Given & Find

8.10 A retaining wall with geotextile reinforcement is 6-m high. For the granular backfill, $\gamma_1 = 15.9\ kN/m^3$ and $\phi_1' = 30°$. For the geotextile, $T_{all} = 16\ kN/m$. For the design of the wall, determine S_V, L, and l_l. Use $FS_{(B)} = FS_{(P)} = 1.5$.

$FSb := 1.5$ $FSp := 1.5$ $\phi'1 := 30deg = 0.524$ $\gamma1 := 15.9\frac{kN}{m^3}$ $z := H = 1\,H$

$Tall := 16\frac{kN}{m}$ $H := 6m$ $\sigma'o := \gamma1 \cdot z = 1.59 \times 10^4\,T^2$

METHOD
1. Calculate Ka
2. Determine Sv
3. Find L

$$Ka := \tan\left(45deg - \frac{\phi'1}{2}\right)^2 = 0.333 \qquad \sigma'a := Ka \cdot \sigma'o = 5.3 \times 10^3\,T^2$$ EQN 8.55

friction angle at geotextile soil interface $\phi'f := \frac{2}{3} \cdot \phi'1 = 0.349$

$RFid := \frac{1.1 + 2.0}{2} = 1.55$ $RFcr := \frac{2 + 4}{2} = 3$ $RFcbd := \frac{1 + 1.15}{2} = 1.075$

$$Tult := Tall \cdot (RFid \cdot RFcr \cdot RFcbd) = 7.998 \times 10^4\frac{kg}{s^2}$$ EQN 8.56

$$Sv := \frac{Tall}{\sigma'a \cdot FSb} = 2.013\frac{A^2 \cdot s^2}{kg} \qquad Sv := \frac{1}{3}m = 0.333\,m$$ EQN 8.57

Z trials: $z := 5m$ $z := 4m$ $z := 3m$ $z := 2m$ $z := 1m$ $z := .5m$ max when z small

$$Lr := \frac{H - z}{\tan\left(45deg + \frac{\phi'1}{2}\right)} = 3.175\,m$$ EQN 8.58

$$Le := \frac{Sv \cdot \sigma'a \cdot FSp}{2 \cdot \sigma'o \cdot \tan(\phi'f)} = 0.229\,m$$ EQN 8.59

$L := Lr + Le = 3.404\,m$ $L := 3.5m$

use length of 3.5m

Given & Find

8.11 With the S_V, L, and l_l determined in Problem 8.10, check the overall stability (i.e., factor of safety against overturning, sliding, and bearing capacity failure) of the wall. For the *in situ* soil, $\gamma_2 = 16.8\ kN/m^3$, $\phi_2' = 20°$, and $c_2' = 55\ kN/m^2$.

$W1 := H \cdot L \cdot \gamma1 = 3.248 \times 10^5\frac{kg}{s^2}$ $x1 := \frac{L}{2} = 1.702\,m$ $c'2 := 55\frac{kN}{m^2}$ $\phi'2 := 20deg$ $\gamma2 := 16.8\frac{kN}{m^3}$

$$Pa := .5 \cdot \gamma1 \cdot H^2 \cdot Ka = 9.54 \times 10^4\frac{kg}{s^2}$$

$$FSoverturning := \frac{W1 \cdot x1}{Pa \cdot \frac{H}{3}} = 2.897 \qquad if(FSoverturning > 3, "OK", "modify") = "modify"$$ EQN 8.50

$FSsliding := \frac{W1 \cdot \tan(\phi'f)}{Pa} = 1.239$ $\text{if}(FSsliding > 1.5, \text{"OK"}, \text{"modify"}) = \text{"modify"}$ EQN 8.51

$Nc := 14.83$ $Nq := 6.40$ $N\gamma := 5.39$ table 3.3 $qu := c'2 \cdot Nc + .5 \cdot \gamma 2 \cdot x1 \cdot N\gamma = 8.927 \times 10^5\ Pa$

$\sigma'o := \gamma 1 \cdot H = 9.54 \times 10^4\ Pa$

$FSbearing := \frac{qu}{\sigma'o} = 9.358$ $\text{if}(FSbearing > 3, \text{"OK!"}, \text{"N.G!"}) = \text{"OK!"}$ EQN 8.54