(3) SHANSEP (Charles C. Ladd (MIT))

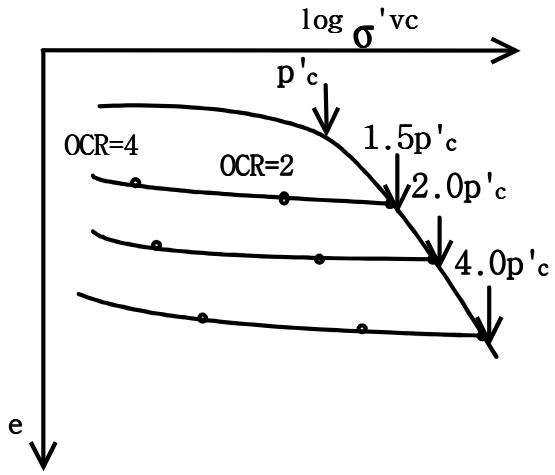
Stress History and Normalized Soil Engineering Properties

⇒ Undrained shearing behaviors of clays can be represented by normalized strength concept. (s_u / σ'_{vc} = f(soil type & OCR…))

① Sample disturbance + consolidation stress state + stress history

NC soils → consolidate samples to 1.5, 2.0 and 4.0 times larger than p'_c (maximum past pressure) with K_0 state

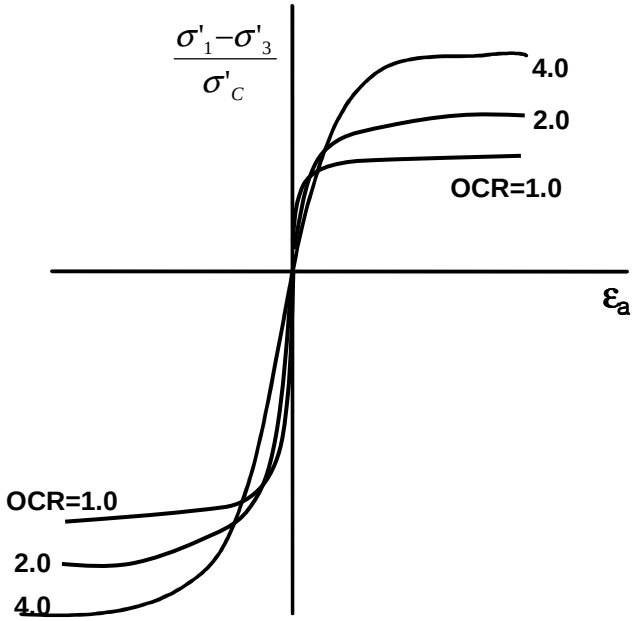
OC soils → follow the same procedure as NC soils and then unload to a given value of OCR



② Strain rate + anisotropy

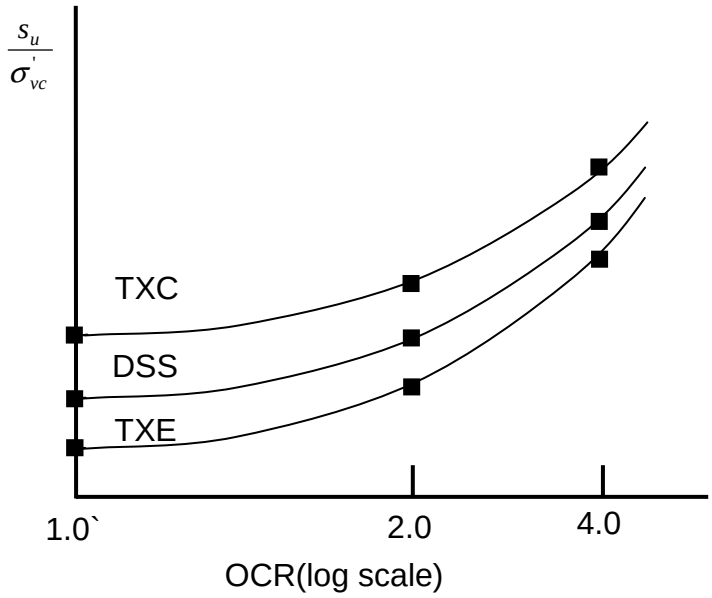
⇒ shear samples with 0.5%/hr strain rate for CK_0U TXC and RTXE, DSS conditions

③ We get normalized results from step ②.



\+ Normalized Pore Pressure Response.

④ Combine the results.



Problems with SHANSEP

1. Determination of p'_c (max. past pressure)
   → Sample disturbance obscures to obtain p'_c and lowers it.
   → Secondary compression can have a large influence on measured value of p'_c for highly compressible clays.
   → Knowledge of geologic history is very important.

2. Determination and duplication of stress systems (stress ratio of consolidation (σ'_h / σ'_v) → K_0 value.)
   → Difficult to measure it and apply it for lab testing

3. Difficult to get s_u for heavily overconsolidated clays (*with high p'_c*)
   → Practically difficult to reach 1.5 to 4.0 p'_c because of high p'_c and OCR
   → Use recompression techniques

4. Not acceptable for sensitive or structured clays
   ← SHANSEP employs mechanical stress history approach

5. In situ soil has some variations of water content even if we assume it is homogeneous.
   → For more precise estimation of strength, we have to consider water content variation.

6. A lot of works are required.

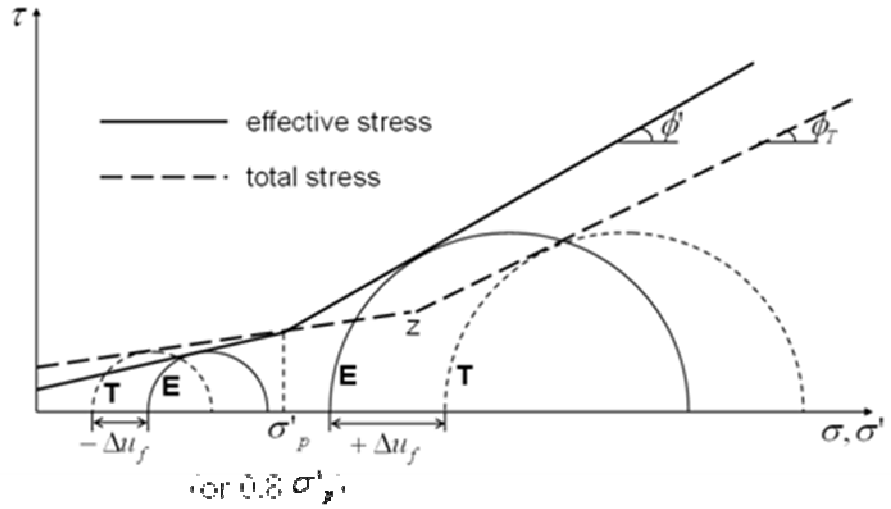
* Comments for lab test result

1. Laboratory stress conditions are generally isotropic, axisymmetric and maybe plane strain.
   → Select a conservative stress state of design if necessary.

2. Time effects
   a) Aging has a large influence on σ-ε behavior.
      → Include at least 1 cycle of secondary compression prior to shearing.
   b) Strain rate effect can be important for some clays.

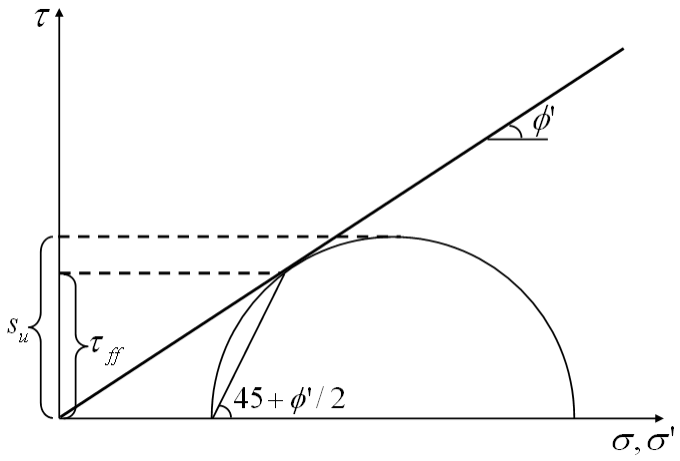
Notes

1. Mohr-Coulomb failure envelopes over a range of stress spanning the preconsolidation stress, σ'_p.



Typical point $z \approx 2\sigma'_p$ (Hirschfeld, 1963)

2. s_u vs. τ_{ff} (shear stress on failure plane at failure)



$$\therefore \tau_{ff}\,(=s_u\cos\phi') < \tau_{\max}\,(=s_u)$$