

FORMULAE – LECTURE 1-2

Sign convention

- + compressive forces and compressive stresses
- + compressive strain

$$\left(i. e. : \varepsilon_a = -\frac{\Delta L}{L_i}, \varepsilon_{vol} = -\frac{\Delta V}{V_i} \right)$$

Effective stress

$$\sigma'_{ij} = \sigma_{ij} - p_w \delta_{ij}$$

$$\sigma'_{ij} = \sigma_{ij} - \left(1 - \frac{K_{SK}}{K_s} \right) p_w \delta_{ij}$$

Triaxial stress and strain variables

$$q = \sigma_1 - \sigma_3$$

$$p = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3}$$

$$p' = \frac{\sigma'_1 + \sigma'_2 + \sigma'_3}{3}$$

$$\tau = \frac{\sigma_1 - \sigma_3}{2}$$

$$\varepsilon_d = \frac{2}{3}(\varepsilon_1 - \varepsilon_3)$$

$$\varepsilon_{vol} = \varepsilon_1 + \varepsilon_2 + \varepsilon_3$$

Induced pore water overpressure in undrained condition

$$\Delta p_w = B[\Delta\sigma_3 + A(\Delta\sigma_1 - \Delta\sigma_3)]$$

Volumetric strain as a function of void ratio

$$\varepsilon_{vol} = \frac{-\Delta e}{1 + e_0}$$

Work

$$\delta W = \sigma'_{xx} \delta\varepsilon_{xx} + \sigma'_{yy} \delta\varepsilon_{yy} + \sigma'_{zz} \delta\varepsilon_{zz} + \sigma'_{xy} \delta\varepsilon_{xy} + \sigma'_{yz} \delta\varepsilon_{yz} + \sigma'_{zx} \delta\varepsilon_{zx}$$

$$\delta W = \sigma'_1 \delta\varepsilon_1 + \sigma'_2 \delta\varepsilon_2 + \sigma'_3 \delta\varepsilon_3 = \sigma'_a \delta\varepsilon_a + 2\sigma'_r \delta\varepsilon_r$$

$$\delta W = \frac{(\sigma'_a + 2\sigma'_r)(\delta\varepsilon_a + 2\delta\varepsilon_r)}{3} + \frac{2(\sigma'_a - \sigma'_r)(\delta\varepsilon_a - \delta\varepsilon_r)}{3}$$

$$\delta W = p' \delta\varepsilon_p + q \delta\varepsilon_q = \delta W_v + \delta W_d$$