

Construction and Materials For Food Science and Engineering

Construction Materials: Timber

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Timber

Timber: Any wood which is used in engineering construction is termed as timber. Timber has been one of the primary materials of engineering construction since the earliest times. Despite the fact that it has been largely superseded by steel and concrete in certain classes of structures, the utilization of timber for structural and other commercial purposes is very large.

Some distinctive advantages of timber over other materials:

1. Timber can be easily worked with tools of any size and can take good polish.
2. It is comparatively stronger than other materials commonly used when considered in proportion to weight.
3. It can be used both load bearing and non-load bearing members in structures and structural connections can be made very easily.
4. Timber construction is very economic because even a small piece can be utilized in one way or the other and therefore, minimizing waste.

Timber

Some distinctive advantages of timber over other materials:

5. Its use for making furniture, sport goods and other decorative and attractive articles of artistic design is quite important and is accepted universally without doubt.
6. Timber has low thermal conductivity, high electrical resistance and good sound proofing property. All of these have always contributed to its importance as a very useful building material.
7. Timber structures are unquestionably durable if properly treated and carefully protected from direct exposure to weather and alternate wet and dry conditions by applying preservatives.
8. Various types of timber products like plywood, veneers, laminated boards and other reconstructed woods are mostly used nowadays for their lightness and beauty.
9. It has a great resale value. Discarded timber can be used as fuel. Saw dust can be utilized to make reconstructed woods like hard boards, light weight planks, partex boards, etc.

Felling of Timber Trees

Felling of Timber Trees: To get timber, a living tree is cut and subsequently treated to impart durability and strength to green wood. The cutting of a tree is done in a systematic manner and the process is termed as “felling”.

Considerations for felling trees:

- Trees should be felled only after they are fully matured so that maximum wood would be obtained from a tree.
- The proper season for felling trees is an important consideration. It can be recalled that in spring and in late summer the wood cells are very active and the sapwood contains great amount of moisture and sap. The starches, sugars, and albumen contents of sap bring about the decay of wood very quickly with fungal growth.
- During winter and early part of summer, the growth of tree is dull and the cambium layer is inactive. The sap and the moisture content are also less. Therefore, this part of the year from October to March is favorable for felling trees.
- To avoid waste, trees should be felled as near as the ground as possible. They should be tied with the aid of anchor ropes and carefully brought to the ground after cutting by axes or saws. Trees standing on slopes should fall uphill.

Conversion of Felled Trees

Conversion of Felled Timber Trees: The preparation of timber from felled trees by strimming off branches, removing the bark, cutting and sawing to convert it into marketable forms is called conversion. The principal market forms into which timbers are converted are as follow:

- **Log:** A log is a trunk of a felled tree and the branches strimmed off.
- **Lumber:** Lumber is the general term applied to cut sections of a log manufactured by sawing.
- **Balk or Squared Timber:** This is obtained by roughly squaring the log.
- **Plank:** A plank is a parallel sided piece of timber roughly 8 to 15 inch wide. 1 to 3 inch thick and 8 to 20 ft long.
- **Deal:** A deal is a plank 2 to 3 inch thick and less than 9 inch wide.
- **Batten:** A batten is a plank 1.5 to 2 inch thick and over 9 inch wide.
- **Board:** A board is a plank less than 2 inch thick and over 6 inch wide.
- **Scantlings:** Scantlings are miscellaneous cut pieces of timber.
- **Poles:** Poles are long round logs free from any defects (knots. etc.) and the greatest diameter not exceeding 8 inch.

Weight and Measurement of Timber

Weight of wood: The specific gravity of the actual wood fibre of all species is about **1.5**. So it is apparent that no wood would float in water.

The timber usually is measured in volume. The following are the various methods of measurement of timber:

1. If d_1 and d_2 are the two end diameters of the log in **inch** and L is the length of the same in **ft**. The volume of the log is given by the following expression:

$$\text{Volume in cu ft} = 0.2618 \times \{d_1^2 + d_2^2 + d_1d_2\} / 144 \times L \dots\dots\dots(1)$$

2. The volume also can be determined by measuring the quarter girth in **ft** at the middle (g_2) and at the two ends (g_1 and g_3) of the log and L is the length of the log in **ft** as follows:

$$\text{Volume in cu ft} = 1.27 \{ (g_1 + g_2 + g_3) / 3 \}^2 \times L \dots\dots\dots(2)$$

3. The volume can also be determined by the following formula:

$$\text{Volume in cu ft} = 1.27 \times g^2 \times L \dots\dots\dots(3)$$

Where, g is quarter girth at the mid-length of the log in **ft** and L is the length of the log in **ft**.

Note: All these measurements are approximate, because the cross-section of log is not a regular geometrical figure.

Seasoning of Timber

Seasoning of Timber

- The seasoning of timber is the process of drying timber that frequently precedes its application to structural purposes.
- The main purpose of seasoning is to dry sap and to reduce the moisture content of timber.

Main objectives of seasoning timber:

1. To bring timber to a state of equilibrium moisture content, which is essential for all subsequent conversion and use.
2. To reduce the weight of timber to facilitate transportation and handling.
3. To make timber durable and more resistant to decay due to fungal action.
4. To make timber strong, hard and stiff as unseasoned timber is weak and soft and more vulnerable to decay.
5. To dry the sap and to reduce the moisture content to a certain degree to apply preservatives on timber.
6. To make timber more suited for polishing and painting.

Seasoning of Timber

Methods of seasoning of Timber:

The following are the principal methods of seasoning of timber:

- **Natural or Air Seasoning:**
- **Artificial Seasoning:**
 - **Kiln Seasoning:**
 - **Chemical Seasoning:**
 - **Electrical Seasoning:**
 - **Steaming:**
 - **Boiling:**
 - **Smoke Seasoning:**
- **Water Seasoning:**

Seasoning of Timber

Methods of Seasoning of Timber:

- A. *Natural or Air Seasoning:*** This is also known as air drying. This is done by long exposure of timber. Timbers are stacked in a dry elevated platform covered by shed to protect from rain. Timber is usually turned frequently to ensure equal drying. Very slow process and takes 2 to 3 years.
- B. *Artificial Seasoning:*** The drying of timber by exposure for a limited period to high temperature in a closed chamber or by applying chemicals, steam and smoke is termed as artificial seasoning.
 - 1. *Kiln Seasoning:*** Timbers are stacked in kiln at high temperature where high or low moisture is maintained. Natural or forced air circulation is done. Temperature of 70 to 82°C are maintained and 4 to 6 days or 6 to 12 days are needed for drying depending on the types of timber.

Seasoning of Timber

Methods of Artificial Seasoning of Timber:

- 2. *Chemical Seasoning:*** This is also known as salt seasoning. Timber is first soaked in a aqueous solution of a suitable chemical salt before it is passed through the process of kiln seasoning. The most commonly used chemical is urea.
- 3. *Electrical Seasoning:*** High frequency alternating current is passed through the timbers in a closed chamber and the resistance caused by the passage of the currents produces heat which dries the timber. This is generally preceded by air drying.
- 4. *Steaming:*** In this process, steam is passed through the stacked timber in a closed chamber and thereafter timber is dried gradually in natural air. The steam is usually passed for 4 to 6 hours.

Seasoning of Timber

Methods of Artificial Seasoning of Timber:

- 5. Boiling:** In this process, the timber is immersed in boiling water for a certain period of time. Thereafter, the timber is dried slowly by natural air. This is a quick method but it reduces the elasticity and strength of timber.
- 6. Smoke Seasoning:** It is a old method of drying timber in smoke heat over a fire of straw, sawdust and wood savings. This method is claimed to be efficient to make timber more durable and resistance to decaying agents. Heat is gradually applied to prevent splitting and wrapping.
- 7. Water Seasoning:** In this process, timber and logs are immersed and allowed to remain in water for a couple of days. Then they are dried in natural air. The sap is diluted and is partly removed. So it reduces the possibility of decay and increases the durability of timber.

Preservation of Timber

Preservation of Timber: Timbers are treated with preservatives to prevent the growth of wood destroying fungi or protect the attract of wood destroying agencies (termites, carpenter ants, wood borers, rats etc.) with a view to prolong the life span of timber.

A good preservative should have the following characteristics.

1. It should be safe in handling and safe to use.
2. It should be non-injurious to the wood tissue and should not act chemically with the wood fibres.
3. It should not get washed away and should preserve wood permanently.
4. Its quality should be such that decorative colors and paints could be applied on timber very easily.
5. It should be non-flammable and should penetrate the wood thoroughly.

Wood preservatives

Preservatives are coated or injected into the wood to protect it from deterioration.

There are mainly 3 types of wood preservatives available in the market:

1. **Preservative Tar oils:** eg. Coal-tar creosote is mostly used.
2. **Water soluble Preservatives:** eg. Salt like zinc chloride is mostly used. Others are mercuric chloride, potassium dichromate, copper sulphate. Treated timber can be painted and is odorless.
3. **Organic compound (preservatives):** Toxic organic compounds such as tetrachlorophenol, pentachlorophenol, copper naphthenate and zinc naphthenate dissolve in non-toxic volatile solvent such as naphtha, spirit etc. Wood is soaked into the preservatives. Treated wood is paintable and odorless.

Wood preservatives

1. **Tar oil:** The most important and widely used tar-oil preservative is **creosote**.

Creosotes are of 3 types:

- a. **Coal-tar creosote**;
- b. **Water gas tar creosote**; and
- c. **Wood-tar creosote**; depending on their origin whether it is from coal, petroleum or wood.

Coal-tar Creosote is a thick dark liquid made from coal tar which is used to **prevent** wood from **rotting**. It is most important and efficient. It is insoluble in water and can not be washed out of timber. Used in outdoor structures such as piling, poles. It can not be painted and It has objectionable odour.

Thanks