

1. Introduction

1.1 Classification of Construction Materials

Construction materials can be classified into:

- I) *Metallic and Non-metallic*
 - a. Non-metallic
 - Cementing materials
 - Concrete
 - Timber
 - Stone
 - Plastics
 - Ceramics
 - b. Metallic
 - Ferrous
 - Wrought iron
 - Cast iron
 - Steel
 - Non Ferrous
 - Aluminium
 - Copper
 - Lead
 - Zinc
- II) *Based on their physical Nature:*
 - a) Solid
 - b) Liquid
 - c) Gaseous
- III) *Based on their mode of manufacture*
 - a) Naturally occurring materials
 - b) Industrially produced materials
 - c) Materials produced at construction site

1.2 Properties of Materials

- a) Physical properties
 - Density and specific gravity
 - Mechanical properties
 - Thermal properties
 - Acoustical properties

b) Chemical properties

- Corrosion

Here only the mechanical properties are dealt with since they have a great practical significance in Civil Engineering.

1.2.1 Mechanical Properties

When forces are applied to a solid body, two results are produced:

- 1) Internal resisting forces
- 2) Deformation

The internal forces and deformations are called *stresses* and *strains* respectively.

Depending up on the arrangement and direction of the external forces, the stress produced may be:

- a) Tensile stress
- b) Compressive stress
- c) Shearing stress
- d) Bending stress
- e) Torsional stress
- f) Combinations of the above stresses

Deformation:

- a) Elastic if it recovers when the external force is released
- b) Plastic if it fails to recover when the external force is released

If a material is capable to carry its own weight and any applied load, it is assumed to be strong material. This way is that the strength of the material is determined.

When a material is said to be strong it is its strength in tension or compression that is usually referred to, but it is often necessary to know its strength in shear and torsion as well.

1.3 Tests for Mechanical Properties

Selection of material for a particular structural application depends on its mechanical properties. There are standard *mechanical tests* to measure these properties.

Mechanical tests are used to examine the performance of materials under the action of external forces.

1.3.1 Classification of Mechanical Tests

I) With reference to the direction of the external forces

- | | |
|---------------------|-----------------|
| a) Tension test | d) Bending test |
| b) Compression test | e) Torsion test |
| c) Shear test | |

II) With reference to the rate and duration of the load application

- a) Static Tests: these are made with gradually increasing load, such as ordinary tests in tension, compression etc.
- b) Dynamic test: these are made with suddenly applied loads, as by falling weight
- c) Wear tests: these are made to determine resistance to abrasion and impact, as in the case of paving materials
- d) Long-time tests: these are made with loads applied to the object under test for a long period of time. They are used for materials such as concrete.
- e) Fatigue test: these are made with fluctuating stresses repeated a large number of times

III) With reference to the effect of the test on the specimen

- a) Destructive tests: Under these test methods, the specimens are either crushed or ruptured and made useless at the end of the tests
- b) Non-destructive tests: These are usually used to test the strength of members of existing structures without affecting their performance.