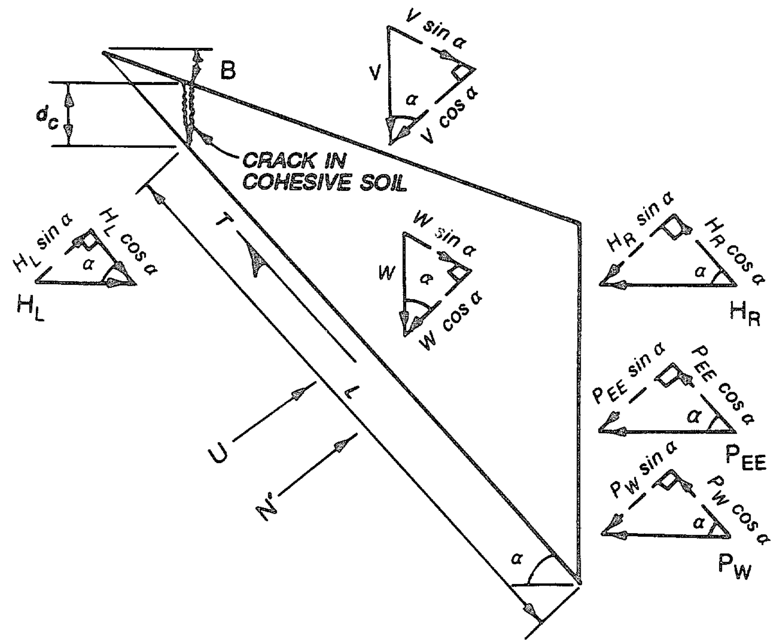
APPENDIX F

DERIVATION OF GENERAL WEDGE EQUATION FOR SINGLE WEDGE ANALYSIS (EQUATION 3-23)

F-1. Effective horizontal earth force. Given the following driving wedge, an equation for P_{EE}, the effective horizontal earth force, will be derived.



Summing forces normal to the slip plane yields,

$$H_L \sin\alpha + U + N' - V\cos\alpha - H_R \sin\alpha - P_{EE}\sin\alpha - P_W \sin\alpha - W\cos\alpha = 0$$

Solving for N' yields,

$$N' = (-H_L + H_R + P_{EE} + P_W)\sin\alpha - U + (V + W)\cos\alpha \qquad [F\text{-}1]$$

According to the Mohr-Coulomb failure criterion,

$$T = N' \tan\phi + cL \qquad [F\text{-}2]$$

Inserting Equation F-1 into Equation F-2 yields,

$$T = \left[(-H_L + H_R + P_{EE} + P_W) \sin \alpha - U + (V + W) \cos \alpha \right] \tan \phi + cL$$

Setting the summation of forces parallel to the slip plane equal to zero yields

$$H_L \cos \alpha + V \sin \alpha + W \sin \alpha - H_R \cos \alpha - P_{EE} \cos \alpha - P_W \cos \alpha - T = 0 \quad \text{[F-3]}$$

Solving for T from Equation F-3 and substituting this expression into Equation F-2 yields,

$$(H_L - H_R - P_{EE} - P_W) \cos \alpha + (V + W) \sin \alpha$$

$$+ \left[(H_L - H_R - P_{EE} - P_W) \sin \alpha + U - (V + W) \cos \alpha \right] \tan \phi - cL = 0$$

Simplifying and solving for P_{EE} yields,

$$P_{EE} = (V + W) \frac{(\sin \alpha - \cos \alpha \tan \phi)}{(\cos \alpha + \sin \alpha \tan \phi)} + \frac{U \tan \phi - cL}{\cos \alpha + \sin \alpha \tan \phi} + H_L - H_R - P_W$$

$$P_{EE} = (V + W) \frac{(1 - \cot \alpha \tan \phi) \tan \alpha}{(1 + \tan \alpha \tan \phi)} + \frac{U \tan \phi - cL}{(1 + \tan \alpha \tan \phi) \cos \alpha}$$

$$+ H_L - H_R - P_W \quad \text{[F-4]}$$

F-2. <u>Soil parameters</u>. For a particular SMF , the corresponding factored parameters ϕ_d and c_d can be inserted into Equation F-4 to yield soil

$$P_{EE} = (V + W) \frac{(1 - \cot \alpha \tan \phi_d) \tan \alpha}{(1 + \tan \alpha \tan \phi_d)} + \frac{U \tan \phi_d - c_d L}{(1 + \tan \alpha \tan \phi_d) \cos \alpha}$$

$$+ H_L - H_R - P_W$$

F-3. <u>Resisting wedge</u>. The same procedure can be applied to a resisting wedge to yield the following equation for P_{EE} .

$$P_{EE} = (W + V)\,\frac{(1 + \tan\phi_d \cot\alpha)\tan\alpha}{(1 - \tan\phi_d \tan\alpha)} - \frac{U\tan\phi_d - c_d L}{\cos\alpha\,(1 - \tan\phi_d \tan\alpha)} - H_L + H_R - P_W$$

If more than one driving or resisting wedge exists, the value of P_{EE} will equal the difference of the earth forces applied to the wedge.