

## (2) Shear Behavior of Sands (also clays)

- Most important factors in determining shear strength itself (for given soils).
  - i) Initial void ratio (density)
  - ii) Confining stress
- Critical State  $\left\{ \frac{dq}{d\varepsilon_a} = 0, \text{ and } \frac{d\varepsilon_v}{d\varepsilon_a} = 0 \text{ or } \frac{dp'}{d\varepsilon_a} = 0 \right\}$

for drained conditions;

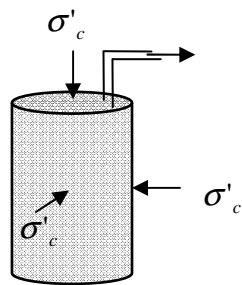
$e_{cr}$  = critical void ratio  $\equiv$  void ratio at which no volume change occurs as shearing progresses.

for undrained conditions;

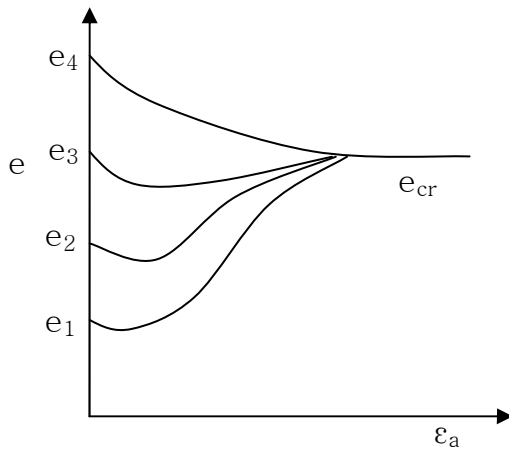
$\sigma'_{3cr}$  = critical confining stress  $\equiv$  confining stress at which no excess pore water pressure change occurs as shearing progresses.

1) CID TXC tests

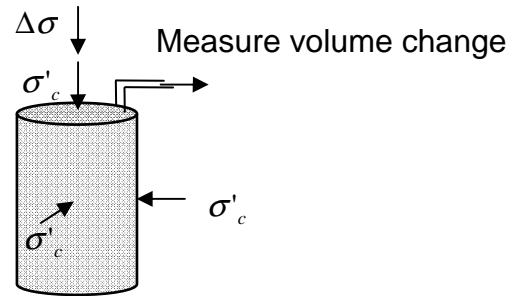
consolidation



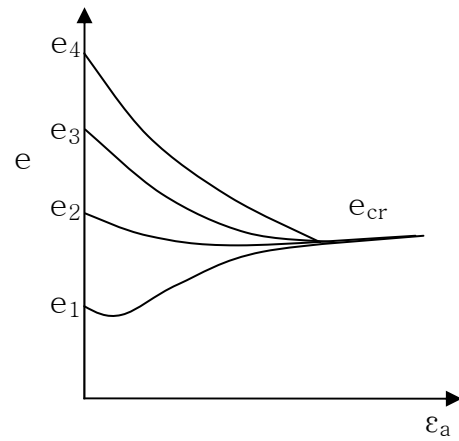
- varying  $e_0$  and low  $\sigma'_3$



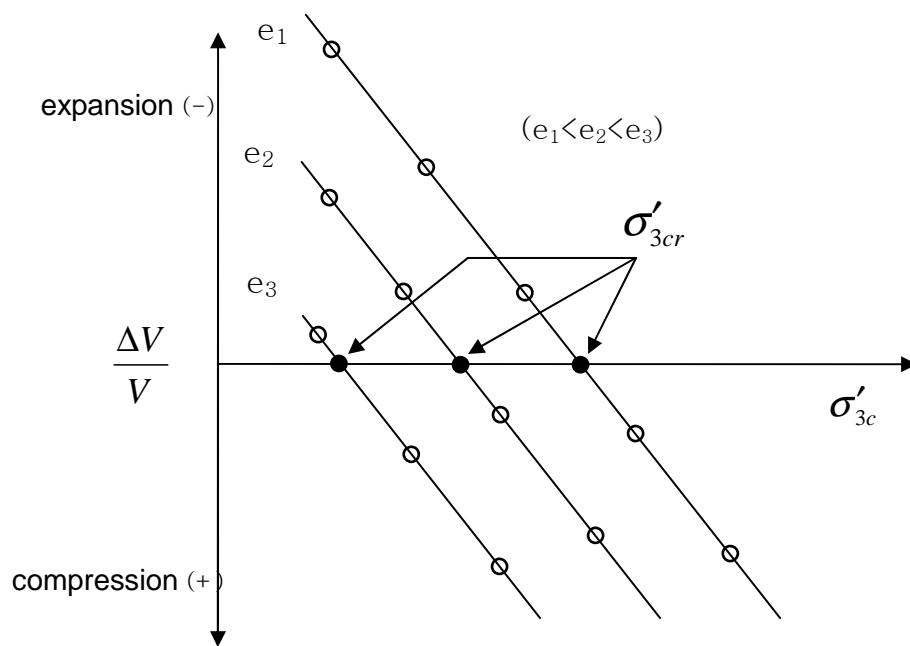
shearing



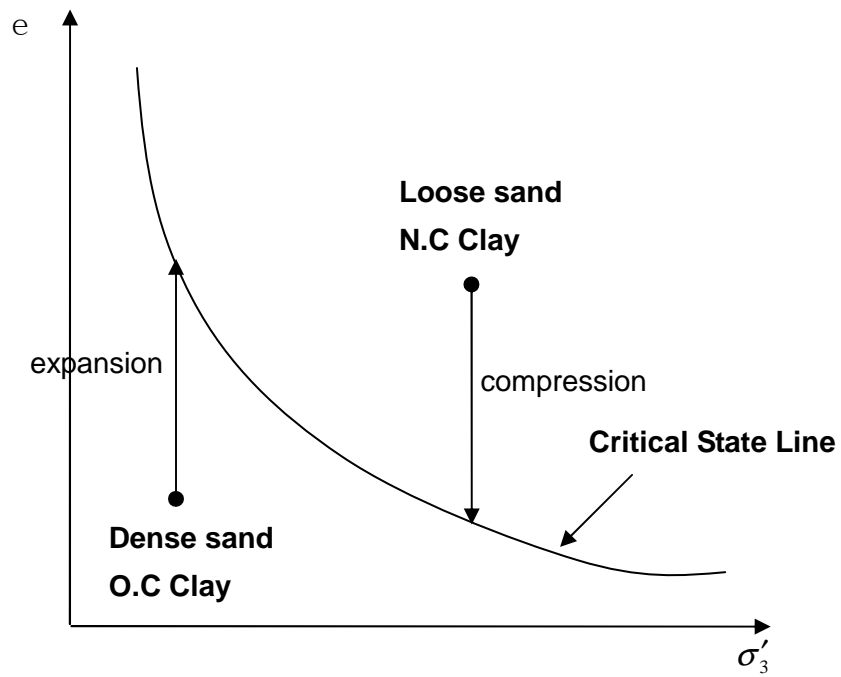
- varying  $e_0$  and high  $\sigma'_3$



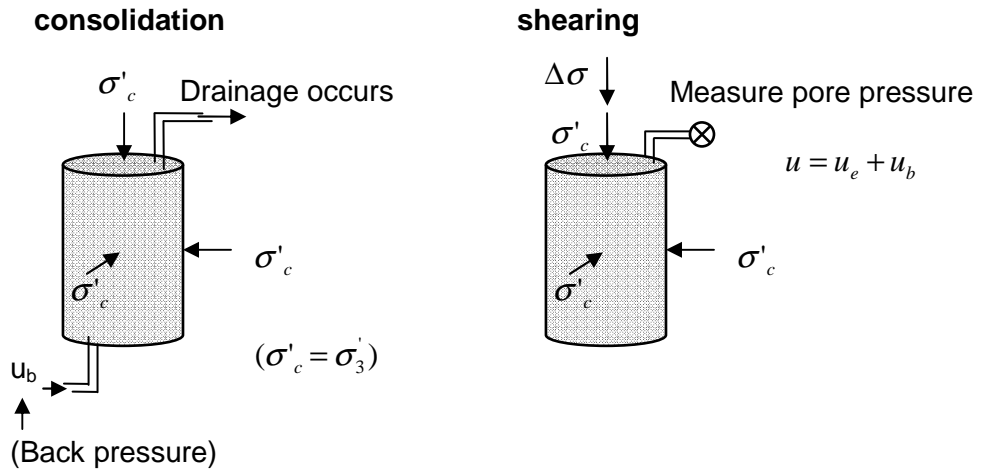
- Series of CID TXC tests with varying  $\sigma'_3$ ,  $e_0$ .



⇒ The denser the sample, the higher the  $\sigma'_{cr}$ .



2) CIU TXC

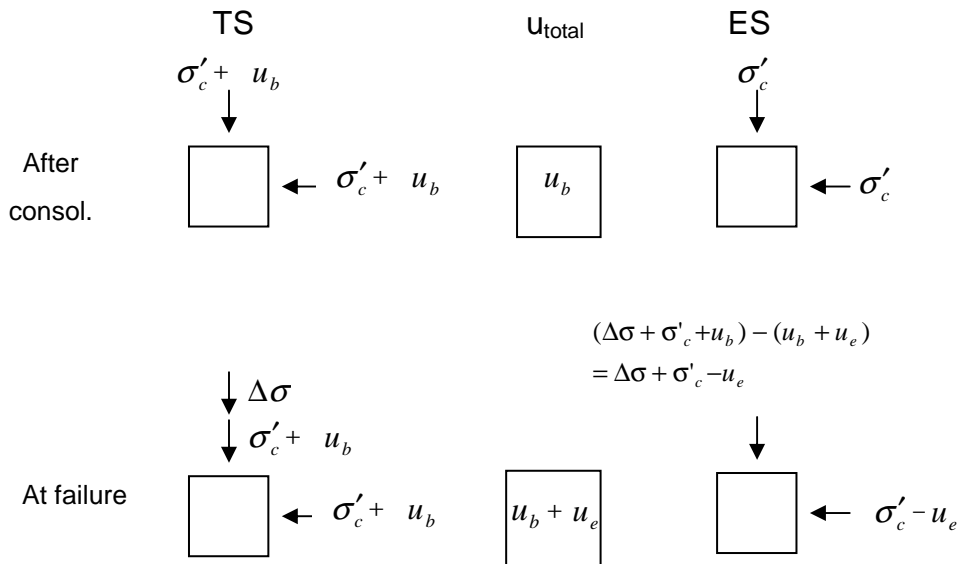


Practically,

$$\sigma_c = \sigma'_c + u_b$$

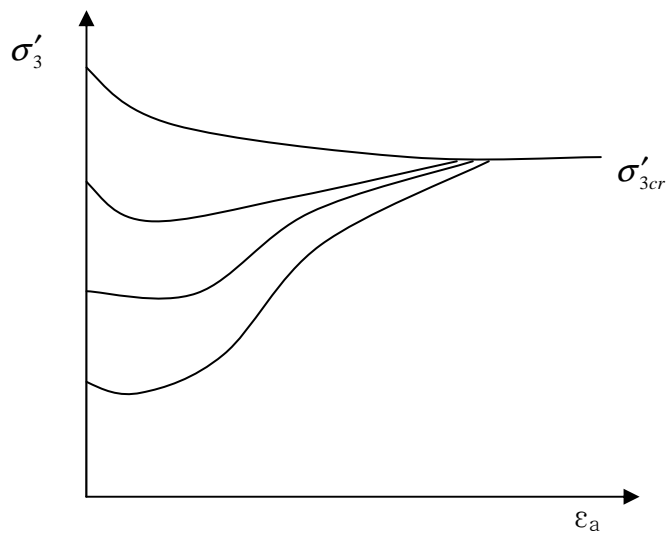
- Why back pressure?

- (1) to saturate the sample.
- (2) to prevent cavitation in sample during shearing in heavily O. C. samples.



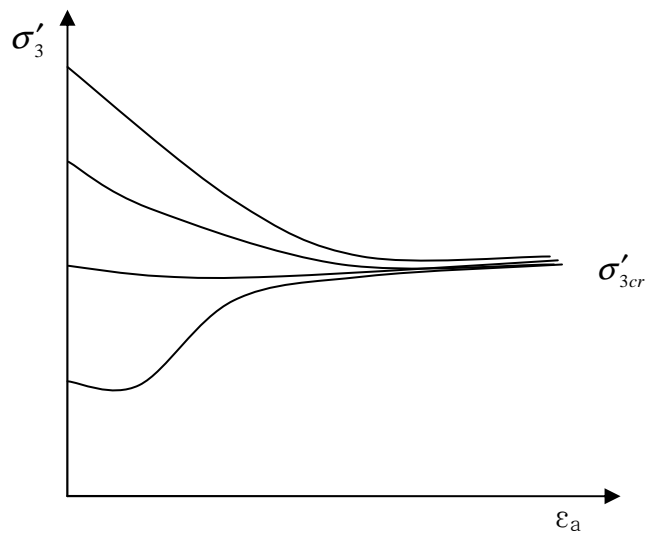
- Varying  $\sigma'_3 (= \sigma'_c)$  with low  $e_0$ .

(dense sand)

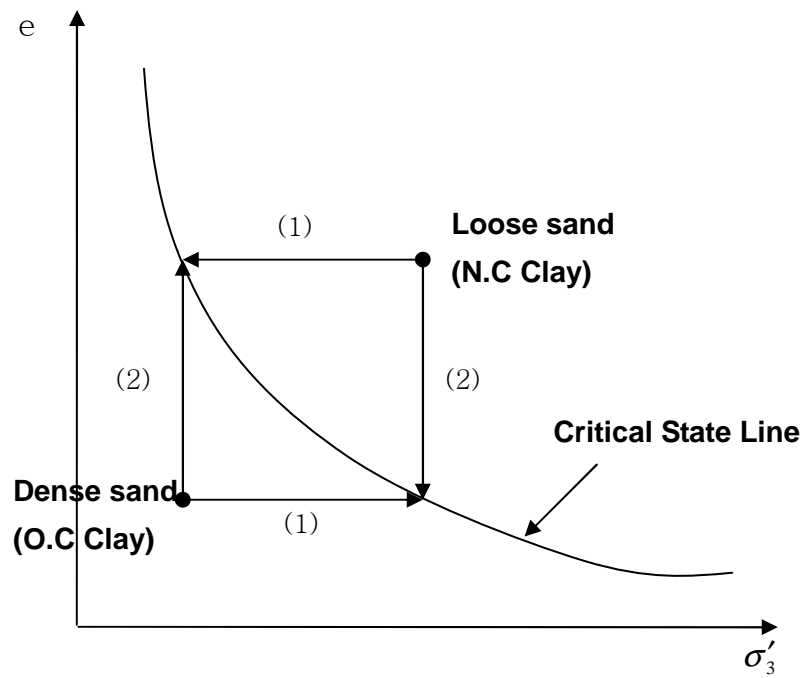
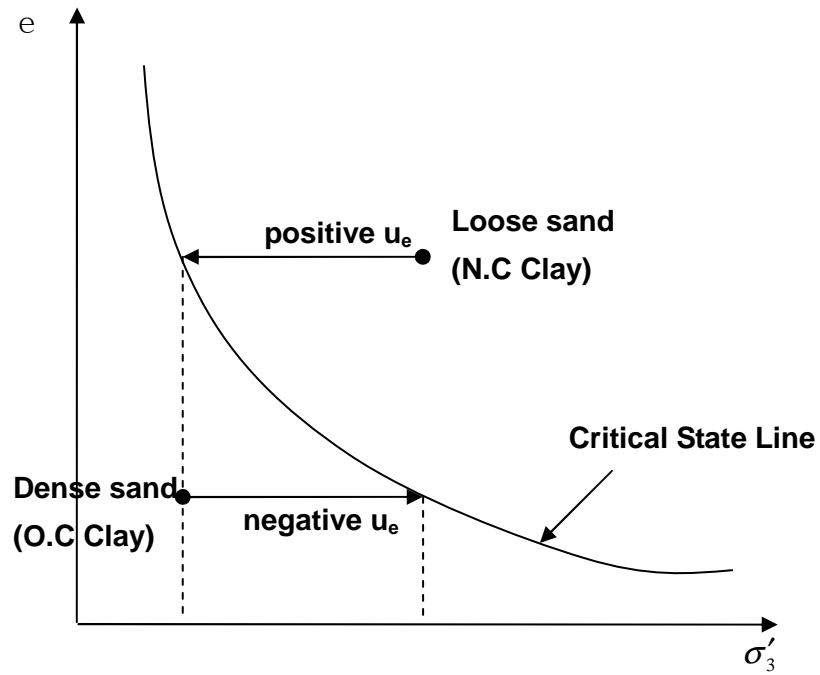


- Varying  $\sigma'_3 (= \sigma'_c)$  with high  $e_0$ .

(loose sand)



$$\sigma'_{3CR} \text{ (loose)} < \sigma'_{3CR} \text{ (dense)}$$



- (1)  $u_e$  development (undrained loading)
- (2) volume change (drained loading)