TESTS ON ROCKS

SOIL MECHANICS

SOIL MECHANICS LABORATORY
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

SLAKE DURABILITY TEST

This test method is used to estimate qualitatively the durability of weak rocks in the service environment.

Background : Rock properties change with time due to processes such as exfoliation, hydration, slaking, solution, oxidation, abrasion, etc.

Exfoliation : Rock being disintegrated sheet by sheet.

Hydration : Reaction with water.

Slaking : Weakening or rock due to repetition of wetting and drying.

Oxidation : Reaction with oxygen.

Abrasion : Smoothening of surface when scraped by other material.

Since these processes cannot be reproduced in the laboratory, resistance or rock (durability of rock) against them is evaluated in terms of some appropriate indices.

Slake Durability Test:

A drum of 100mm in length and 140mm in diameter is rotated, half immersed in water, at 20 rounds per minute. The drum is made of a 2mm sieve. About 500g of rock is broken into 10 pieces and put in the drum. After rotation for 10 minutes, the percent of rock retained inside the drum, on a dry weight basic, is reported as the slake durability index, I_d (Goodman, 1980). A smaller I_d means that a greater amount of rock was broken into small pieces and lost through the sieve.

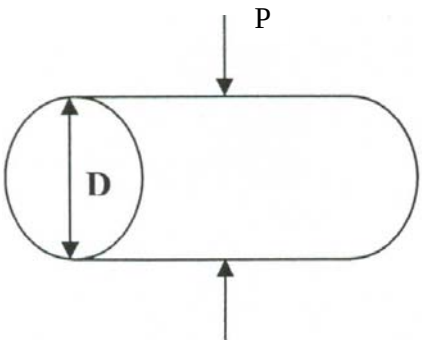
Gambles' Slake Durability Classification (Goodman, 1980)

Group Name	% retained after one 10 min cycle (dry weight basis)	% retained after two 10 min cycle (dry weight basis)
Very High Durability	> 99	> 98
High Durability	98 - 99	95 – 98
Medium High Durability	95 – 98	85 – 95
Medium Durability	85 – 95	60 – 85
Low Durability	60 – 85	30 – 60
Very Low Durability	< 60	< 30

(After Dr. I. Towhata, University of Tokyo)

POINT LOAD INDEX TEST

Point load index test can be used in either the field or laboratory to find the uniaxial compressive strength or rock. This is a simple and inexpensive test as compared to other tests to find the uniaxial compressive sgth.



The core of diameter D is compressed between the two hemi - spherical indenters of the testers. The maximum force (P) to break the sample is used to define the point load index $\mathbf{I_s}$ as:

$$I_s = \frac{P}{D^2}$$

A reasonable correlation exists between the point load index (Is) and the uniaxial compressive strength (f_c) of the material, given by;

$$I_c = K I_s$$

Value of the constant K depends on the diameter of the core.

Diameter of Core (mm)	**Value of K**
20	17.5
30	19
40	21
50	23
54	24
60	24.5

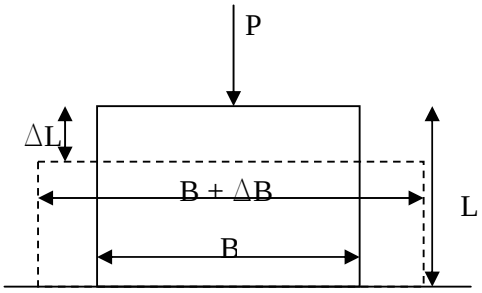
Validity of the Test

If a clean fracture runs from one loading point indentation to the other, the test results can be accepted. However, if the fracture runs across some other plane or if the points sink into the rock surface· causing excessive crushing or deformation, the test should be rejected.(After Hoek & Bray, 1981)

UNIAXIAL COMPRESSIVE STRENGTH TEST

Tests to Evaluate Deformation Modulus

Uniaxial compression tests are used to obtain the static modulus of elasticity of rock material E, and associated Poisson's Ratio ν.

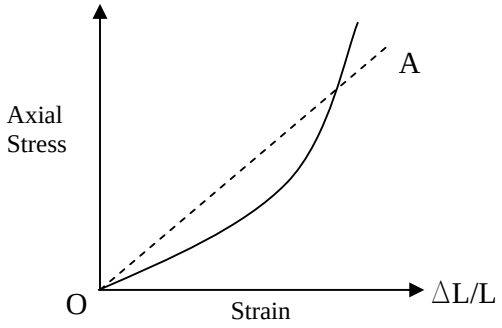


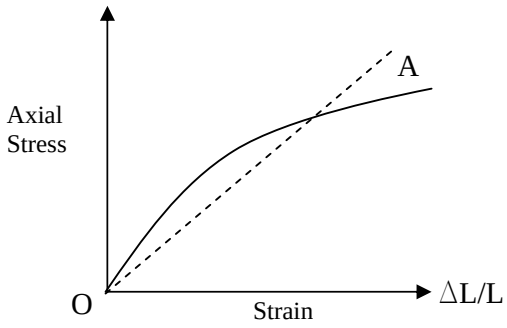
If Hooke's law for isotropic linear elasticity is assumed to hold for the given rock material,

$$E = \frac{Stress}{Strain} = \frac{P/(B \times B)}{\Delta L/L}$$

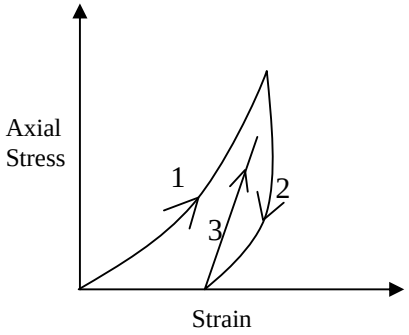
Original cross - section B x B

Usually the stress - strain relationship is not linear during the initial loading, but is slightly convex or concave. Secant modulus is evaluated by the slope of OA, which is also known as the modulus of compression.





Repeated loading and unloading can be carried out until the stress - strain curve becomes approximately linear, and from this line E can be calculated.



1. First Loading
2. Unloading (rebound curve)
3. Second Loading

Uniaxial Compressive Strength Test

Uniaxial compressive strength of rock is used in many design formulas and is sometimes used as an index property to select the appropriate excavation technique. The strength of rock cores measured in the laboratory usually do not accurately reflect large-scale in situ properties because the latter are strongly influenced by joints, faults, inhomogeneities, weakness planes and other factors. Therefore, laboratory values for intact specimens must be employed with proper judgment in engineering applications. These tests are expensive; primarily because of the need to carefully prepare the samples to ensure that there ends are perfectly parallel.

In this experiment, a circular core barrel of rock is compressed in the Amsler machine, and from the (convex/concave) stress - strain diagram, the secant modulus of deformation is evaluated. The Uniaxial Compressive Strength is evaluated by loading the element to failure.

Common Sense in Lab Testing of Rocks

- Clear identification of samples and 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 gauges, load cells or displacement transducers.
- Save remnant pieces of rock after testing.