Achievable

Geotechnical engineering, hydrology, hydraulics

FE CIVIL DUMP SHEET

Soil relations

Soil relations

$e = V_v/V_s$
$n = V_v/V_t$
$w = W_w/W_s$
$S = V_w/V_v$
$\gamma' = \gamma_{sat} - \gamma_w$

Stress in soil

$\sigma = \gamma z$
$u = \gamma_w z$
$\sigma' = \sigma - u$

Compaction

$\gamma_z AV = G_s \gamma_w / (1+w)$

Consolidation

$$S_c = \frac{(C_c H)}{(1+e_o)\log(\sigma_f'/\sigma_o')}$$

$$T_v = \frac{C_v t}{Hd^2}$$

Shear strength

$\tau = c + \sigma' \tan\varphi$

Bearing capacity

$q_{ult} = cN_c + \gamma D_f N_q + 0.5\gamma B N_\gamma$
$q_{allow} = q_{ult} / FS$

Earth pressure

$K_a = \tan^2(45 - \varphi/2)$
$K_p = \tan^2(45 + \varphi/2)$
$\sigma_h = K \sigma_v$

Stress in soil

Hydraulics

$Q = VA$

- Bernoulli:

  $p/\gamma + z + V^2/(2g) = \text{const}$
  $p = \gamma h$
  $F = \gamma h_c A$

- Pipeflow

  $R_e = VD / \nu$
  $h_f = f\, L/D * V^2/(2g)$

- Pumps

  $P = \gamma Q hp/\eta$

- Open channels

  $$V = \left(\frac{1}{n}\right) R^{\frac{2}{3}} S^{\frac{1}{2}}$$
  $Fr = V / \text{sqrt}(gD)$
  $$y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}}$$

Hydrology

$Q = C\, i\, A$

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$S = 1000/CN - 10$
$T_c = 0.0078\, L^{0.77}\, S^{-0.385}$