- Notes

i) Advantages and Disadvantages of TX tests(comparing with direct shear tests)

Advantages

① Drainage control

② Some control over stresses (independent control over 2 principal stresses).

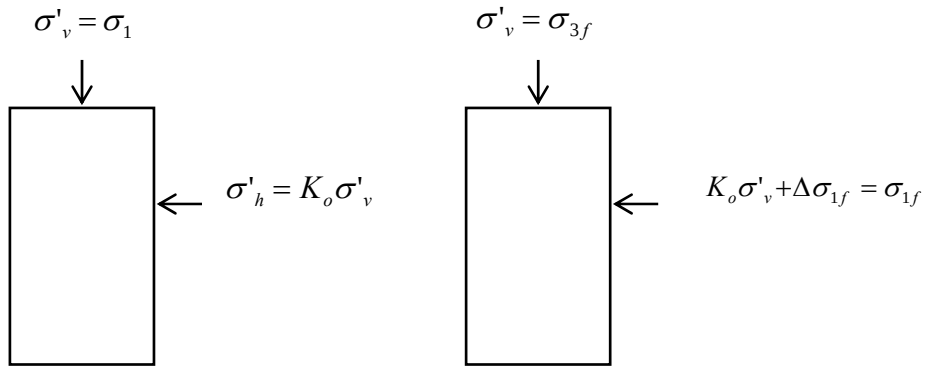
Disadvantages

① "Relatively" complicated and expensive.

② Drainage paths are long. → Consolidation takes longer time.

③ $\sigma_2 = \sigma_3$ (two of the principal stresses are equal.)

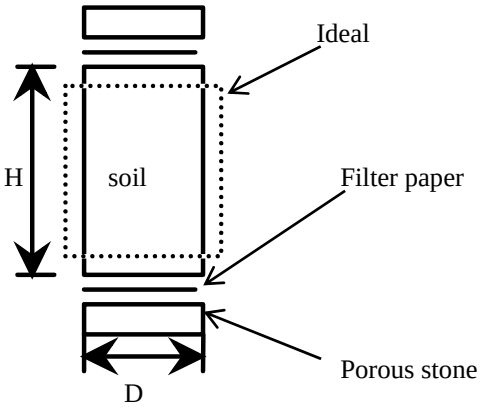
④ Directions of principal stresses are fixed. (Jump of 90° is only possible.)



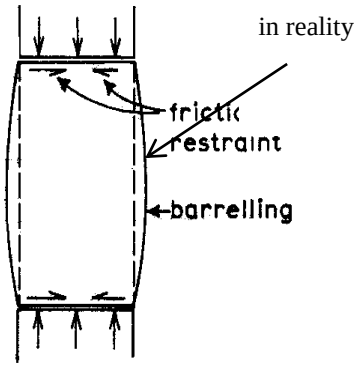
consolidation TXE shearing

ii) Comments

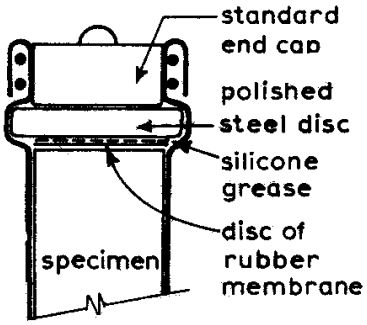
① End – conditions



- Rough ends test



- Frictionless ends tests



(multiple slip layers)

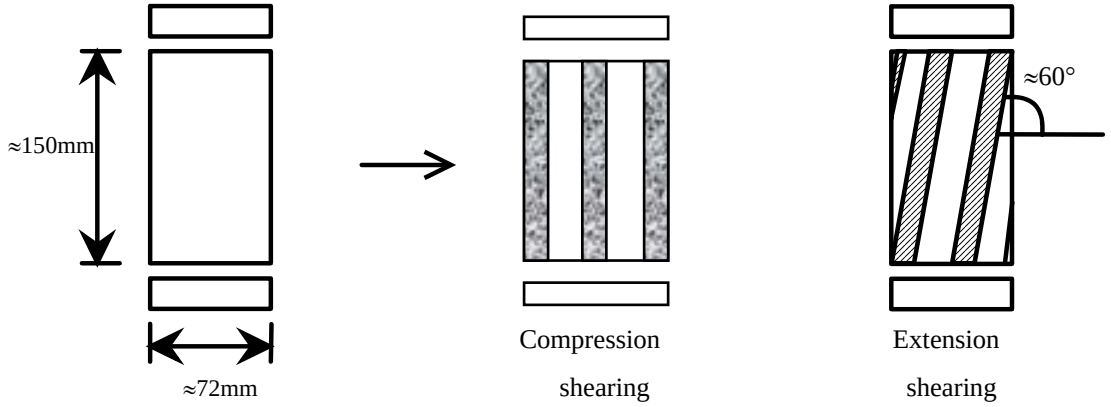
$\phi'_{F.E} \approx \phi'_{R.E.}$

$\varepsilon_{axial(F.E.)}$ *at peak* $< \varepsilon_{axial(R.E)}$ *at peak* (for the given vertical stress increments.)

To reduce the end friction effect, we should employ frictionless ends treatment with multiple slip layers or alternatively restrict H/D ratio in the range of 2 – 2.5.

② Drainage paths.

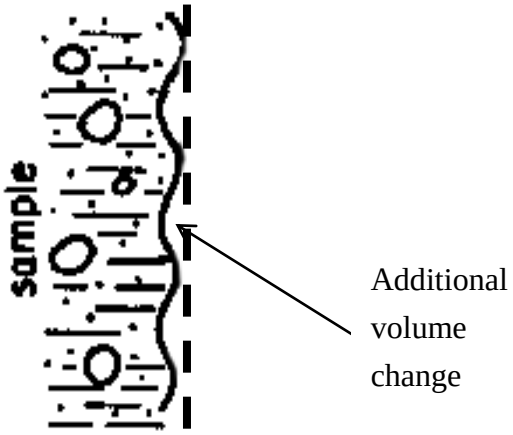
- To minimize time : use radial drains.



covered area ≤ 0.5 × sample surface area

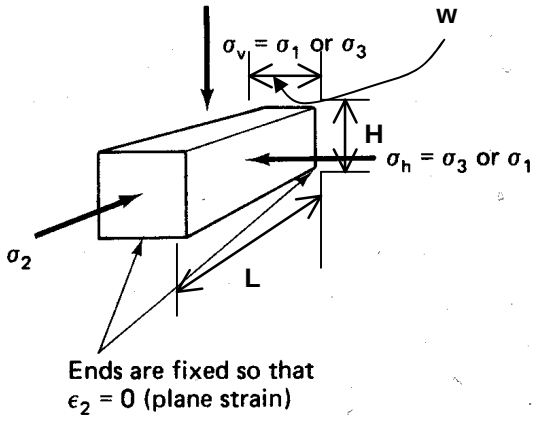
③ Membrane penetration effects

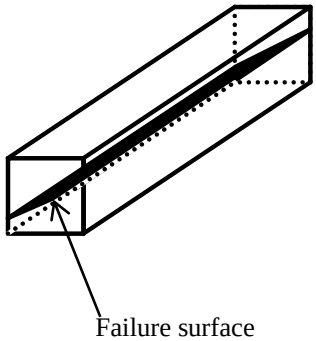
Error of ε_{vol} ⇨ Especially in coarse grained soils.



- Other tests

① Plane Strain Triaxial Tests.





L > w

H = (2~2.5)w

$\sigma_2 = f(\sigma_1, \sigma_3)$

for elastic soils : $\sigma_2 = \nu(\sigma_1 + \sigma_3)$

Advantages

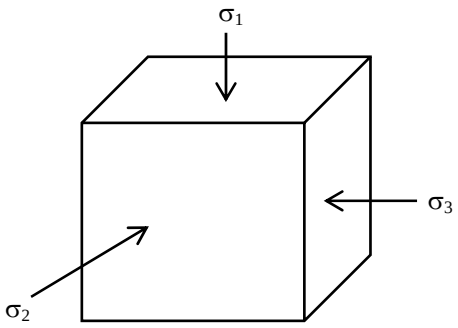
1. Same as TX.
2. $\sigma_2 \neq \sigma_3$.
3. Can model some field conditions.

Disadvantages

1. Complicated and expensive.
2. Long drainage path
3. Directions of principal stresses are fixed.
4. Odd shaped sample.

② True Triaxial Test.

- Control over 3 principal stresses.

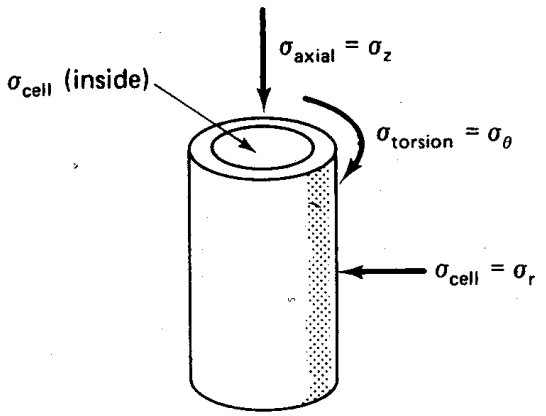


- Types of devices.
  Stress – controlled (flexible – wall)
  Strain – controlled (rigid – wall)
  Mixed

- Research tool → especially good for looking at effects of σ_2 on strength and deformation.

③ Hollow Cylinder Test.

- Specimen of hollow cylinder shape subjected different internal and external pressure as wall as to axial and torsional pressure.

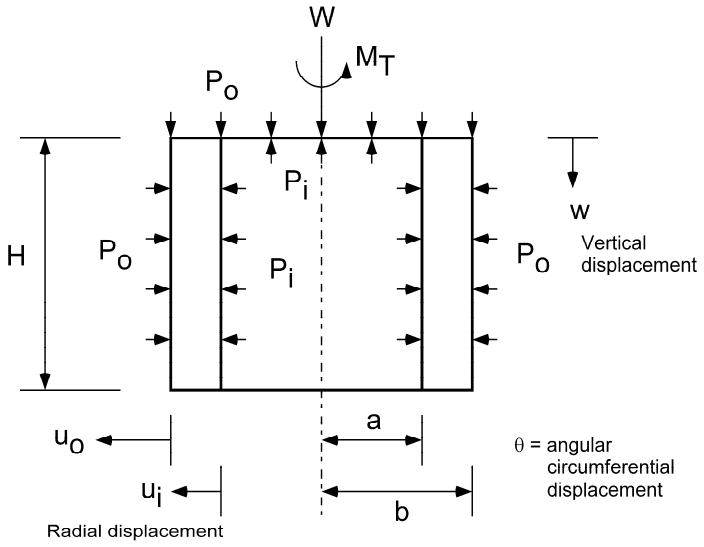


Advantages

- Rotation and control of all 3 principal stresses.

Disadvantages

- Difficult to prepare " undisturbed" samples.



Average vertical stress $\sigma'_z = \frac{W}{\pi(b^2 - a^2)} + \frac{(p_o b^2 - p_i a^2)}{(b^2 - a^2)}$ (1)

Average radial stress $\sigma'_r = \frac{(p_o b + p_i a)}{(b + a)}$ (2)

Average circumferential stress $\sigma'_\theta = \frac{(p_o b - p_i a)}{(b - a)}$ (3)

Average shear stress $\tau_{z\theta} = \frac{3M_T}{2\pi(b^3 - a^3)}$ (4)

Average axial strain $\varepsilon_z = \frac{w}{H}$ (5)

Average radial strain $\varepsilon_r = -\frac{(u_o - u_i)}{(b - a)}$ (6)

Average circumferential strain $\varepsilon_\theta = -\frac{(u_o + u_i)}{(b + a)}$ (7)

Average shear strain $\gamma_{z\theta} = \frac{2\theta(b^3 - a^3)}{3H(b^2 - a^2)}$ (8)

< Definitions of average stresses and strains in HCA (Hight et al. 1983) >