# ACBA6014 Formula Sheet

## Slope Stability

$$FoS = \frac{Resisting\ Forces}{Driving\ Forces} = \frac{\tau_f}{\tau}$$

$$\tau_f = c' + (\sigma - u)\tan \emptyset'$$

$$\tau = \big((1-m)\gamma + m\gamma_{sat}\big) z \sin\beta \cos\beta$$

$$\sigma = \big((1-m)\gamma + m\gamma_{sat}\big) z cos^2\beta$$

$$u = mz\gamma_w cos^2\beta$$

$$FoS = \frac{C_u L_a r}{Wd}$$

## Retaining Walls

### Hydrostatic Pressure

$$P_w = \frac{1}{2}\gamma_w H^2$$

### Active Earth Pressure

$$p_a = K_a \gamma z$$

$$K_a = \frac{1-sin\,\emptyset}{1+sin\,\emptyset}$$

$$p_a = K_a \gamma z - 2c\sqrt{K_a}$$

$$P_a = \frac{1}{2} K_a \gamma H^2$$

### Passive Earth Pressure

$$p_p = K_p \gamma z$$

$$K_p = \frac{1+sin\,\emptyset}{1-sin\,\emptyset}$$

$$p_p = K_p \gamma z + 2c\sqrt{K_p}$$

$$P_p = \frac{1}{2} K_p \gamma H^2$$

At Rest Earth Pressure

$$\sigma_h = K_o \gamma H$$

$$K_o = 1 - sin\,\emptyset$$

Surcharge

$$p_{sur} = qK_a$$

$$p_{sur} = qK_p$$

**Overtopping**

$$R * = \frac{R_c}{T_m \sqrt{g H_S}}$$

$$Q * = Ae^{(-\frac{BR*}{r})}$$

$$q = Q * T_m g H_s$$

| Armour Type | r |
|---|---|
| Smooth Impermeable | 1 |
| Pitched stone in mortar | 0.75 - 0.8 |
| Stepped concrete | 0.95 |
| Grass / turf | 0.9 - 1 |
| Rock armour, 2 layers | 0.55 |
| Open rock, > 2 layers, shallow slope | 0.45 |
| Hollow cube armour units, 1 layer | 0.5 |
| Dolos or Stabit armour units | 0.4 |
| Tetrapods, 2 layers | 0.3 |

| Slope | A | B |
|---|---|---|
| 1 : 1 | 0.0079 | 20.1 |
| 1 : 1.5 | 0.0102 | 20.1 |
| 1 : 2 | 0.0125 | 22.1 |
| 1 : 3 | 0.0163 | 31.9 |
| 1 : 4 | 0.0192 | 47.0 |

**Discharge**

Rectangular Weir

$$Q = C_d b H^{1.5}$$

V-Notch Weir

$$Q = \frac{8}{15} C_d \tan\frac{\theta}{2} \sqrt{2g} H^{2.5}$$

Broad Crested Weir

$$Q = C_d L \sqrt{2g} (H_1 - H_2)^{1.5}$$

**Hydrological Budget**

$$\Delta S = P - E \pm G - Q$$

**Embodied Carbon**

*material quantity × carbon factor = embodied carbon*

**Groundwater**

$$n = \frac{V_p}{V_b}$$

$$i = \frac{\Delta h}{\Delta x}$$

$$h = z + \frac{P}{\rho g}$$

$$Q = -KA\frac{\Delta h}{L}$$

$$q = \frac{Q}{A}$$

$$q = -ki$$

$$v_i = \frac{q}{n_d} = \frac{Ki}{n_d}$$

| **Renewable Energy** |
| --- |
| Wind |
| $Power\ (W) = \frac{1}{2}\rho A v^3$ |
| Hydroelectric |
| $P = \eta \rho g h Q$ |
| Tidal |
| $P = \frac{1}{2} A \rho g h^2$ |