$$\rho_{bulk} = \frac{M_{moist}}{V_T} \quad \rho_{dry} = \frac{M_{dry}}{V_T} \quad \rho_{sat} = \frac{M_{sat}}{V_T} \quad \rho_m = \frac{M_s}{V_S} \quad G = \frac{\rho_{dry}}{\rho_w} \qquad \gamma = \rho g \qquad V_T = V_s + V_v$$

$$n = \frac{V_v}{V_T} \qquad e = \frac{V_v}{V_s} \qquad n = 1 - \left(\frac{\rho_{dry}}{\rho_m}\right) \qquad e = \frac{n}{1-n} \quad n = \frac{e}{1+e} \qquad \Delta H = H_o \left[\frac{n_o - n}{1-n}\right]$$

$$V_s = (1-n)V_T \qquad \gamma_L = \frac{W_L}{V_L} \qquad W_{sat} = W_{dry} + W_L \qquad \gamma_{sat} = \gamma_{dry} + n\gamma_L \qquad \rho_{sat} = \rho_{dry} + n\rho_L$$

$$\sigma_N = \frac{F_N}{A} \qquad \sigma = \frac{W}{A} = \rho g h \qquad \sigma = \sum \rho_i g h_i \qquad \sigma_u = (\mathrm{FS})(\rho g h)\left(\frac{A}{nA_p}\right)$$

$$\sigma = E\epsilon_A \qquad \epsilon_A = \frac{\Delta L}{L_o} \qquad \epsilon_T = \frac{\Delta D}{D_o} \qquad \nu = -\frac{\epsilon_T}{\epsilon_A} = \left|\frac{\epsilon_T}{\epsilon_A}\right| \qquad \frac{\Delta V}{V_o} = \epsilon_A(1-2\nu) \qquad \sigma = -k\left(\frac{\Delta V}{V_o}\right)$$

$$\tau = \frac{F_P}{A} \qquad \tan\theta = \frac{\Delta x}{L} \quad (\theta \approx \frac{\Delta x}{L}) \qquad \tau = G\tan\theta \approx G\theta \qquad (\text{where } \theta \text{ is in radians})$$

$$G = \frac{E}{2(1+\nu)} \qquad k = \frac{E}{3(1-2\nu)} \qquad \nu = \frac{3k-2G}{6k+2G} \qquad E = \frac{9kG}{3k+G}$$

$$v_p = \sqrt{\frac{k + \frac{4}{3}G}{\rho}} \quad v_p = \sqrt{\frac{E(1-\nu)}{\rho(1+\nu)(1-2\nu)}} \quad v_s = \sqrt{\frac{G}{\rho}} \quad v_s = \sqrt{\frac{E}{\rho(2+2\nu)}}$$

$$f_s = \mu_s F_N \qquad \tan\phi = \mu_s \qquad \mathrm{FS} = \frac{W\cos\alpha\tan\phi + cA}{W\sin\alpha + F_{ext}} \qquad \mathrm{FS} = \frac{\sigma_n \tan\phi + c}{\sigma_n \tan\alpha} \qquad \tan\alpha = \frac{b}{h}$$

$$\mathrm{FS} = \frac{(W\cos\alpha + n\sigma_B A_B)\tan\phi + cA + n\tau_B A_B}{W\sin\alpha + F_{ext}} \qquad \mathrm{FS} = \frac{\tan\phi}{\tan\alpha} + \left(\frac{2c}{\rho g H}\right)\left[\frac{1}{\sin^2\alpha(\cot\alpha - \cot\beta)}\right]$$

$$wc = \frac{M_w}{M_s} \qquad PI = LL - PL \qquad LI = \left(\frac{wc - PL}{PI}\right) \qquad C_u = \frac{D_{60}}{D_{10}} \qquad C_c = \frac{(D_{30})^2}{(D_{10})(D_{60})}$$

$$\sigma_T = \rho_{dry} g z + n\rho_w g h \qquad \sigma_e = \sigma_T - P \qquad P = \rho_w g h \qquad F_B = \rho_L g V_{object}$$

$$\sigma_z = \frac{F}{z^2} \cdot \frac{3}{2\pi\left(1 + \left(\frac{r}{z}\right)^2\right)^{5/2}_{point}} \quad \sigma_z = q\left[1 - \left(\frac{1}{1 + (\frac{B}{2z})^2}\right)^{1.76}\right]_{square} \quad \sigma_z = q\left[1 - \left(\frac{1}{1 + (\frac{B}{2z})^2}\right)^{1.50}\right]_{circle}$$

$$q = \frac{F}{A} \qquad e_o - e = \Delta e = C_c^* \log_{10}\left(1 + \frac{\sigma_z}{\sigma_e}\right) \qquad \Delta H = H_o\left[\frac{\Delta e}{1+e_o}\right]$$

$$\tau = c + \sigma_n \tan\phi \qquad FS = \frac{\bar{\tau} LR}{Wr} \qquad FS = \frac{\sum_{n=1}^{N}[cl + (W\cos\alpha - Pl)\tan\phi]}{\sum_{n=1}^{N}[W\sin\alpha]} \qquad FS = \frac{\sigma_n \tan\phi + c}{\frac{W}{A}\sin\alpha}$$