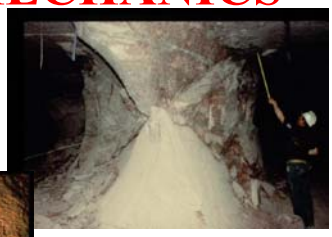
ROCK MECHANICS



SCOPE OF ROCK MECHANICS

- CIVIL ENGINEERING
- MINING ENGINEERING
- PETROLEUM ENGINEERING
- GEOLOGY
- GEOPHYSICS

SCOPE OF ROCK MECHANICS

- Evaluation of GEOLOGICAL HAZARDS .. landslides, seismic etc.
- Selection of CONSTRUCTION MATERIALS
- Selection and layout of CONSTRUCTION SITES
- Analysis of STABILITY
- Design of BLASTING OPERATIONS
- Design of SUPPORT SYSTEMS
- Design of HYDRAULIC FRACTURING PROGRAMS
- Design of INSTRUMENTATION PROGRAMS
- Evaluation of EXCAVATION CHARACTERISTICS
- Studies of rock deformation at high temperatures and pressures (STRUCTURAL GEOLOGY)

SCOPE OF ROCK MECHANICS

APPLICATION OF ROCK MECHANICS

• SURFACE STRUCTURES
- Low rise (Housing)
- High rise (Tower blocks)
- High load (Dams, power plants, bridges)

•TRANSPORTATION ROUTES
- Highways, railways
- Canals
- Pipelines

•SHALLOW EXCAVATIONS
- Quarries
- Open pits, strip mines
- Trenches, cuttings

APPLICATION OF ROCK MECHANICS

• DEEP EXCAVATIONS
- **Mines (Temporary and Permanent)**
- **Tunnels (Roads, H.E.P.)**
- **Underground chambers (Power stations, storage, recreational)**

• ENERGY DEVELOPMENT
- **Petroleum**
- **Geothermal**
- **Nuclear (Power plants, Waste Disposal)**
- **Energy storage caverns**

CHILE

CONTINUOUS

HOMOGENEOUS

ISOTROPIC

LINEAR ELASTIC

DIANE

DISCONTINUOUS

⇨ **pores/microfractures - vugs, joints - faults, caverns**

INHOMOGENEOUS

⇨ **mineralogy-layering-facies**

ANISOTROPIC

⇨ **fabric - mineral alignment-discontinuity sets**

NON ELASTIC

THE MECHANICAL CLASSIFICATION OF ROCKS

Goodman proposed a classification based on rock **TEXTURE** recognizing **four** textural groups

1. **CRYSTALLINE**
2. **CLASTIC**
3. **VERY FINE GRAINED**
4. **ORGANIC**

The mechanical strength varies considerably within each textural group.

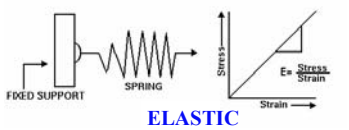
CRYSTALLINE TEXTURE

• *characterized by tightly interlocked texture*

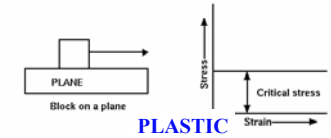
A. **Evaporites** .. carbonates, sulphates, halides etc
B. **Banded Phyllosilicates** .. mica schists etc.
C. **Banded Silicates** .. some schists, gneiss etc.
D. Plutonic igneous .. granite, gabbro etc
E. **Porphyritic igneous** .. lavas etc.
F. **Highly sheared** .. serpentinite, mylonite

i. Unweathered banded silicates, plutonic and porphyritic igneous rocks tend to behave in a **BRITTLE-ELASTIC** manner under **normal** rock engineering conditions.
ii. Evaporites and weathered crystalline silicates behave in a **PLASTIC** or **VISCO- ELASTO-PLASTIC** manner.
iii. Banded phyllo- (sheet) silicates, banded silicates and highly sheared rocks often are very strongly **ANISOTROPIC** and **ELASTO-PLASTIC**.

IDEALISED MECHANICAL BEHAVIOUR

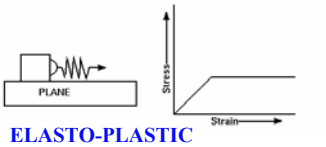


ELASTIC

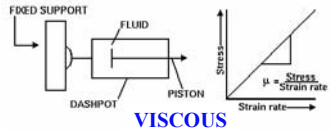


PLASTIC

IDEALISED MECHANICAL BEHAVIOUR



ELASTO-PLASTIC



VISCOUS

POTASH

CLASTIC TEXTURE

… Characterized by the presence of strong mineral grains in a cement or binder matrix

A. **Stably cemented** .. silica and limonite cements
B. **Slightly soluble cement**.. calcareous cement
C. **Highly soluble cement** .. gypsum cement
D. **Weakly cemented**.. friable sandstones, some tuffs
E. **Uncemented** .. clay-bound sandstones etc.

i. **Stably cemented** rocks often behave in a **BRITTLE-ELASTIC** manner
ii. Rocks with slightly-**highly soluble** cements tend to show **ELASTO-PLASTIC** behavior characteristic of the cement
iii. **Weakly cemented** or **uncemented** rocks (and **B** and **C** in the presence of water) exhibit behavior resembling **UNCONSOLIDATED SOILS**.

VERY FINE GRAINED

A. **Isotropic Hard Rocks** .. hornfels, some basalts
B. **Anisotropic thickly bedded** .. flagstones, mudstones.
C. **Anisotropic thinly bedded** .. slate phyllite
D. **Soft, soil like rocks** .. shales, chalk, marls

i. Isotropic hard rocks display **BRITTLE-ELASTIC** response to load.
ii. Bedded fine grained rocks are essentially **BRITTLE-ELASTIC** in response to stress but are strongly **ANISOTROPIC** and may show permanent **PLASTIC** strains parallel to bedding at relatively low stress levels.

VERY FINE GRAINED

ORGANIC TEXTURE

A. **Soft Coals**
B. **Hard Coals**
C. **Oil Shales**
D. **Bituminous shale**
E. **Tar sands**

i. Hard coals and oil shales may display **BRITTLE-ELASTIC** behavior
ii. Both hard and soft coals are frequently **HEAVILY FISSURED** and may behave as **GRANULAR MATERIALS**
iii. Tar sands can behave as **VISCOUS FLUIDS** and bituminous shales and soft coals sometimes exhibit extreme **PLASTICITY**
iv. **PORE FLUID** content can often control mechanical behavior.