

Mechanical Properties of Timber:

The intelligent use of wood for any structural purpose requires a general knowledge of the mechanical properties of different woods:

- 1- **Tensile strength:** Timber in construction is practically never subjected to pure tensile stresses for the simple reason that the end connections cannot be so devised that they do not involve either shear along the grain or compression across the grain. Failure in tension across the grain involves principally the resistance offered by the thinner-walled wood elements to being torn apart longitudinal.
- 2- **Compressive strength:** The compressive strength of wood in a direction normal to the grain is simply a matter the resistance offered by the wood elements to being crushed or flattened. The cells with thinnest walls collapse first, and the action proceeds gradually. Compressive strength of wood in a direction //to the grain depends upon the internal structure and the moisture content of the wood and the manner of failure is fixed by these same factors.
- 3- **Flexural strength:** The flexural strength of timber is determined by the following formula:

$$S_b = 3/2 (PL/bh^2)$$

The tensile strength of all timber is greatly an excess of its compressive strength (about 3 times as much the average), and the latter will usually be the determining factor in limiting the cross- breaking strength.

- 4- **Stiffness:** Stiffness of timber largely upon the same factors as strength. Dense woods are always stiffer than open, porous woods, and heavy woods are stiffer than lightwoods.

Physical Properties of Wood:

- 1- **Bulk Density:** depends on the volume of pores and moisture content of the wood. Bulk density value is used to determine the quality factor, which is the ratio of compressive strength to the bulk density. it is 0.6 for pine and 0.57 for oak.
- 2- **Shrinkage:** is the reduction in linear and volumetric dimensions in drying of wood. Evaporation of capillary water is not accompanied by shrinkage, the

latter taking place only when hygroscopic moisture evaporates. Because of structural non-uniformity, wood shrinks or swells irregularly in various directions. Linear shrinkage along the fibers lies between 0.1 and 0.3 percent, in radial direction between 3 and 6 percent and in tangential direction between 7 and 12 per cent. In general, the radial shrinkage of wood is 60 percent of the tangential, and the longitudinal shrinkage is negligible.

- 3- **Swelling:** is the capacity of wood to increase both its linear and volumetric dimensions when it absorbs water. Swelling of wood along the length of fibers ranges from 0.1 to 0.8 percent.
- 4- **Sound Conductivity:** The velocity of sound in wood is 2 to 17 times greater than that in air and as such wood may be considered to have high sound conductivity.
- 5- **Resistance to action of acids and alkalis:** Wood is not affected by weak alkali solution but decays in an acid medium ($\text{pH} < 4$).

Tar

Definition and Properties

Tar is a black solid mass obtained during the destructive distillation of coal, peat, wood, or other organic material. According to American Society of Testing Materials, tar can be defined as black to dark-brown bituminous condensate which yields substantial quantities of pitch when practically evaporated or fractionally distilled and which is produced by destructive distillation of organic material such as coal, oil, lignite, peat and wood. It is the byproduct of the manufacture of bituminous coke and is soluble in carbon disulphide.

- Tar contains 75 to 95% of bituminous contents.
- It contains higher percentage of carbon.
- The properties of tar depend upon the type of raw material used for manufacture. Method of distillation and proportion of residual matter incorporated.
- It hardens much quicker than asphalt.
- It is more adhesive than asphalt.
- It possesses toxicity to a high degree.

Uses of Tar

Following are the uses of tar:

- 1- It is used for roofing and road making.
- 2- It is used for making bituminous paints and water-proofing compounds.
- 3- Coal tar is used as a preservative for timber.
- 4- It is used as a saturant for felts.

Types of Tar

According to the raw material used in the manufacture, tar is classified as follows:

- 1- **Coal tar:** It is produced by destructive distillation of coal or as a by-product in the manufacture of coal gas. It is used as a preservator for timber and in making tar-macadam roads.
- 2- **Mineral tar:** It is produced by distillation of bituminous shales. It contains less volatile matter, however, its composition is same as of other kinds of tar.
- 3- **Wood Tar:** It is produced by distillation of pure and resinous trees. It contains creosote oil and hence possesses strong preservative property.