Appendix B
Notation

Dimensions: F indicates force, L indicates length

A = cross-sectional area of slice (L^2)

b = width of slice (L)

b = slope ratio = cot β (dimensionless)

c = cohesion intercept for Mohr-Coulomb diagram plotted in terms of total normal stress, σ (F/L^2)

c' = cohesion intercept for Mohr-Coulomb diagram plotted in terms of total effective stress, σ' (F/L^2)

c_R = cohesion intercept as determined from the R envelope (F/L^2)

c_b = cohesion at the base of an embankment (F/L^2)

c_{avg} = average cohesion over length of slip surface (F/L^2)

c_D = 'developed' or 'mobilized' cohesion (F/L^2)

c'_D = 'developed' or 'mobilized' cohesion (F/L^2)

C_D = force because of the 'developed' or 'mobilized' cohesion on base of slice (F)

C_1 = term used to calculate side forces on a slice (F)

C_2 = term used to calculate side forces on a slice (F)

C_3 = term used to calculate side forces on a slice (F)

C_4 = term used to calculate side forces on a slice (F)

d = depth factor = D/H (dimensionless)

d = intercept value of failure envelope on 'p-q' diagram (F/L^2)

d_h = horizontal moment arm (L)

d_V = vertical moment arm (L)

d' = intercept value of failure envelope on (σ_1-σ_3) vs. σ_3 'modified' Mohr-Coulomb diagram (F/L^2)

d_R = intercept value of R failure envelope on 'p-q' diagram (F/L^2)

d_{crack} = depth of vertical 'tension' crack (L)

$d_{Kc=1}$ = intercept value for τ_{ff} vs. σ'_{fc} shear strength envelope for isotropic consolidation (F/L^2)

D = depth from toe of slope to lowest point on the slip circle (L)

e = void ratio (dimensionless)

E = horizontal component of the interslice force (F)

E_A = active force acting on a wedge (F)

E_P = passive force acting on a wedge (F)

F = factor of safety (defined with respect to shear strength) (dimensionless)

FS = factor of safety (defined with respect to shear strength) (dimensionless)

F_D = resultant force because of total normal force, N, and developed frictional resistance, N tan ϕ_D, on the bottom of a slice (F)

h_{avg} = average height of slice (L)

h_i = piezometric height above the bottom of the slice (pressure head) at the upslope side of the slice (L)

h_{i+1} = piezometric height above the bottom of the slice (pressure head) at the downslope side of the slice (L)

h_p = piezometric height above the bottom of the slice (pressure head) at the midpoint of the slice (L)

h_s = average height of water above top of slice (L)

H = height of the slope (L)

H_0 = height above slope where soil strength vs. depth intersects zero (L)

H_w = depth of water outside slope (L)

H'_w = height of water within slope (L)

K_o = at-rest pressure coefficient (dimensionless)

K_A = active earth pressure coefficient (dimensionless)

K_P = passive earth pressure coefficient (dimensionless)

K_c = effective principal stress ratio, $\sigma'_{1c}/\sigma'_{3c}$, for consolidation (dimensionless)

K_f = effective principal stress ratio, $\sigma'_{1f}/\sigma'_{3f}$ at failure (dimensionless)

ℓ_{top} = length of the top of the slice (L)

m_α = term used in the Simplified Bishop method (dimensionless)

M = term to relate height above slope where soil strength is zero to height of slope

M_P = moment produced by the force P about the center of the circle (FL)

n_α = term used to calculate side forces on a slice (dimensionless)

N = total normal force on the bottom of the slice (F)

N = stability number for an embankment with an uniform increase in cohesion with depth (dimensionless)

N' = effective normal force on the bottom of the slice (F)

N_0 = stability number for a homogeneous embankment and foundation overlying a rigid boundary with $\phi_u=0$ (dimensionless)

N_{cf} = stability number for a homogeneous embankment and foundation overlying a rigid boundary with $\phi>0$ (dimensionless)

p = total stress state variable used to plot ‘modified’ Mohr-Coulomb diagrams, usually $\frac{1}{2}(\sigma_1+\sigma_3)$ but sometimes used to represent $\frac{1}{3}(\sigma_1+\sigma_2+\sigma_3)$ (F/L^2)

p' = effective stress state variable used to plot ‘modified’ Mohr-Coulomb diagrams, usually $\frac{1}{2}(\sigma_1+\sigma_3)$ but sometimes used to represent $\frac{1}{3}(\sigma_1+\sigma_2+\sigma_3)$ (F/L^2)

p_{avg} = average water pressure on top of slice (F/L^2)

P = water force on top of slice, acting perpendicular to top of slice (F)

P_d = term to account for weight of slope and surcharge loading, submergence, and tension crack corrections (F/L^2)

P_e = term to account for the effects of water within the slope (F/L^2)

q = surcharge load (F/L^2)

q = stress state variable used to plot 'modified' Mohr-Coulomb diagrams, usually $\frac{1}{2}(\sigma_1-\sigma_3)$ but sometimes used to represent $(\sigma_1-\sigma_3)$ (F/L^2)

q_{ult} = ultimate bearing capacity (F/L^2)

R = radius of the circle (L)

R = resultant force because of weight of slice and water pressures on top, sides and bottom of slice (F)

s = shear strength (F/L^2)

s_d = drained shear strength (F/L^2)

$s_{passive}$ = shear strength based on active Rankine stress state (F/L^2)

s_2 = shear strength used for second stage of computations for rapid drawdown (F/L^2)

S = shear force on the bottom of the slice (F)

u = pore water pressure (F/L^2)

u_{bp} = back pressure – pore water pressure for consolidation and drained shear in the triaxial test (F/L^2)

u_c = pore water pressure at consolidation (F/L^2)

u_f = pore water pressure at failure (F/L^2)

U_b = force resulting from pore water pressure on the bottom of the slice (F)

U_i = force resulting from water pressures on the upslope side of the slice (F)

U_{i+1} = force resulting from water pressures on the downslope side of the slice (F)

U_L = water force on left of slice (F)

U_R = water force on right of slice (F)

W = weight of slice (F)

W' = effective weight of slice (F)

X = shear component of the interslice force (F)

y_t = location of side forces (L)

z = vertical depth to a plane parallel to slope (L)

Z_i = interslice force on the upslope side of the slice (F)

Z_{i+1} = interslice force on the downslope side of the slice (F)

z_t = depth of tensile stresses (L)

α = inclination from horizontal of the bottom of the slice (degrees)

α_s = angle between flow lines and embankment face (degrees)

β = inclination from horizontal of the top of the slice (degrees)

δ = inclination of the earth pressure force (degrees)

$\Delta\ell$ = length of bottom of slice (L)

Δu = change in pore water pressure, usually during shear (F/L^2)

Δx = width of slice (F)

$\Delta\phi$ = change in friction angle (degrees)

γ = total unit weight of soil (F/L^3)

γ' = submerged unit weight of soil (F/L^3)

γ_m = moist unit weight of soil (F/L^3)

γ_w = unit weight of water (F/L^3)

γ_{sat} = saturated unit weight of soil (F/L^3)

$\lambda_{c\phi}$ = term to relate P_e with shear strength parameters (dimensionless)

μ_q = surcharge correction factor (dimensionless)

μ_w = submergence correction factor (dimensionless)

μ_t = tension crack correction factor (dimensionless)

μ'_w = seepage correction factor (dimensionless)

Ω = term used to calculate the inclination of the critical slip surface (dimensionless)

ϕ = angle of internal friction for Mohr-Coulomb diagram plotted in terms of total normal stress, σ (degrees)

ϕ' = angle of internal friction for Mohr-Coulomb diagram plotted in terms of effective normal stress, σ' (degrees)

ϕ_D = 'developed' or 'mobilized' total stress angle of internal friction (degrees)

ϕ'_D = 'developed' or 'mobilized' effective stress angle of internal friction (degrees)

ϕ_R = angle of internal friction as determined from the R envelope (degrees)

ϕ_u = undrained friction angle (degrees)

ϕ_{secant} = secant value of friction angle ($\tan \phi_{secant} = \tau_f/\sigma_f$) (degrees)

σ = total normal stress (F/L^2)

σ' = effective normal stress (F/L^2)

σ'_v = effective vertical stress (F/L^2)

σ'_{vc} = effective vertical stress for consolidation (F/L^2)

σ_{1f} = major principal total stress at failure (F/L^2)

σ'_{1f} = major principal effective stress at failure (F/L^2)

σ'_{1c} = effective major principal stress for consolidation (F/L^2)

σ_{3f} = minor principal total stress at failure (F/L^2)

σ'_{3f} = minor principal effective stress at failure (F/L^2)

σ'_{3c} = minor principal effective stress for consolidation (F/L^2)

$\sigma'_{3\text{-critical}}$ = 'critical' effective confining pressure for critical state (F/L^2)

σ'_c = effective normal stress on the slip surface at consolidation, before rapid drawdown (F/L^2)

σ'_d = effective normal stress on the slip surface after drainage following rapid drawdown (F/L^2)

σ'_{fc} = effective normal stress on the failure plane at consolidation (F/L^2)

σ_i = normal stress where R and S envelopes intersect (F/L^2)

σ'_1 / σ'_3 = principal stress ratio (dimensionless)

$(\sigma_1\text{-}\sigma_3)$ = principal stress difference (F/L^2)

$(\sigma_1\text{-}\sigma_3)_f$ = principal stress difference at failure (F/L^2)

τ = shear stress (F/L^2)

τ_c = shear stress on the slip surface at consolidation, before rapid drawdown (F/L^2)

τ_{fc} = shear stress on the failure plane at consolidation (F/L^2)

τ_{ff} = shear stress on the failure plane at failure (F/L^2)

$\tau_{ff\text{-}Kc=1}$ = shear stress (strength) from envelope of τ_{ff} vs. σ'_{fc} for isotropic consolidation (F/L^2)

$\tau_{ff\text{-}Kc=Kf}$ = shear stress (strength) from envelope of τ_{ff} vs. σ'_{fc} for maximum degree of anisotropic consolidation, $K_c = K_f$ (F/L^2)

θ = inclination of the interslice force (degrees)

Ψ = angle of inclination of failure envelope on 'p-q' diagram (degrees)

Ψ' = angle of inclination of failure envelope on $(\sigma_1\text{-}\sigma_3)$ vs. σ_3 'modified' Mohr-Coulomb diagram (degrees)

Ψ_R = angle of inclination of the R failure envelope on 'p-q' diagram (degrees)

$\Psi_{Kc=1}$ = slope angle for τ_{ff} vs. σ'_{fc} shear strength envelope for isotropic consolidation (degrees)