

## Timber

- denotes structural wood obtained from tree;
- a standing tree is called ‘standing timber;’
- when a tree has been cut and its stems and branches are roughly converted into pieces of suitable lengths, it is known as rough timber;
- When a roughly converted timber is further sawn and converted into commercial size, such as: plank, logs, batten, post, beam, etc., it is called converted timber.

### Difference between wood and timber:

- Wood includes all types of wood which may be burning wood, structural wood, furniture wood, etc.
- But wood suitable for use as a structural material is called timber.

### Advantages of using timber:

- Easily available everywhere;
- High salvage value;
- Can be transported easily by converting into small commercial sizes;
- Working with timber (i.e., repairing, alteration, addition, etc.) is easy;
- Can be easily jointed;
- Not corroded (so, it can be used in marine works);
- Light weight;
- Withstands shocks better than iron and concrete;
- Good insulator of heat and electricity;
- Good sound absorbing material.

## Classification of trees:

### Exogenous trees:

- These trees increase in bulk by the formation of successive annual rings radially on the outside under the bark. Every year a new ring is added to the tree section. Age of tree can be determined from the number of annual rings. Used for engineering purposes. Two types:
  - i. *Evergreen trees or conifers:* Having pointed needle-like or scale-like leaves bearing cone-shaped fruits. They are generally evergreen trees. Yield softwood. Ex. Cedar and cypress trees.

- ii. *Deciduous trees*: Having flat broad leaves, which fall in autumn and new leaves appear in spring. Yield hardwood. Ex. Oak, Mahogany, teak, etc.

#### Endogenous trees:

- These trees grow inward by depositing each fresh layer internally. Thus the older formations/layers of wood material are on the outside. They grow vertically in a fashion that the links (approx. annual growth) placed end-to-end with knots connecting two adjacent links. Example: Bamboo, palm, etc.

#### Hardwood/ softwood:

- Characteristically, broad-leaved trees yield hardwood while conifers (needle-leaved trees) yield softwood;
- Hardwoods are dense with having narrow and well-defined annual rings. Softwoods comparatively less dense, lighter in color. They are not very strong but are soft with straight grains;
- Softwoods have more uniformity of structure than hardwoods.

#### Timber section:

- Consists of pith, heartwood, sapwood, cambium layer, inner bark, outer bark and medullar ray.

#### *Pith:*

Central part, dark colored, consists of cellular tissues and nourishes the plant in its young age; In old age, the pith dries up and decays; Sap is transmitted by fibers deposited round the pith.

#### *Cambium layer:*

A thin layer of sap lying between sapwood and the inner bark; it is full of sap which is yet to convert into sapwood; this is very sensitive layer; if it is exposed by removing the bark, cell stopped transmitting sap into the inner part and the tree dies.

#### *Medullar ray:*

These are thin radial fibers, extending from cambium layer right up to pith. These rays help in holding together annual rings of both heartwood and sapwood. They may be continuous but mostly they are broken.

### **Heartwood:**

Dark colored portion of the tree surrounding the pith. Almost dead portion of tree and does not take active part in its growth. It provides strongest and durable timber for various engineering purposes.

### **Sapwood:**

Light colored wood lying between heartwood and cambium layer. Light in weight and is of recent growth containing a lot of sap. This is the active part of the wood and thus helps in growth in the tree.

### **Felling of trees:**

Cutting of trees in order to get timber from them is called felling of timber. The following facts should be carefully considered while felling trees:

- i. **Season of felling:** Trees should be cut only when sap is not active, i.e., in mid-summer and mid-winter. In autumn and spring sap is in vigorous motion, hence felling should be avoided. For hilly region, mid-summer and for plain areas, mid-winter are proper seasons for felling trees.
- ii. **Age of trees:** Trees should be felled only when it has just attained maturity. Under-aged trees would yield more of sapwood, while over-aged trees develop certain defects in heartwood.
- iii. **Method of felling trees:** Felling should be entrusted to an experienced person. Before felling, slope of the tree is assessed and cut is given to the stem on the side of the slope of the tree, as near to the ground as possible. Then cut is made on the opposite side of the slope to fell the tree.

If tree is to be felled against the direction of the slope, ropes are tied to the tree and pulled to the direction of felling by giving suitable cut to the stem.

### **Conversion of timbers:**

The process by which timber is cut and sawn into suitable marketable sizes is known as 'conversion of timber'. After felling, stems and branches of trees are cut into logs of suitable lengths. The logs are then transported to the sawmill and converted into marketable sections (i.e., planks, battens, beams, etc.).

### **Seasoning of timber:**

The process of removing surplus moisture (in excess of equilibrium moisture content) from freshly converted timber is seasoning.

#### Advantage of seasoning:

- Seasoned timber is light.
- Improves strength properties.
- Easy to transport and handle.
- Timber less liable to be attacked by fungus and insects.
- Reduces the tendency to shrink and warp.
- Can easily be worked with.
- A seasoned timber maintains the shape of timber article unchanged.

Methods: a. Natural seasoning; b. Artificial seasoning.

#### *a. Natural seasoning:*

- After felling, timbers are sawn into commercial sizes;
- They are stacked under covered shed;
- Sufficient space is left around each sawn piece for free air-circulation;
- Also known as air seasoning; natural air remains circulating around each piece of the stack and in due course of time, seasoning is brought about.

#### **Advantages:**

- No skilled supervision is required;
- Simple and cheap method of seasoning;
- Thick section can be successfully seasoned.

### Disadvantages:

- Since depends on natural air, no control can be exercised over it;
- Slow method; depends on climatic conditions, size and shape of the timber;
- Seasoning non uniform and even;
- Requires large space;
- Moisture cannot be brought to the desired level;
- Seasoned timber may have end split;
- Liable to be attacked by fungus and insects.

### b. Artificial seasoning:

#### Advantages:

- Rate of drying can be regulated;
- No chance of timber being attacked by fungus and insects;
- Takes short time;
- Desired moisture content can be attained during seasoning;
- Better control of air, temperature and humidity;
- Seasoning more uniform;
- No end splits.

#### Methods of artificial seasoning:

1. Water seasoning;
2. Boiling or steaming;
3. Kiln seasoning;
4. Chemical seasoning;
5. Electrical seasoning.

#### Decay or disease of timber:

- Occurs due to fungal action; the fungi feeds on softwood and converts it into powder; however, decay does not occur either due to any chemical action or due to fermentation of sap.

#### *The main causes of timber decay are:*

- Alternate dry and wet conditions;
- Defective seasoning of timber;
- Presence of fungi and insects such as marine borer, beetles, termite, etc.
- Lack of ventilation;
- Dark and damp condition.

### *Timber rot:*

- It is a sort of timber decay. During rot disintegration of timber takes place and gases like H<sub>2</sub>S and CO<sub>2</sub> are generated.
- Two types: Dry rot and Wet rot.

#### **Dry rot:**

- Disintegration of converted timber by the harmful effects of certain fungi, which feeds on timber and converts it into dry powder.
- Factors responsible are the same as those responsible for decay;
- If some timbers are affected by dry rot, the best way is to cut the affected portion;
- Dry rot may be preserved by using well-seasoned timber free from sap, and the timber should be adequately ventilated by fresh air;
- **Detection:** by tapping or scratching at one end and placing the ear at the other end of log.

#### **Wet rot:**

- It is the decomposition of timber caused by moisture;
- It is caused if alternate dry and wet conditions prevail around the timber;
- Not caused by fungal attack;
- When unseasoned timbers are exposed to rain and wind, they are liable to be attacked by wet rot;
- In wet rot, the timbers get converted into grayish brown powder;
- Can be prevented by using well-seasoned timber; also using tarred or painted timbers exposing to rain or water.

### Preservation of timber:

- Preservation indicates an increase in life by developing resistance to insect attack, fungal infection and disease of timbers;
- A preservative acts like a disinfectant;
- A seasoned timber, since dried, is hygroscopic and to prevent re-absorption of moisture and to impart immunity, the tissues of dry/seasoned wood have to be soaked with some type of a preservative;
- Seasoning, therefore, prepares a timber for preservative treatment by driving away moisture and sap.

### Choice of preservative governed by:

- Their toxicity and poisonous effects;
- Permanency in their effect in treated wood;
- Should not be injurious to wood tissues;
- Cheaply available and safe to handle;
- Should allow a decorative treatment;
- Should not disfigure exposed surface of timber;
- Non-inflammable;
- Should have a good covering quality.

### - Methods of preservatives:

#### Charring:

- Crude method; No special preservative is used;
- Timber kept wet for 0.5~1.0 hour and then burnt to a depth of 15-mm and cooled with water;
- A coal layer is formed on the surface which performs preservative functions;
- Layer is not affected by fungi, moisture or white ant;
- Used at lower ends of posts of timber.

#### Tarring:

- Application of a layer of hot tar on the surface;
- Generally applied to a embedded ends of posts.

#### Painting:

- Performs both aesthetic and preservative purposes.

#### Creosoting:

- Creosotes are obtained by the distillation of coal, petroleum or wood substances;
- Three types: Coal-tar creosote, water gas-tar and wood-tar creosote;
- Creosote oil is applied under pressure on wood surface;
- Used on piles, poles and railway sleepers, etc.

Water soluble chemical salts:

- Used some chemical salts which are not toxic in nature and are also soluble in water;
- They are odorless and can be painted on drying;
- When appearance is important in wood, this type is most suitable;
- Wood treated with water soluble salts requires to be re-dried;
- The effects of these chemicals are lost gradually and so wood requires be painting or varnishing for surface treatment;
- Cheaper than creosote treatment;
- Example: Zinc chloride treatment; Creosote oil + NaF → known as Wolman's salt.

Ascu-Treatment:

- Mixture of 3 parts of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  + 4 parts of  $\text{K}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$  + 1 part of  $\text{As}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$
- The solution is prepared by mixing six parts of this powder to 100 parts of water by weight;
- The solution is then sprayed on the timber surface;
- After drying, the surface needs to be waxed, varnished, polished and painted;
- The solution is colorless.

## **Artificial wood:**

### **Veneer:**

- Thin sheets of timber of superior quality;
- Obtained by rotating wooden logs of the timber against a sharp knife of rotary cutter;
- Thickness 0.4 to 6.0 mm or even more;
- After removing from parent logs, they are dried in kiln to remove moisture;
- Used for manufacturing of plywood.

### **Plywood:**

- Made from multiple veneers;
- Veneers are taken in odd numbers and are placed one above the other at right angles in successive veneers;
- All veneers held together with the help of adhesives;
- 3-ply, 5-ply, 7-ply, etc. are available; that is, veneers are used in odd numbers in a plywood;

### ***Advantages:***

- Suffers little expansion or shrinkage due to change in moisture content;
- Light and available in large sizes;
- Available in decorative designs;
- Not liable to split and cracks;
- Easily to work with;
- Make use of costly timber in most economical manner.

### **Impreg timber:**

- Sunmica, formica, sungloss, etc.
- Veneers are partly or fully covered with resin;
- For this purpose, veneers are taken and immersed in resin. The resin fills in the wood cells and a consolidated mass is developed. The mass is then cured at a temperature of about 150 to 160<sup>0</sup>C.

### ***Characteristics:***

- Strong, durable, good looking, weather resistant, electrically insulated and resist acidic effects.

### **Compreg timber:**

- Same as impreg timber; except, they are cured under pressure;
- More durable and strong than impreg timber.

### **Fiber-board:**

- Manufactured from wood or other vegetable fibers; they are rigid boards of thickness varying from 6 mm to 25 mm; width 1.2m and length 3.5 m;
- The pieces of woods, cane or other vegetable fibers are heated in a hot water boiler; Due to boiling, the fibers get separated;
- These fibers are put in a vessel and steam is admitted in it under a pressure;
- The steam is then suddenly increased to 70 kg/cm<sup>2</sup> and this pressure is maintained for a few seconds;
- The steam pressure is suddenly dropped down; in doing so, the natural adhesive contained in fibers is completely separated;
- Fibers are taken out of vessel and cleaned off all superfluous gums;
- They are spread on wire screen in form of loose sheets and pressed; the resulting material is called fiberboard;
- Depending on their form and composition, they are classified as insulating boards, medium hardboards, hardboards, super hardboards and laminated boards.
- They may be used for following purposes:
  - i. For the construction of walls panels and suspended ceilings;
  - ii. Construct partitions;
  - iii. Form-works;
  - iv. As insulating materials against heat and sound;
  - v. As tabletops and for flush doors.

## **Rubber:**

### **Natural rubber:**

- Derived from juice of rubber trees which are tapped by forming vertical and inclined grooves round the trunk;
- Depth of groove does not extend beyond the cambium layer;
- The fluid or milky juice drawn through the tap is called 'latex';
- Latex is coagulated by heating it with the addition of weak acidic acid solution;
- Heating liberates water from latex and the mixture is cuddled up;
- The mass is then rolled into sheets, which is the crude rubber.

### **Vulcanization:**

- Crude rubber becomes hard and brittle in winter and soft and sticky in summer. In order to make rubber useful for all seasons, it has to be vulcanized;
- The process of mixing rubber with sulphur to make it hard and resistant for all seasons is called vulcanization;
- *Soft rubber*: contains 1-5% sulphur and the heating temperature being 130<sup>0</sup>C during vulcanization; Used for shoe, soles, tube, etc.
- *Hard rubber*: Contains about 30% sulphur, while heating up to 1700C during vulcanization; Used for tyre, conveyor belts, etc.

*Vulcanization brings about the following changes:*

- Rubber becomes more durable; the permanent set becomes very small;
- Offers great resistant to friction and solvents;
- Tensile strength increases considerably;
- Less susceptible to temperature changes.

### **Compounding of rubber:**

In order to make rubber more useful, certain compounds have to be added, which are: pigments, plasticizers, hardeners, fillers, accelerators and activators, etc.

Fillers: Impart bulk volume, increase strength and rigidity; e.g., carbon, cotton, etc.

Pigments: Impart the desired color;

Plasticizers: Imparts softness to rubber; e.g., wax, resin, vegetable oil, etc.

Hardeners: Impart hardness and also increased strength; e.g.,  $\text{CaCO}_3$ ,  $\text{BaSO}_4$ , sealing wax, etc.

Accelerators and activators: Reduce the preparation period of rubber and also improve its properties.

### **Synthetic rubber:**

- Made synthetically by polymerization of hydrocarbon;
- Neoprene is a variety of synthetic rubber made from acetylene;
- Superior to natural rubber in the following:
  - i. Possesses excellent weather resistant properties;
  - ii. Good resistant to acids, oils and grease;
  - iii. Having better mechanical properties;
  - iv. Better abrasion resistant.

### **Usage:**

- Sound and heat insulator;
- Shock absorbing medium;
- Electrical insulation;
- Floor finishing, etc.

### **Forms of rubber:**

- Sponge rubber
- Foamed rubber
- Smoked rubber
- Crepe rubber: a variety of crude rubber; obtained by passing coagulated latex through rollers; available in the form of rolls.
- Polybutadiene rubber: a variety of synthetic rubber;
- Guayule rubber: a variety of natural rubber;

**Class test – 3**  
**CE 201**

**Name:**

**12.05.2003**

**ID:**

**Time: 15 min.**

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**Q.1. Name six converted timbers that are commercially available.**

3

**Q.2. State the differences between sapwood and heartwood.**

3

**Q.3. What is medullar ray? What is its function?**

2+2

**Class test – 3**  
**CE 201**

**Name:**

**28.05.2003**

**ID:**

**Time: 15 min.**

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**Q.1. Name five advantages of using plywood instead of normal timber.**

**5**

**Q.2. What is an Ascu solution?**

**3**

**Q.3. What do you mean by preservation of timber?**

**2**