## 1.1 CIVIL ENGINEERING MATERIALS

### STONES

Igneous Rocks

Sedimentary Rocks

Metamorphic Rocks

Physical Classification

Chemical Classification

Properties of Stones

# CIVIL ENGINEERING MATERIALS

## STONES

Stone is a _naturally available building material' which has been used from the early age of civilization. It is available in the form of rocks, which is cut to required size and shape and used as building block.

It has been used to construct small residential buildings to large palaces and temples all over the world. Red Fort, Taj Mahal, Vidhan Sabha at Bangalore and several palaces of medieval age all over India are the famous stone buildings.

## TYPE OF STONES

Stones used for civil engineering works may be classified in the following three ways:

- Geological
- Physical
- Chemical

## GEOLOGICAL CLASSIFICATION

Based on their origin of formation stones are classified into three main groups—

- Igneous
- sedimentary
- metamorphic.

**Igneous Rocks**: These rocks are formed by cooling and solidifying of the rock masses from their molten magmatic condition of the material of the earth. Generally igneous rocks are strong and durable.

**Sedimentary Rocks**:

Due to weathering action of water, wind and frost existing rocks disintegrates. The disintegrated material is carried by wind and water; the water being most powerful medium. Flowing water deposits its suspended materials at some points of obstacles to its flow. These deposited layers of materials get consolidated under pressure and by heat.

**Metamorphic Rocks**:

Previously formed igneous and sedimentary rocks under go changes due to metamorphic action of pressure and internal heat. For example due to metamorphic action granite becomes gneisses, trap and basalt change to schist and laterite, lime stone changes to marble, sand stone becomes quartzite and mud stone becomes slate.

**Physical Classification**

Based on the structure, the rocks may be classified as:

- Stratified rocks
- Un stratified rocks

**Stratified Rocks**:

These rocks are having layered structure. They possess planes of stratification or cleavage. They can be easily split along these planes. Sand stones, lime stones, slate etc. are the examples of this class of stones.

**Un stratified Rocks**:

These rocks are not stratified. They possess crystalline and compact grains. They cannot be split in to thin slab. Granite, trap, marble etc. are the examples of this type of rocks.

**Foliated Rocks**:

These rocks have a tendency to split along a definite direction only. The direction need not be parallel to each other as in case of stratified rocks. This type

of structure is very common in case of metamorphic rocks

## Chemical Classification

On the basis of their chemical composition engineers prefer to classify rocks as:

- Siliceous rocks
- Argillaceous rocks
  Calcareous rocks

**Silicious rocks**:

The main content of these rocks is silica. They are hard and durable.

Examples of such rocks are granite, trap, sand stones etc.

**Argillaceous rocks**:

The main constituent of these rocks is argil i.e., clay. These stones are hard and durable but they are brittle. They cannot withstand shock. Slates and laterites are examples of this type of rocks.

## Properties of Stones

The following properties of the stones should be looked into before selecting them for engineering works:

(i) **Structure**: The structure of the stone may be stratified (layered) or un stratified. Structured stones should be easily dressed and suitable for super structure. Un stratified stones are hard and difficult to dress. They are preferred for the foundation works.

(ii) **Texture**: Fine grained stones with homogeneous distribution look attractive and hence they are used for carving. Such stones are usually strong and durable.

(iii) **Density**: Denser stones are stronger. Light weight stones are weak. Hence stones with specific gravity less than 2.4 are considered unsuitable for buildings.

(iv) **Appearance**: A stone with uniform and attractive colour is durable, if grains are compact. Marble and granite get very good appearance, when polished. Hence they are used for face works in buildings.

(v) **Strength**: Strength is an important property to be looked into before selecting stone as buildi2ng block. Indian standard code recommends, a minimum crushing strength of 3.5 N/mm for any building block.

(vi) **Hardness**: It is an important property to be considered when stone is used for flooring and pavement. Coefficient of hardness is to be found by conducting test on standard specimen in Dory‘s testing machine. For road works coefficient of hardness should be at least 17. For building works stones with coefficient of hardness less than 14 should not be used.

(vii) **Percentage wear**: It is measured by attrition test. It is an important property to be considered in selecting aggregate for road works and railway ballast. A good stone should not show wear of more than 2%.

(viii) **Porosity and Absorption**: All stones have pores and hence absorb water. The reaction of water with material of stone cause disintegration.

(ix) **Weathering**: Rain and wind cause loss of good appearance of stones. Hence stones with good weather resistance should be used for face works.

(x) **Toughness**: The resistance to impact is called toughness. It is determined by impact test. Stones with toughness index more than 19 are preferred for road works.

Toughness index 13 to 19 are considered as medium tough and stones with toughness index less than 13 are poor stones.