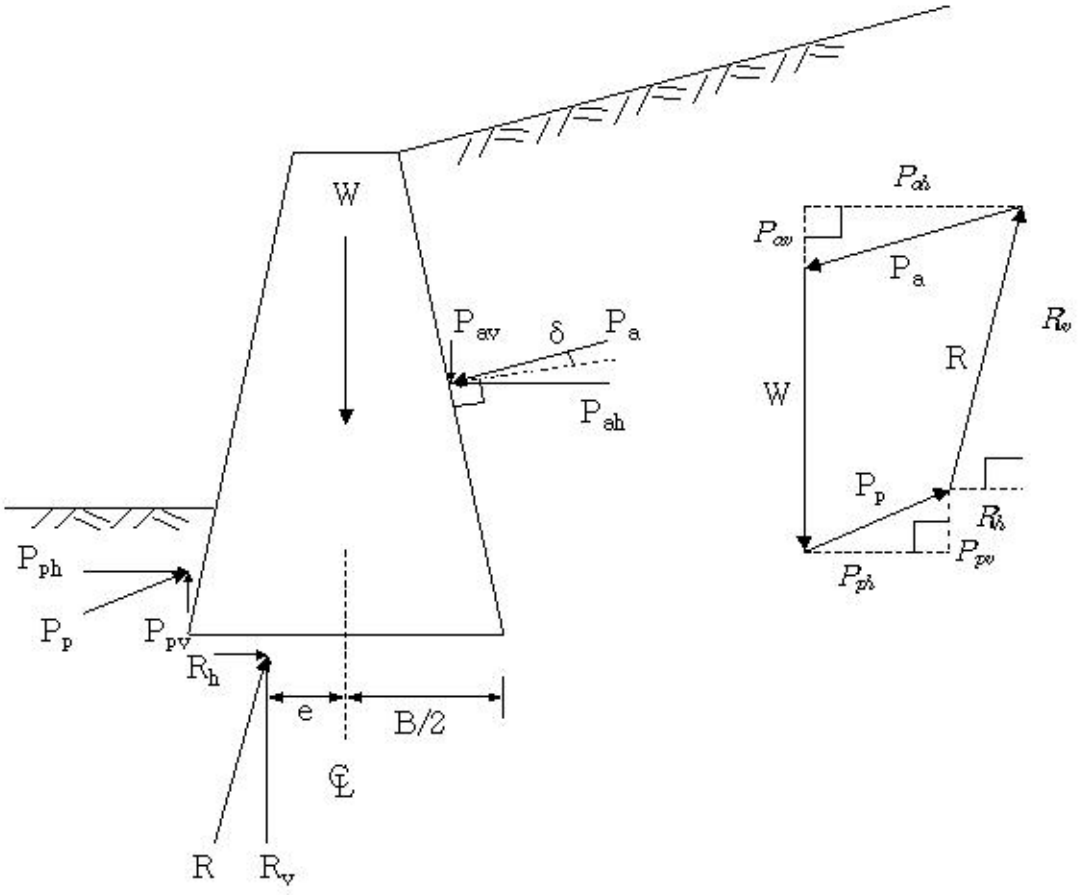
6.7 Design Principles of Retaining Walls

1) Requirements for a satisfactory design

① The wall must be safe against (Sliding)
② The wall must be safe against (Overturning)
③ The contact pressure mobilized at the toe of the wall must not exceed (the allowable bearing capacity of foundation soil)

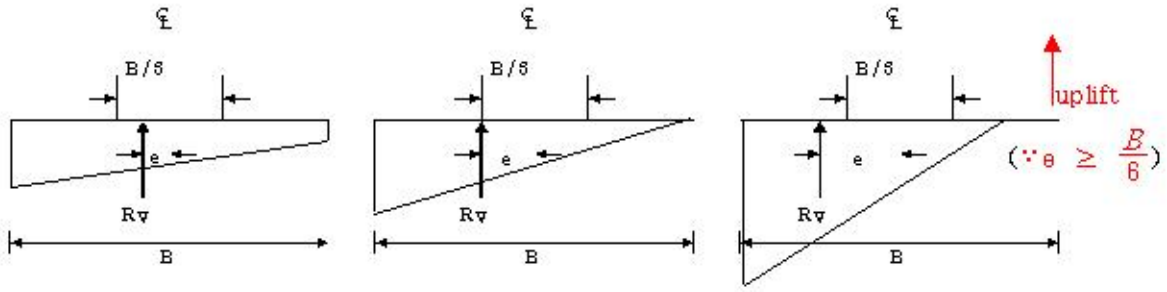
2) Gravity Walls



(a) (b)

Fig. 1

- Pressure distributions underneath the wall



(a) $e < \frac{B}{6}$ (b) $e = \frac{B}{6}$ (c) $e > \frac{B}{6}$

Fig. 2

- From equilibrium of the wall

$$R_v = W + P_{av} - \cancel{P_{pv}}^{0}$$

$$R_h = P_{ah} - \cancel{P_{ph}}^{0}$$

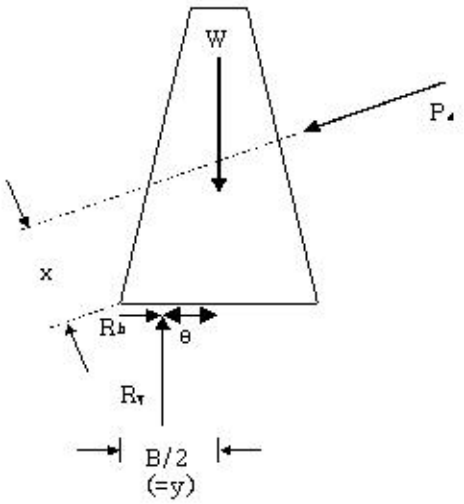
○ R_v , R_h determined

- Design Criteria

① Against sliding :

$$R_v \tan\delta \geq FS \cdot R_h$$

② Against overturning : $W \cdot y \geq FS\ (P_a \cdot x + R_v(y-e))$



③ Bearing capacity of foundation soils :

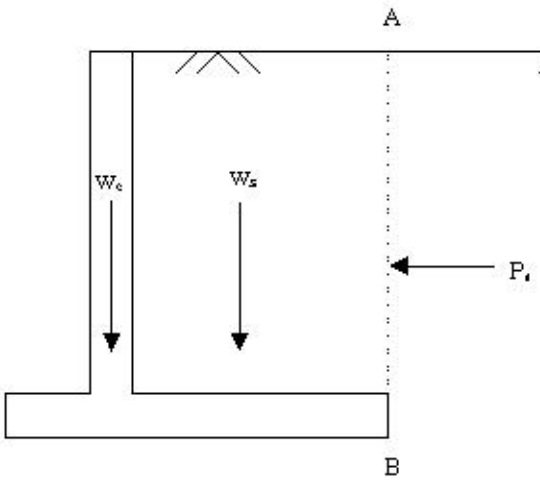
- Case 2(a) and 2(b)

$$Q_a \geq \frac{R_v}{B}\left(1 + 6\frac{e}{B}\right)$$

- Case 2(c)

$$Q_a \geq \frac{4}{3}\frac{R_v}{B-2e}$$

3) Cantilever walls



* Remark :
Calculated by Rankine's method always because no shear stress act on this plane ($\overline{AB}$)

6.8 Braced excavations

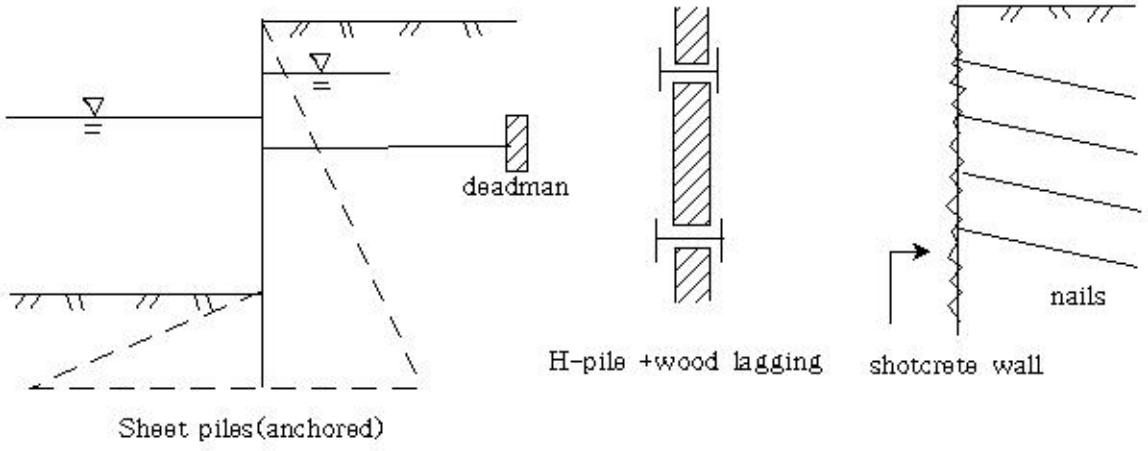
1) Types of excavation walls

- Sheet piles : Cantilevered / Anchored

  * supported by the passive thrust and/or by the bracing elements

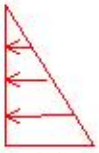
- Soldier pile (e.g., H-pile) + wood-lagging

- Slurry walls / Soil nailing walls / Reinforced earth

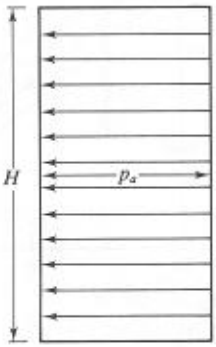


2) Types of supports

- Struts / earth anchors / rakers

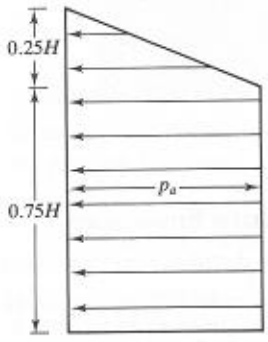
3) Pressure distributions ( rakers / E/A / less struts)

① Peck's apparent pressure envelope for cuts in sand



$$p_a = 0.65\gamma HK_a$$

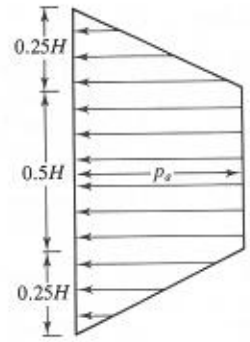
② Peck's apparent pressure envelope for cuts in soft to medium clay



$$p_a = \gamma H\left[1-\left(\frac{4c}{\gamma H}\right)\right]$$

or $p = 0.3\gamma H$

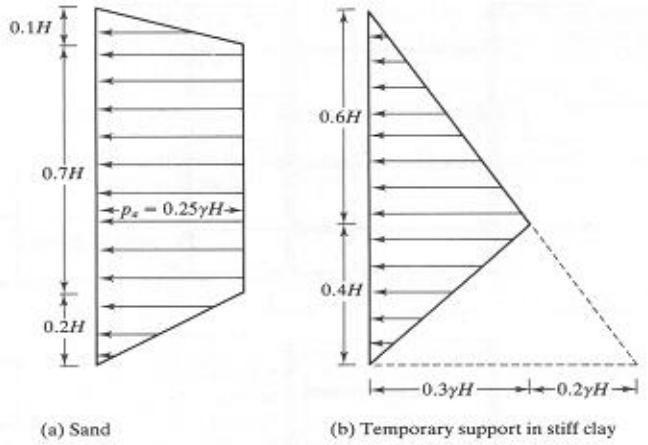
③ Peck's apparent pressure envelope for cuts in stiff clay



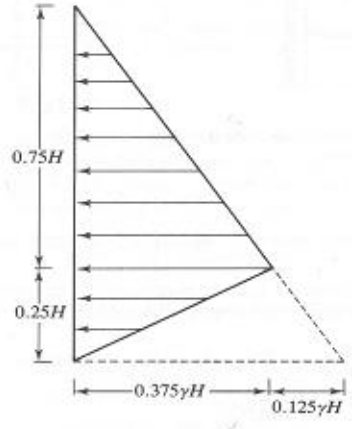
$p_a = 0.2\gamma H$ to $0.4\gamma H$

(with an average of $0.3\gamma H$)

④ Tschebotarioff's pressure envelopes



(a) Sand (b) Temporary support in stiff clay



(c) Permanent support in medium clay

4) Slurry walls (Diaphragm walls) (P. 183, 그림 6.21)

- Bentonite Slurry → thixotropic properties (gel ↔ fluid)

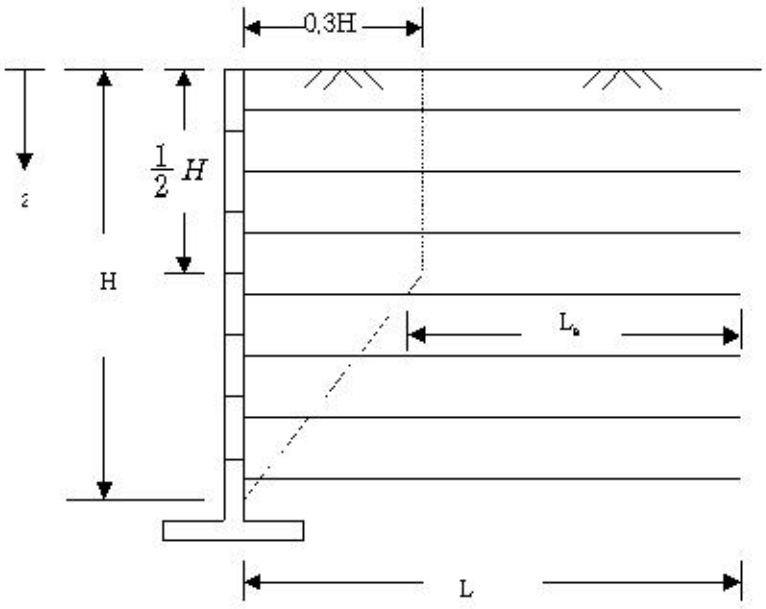
- Bentonite particles form a (filter cake)

if ① fluid pressure > p.w.p. in soil

② k not too low, not too high

- Slurry specifications : pH, γ, ···

5) Reinforced earth



S_x, S_z: horizontal, vertical spacings

b: width of strip

- Fill material : Coarse grained soil
  * #200 ≤ 10%
- Facing elements : Flexible
- Tensile force (T) in the element :

$$T = K_A \sigma_z S_x S_z$$

- Resisting force(R) of the strip :

$$R = 2bL_e\sigma_z \tan\delta$$

$(\sigma_z = \gamma \cdot z)$

- Requirements:

$$R/T \geq 2$$