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
Index Testing of Intact Rocks

- Unit weight, $\gamma_R = \text{Weight/Volume}$
- 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
Lab Ultrasonics Testing of Rocks

FIG. 8-7
Uniaxial Compression Test

GCTS Device

ARA Setup at Tyndall AFB, Florida

Page 8-4
Uniaxial Compression Test

State of stress in the middle part of the sample:
\[ \sigma_1 = \sigma , \quad \sigma_2 = \sigma_3 = 0 \]

Specimen strains:
\[ \varepsilon_{\text{axial}} = \frac{\Delta H}{H} \quad \varepsilon_{\text{radial}} = \frac{\Delta D}{D} \]

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 procedures.
- Planar ends on NQ size core \( (d = 47.6 \text{ mm}) \)
- Length-to-width ratio: \( 2 < H/d < 2.5 \)
- Axial loading of cylindrical core specimen
- \( \sigma_u = \text{Max. Force}/(\pi d^2/4) \)
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: \( I_s = \frac{P}{d_e^2} \) where \( d_e = \) equivalent core diameter

Fig.8-1
Point Load Index

GCTS Device

Roctest Equipment

Fig. 8-1
Triaxial Compression (ASTM D 2664)

Computerized Compression Frame

Rock Triaxial Cell
Deformation Parameters of Intact Rocks

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

\[ \sigma_T = \frac{2P}{\pi LD} \]

Fig. 8-3
Direct Shear Testing of Rock Specimens (ASTM D 5607)

Fig. 8-4
Direct Shear Testing of Rock Specimens
(ASTM D 5607)

Rocctest 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

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