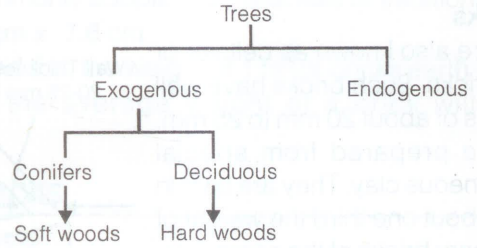
6. TIMBER

CLASSIFICATION OF TREES

- Trees are classified according to their mode of growth. Following is the classification of trees:



1. **Exogenous Trees**
   - Conifers are also known as evergreen trees and leaves of these do not fall till new ones are grown. As these trees bear cone-shaped fruits, they are given the name conifers. These trees yield soft woods.
   - Deciduous trees are also known as broadleaf trees and leaves of these trees fall in autumn and new ones appear in spring season. Timber for engineering purposes is mostly derived from deciduous trees. These trees yield hard woods.

Comparison of Soft Wood and Hard Wood

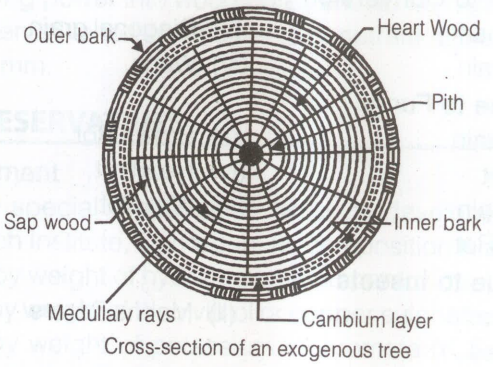
No.	Item	Soft Woods	Hard Woods
1.	Annual rings	Distinct	Indistinct
2.	Colour	Light	Dark
3.	Fire resistance	Poor	More
4.	Medullary rays	Indistinct	Distinct
5.	Strength	Strong for direct pull and weak for resisting thrust of shear	Equally strong for resisting tension, compression and shear
6.	Structure	Resinous and split easily	Non-resinous and close-grained
7.	Weight	Light	Heavy

2. **Endogenous Trees**
   These trees grow inwards and fibrous mass is seen in their longitudinal sections. Timber from these trees has very limited engineering applications. Examples of endogenous trees are bamboo, cane, palm, etc.

STRUCTURE OF A TREE

From the visibility aspect, the structure of a tree can be divided into *two* categories:

1. **Macrostructure**
   (i) **Pith:** The innermost central portion or core of the tree is called the pith or medulla.
   (ii) **Heart Wood:** The inner annual rings surrounding the pith is known as heart wood. It is usually dark in colour.



Cross-section of an exogenous tree

   (iii) **Sap Wood:** The outer annual rings between heart wood and cambium layer is known as sap wood.
   (iv) **Cambium Layer:** The thin layer of sap between sap wood and inner bark is known as cambium layer.
   (v) **Inner Bark:** It gives protection of cambium layer from any injury.
   (vi) **Outer Bark:** It consists of cells of wood fibre and is also known as cortex.
   (vii) **Medullary Rays:** The thin radial fibres extending from pith to cambium layer are known as *medullary rays.*

2. **Microstructure**
   - Wood consists of living and dead cells of various sizes and shapes.
   - A living cell consists of four parts, namely (i) membrane, (ii) protoplasm (iii) sap (iv) core. Cell membrane consists mainly of cellular tissue and cellulose. Protoplasm is a granular, transparent, viscous vegetable protein composed of carbon, hydrogen, oxygen,

nitrogen and sulphur. Core of cell differs from protoplasm merely by the presence of phosphorus and it is generally oval.

- **Age of trees for felling:** The age of good trees for felling varies from 50 to 100 years.
- **Season for felling:** In autumn and spring, sap is in vigorous motion and hence, felling of trees in these seasons should be avoided. For hilly areas, mid-summer would be the proper season for felling as there is heavy rainfall in winter. For plain areas, mid-winter would be the proper season for felling as in summer, water contained in sap would be easily evaporated and it will lead to the formation of cracks.

DEFECTS IN TIMBER

Defects occurring in timber are grouped into the following five divisions.

1. **Defect Due to Conversion**
   (i) Chip mark (ii) Diagonal grain
   (iii) Torn grain (iv) Wane
2. **Defects Due to Fungi**
   (i) Blue Stain (ii) Brown Rot
   (iii) Dry Rot (iv) Heart rot
   (v) Sap Stain (vi) Wet Rot
   (vii) White Rot
3. **Defects Due to Insects**
   (i) Beetles (ii) Marine Borers
   (iii) Termites
4. **Defects Due to Natural Forces**
   (i) Burls (ii) Callus
   (iii) Chemical stain (iv) Coarse grain
   (v) Dead wood (vi) Druxiness
   (vii) Foxiness (viii) Knots
   (ix) Rind galls (x) Shakes
   (xi) Twisted fibres (xii) Upsets
   (xiii) Water stain (xiv) Wind cracks
5. **Defects Due to Seasoning**
   Following defects occur in seasoning process of wood.
   (a) Bow (b) Case-hardening
   (c) Check (d) Collapse
   (e) Cup (f) Honey-combing
   (g) Radial shakes (h) Split
   (i) Twist (j) Warp

PRESERVATION OF TIMBER

Preservation of timber is carried out to achieve the following three objects:

- To increase the life of timber structures
- To make the timber structures durable, and
- To protect the timber structures from the attack of destroying agencies such as fungi, insects, etc.

REQUIREMENTS OF A GOOD PRESERVATIVE

- It should allow decorative treatment on timber after being applied over timber surface.
- It should be capable of covering a large area with small quantity.
- It should be cheap and easily available.
- It should be free from unpleasant smell.
- Its penetrating power into wood fibres should be high. It is necessary for the preservative to be effective to penetrate at least for a depth of 6 mm to 25 mm.

TYPES OF PRESERVATIVES

1. **Ascu Treatment**
   - Ascu is special preservative which is developed at the Forest Research Institute, Dehradun. Its composition is as follows.
   - X- Part by weight of hydrated arsenic pentoxide, ($As_2O_5.2H_2O$).
   - Y- Part by weight of blue vitriol or copper sulphate, ($CuSO_4.5H_2O$).
   - Z-Part by weight of potassium dichromate ($K_2Cr_2O_7$) or sodium dichromate ($Na_2Cr_2O_7.2H_2O$)
   - This preservative gives timber protection against the attack of white ants. The surface treated with this preservative can be painted, polished, varnished or waxed.
2. **Chemical Salts**
   - These are water-borne preservatives and they are mostly salts dissolved in water. The usual salts used are copper sulphate, mercury chloride, sodium fluoride and zinc chloride.
   - These preservatives are odourless and non-inflammable.
3. **Coal Tar**
   Its cheapness and effective resistance. Coal tar is fire-resistant.
4. **Creosote oil**
   In this case, timber surface is coated with creosote oil.
   - Creosote oil is one of the best antiseptic. It is a black or brown liquid, weakly affected by water, neither volatile nor hygroscopic,

harmless to wood or metal, inflammable, with an unpleasant odour and having low wood-penetrating ability to the extent of 1 mm to 2 mm only.

- Creosote oil should not be used for interior surfaces of dwelling houses, foodstuff-storage premises, in underground installations and near inflammable surfaces.

5. **Oil Paints**
   - The timber surface is coated with 2 or 3 coats of oil paint.
   - The wood should be seasoned, otherwise sap will be confined and if will lead to the decay of timber.
   - The oil paints preserve timber from moisture and make it durable.
6. **Solignum Paints**
   - These paints preserve timber from white ants as they are highly toxic in nature.
   - They can be mixed with colour pigment and applied in hot state with the help of brush.
   - The timber surface may therefore be given the desired colour or appearance.

METHODS FOR PRESERVATION

There are six Methods Adopted for Preservation of Timber:

1. **Brushing**
   - The solution prepared from preservative is applied on timber surface by good quality of brushes.
   - This is the simplest method and it is generally adopted for seasoned timber.
   - The crocks should be filled up before the application of preservative.
2. **Charring**
   - The surface to be charred is kept wet for about half an hour and it is then burnt up to a depth of about 15 mm over a wood fire.
   - The charred portion is then cooled with water.
   - Due to burning, a layer of coal is formed on the surface.
   - This layer is not affected by moisture and it is not attacked by white ants, fungi.
   - The disadvantage of this method are:
     (i) The charred surface becomes black in appearance and hence it cannot be used for exterior work.
     (ii) There is some loss of strength of timber as the cross-section is reduced due to charring.
3. **Dipping and Steeping**
   - In this method, the timber to be given preservative treatment is dipped or soaked for a short period in the solution of preservative.
   - This method gives slightly better penetration of preservative than in case of brushing or spraying.
4. **Hot and Cold Open Tank Treatment**
   - In this method, the timber is submerged in a tank containing solution of preservative which is heated for a few hours at temperature of 85°C-95°C.
   - Tank is then allowed to cool down gradually while the timber is still submerged in the tank.
   - This method is effective in giving protection to the sap wood.
5. **Injecting Under Pressure**
   - This method proves to be essential for treating non-durable timbers which are to be used as places where there is danger of attack by fungi and insects.
6. **Spraying**
   - In this method the solution of preservative is filled in a spraying pistol and it is then applied on timber surface under pressure.
   - This method is also quite effective and it is superior than brushing.

FIRE RESISTANCE OF TIMBER

1. **Application of Special Chemicals**
   - It is found that two coats of solution of borax or sodium arsenate with strength of 2 per cent are quite effective in rendering the timber fire-resistant.
   - When the temperature rises, they either melt or give off gases which hinder or forbid combustion.
2. **Sir Abel's Process**
   In this process, timber surface is cleaned and it is coated with a dilute solution of sodium silicate. A cream-like paste of slaked fat lime is then applied and finally, a concentrated solution of silicate of soda is applied on the timber surface.

SEASONING OF TIMBER

1. **Objects of Seasoning**
   - To allow timber to burn readily, if used as fuel.
   - To decrease the weight of timber and thereby to lower the cost of transport and handling.
   - To make timber safe from the attack of fungi and insects

- To reduce the tendency of timber to crack, shrink and warp.
- To make timber fit for receiving treatment of paints, preservatives, varnishes
- To import hardness, stiffness, strength and better electrical resistance to timber.

2. Methods of Seasoning

(a) Natural Seasoning

In this method, the seasoning of timber is carried out by natural air and hence it is also sometimes referred to as air seasoning.

Advantage

(i) Depending upon the climatic conditions, the moisture content of ward can be brought down to about 10-20%
(ii) It does not require skilled supervision
(iii) This method of seasoning timber is cheap and simple.
(iv) It is uneconomical to provide artificial seasoning to timber sections thicker than 100 mm, as such sections dry very slowly.

Disadvantage

(i) As the process depends on the natural air, it sometimes becomes difficult to control it
(ii) The drying of different surface may not be even and uniform.
(iii) If ends of thick sections of timber are not projected by suitable moistureproof coating, there are chances for end splitting.

(b) Artificial Seasoning

- Following are the reasons for adopting the artificial seasoning to the natural seasoning.
  (a) The defects such as shrinkage, cracking and warping are minimized.
  (b) The drying is controlled and there are practically no chances for the attack of fungi and insects.
  (c) The drying of different surface is even and uniform.
  (d) It considerably reduces the period of seasoning.
  (e) There is better control of circulation of air, humidity and temperature.

(i) Boiling

In this method of artificial seasoning, timber is immersed in water and water is then boiled. But it affects the elasticity and strength of wood.

(ii) Chemical seasoning

This is also known as salt seasoning. In this method, timber is immersed in a solution of suitable salt. It is then taken out and seasoned in the ordinary way.

(iii) Electrical seasoning

- In this method, use is made of high frequency alternating currents.
- This is the most rapid method of seasoning.
- Due to high cost this method is unecomonical.

(iv) Kiln Seasoning

- In this method, drying of timber is carried out inside an airtight chamber or oven.

(v) Water Seasoning

- Timber pieces are immersed wholly in water, preferably in running water of a stream. Care should be taken to see that timber is not partly immersed.
- Timber is taken out after a period of about 2 to 4 weeks. During this period, sap contained in timber is washed away by water.

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