Design of Abutment

Calculate Resultant Force R, Using Known F_x, F_y, and F_z values.

$$R_{xy} = \sqrt{x^2 + y^2}$$

$$R = \sqrt{R_{xy}^2 + z^2}$$

Known Values

Compressive Strength of Concrete

$$f'c = 4000\ psi$$

Allowable Soil Pressure

$$q_a = 8000\ psi$$

Concrete Self weight

$$w_c = 150\ pcf$$

Based on Soil Type, Silty Sand, Sand and Gravel with High Clay Content

Soil Pressure

$$w = 120\ pcf$$

Internal Friction Phi,

$$\phi = 30^o$$

Friction Coefficient

$$f = 0.5$$

Using Equations obtain soil pressure coefficients

$$K_{ah} = \frac{1 - sin\phi}{1 + sin\phi} = .333$$

$$K_{ah} = \frac{1 + sin\phi}{1 - sin\phi} = 3$$

Optimum Design of Retaining wall is through approximations with reasonable dimensions and stability checks.

Solve for Total Earth Thrust

$$P = \frac{1}{2} \times cos\phi \times 120 \times H^2$$

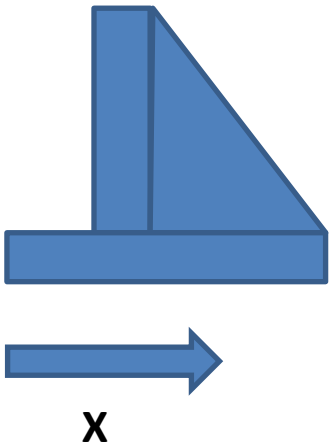
Distance from Base y is equal to Height divided by 3

$$y = \frac{H}{3}$$

Solve for Overturning Moment

$$M_o = y \times P$$

Calculate Component Weights of Abutment



Find the Component Weights W, by multiplying component area times concrete weight,

$$\mathrm{W} = \mathrm{A} \times \mathrm{W_c}$$

Also find sum of all Component Weights

$$\Sigma W$$

Find the Restoring Moment by multiplying each Component Weight W by distance X away from the front edge.

$$M_r = xW$$

Also find the Sum of all Restoring Moments

$$\Sigma M_r$$

Solve for the Factor of Safety

$$F_{safety} = \frac{M_r}{M_o}$$

Distance from Resultant front edge A

$$a = \frac{M_r - M_o}{\Sigma W}$$

Maximum Soil Pressure q

$$q_1 = [(4 \times l) - (6 \times a)]\left(\frac{R_v}{L^2}\right)$$

Crresponding Resisting Friction

$$F = f \times \Sigma W$$

Passive Pressure

$$P_p = \frac{1}{2} \times w \times h^2 \times K_{ph}$$

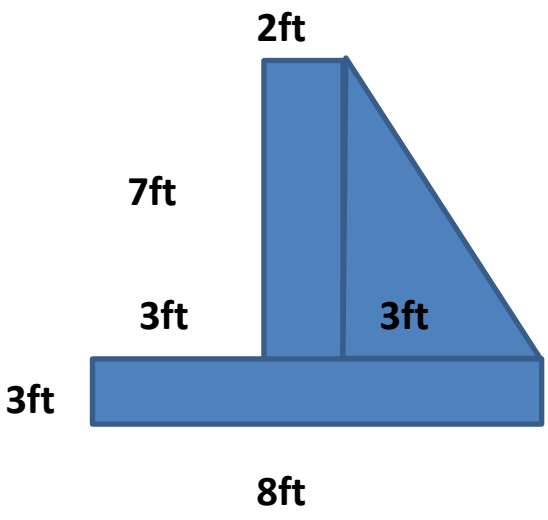
Using Passive Pressure, and Friction Force, Solve for Factor of Safety against liding

$$F_{sliding} = \frac{F + P_p}{P}$$

If Fsliding is greater than 1.5, then favorable design of Abutment.

Recommended Abutment Design

Side View



Front View