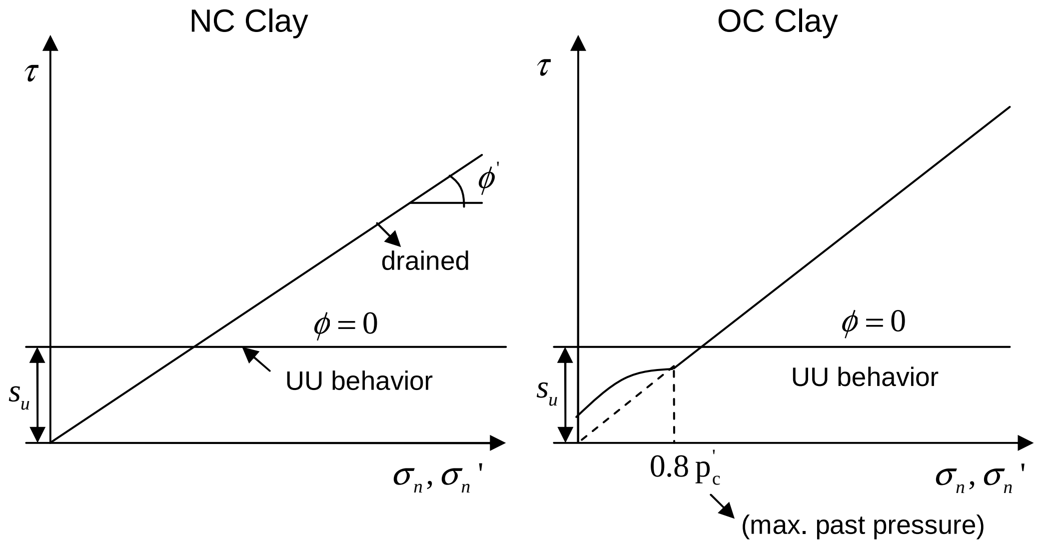
1.3 Shear Strength of Cohesive Soils

(1) Drained Strength



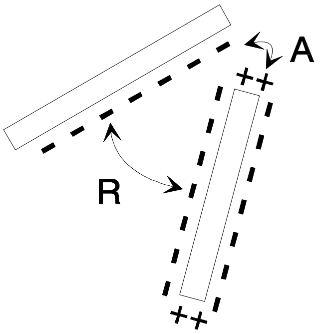
"Fundamental Shear Strength Parameters"

- Hvoslev Parameter

  c_e, ϕ_e

- Work based on lab tests of saturated remolded clays

Physico-chemical Forces (Intrinsic Forces)



Attractive Forces, A

1) Electrostatic attraction
2) Van der Waal's Force

Repulsive Forces, R

1) Electrostatic repulsion

- Factors affecting intrinsic forces
  1. Type of clay
  2. Particle spacing
  3. Geometric arrangement of particles
  4. Specific surface

- Effective stress equations

$$\sigma' = \sigma - u + A - R$$

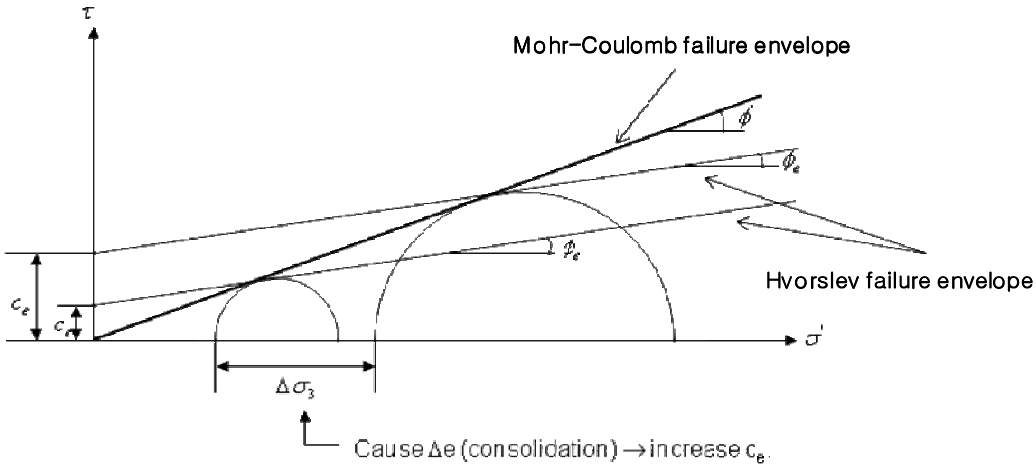
S ≡ shear strength $= S_{granular} + S_{cohesive}$

$$S = S_g + S_c = (\sigma - u)K_g + (\sigma - u + A - R)K_c$$
$$= (\sigma - u)(K_g + K_c) + (A - R)K_c$$
$$= (\sigma - u)\tan\phi_e + c_e$$

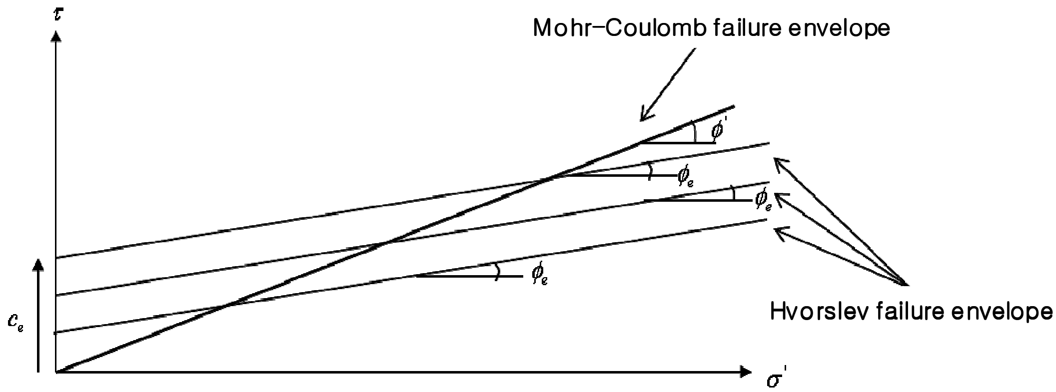
Equivalent friction angle. →material constant (ϕ_e)

Equivalent cohesion (c_e)

For NC Clay (drained test)

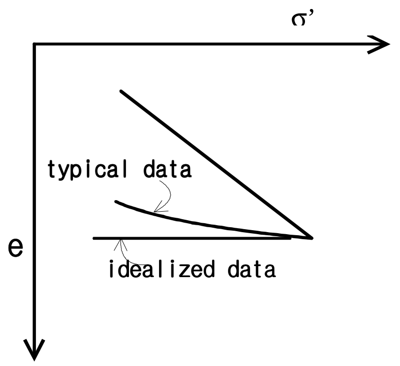


→ No longer 1 failure envelope, but a series of envelope for Hvorslev theory



For OC Clay

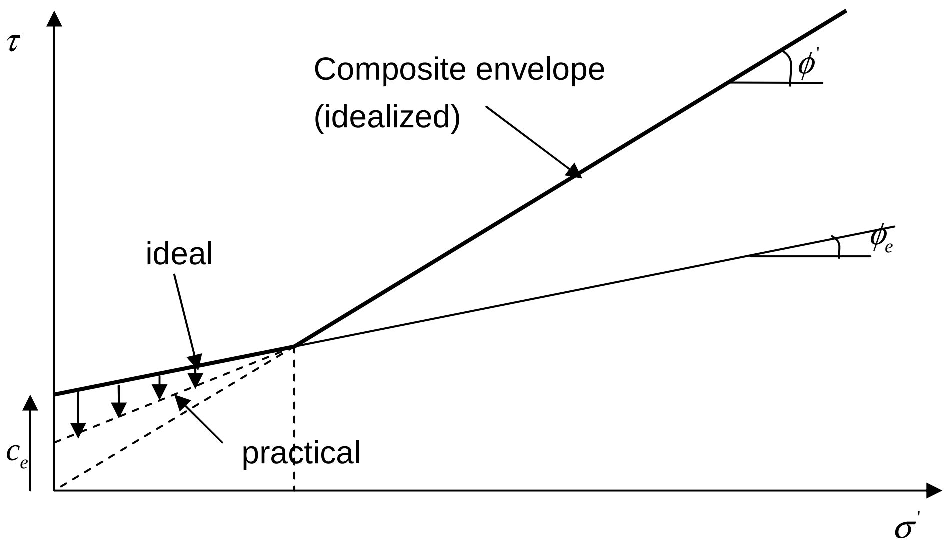
Ideal Soils → No Δe during unloading



In terms of Hvorslev parameters;

For any unloading (OCR > 1)

$$\phi_e = \text{constant}$$
$$c_e = \text{constant}$$



Practical decrease in strength due to increase in e during 'actual' unloading

→ So, Hvorslev ideal envelope (OC Clay) → upper bound strength

- **Summary**

An increase in effective stress has two effects on strength of clays.

1. Increase particle to particle contact forces.

   $\rightarrow$ increase in frictional resistance $\rightarrow$ $S = \underline{(\sigma - u)}\tan\phi_e$

   ↑ increase

2. Decrease volume and void ratio, and increase (A-R) and c_e.