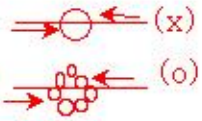
Effective Stress

Prel.

○ Volume change of soil (solid particles + water + air)
- rearrangement of the skeleton of solid particles
  (∴ irreversible)
- compression of the air

○ Resisting Forces
- normal stress → by the soil skeleton and, if (fully saturated), by the pore water.
- shear stress → only by the (soil skeleton)

Soil particle (x)
Soil skeleton (o)



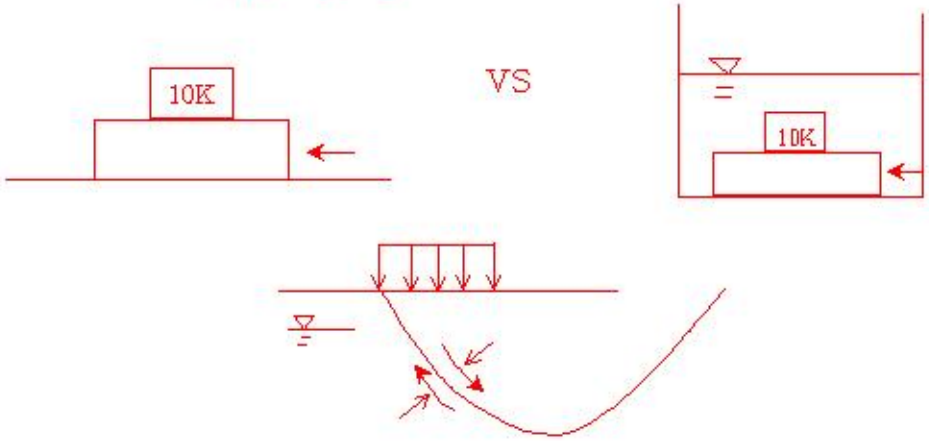
1. The Principle of Effective Stress

○ The total normal stress(σ) on a plane within the soil mass = the force per unit area of the plane (imagining the soil to be a single-phase material)

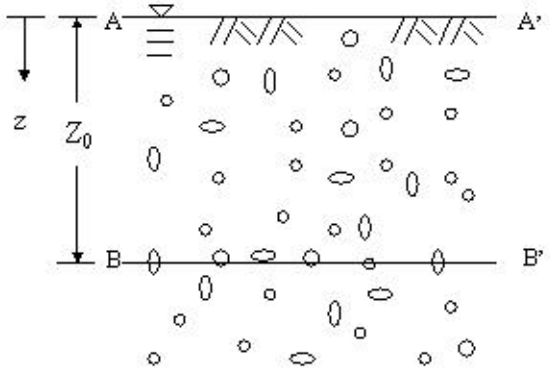
○ The pore water pressure(u) = the pressure of the pore water $(h_w \times \gamma_w)$

○ The effective normal stress ($\bar{\sigma}$ or σ') on a plane representing the stress transmitted thru the soil skeleton only.

→ $\bar{\sigma} = \sigma - u$



2. Effective Vertical Stress due to Self-wt. of Soil



○ at $\overline{BB'}$,

$\sigma_v = \gamma_{sat} \cdot z_0$

$u = \gamma_w \cdot z_0$

$\overline{\sigma_v} = \sigma_v - u = (\gamma_{sat} - \gamma_w) z_0$

$= (\gamma') \cdot z_0$

3. Effective Stress vs. Pore Water Pressure

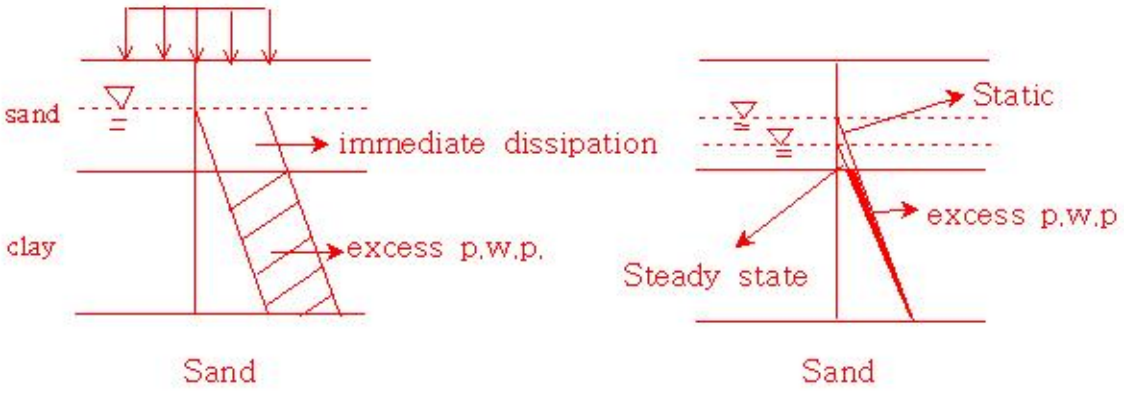
○ Static p.w.p : pore pressure in a natural condition

○ Excess p.w.p : pore pressure after the total stress is increased

○ Steady state p.w.p : pore water pressure at the end of the transient flow of p.w (In most cases = Static p.w.p.)

* Fig. 2.17 (p. 57) : Spring analogy for Effective Stress & P.W.P

(보조자료 #1)

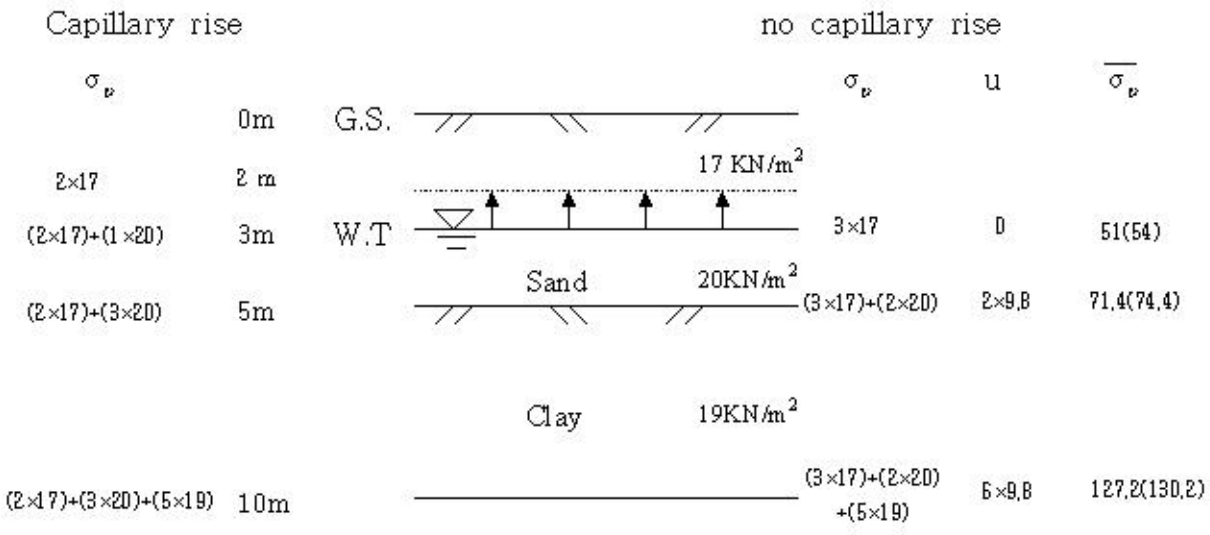


4. Dissipation of Excess p.w.p.

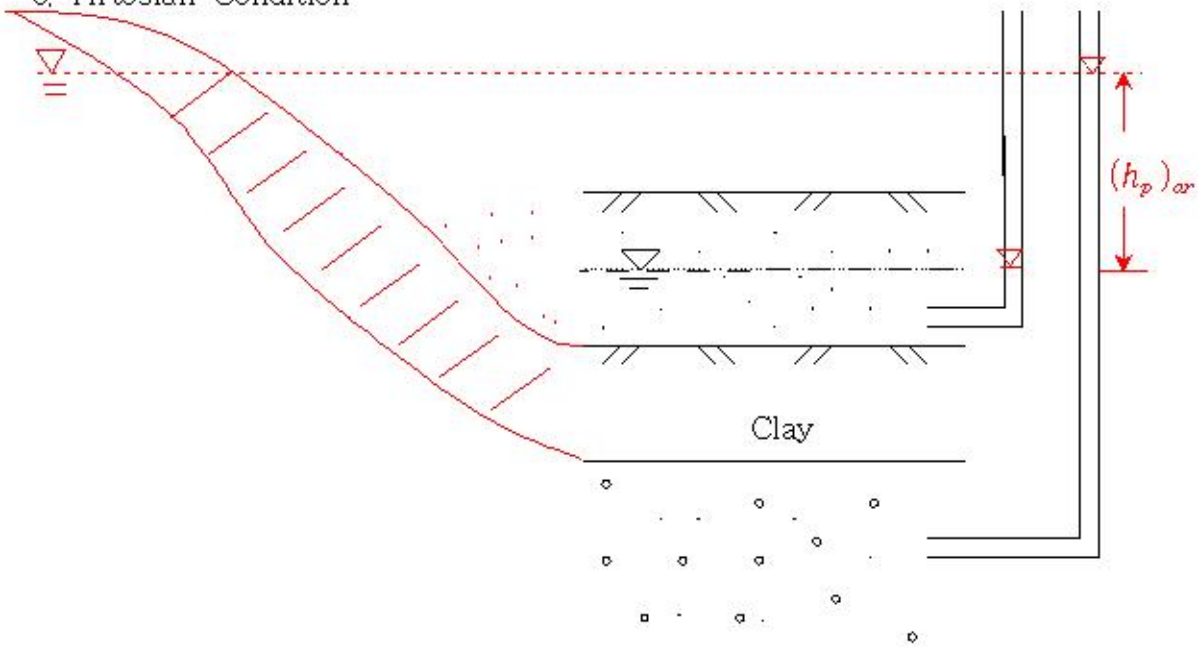
- ○ The dissipation(drainage) period
  = f (permeability)
- ○ Consolidation : drainage process for the soils of low permeability
  (e.g., Saturated clay)
- ○ Swelling (↔consolidation) : volume increase due to total stress decrease is limited
  (∵ Particle rearrangement is irreversible)

5. Capillary Rise

- ○ Saturation of soil due to the capillary rise above the water table does not contribute to the hydrostatic pressure below w.t. .



6. Artesian Condition



- Artesian well
- Artesian pressure $(h_p)_{ar} \times \gamma_w$