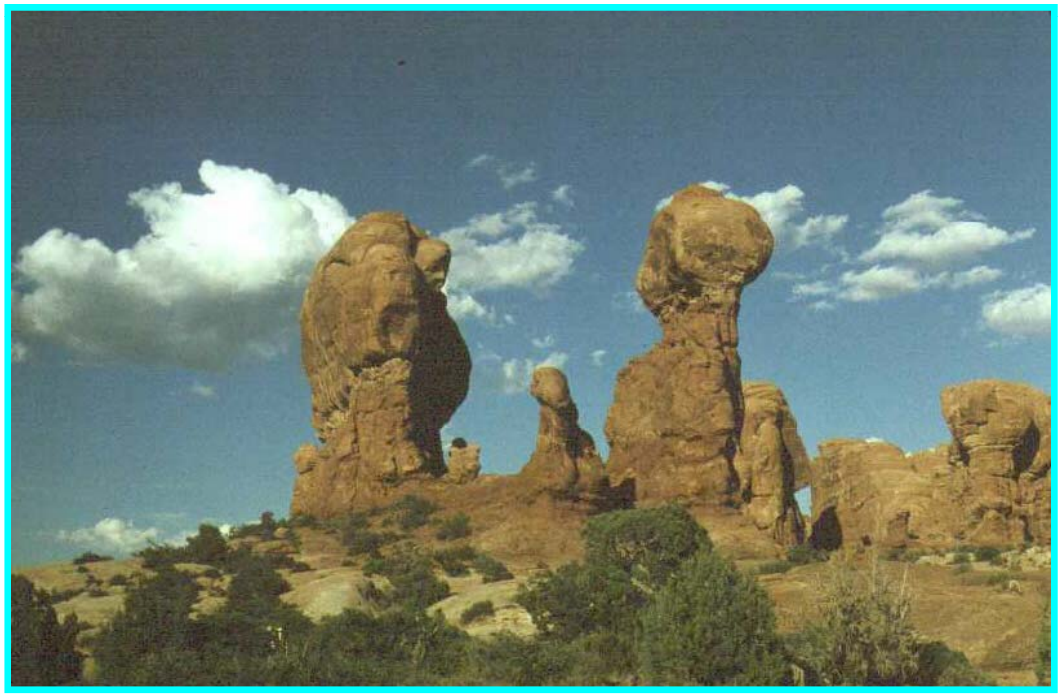
Laboratory Testing of Intact Rocks



Objectives: Lab Testing of Rock

- Recognize why and when to test intact rock
- Locate & review standard lab testing procedures for indexing parameters of strength, stiffness, and durability.
- Select representative specimens for testing
- Recognize importance of QA/QC for mitigating common errors during lab testing of intact rock.

Laboratory Testing of Rocks

- Index testing of intact rock materials for identification & classification.
- Strength and stiffness characteristics
- Degradation potential; Durability
- Used in assessing the overall Rock Mass
- Purposes of Construction: rockfill, cuts, slopes, foundations, tunnels

Rock Core Specimens

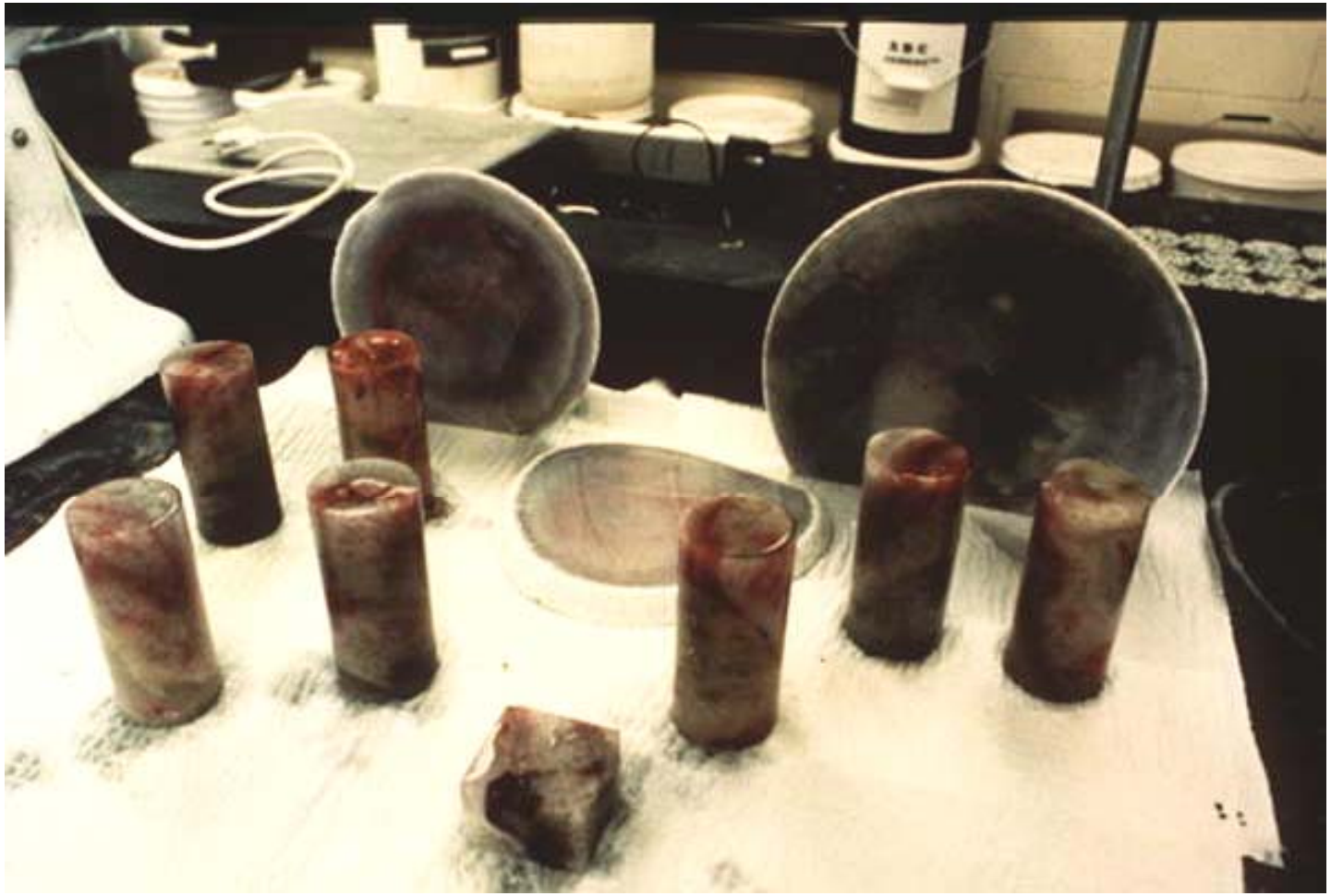


FIG.8-0

Index Testing of Intact Rocks

- Unit weight, γ_R = Weight/Volume
- Ultrasonics Velocities
- Strength
  - Point Load Index
  - Swiss Hammer (Schmidt Hammer)
  - Uniaxial Compressive Strength

Ultrasonics Testing

- Determine compression (P-wave) and shear (S-wave) velocities of rock core
- Nondestructive measurements
- Fast and inexpensive
- Evaluation of small-strain elastic stiffness (strains < 10^{-6} mm/mm)
- May be used to evaluate anisotropy

FIG.8-7

Lab Ultrasonics Testing of Rocks

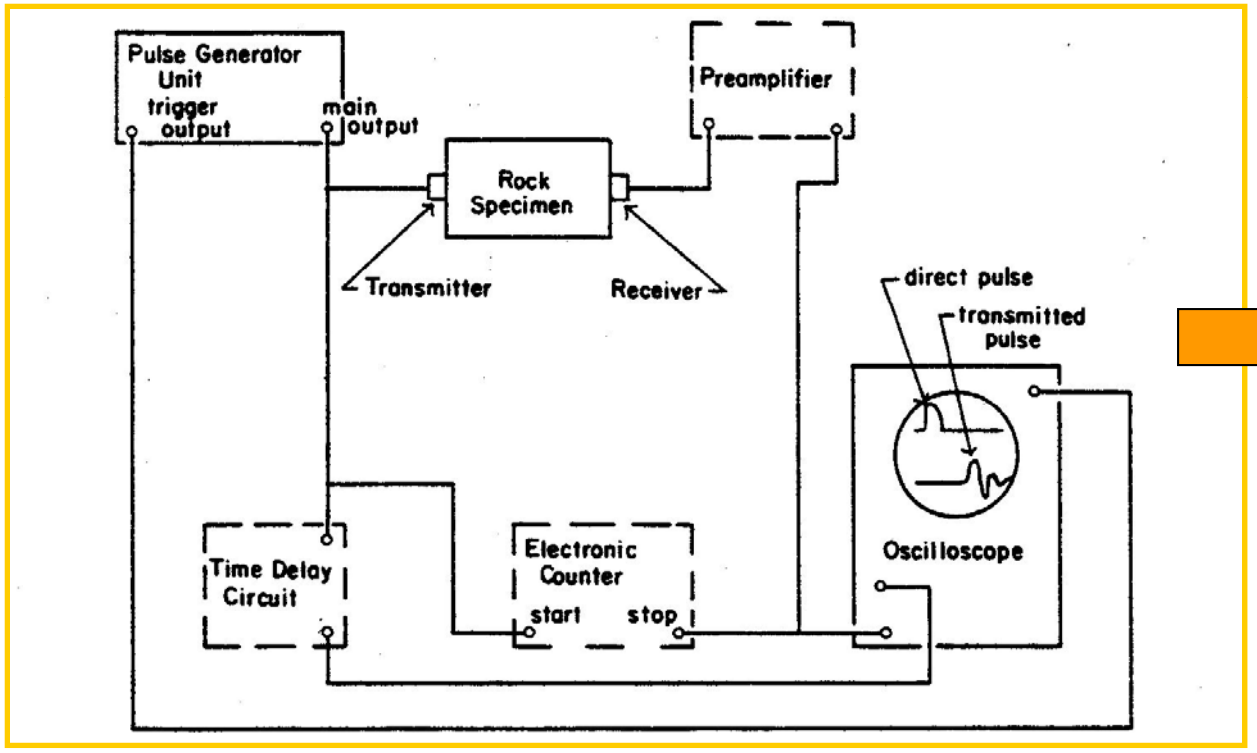
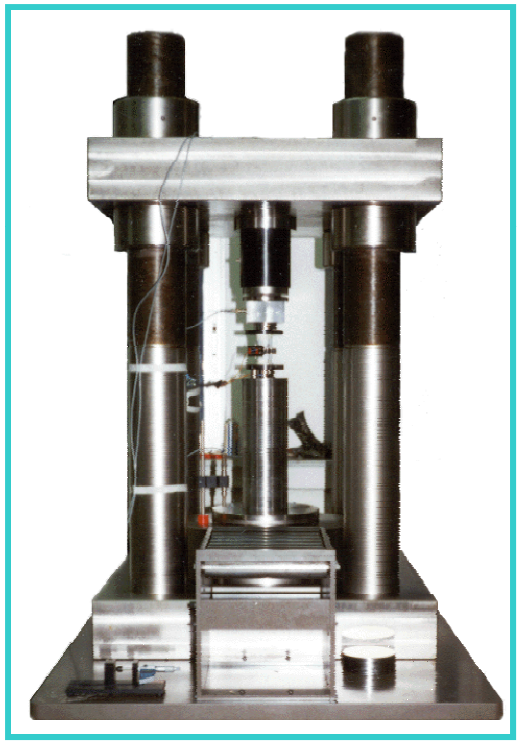


FIG.8-7

Uniaxial Compression Test



GCTS Device

ARA Setup at Tyndall AFB, Florida

Uniaxial Compression Test

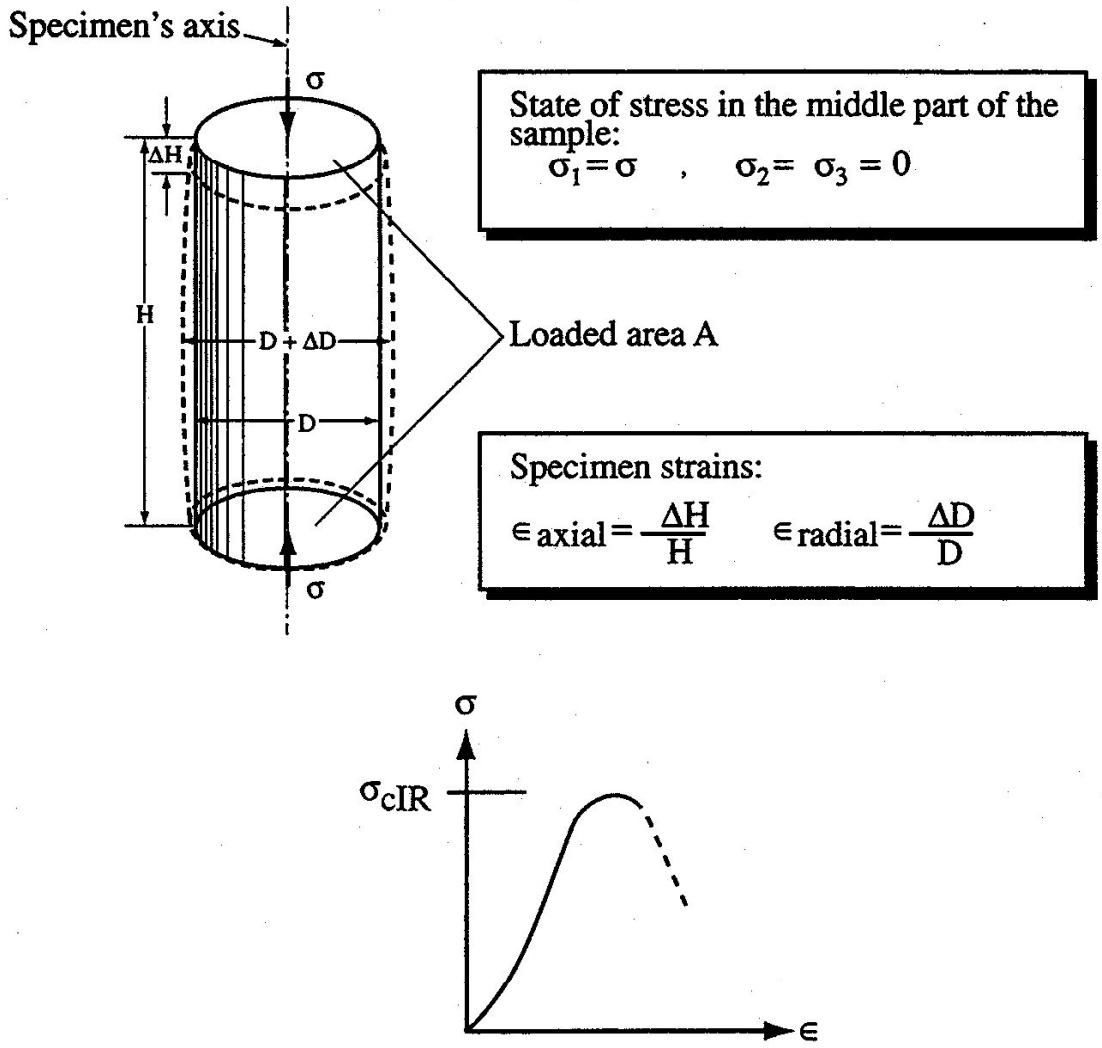


Fig.8-2

Uniaxial Compressive Strength

- Standard index property ($q_u = \sigma_u = \sigma_c$)
- Analogous tests in concrete and soil (unconfined compression test).
- ASTM 4543 procuredures.
- Planar ends on NQ size core (d = 47.6 mm)
- Length-to-width ratio: $2 < H/d < 2.5$
- Axial loading of cylindrical core specimen
- σ_u = Max. Force/($\pi d^2/4$)

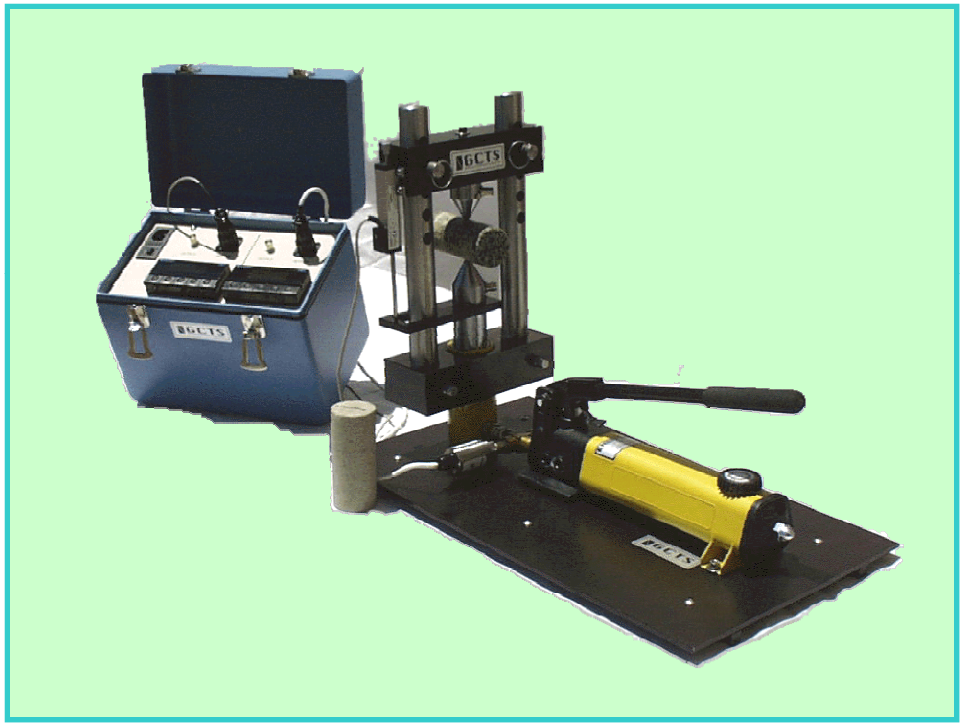
Swiss Hammer (Schmidt Hammer)

Point Load Index

- Quick evaluation for uniaxial strength (field or lab setup)
- ASTM D 5731 procedures
- Little sample preparation (cores, pieces)
- Measure force (P) to crunch intact rock specimen
- Point Load Index: $I_s = P/d_e^2$ where d_e = equivalent core diameter

Fig.8-1

Point Load Index



GCTS Device

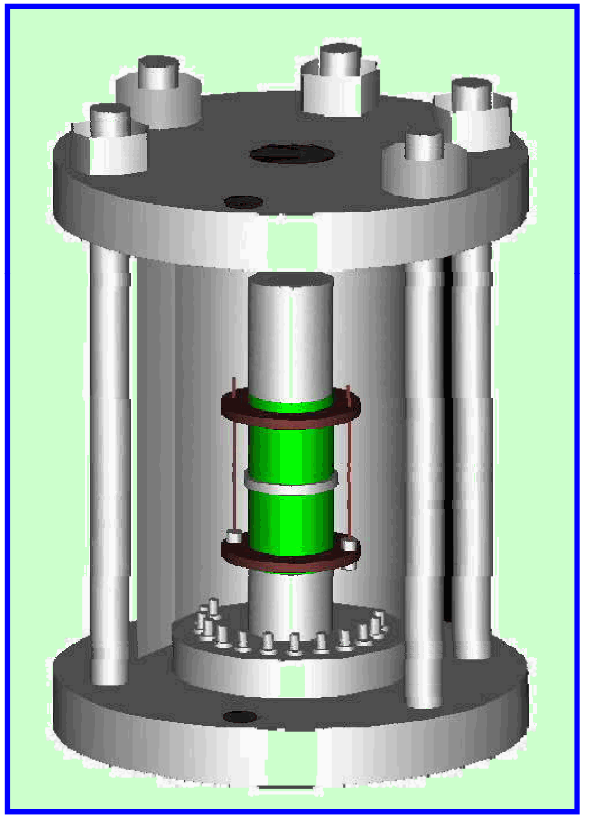
Roctest Equipment

Fig.8-1


New Martinsville 24
Parkersburg 71

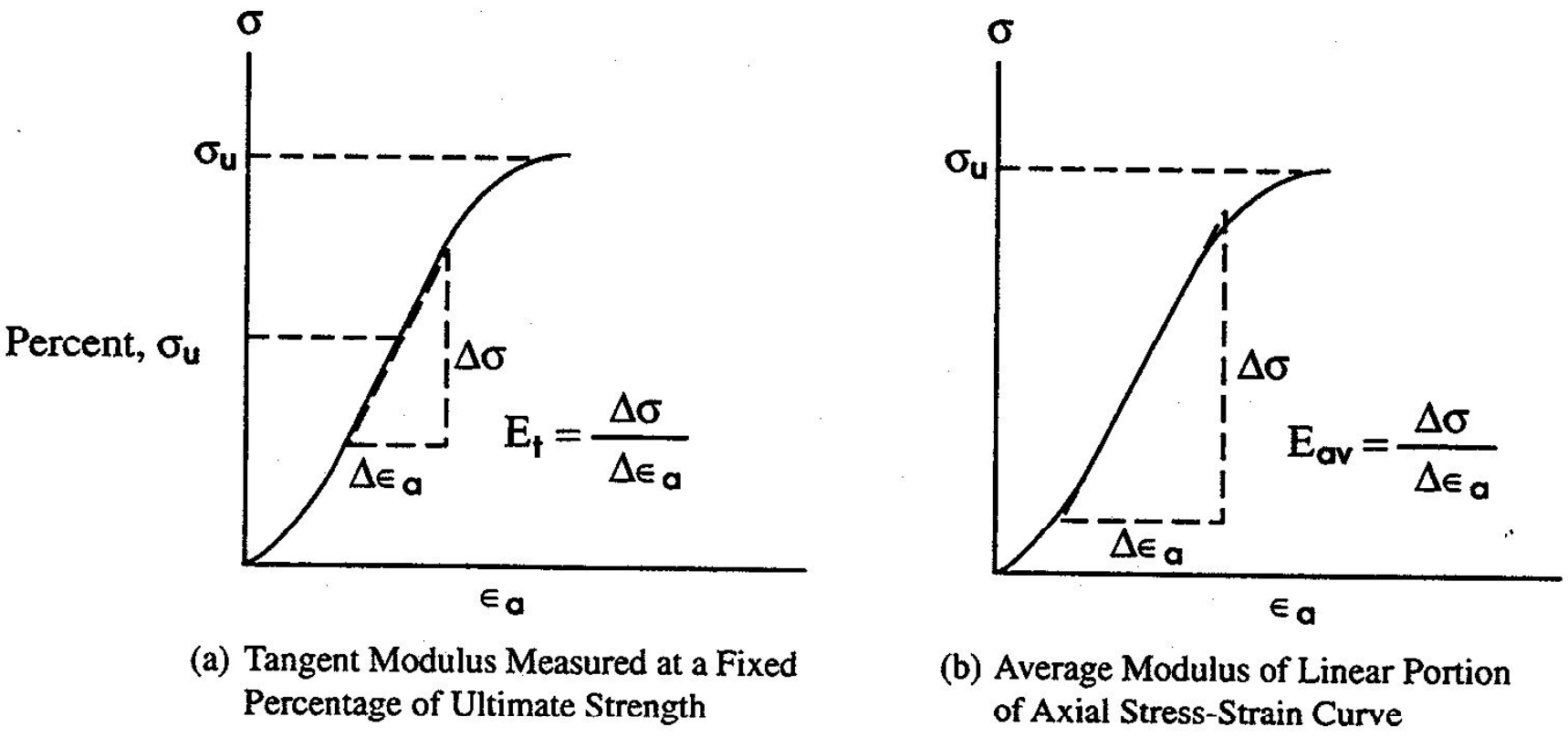
Triaxial Compression (ASTM D 2664)

Computerized Compression Frame



Rock Triaxial Cell

Deformation Parameters of Intact Rocks



(a) Tangent Modulus Measured at a Fixed Percentage of Ultimate Strength

(b) Average Modulus of Linear Portion of Axial Stress-Strain Curve

Elastic Modulus from Uniaxial and/or Triaxial Compression

Fig. 8-6

Tensile Strength (T_0) of Rocks

- Direct tensile strength (ASTM D 2936) is difficult because of end effects.
- Generally replaced by indirect (Brazilian) split-tension test (ASTM D 3967).
- Length-to-diameter ratios: $2 < H/d < 2.5$
- Diametrical compression of rock core specimens across

Brazilian Split-Tension Test on Rock

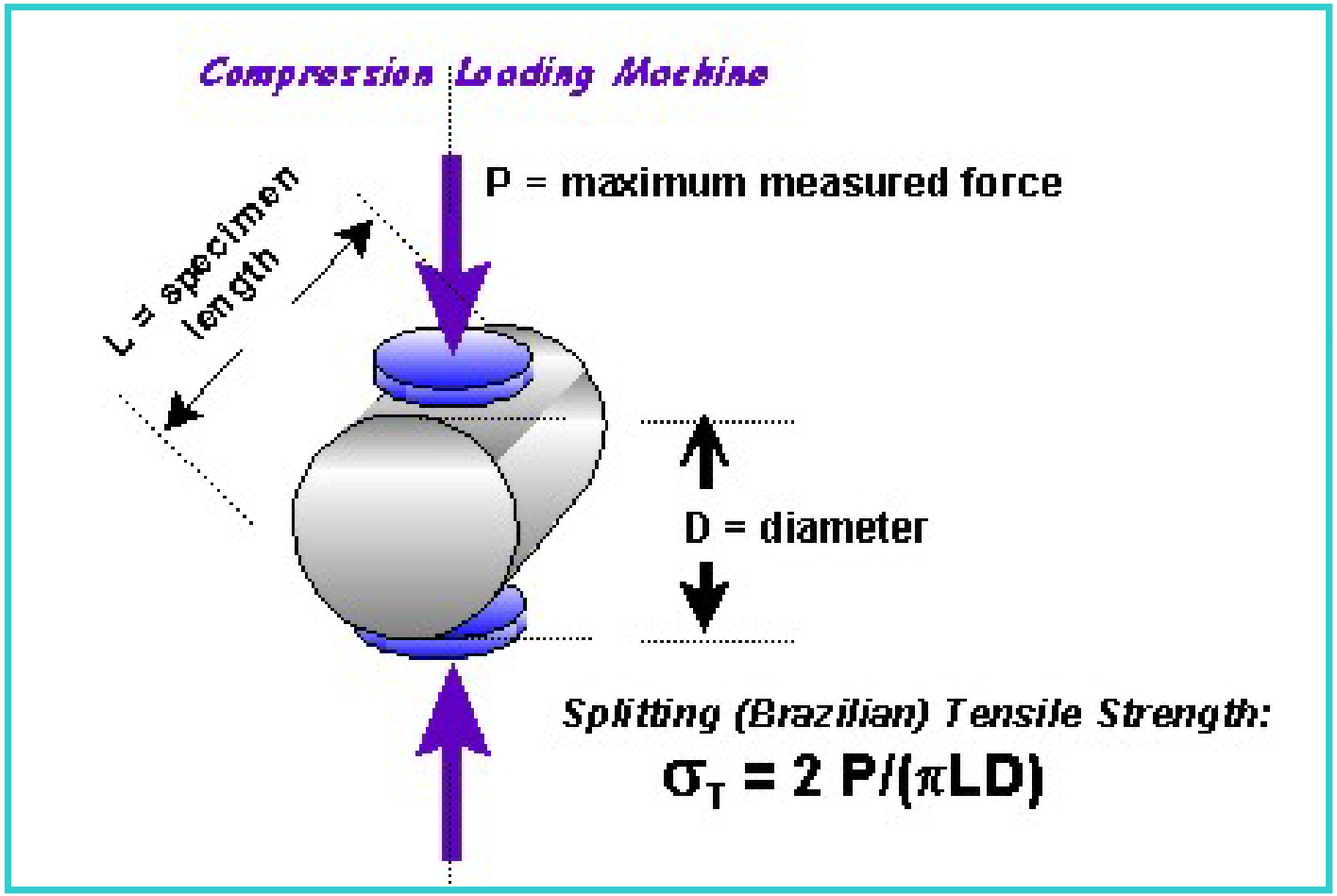


Fig. 8-3

Direct Shear Testing of Rock Specimens (ASTM D 5607)

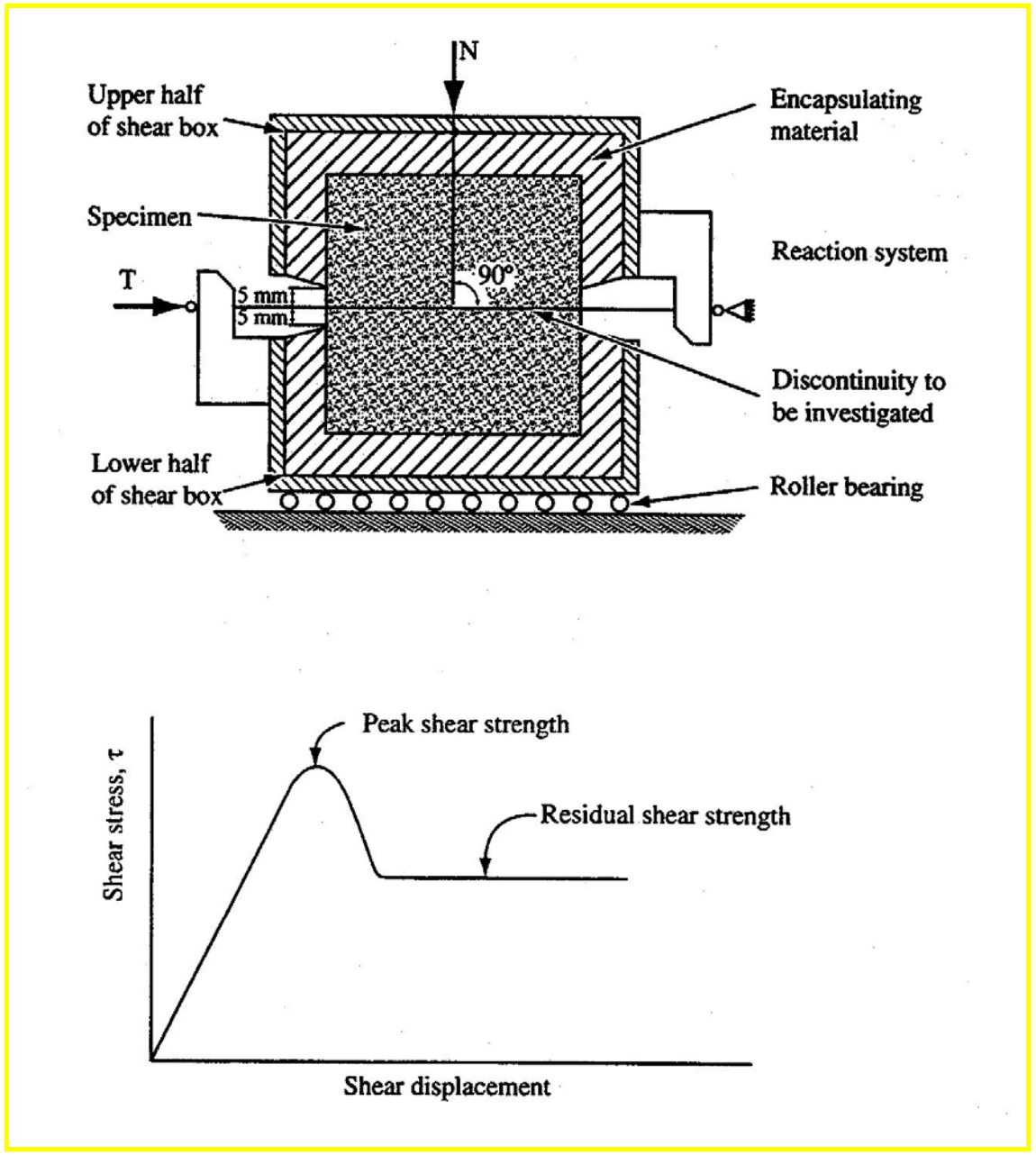
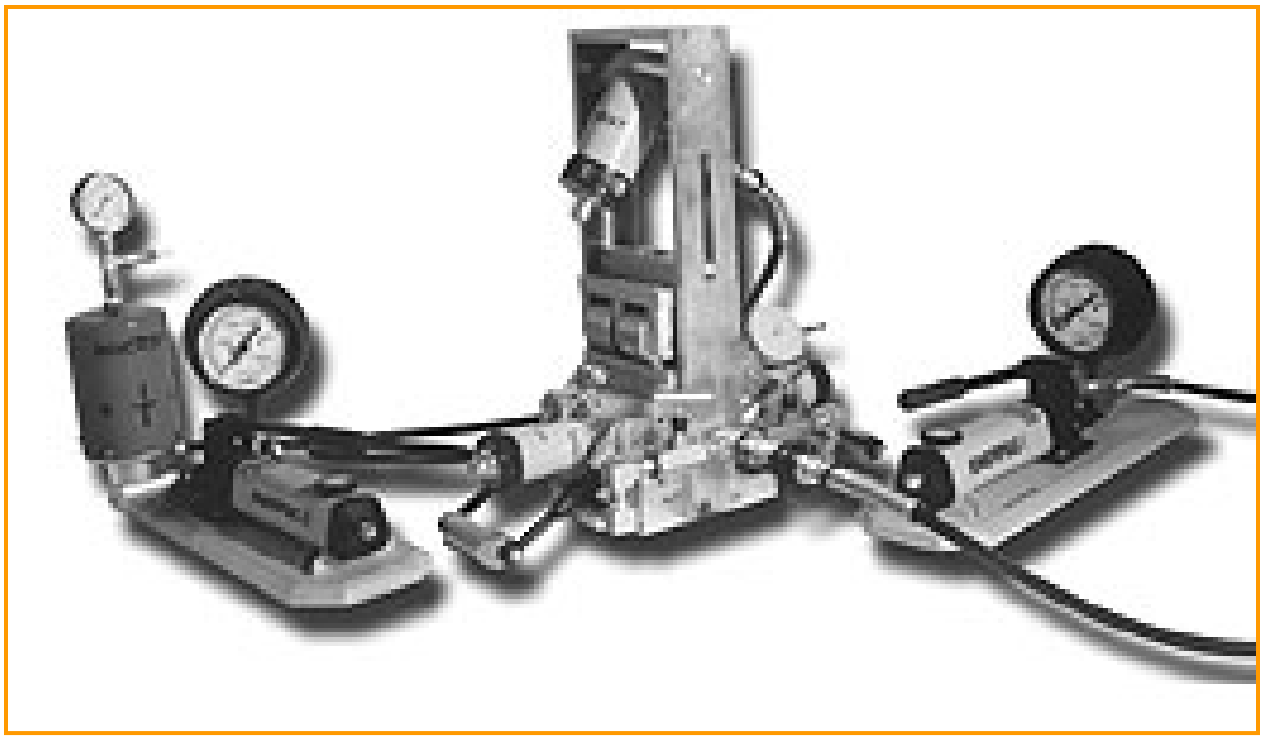


Fig. 8-4

Direct Shear Testing of Rock Specimens (ASTM D 5607)



Roctest Equipment, Montreal

Durability of Rock Materials

- Longevity of the materials for use in construction (fill, backfill, rockfill)
- Will the rock deterioriate when exposed to the elements, time, freeze-thaw, wet-dry cycles, temperatures, chemicals.
- Tests used to accelerate exposure (slake durability, LA abrasion, freeze-thaw).

Section 8.2.2.

Slake Durability Test of Rocks

- Evaluate shales and weak rocks that may degrade in service environment.
- Rock fragments of known weight placed in rotating drum apparatus (ASTM D 4644).
- Materials are circulated through wet & dry cycles.
- Reweigh rock fragments to determine the Slake Durability Index (SDI).

Fig. 8-5.

Slake Durability Test

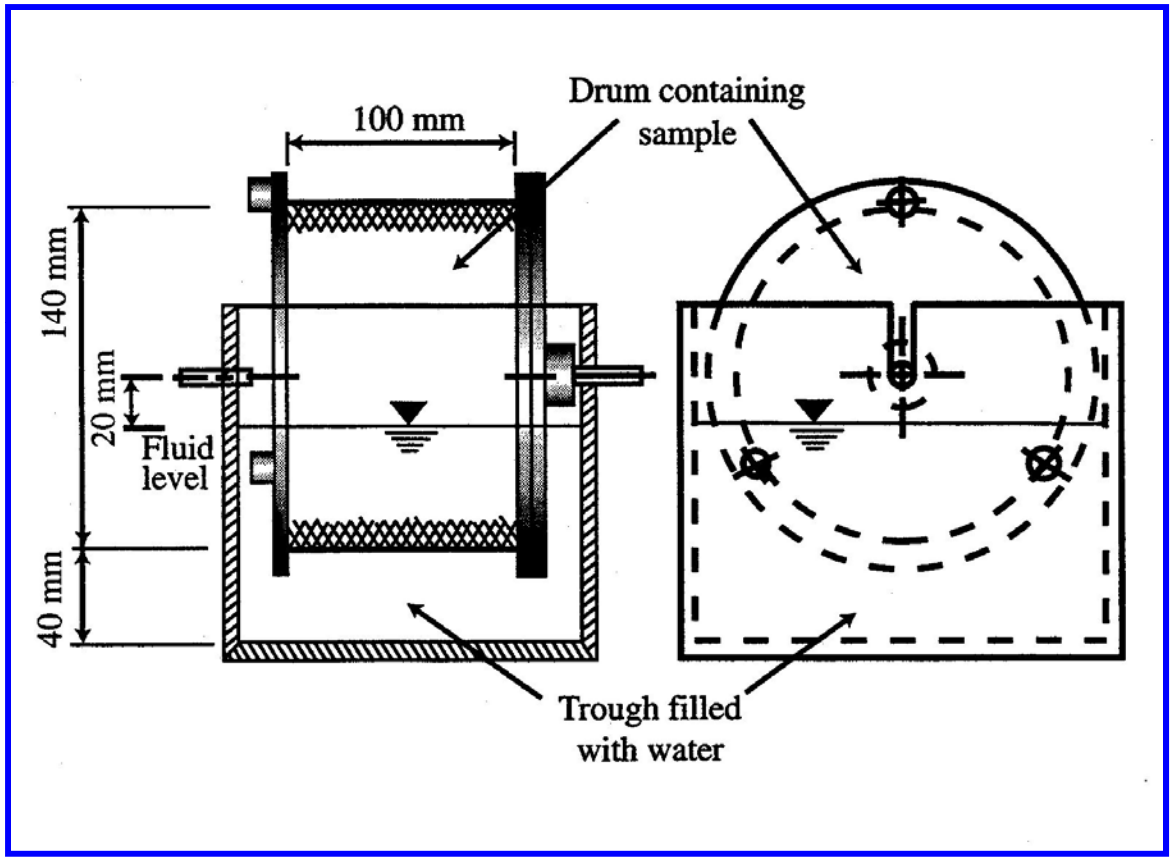


Fig. 8-5

Common Sense Lab Testing of Rocks

- Clear identification of samples & specimens
- Avoid moisture loss
- Prevent physical damage to samples
- Consult field records during specimen selection
- Maintain equipment in good working order
- Photo documentation of test specimens
- Careful alignment of axes for measurement by dial gages, load cells, and displacement transducers
- Save remnant pieces of rock after testing.

Table 8.2

Objectives: Lab Testing of Rock

- Recognize why and when to test intact rock
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- Select representative specimens for testing
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