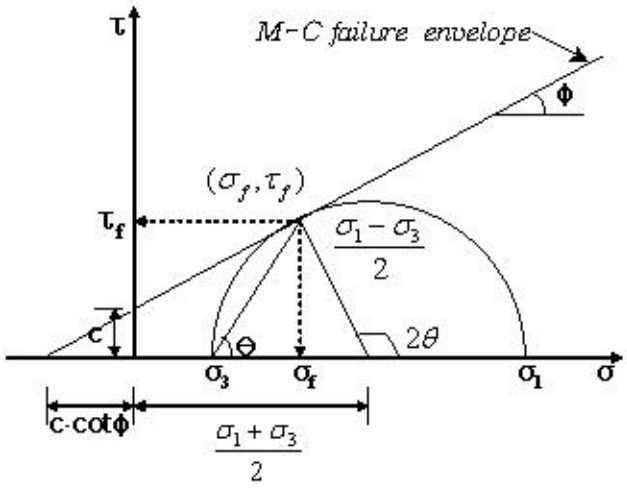
Chapter 4. Shear Strength of Soils 1/5

1. Mohr-Coulomb's failure criteria



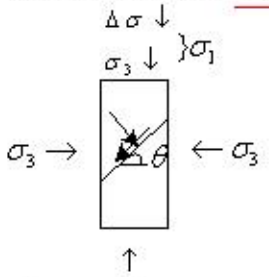
c, Φ : *shear strength parameters*

c : *cohesion intercept (apparent cohesion)*

Φ : *angle of internal friction*

* How do we get the M-C Failure Envelope ?

i) Run tri-axial tests : (p.106 : tri-axial test set-up) 보조자료



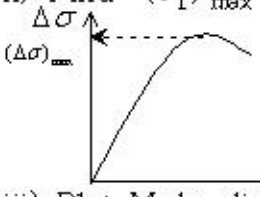
$\theta : 45° + \phi/2$

(σ_f, τ_f) : stresses on failure plane

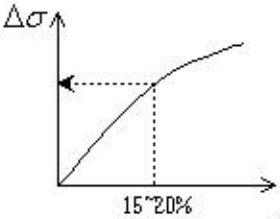
$\Delta\sigma$: deviator stress

σ_3 : cell pressure(confining pressure)

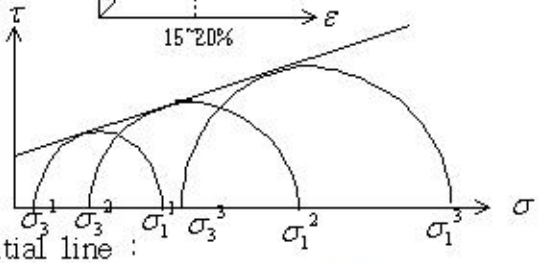
ii) Find $(\sigma_1)_{max}$:



or

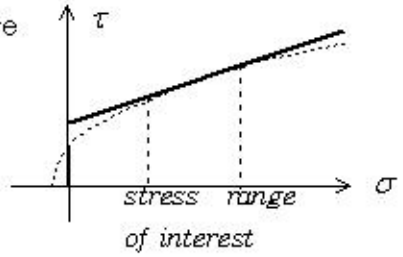


iii) Plot Mohr diagrams :



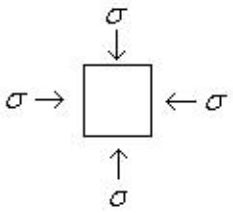
iv) Find a common tangential line :

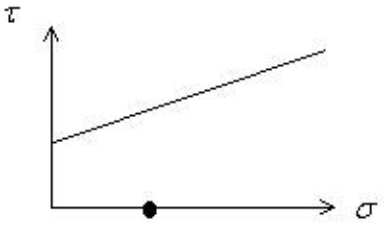
○ In fact, the M-C failure envelope is (*curvilinear*) by nature



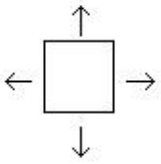
* Why mention the shear strength only ?

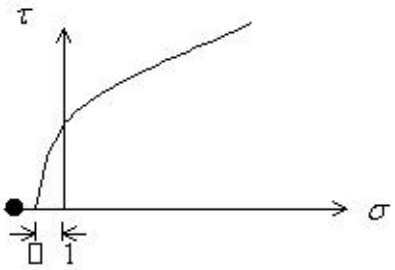
i) pure compression :



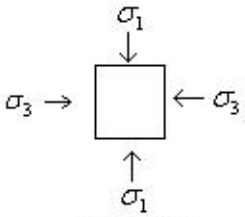


ii) pure tension :

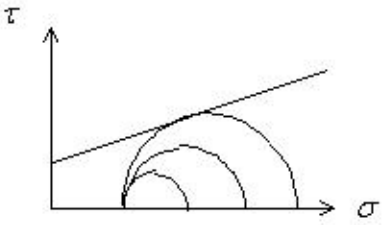




iii) shear : $\tau \propto \sigma_1 - \sigma_3$



$(\sigma_1 \neq \sigma_3)$

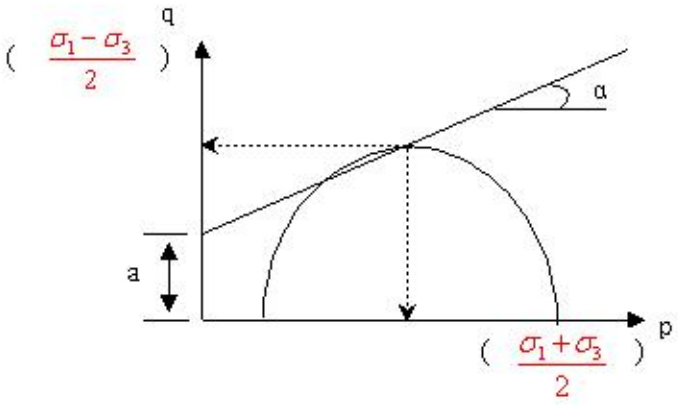


* Mohr-Coulomb's failure criteria

$$\tau_f = c + \sigma_f \tan\phi \qquad (\leftarrow y = ax + b)$$

$$(= \frac{1}{2}(\sigma_1 - \sigma_3)\sin 2\theta)$$

* p-q diagram



$$\Phi = \sin^{-1}(\tan\alpha)$$

$$c = a/\cos\phi$$

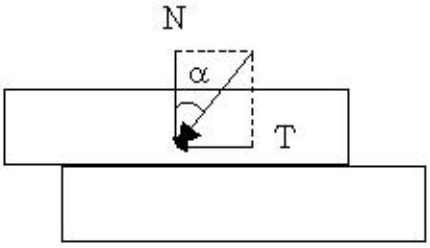
2. Strength Tests

○ In-Situ : SPT/CPT/FVT/PMT/DMT

○ Laboratory : Direct shear/Simple shear/Triaxial test

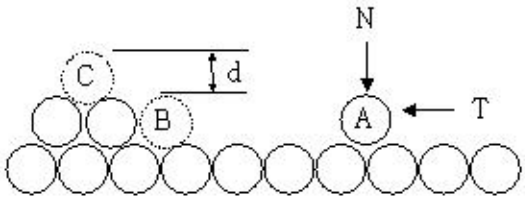
* Direct Shear Test

○ Friction between blocks



$T = N \cdot \tan \alpha$

Between soil particles

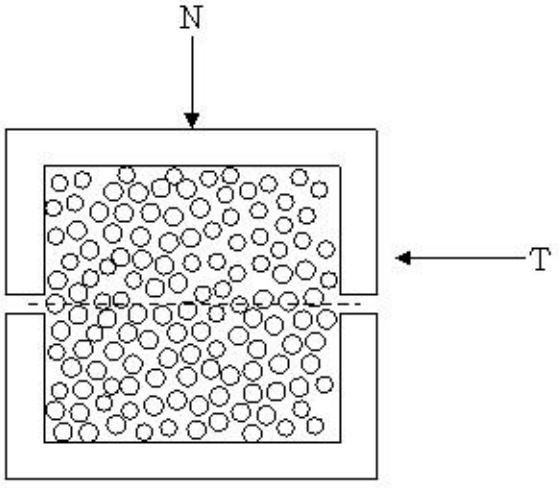


A→B : *Sliding or rolling*

B→C : *overcome interlocking*

(extra work = d · N)

○ Schematic drawing of test setup



- $\sigma = N/A,\ \tau = T/A$

$\tau_f = \sigma \cdot \tan \Phi$

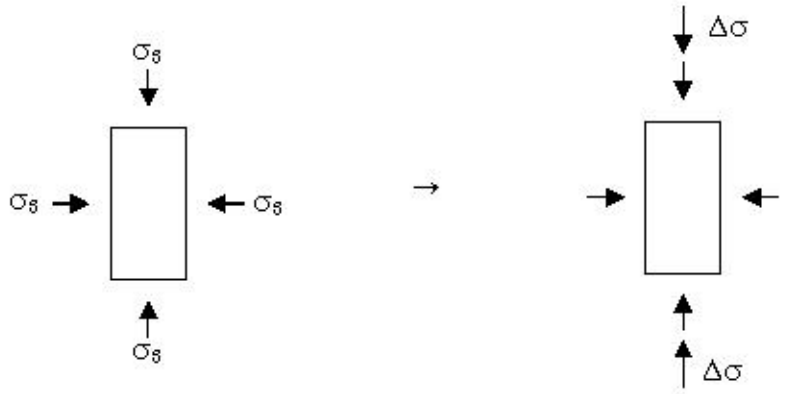
- If cohesive : $c = \frac{C}{A}$

$\tau_f = c + \sigma \cdot \tan \Phi$

↑

independent of normal stress

* Triaxial Test



Hydro-static pressure application (*consolidation stage*) + Deviatoric stress application (*shearing stage*)

○ Types of triaxial tests according to the drainage conditions for each stage. (*clay soils*)

i) Undrained test (U.U.), (Q)

- *No drainage is permitted in both stage*

ii) Consolidated-undrained test (C.U.), (Q_c)

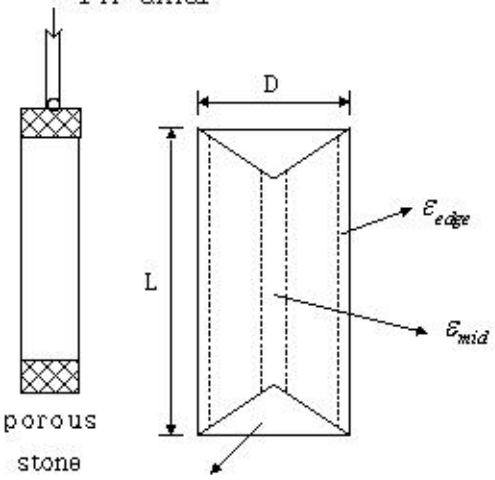
- *Drainage is permitted during the consolidation stage, and no drainage is permitted during the shearing stage.*

iii) Drained test (C.D.), (S)

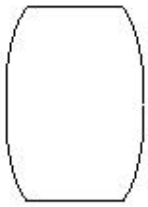
- *Drainage is permitted thruout the tests.*

3. Comparisons between the triaxial and the direct shear tests

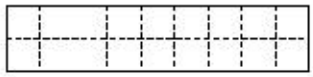
- Tri-axial

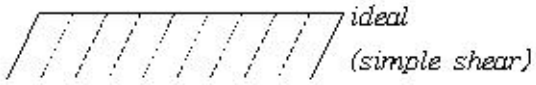


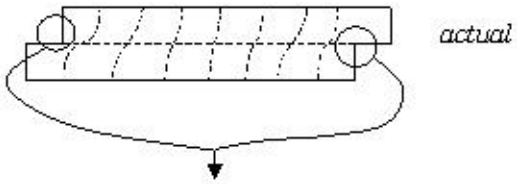
(*dead zone*) ↓



- Direct shear



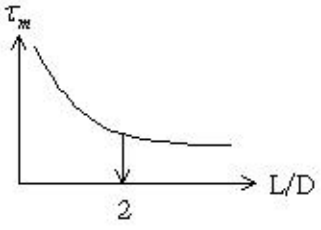


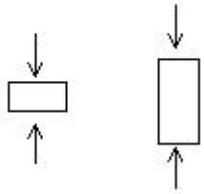


fails much earlier

End effect decrease

if ($L/D \geq 2$)





i) Progressive effects :

In direct shear, full critical stress is not simultaneously mobilized thruout the specimen

ii) Dead zone in triaxial test

iii) State of stress :

T.T : defined in any stage at any point

D.S : failure stress is only defined.