Determine minimum section modulus:

$$S = \frac{M_{max}}{\sigma_{all}} = 21.0\ in^3 \text{ per foot of wall}$$

$(\sigma_{all} = 25\ ksi)$