



JECRC Foundation



**JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE**

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE DEPARTMENT OF CIVIL ENGINEERING

Class – III Semester /II Year

Subject –Building Materials And Construction

Chapter –3(Timber)

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VISION AND MISSION OF INSTITUTE

VISION

To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

MISSION

Focus on evaluation of learning outcomes and motivate students to inculcate research Aptitude by project based learning. Identify, based on informed perception of Indian, Regional and global needs, areas of focus and provide platform to gain knowledge and solutions. Offer opportunities for interaction between academia and industry. Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

VISION AND MISSION OF DEPARTMENT

VISION

To become a role model in the field of Civil engineering for the sustainable development of the society.

MISSION

To provide outcome base education

To create a learning environment conducive for achieving academic excellence

To prepare civil engineers for the society with high ethical values.

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INTRODUCTION

Timber is the term which denotes wood, suitable for building carpentry or other engineering purposes. Timber is one of the oldest structural materials used by man. Temples and monuments built several centuries ago but still remain in excellent condition so the durability usefulness of timber.

Wood used for structural purpose is known as timber. There is a-lot-of demand for primary species of timber like teak, deodhar, sisam , sal etc.

The timber contained in a living tree is known as standing timber. The timber obtained after falling a tree is known as rough timber and that which is sawn and cut into suitable commercial sizes is known as converted timber.

SOURCE OF TIMBER

The source of timber supply is the tree in forests. It is a part of plant life that thrives in many forms. Though trees are different from other forms of plant life like herbs, they are basically of the same group, both in their structure and growth. They grow much taller than herbs and take long time, to nature . It is important to understand the nature of trees. i.e. the source of timber, for a good understanding of the properties. Classification and use of timber.

Tree and its growth. All plant life is basically made up of roots , stem , leaves and branches.

The roots anchor the tree to the ground and take in mineral nutrients from the soil.

SOURCE OF TIMBER

The stem conducts the food materials to the leaves, stores them and also provides mechanical rigidity by supporting the leaves and branches. The leaves are the most important part of the tree for its existence because it is here that the complex substances required for life processes are manufactured. Leaves take in carbon dioxide from the atmosphere and with the energy obtained from sunlight manufacture the complex substances required for the growth of the tree. Between the bark and the stem is a delicate tissue not known as cambium which forms a complete sheath around the stem and the branches.

CLASSIFICATION OF TREES

According to the mode of growth the trees are classified as :

1. Exogenous trees, 2. endogenous trees

➤ **EXOGENOUS TREES:**

which comprise the great majority of modern trees (all conifers, and all broadleaf trees), grow by the addition of new wood outwards, immediately under the bark.

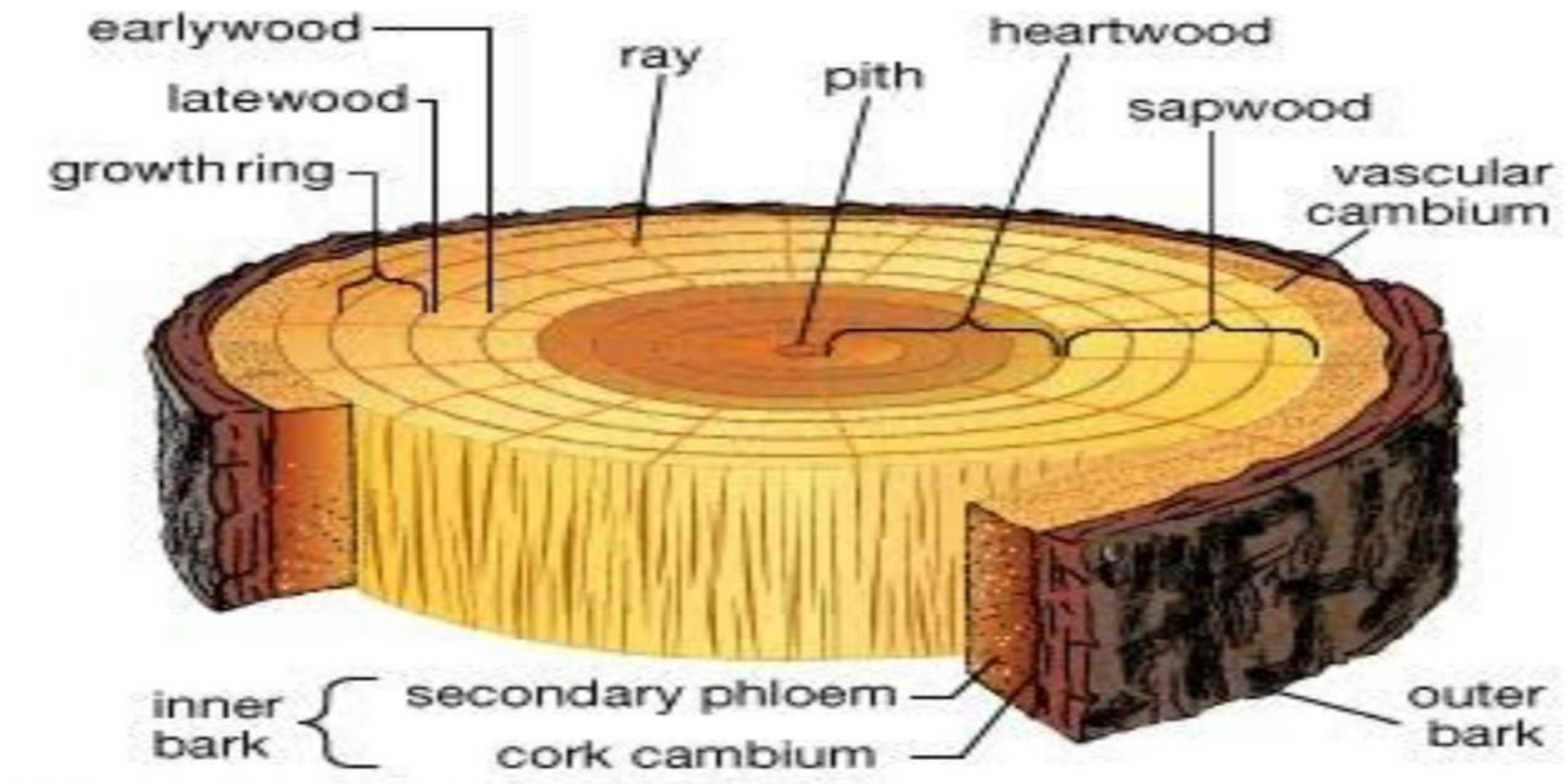
➤ **ENDOGENOUS TREES:**

Grow by addition of new material inwards.(bamboo.cane,palm)

STRUCTURE OF AN EXOGENEOUS

Fig. a cross section of an exogenous tree in which names of all the parts have been given the different parts that can be distinguished are as follows:

- 1 Pith
- 2 Heart wood
- 3 Sapwood
- 4 Cambium layers
- 5 Inner bark
- 6 Outer bark
- 7 Medullary ray
- 8 Annual rings



SOFTWOOD AND HARDWOOD

SOFTWOOD

- softwood is not necessarily a softer material (less dense).
- softwood comes from a conifer, which usually remains evergreen.
- Light- coloured.
- Growth rings distinct.
- Usually light in weight.
- Can be easily split

HARDWOOD

- Hardwood is not necessarily a harder material (more dense)
- hardwood comes from a deciduous tree which loses its leaves annually. Hardwoods tend to be slower growing, and are therefore usually more dense.
- Generally dark- coloured.
- Growth rings are not as distinct as in softwood.
- Usually heavier in weight.
- Cannot be easily split

FELLING

Felling:- Felling is the process of cutting down individual trees, an element of the task of logging. The person cutting the trees is a feller.

Methods

- **Hand felling** :-In hand felling, an axe, saw, or chainsaw is used to fell a tree, followed up by limbing, bucking in traditional applications. In the modern commercial logging industry, felling is typically followed by limbing and skidding.
- **Feller- Buncher:-**A feller- buncher is a motorized vehicle with an attachment which rapidly cuts and gathers several trees in the process of felling them. In cut-to-length logging a harvester performs the tasks of a feller-buncher additionally doing the delimiting and bucking of the trees as well.



PROPERTIES OF TIMBER

Followings are the physical and mechanical properties of timber:

- Color
- Appearance
- Hardness
- Specific Gravity
- Moisture Content
- Grain
- Shrinkage and Swelling
- Strength
- Density
- Toughness
- Elasticity
- Warping
- Durability
- Deffectless
- Workability
- Soundness
- Free of abrasion

Color is a uniform property by which most trees are characterized as they show variation from tree to tree. Light color indicates weak timber. For example, freshly cut teak, Deodar, and Walnut have a golden yellow, whitish and dark brown shades respectively.

Appearance:-Smell is a good property as timbers for few plants as they can be identified by their characteristic aroma. Fresh cut timbers have a good smell. For example resinous smell from pine.

Hardness:-For the resistance of any kind of damage, hardness is an obvious property.

Specific Gravity:-Variation of timber in specific gravity (0.3-0.9) is found. It depends on pores present inside timber. The specific gravity of this light material is less than that of water (<1). But in case of compact wood where pores are almost absent and become heavier, their specific gravity increases up to 1.5.

Moisture Content:-Timbers are hygroscopic and gain water from nature (atmosphere). The absorption of water or dehydration depends on atmospheric humidity. If timbers moisture content is high that means the timber quality is low. Water content is the risk of fungal attack.

Straight grain: Arrangement of vascular tissue (xylem and phloem) is important which grow parallel to the length of the timber that is termed as straight grain.

Coarse grain: vascular tissue and fibre arranged broadly and widely.

Interlocked grain: Instead of parallel arrangement twisted, a spiral arrangement may be found.

Shrinkage and Swelling:-The percentage of shrinkage and swelling varies from plant to plant. Some give higher percentage after drying. Shrinkage starts when cell walls of timber start to release water. In moisture atmosphere timber swells when cell walls absorb water. Good quality timbers swell less. Timbers having thicker wall swell more than a thinner one.

Strength:-Best quality timbers have the highest strength. Strength means capable to bear loads. Anisotropic material like timber has different structure at the different portion. So, the strength of timber is different at different points. Grain structure determines the strength of the timber. Some types of strength are

Compressive strength: 500 kg/cm² to 700 kg/cm² load is enough to test timbers strength.

Tensile strength: When timber is enough strong to the tensile force. If perpendicular force is made then timber is weaker. 500-2000 kg/cm² is the range of tensile strength load.

Transverse strength: Enough bending strength indicates good quality timber

Density:-Timber having higher density have a thicker wall. An important property that quality of timber. Moisture content: Presence of defects: There may be some of the natural and artificial defects in timber such as cross-grain, knots, and shakes, etc. All of them cause a decrease in the strength of the timber.

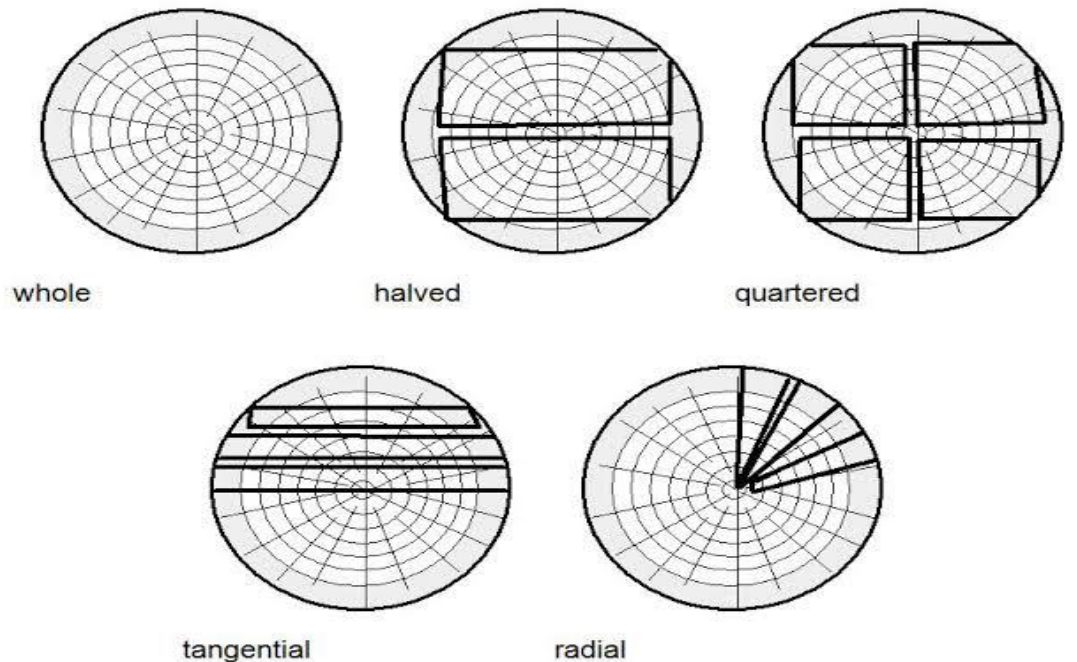
Toughness:-Timber has to have the capability to bear shocks, jerk. Anti-bending and ant splitting characteristic is needed.

CONVERSION OF TIMBER

The process of sawing and cutting of timber into suitable sections is known as the conversion of timber. There are four types of sawing of timber.

1. Ordinary or bastard or flat or slab sawing
2. Quarter sawing
3. Tangential sawing
4. Radial sawing

In ordinary sawing the saw cuts are tangential to the annual rings. In quarter sawing the saw cuts are at right angles to each other. In radial sawing the saw cuts are made radially in a parallel direction to the medullary rays .



DEFECTS IN TIMBERS

The followings are the five main types of defects in timber:

- Defects due to Natural Forces
- Defects due to Attack by Insects
- Defects due to Fungi
- Defects due to Defective Seasoning
- Defects due to Defective Conversion

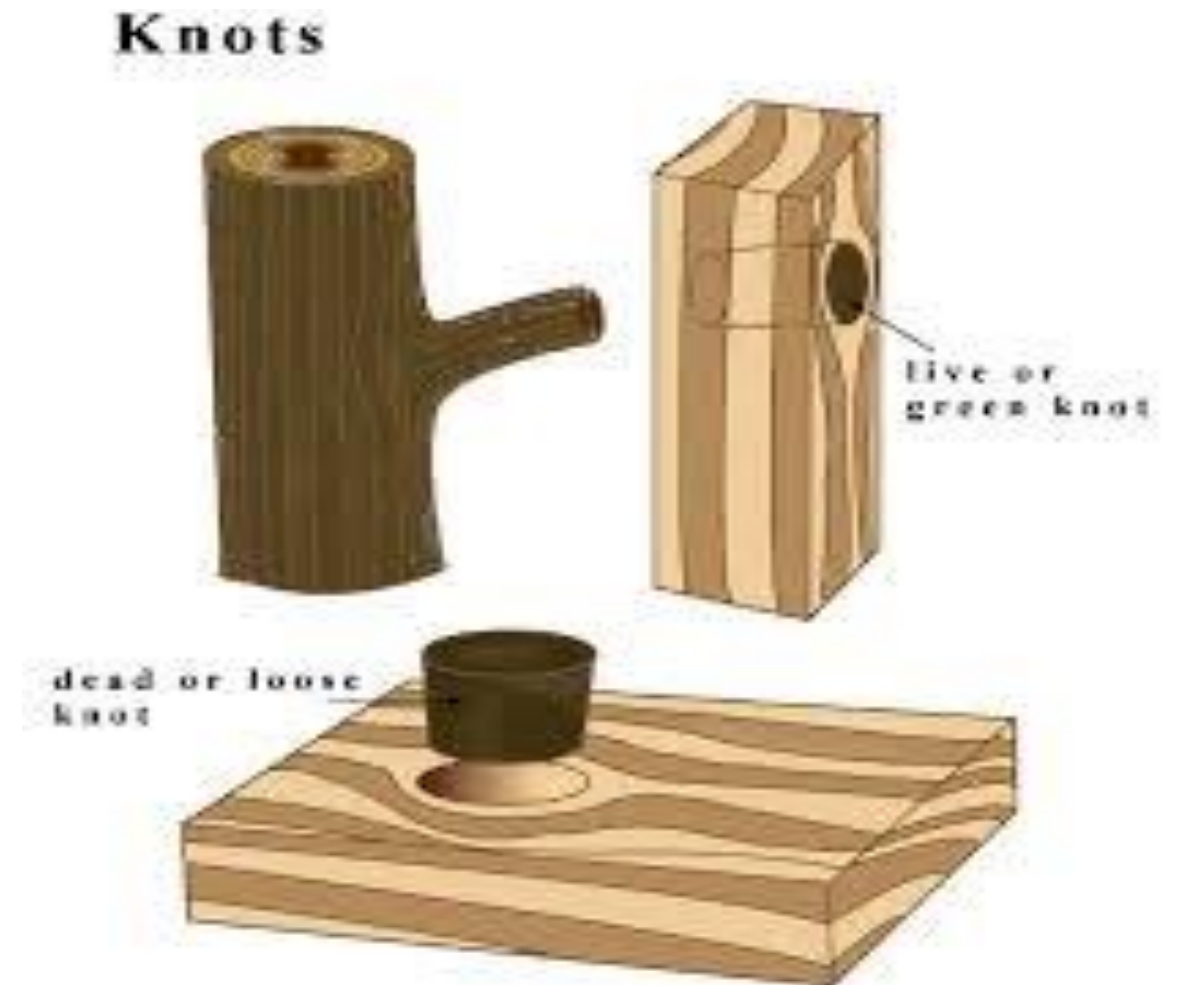
DEFECTS IN TIMBER



DEFECTS IN TIMBER

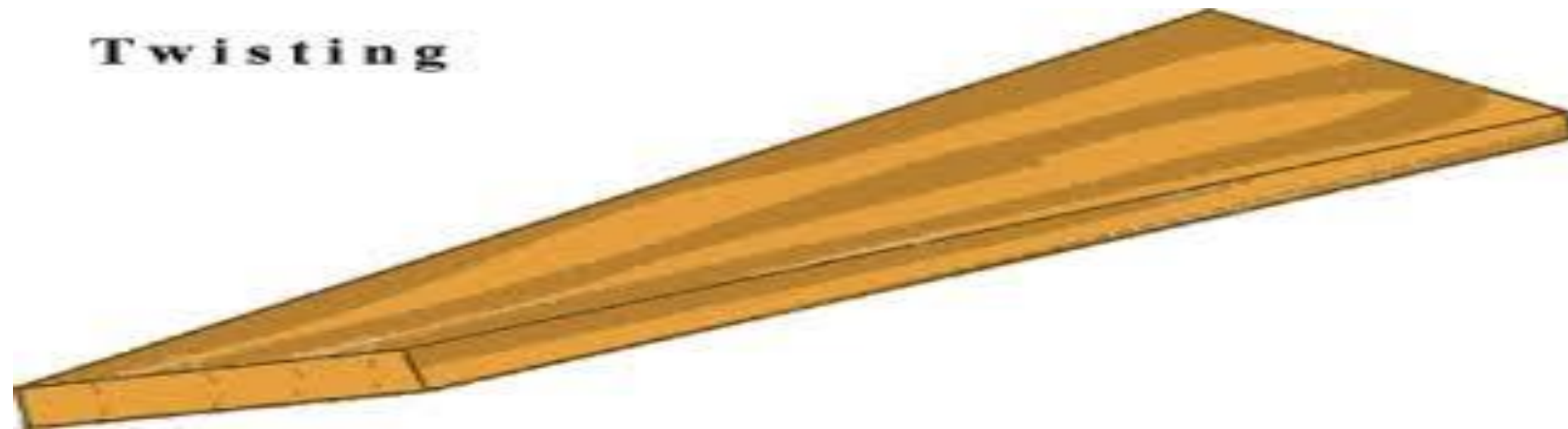
Defects in Timber due to Natural Forces :-

Knots: Knots are the most common defects caused due to natural forces. During the growth of a tree, branches close to the ground or lower branches die. Bases of those branches remain in the tree as the trees grow. These bases may create imperfection known as knots.



DEFECTS IN TIMBER

Twist: Twist in timber rotates the ends of the timber in opposite directions. The main reason behind this defect is twisting of the trees by the strong wind.



DEFECTS IN TIMBER

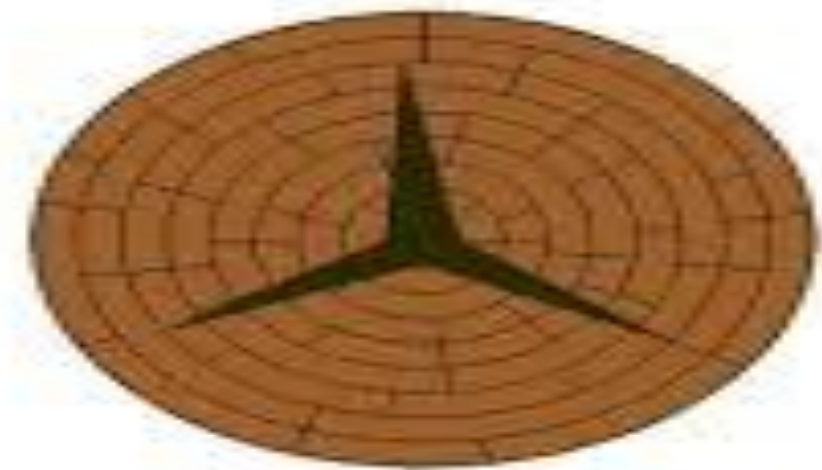
Shakes: Shakes are timber defects that occur around the annual ring or growth ring of a timber. In other words, cracks or splits in the woods are called shakes.



Star Shake



Ring Shake



Heart Shake

DEFECTS IN TIMBER

Defects of Timber due to Attack by Insects:-

Insects like beetles, termites or marine boars eat wood, make holes and weaken the strength of the wood. Beetles are small insects that make holes in almost all the sapwoods. The larvae make tunnels through the sapwood in all directions and turn wood into powder.

Defects in Timber due to Attack by Fungi:-

Stain: When fungi feed only on sapwood, where the food materials are stored, it causes a stain. Heartwood doesn't contain these kinds of food materials and is not affected by it. Stain action causes color but does not affect the strength of the wood.

Blue stain- sap of wood is stained to bluish color by the action of certain type of fungi



DEFECTS IN TIMBER

Defects in Timber due to Attack by Fungi:-

Sap stain- certain type of fungi feed on cell contents of sap wood; sap wood loses its color

Brown rot- fungi of certain types remove cellulose compounds from wood and hence the wood assumes the brown color

Dry rot- fungi of certain types feed on wood and during feeding, they attack on wood and convert it into dry powder form

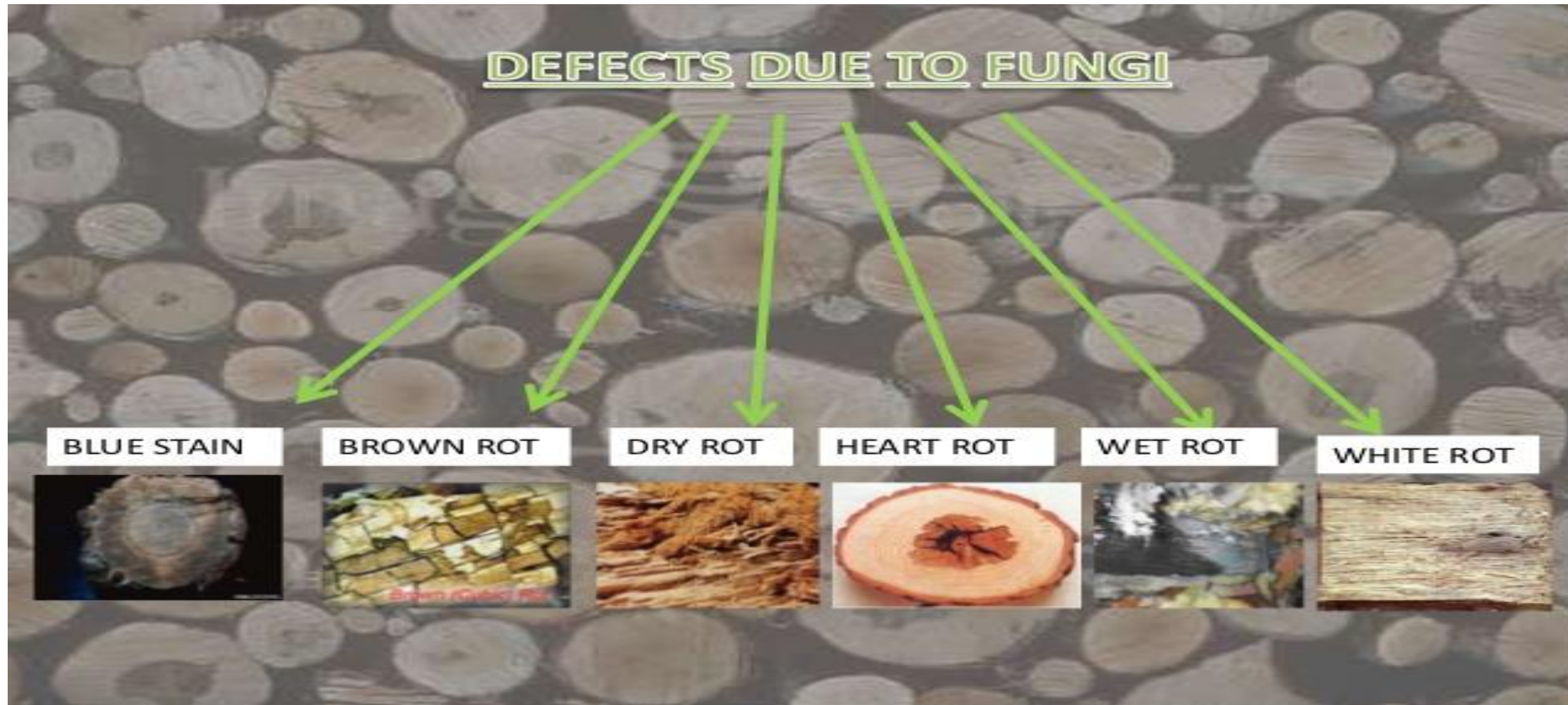
Heart rot- heart wood is exposed to the attack of atmospheric agents; tree becomes weak and it gives out hollow sound when struck with a hammer

Wet rot- some fungi cause chemical decomposition of wood; convert timber into greyish brown powder

White rot- certain types of fungi attack lignin of wood; wood assumes appearance of white mass consisting of cellulose compounds

DEFECTS IN TIMBER

Defects in Timber due to Attack by Fungi:-



DEFECTS IN TIMBER

Defect in Timber due to Defective Seasoning:-

Faulty method of seasoning causes serious defects in woods. During seasoning of timber, exterior or surface layer of the timber dries before the interior surface. So, stress is developed due to the difference in shrinkage. In a perfect seasoning process, stress is kept minimum by controlling the shrinkage. Some of the defects resulting from defective seasoning are as follows:-

Bow: Curvature formed in direction of the length of the timber is called bow.

Cup: Curvature formed in the transverse direction of the timber is called a cup.

Check: Check is a kind of crack that separates fibers, but it doesn't extend from one end to another.

Split: Split is a special type of check that extends from one end to another.

Honey Combing: Stress is developed in the heartwood during the drying process or seasoning. For these stresses, cracks are created in the form of honeycomb texture.

DEFECTS DUE TO SEASONING

TWIST

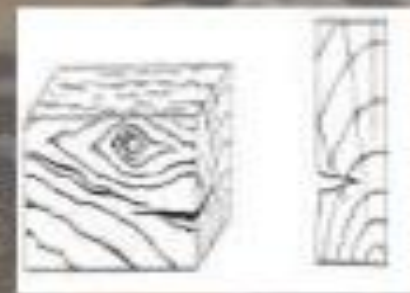
CUP

BOW

SPRING

SPLIT

HONEY COMBING



DEFECTS IN TIMBER

Defects of Timber due to Conversion:-

Chip mark- indicated by marks or signs placed by chips on the finished surface of timber

Diagonal grain- formed due to improper sawing of timber

Torn grain- defect is caused when a small depression is formed on the finished surface of timber by falling of a tool or so

Wane- denoted by presence of original rounded surface on the manufactured piece of timber



SEASONING OF TIMBER

Air drying timber stack. Wood drying (also seasoning lumber or wood seasoning) reduces the moisture content of wood before its use when the drying is done in a kiln . The product is known as kiln dried timber or lumber whereas air drying is the more traditional method.

Methods of seasoning:-

- NATURAL DRYING
- KILN DRYING

There are two main ways of seasoning timber, Natural (Air) and Artificial (Kiln) drying. Both methods require the timber be stacked and separated to allow the full circulation flow of air, etc. around the stack. Air seasoning is the method used with the timber stacked in the open air

SEASONING OF TIMBER



ADVANTAGES OF TIMBER

- **Excellent insulator:** houses they are built out of bricks also known to have outstanding insulating properties, but timber manages them
- **Timber is an elastic material:** At the opposite of brick or concrete walls, timber walls don't need to be very thick. A 20m timber wall for example, is strong enough to protect the internal space against the winter cold, in conjunction with a proper treatment
- **Easy and fast to build:** a timber construction can be build very easy and fast in contrast to a common brick or concrete construction
- **sustainable:** timber is a renewable resource
- **Reusable:** timber can be used more than once. It is easy to recycle
- **Price:** to build a timber house or a timber construction is cheaper than any other common procedure which has the same requirements or sizes.
- **Weight:** timber is very light
- **Strength:** Timber framings are strong in real structural terms
- **Esthetic appeal:** timber is a beautiful material for both internal and external appearance

QUALITIES OF GOOD TIMBER

Good timber should have the following qualities

HARDNESS

A good quality timber should be hard enough to resist deterioration.

STRENGTH

It should have sufficient strength to resist heavy structural loads.

TOUGHNESS

It should have enough toughness to resist shocks due to vibrations. It should not break in bending and should resist splitting. Timbers having narrow annual rings, are generally the strongest.

ELASTICITY

It should have the property of elasticity so as to regain its original shape after removal of loads. This is a very important property to be considered if the timber is used in making sport goods.

DURABILITY

It should be able to resist attacks of fungi and worms and also atmospheric effects for a longer period of time.

DEFECTS

Timber should be prepared from the heart of a sound tree and be free from sap, dead knots, shakes and other similar defects.

QUALITIES OF GOOD TIMBER

FIBRES AND STRUCTURE

It should have straight and closed fibers and compact medullary rays. It should give a clear ringing sound when struck. Dull heavy sound is an indication of internal decay. Its annual rings should be uniform in shape and colour.

structure of a timber

APPEARANCE AND COLOUR

Freshly cut surface should give sweet smell and present shining surface. It should have dark colour, as light colored timbers are generally weak in strength.

SHAPE AND WEIGHT

It should retain its shape during the process of seasoning. Heavy timbers are always stronger than light weight timbers.

WORKABILITY

It should be well seasoned and easily workable. Teeth of saw should not get clogged during the process of sawing. It should provide smoothened surface easily.

USES OF TIMBER

- 1. For heavy construction works like columns, trusses, piles.
- 2. For light construction works like doors, windows, flooring and roofing.
- 3. For other permanent works like for railway sleepers, fencing poles, electric poles and gates.
- 4. For temporary works in construction like scaffolding, centering, shoring and strutting, packing of materials.
- 5. For decorative works like showcases and furniture's.
- 6. For body works of buses, lorries, trains and boats
- 7. For industrial uses like pulps (used in making papers), card boards, wall papers
- 8. For making sports goods and musical instruments.

PRESERVATION OF TIMBER

The preservation of wood includes painting and other applied finishes. Timber preservation became necessary because naturally durable timbers became scarce, so ways of improving the durability of cheaper timbers were developed.

Timber needs to be protected from:

- Insects and fungi
- Wear and tear
- Effects of weathering

PRESERVATIVE TYPES

The main forms of preservative are:

- Tar oil preservatives
- Water borne preservatives
- Solvent-based preservatives.

These preservatives can protect the timber in two ways.

1. They give physical protection by stopping fungi and insects getting at the wood.
2. They give chemical protection, making the wood poisonous to insects and fungi. Paint, for example, gives excellent physical protection.

TAR OILS

- Normally dark liquids
- Made from coal-tar mixed with chemicals
- Suitable for outdoor use
- Black / Brown colour
- Example: creosote (ESB poles)
- Applied by brushing, spraying, dipping or pressure treatment

TAR OILS

Advantages

- Toxic to fungi and insects
- Easily absorbed by the wood
- Long lasting
- Inexpensive

Disadvantages

- Strong smell
- Toxic to plants
- Difficult to paint over

WATER-BORNE PRESERVATIVES

Made from mixture of toxic salts(copper and zinc) and water. When applied to wood, water evaporates leaving toxic salts to act as preservatives

- Usually pressure impregnated
- Chemical protection given
- Uses structural timber and furniture

WATER-BORNE PRESERVATIVES

Advantages

- Colourless
- Odorless
- Can be painted over

Disadvantages

- Timber needs to be dried out by a kiln after treatment
- Can cause swelling
- Salts can be washed out from the wood

SOLVENT BASED PRESERVATIVE

Made from toxic chemicals dissolved in a liquid other than water (usually white spirits)

After treatment the solvent evaporates, leaving the preservative in the wood

Can be applied with a brush or with a spray gun

Uses furniture and all external woodwork.

Advantages

- Resistant to leaching
- Can be painted over
- Can be used indoors

Disadvantages

- Have a strong smell
- Can be a fire hazard
- Expensive

METHODS OF APPLICATION

Without pressure or with pressure.

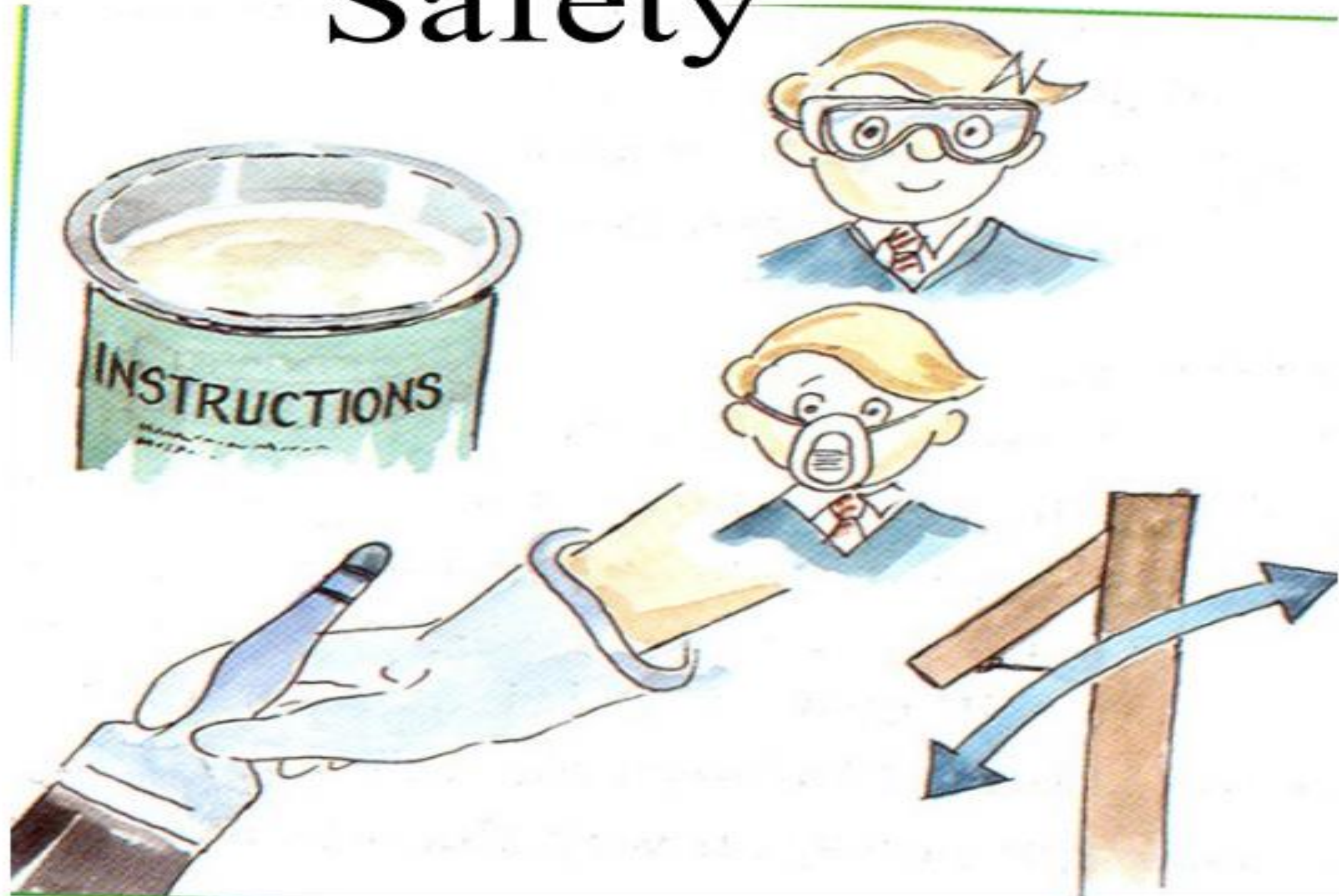
- Brushing
- Spraying
- Dipping
- Pressure Treatment

SAFETY

All preservatives must be handled with care.

- Read any instructions on the container carefully.
- At all times ensure it is safe for use in the room or house and that it will not harm people, animals or the environment in any way.
- When working with any chemicals you should wear all the appropriate protective clothing.
- Remember that safety and care of the environment also applies to the disposal of cartons and containers which hold the preservatives.

Safety

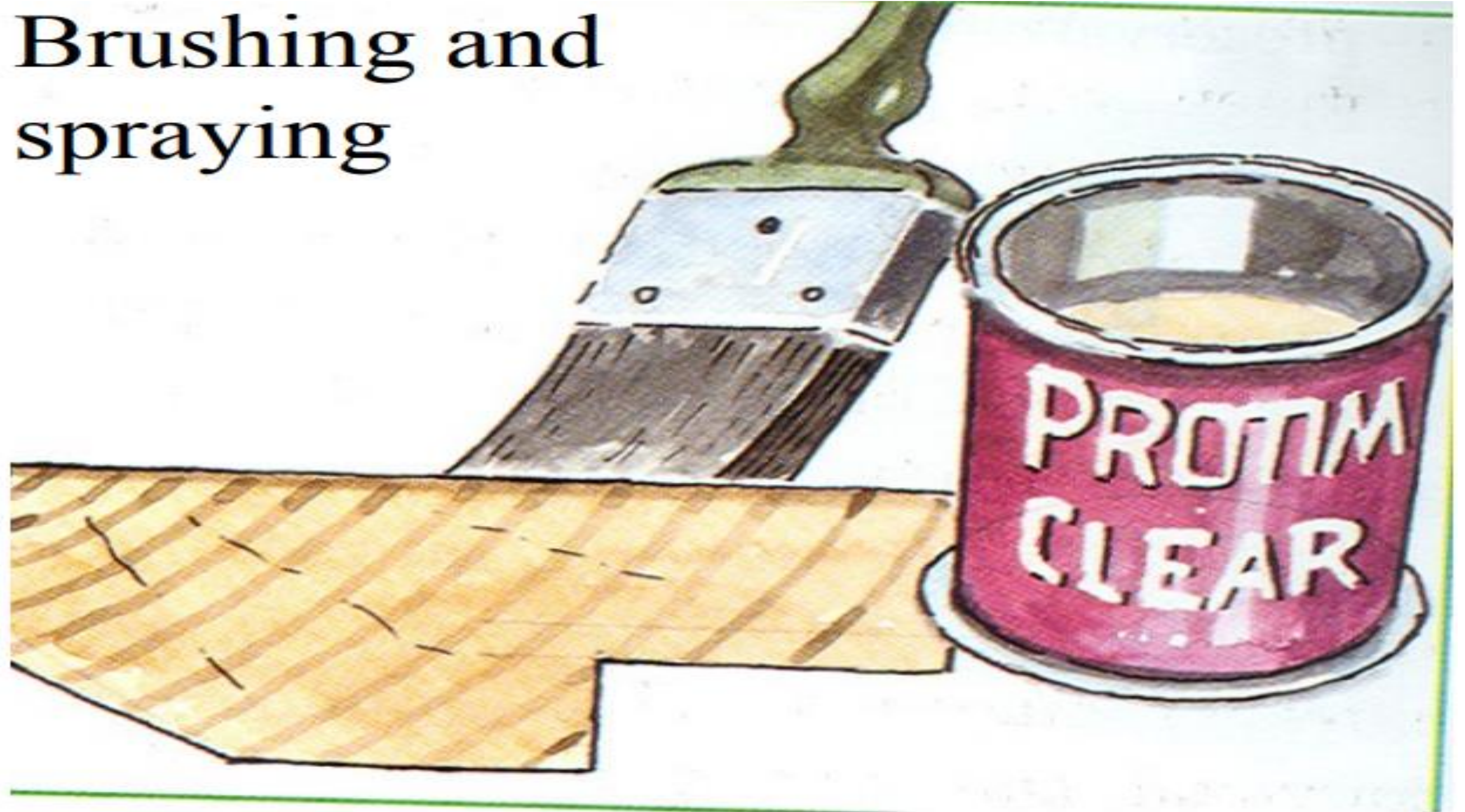


BRUSHING AND SPRAYING

Preservatives can be applied using a brush or a spray gun. This method is the easiest to use and is not too costly.

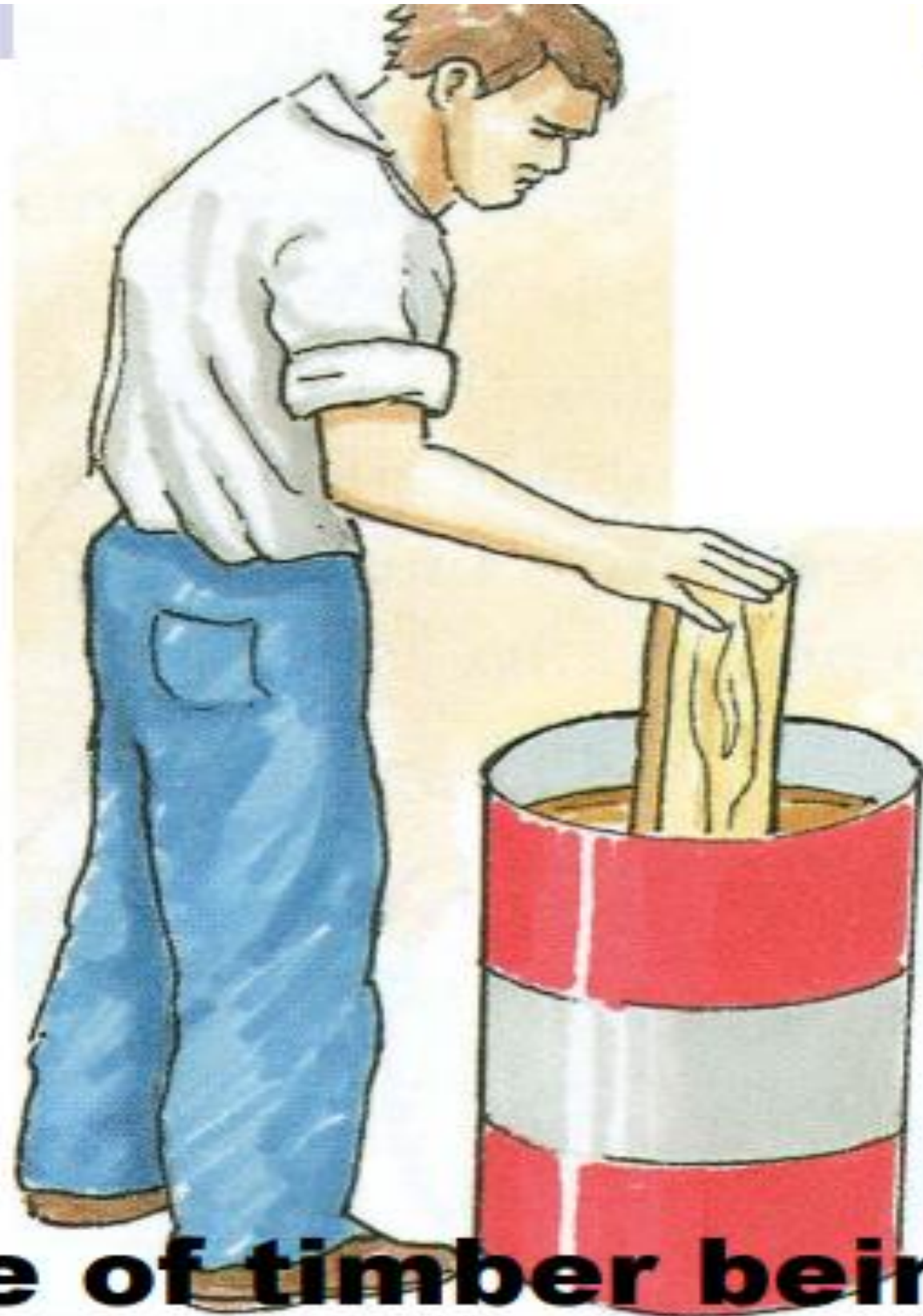
The preservative, however, doesn't penetrate deep into the wood and the treatment needs to be repeated regularly to keep the wood protected.

Brushing and spraying



IMMERSION

- The wood is placed into a container of preservative.
- The wood absorbs the preservative over a short time.
- The immersion can be done for a short time (dipping) or for a longer period (steeping).
- The immersion process penetrates better than brushing and can be even more effective if the preservative is heated.



Piece of timber being immersed

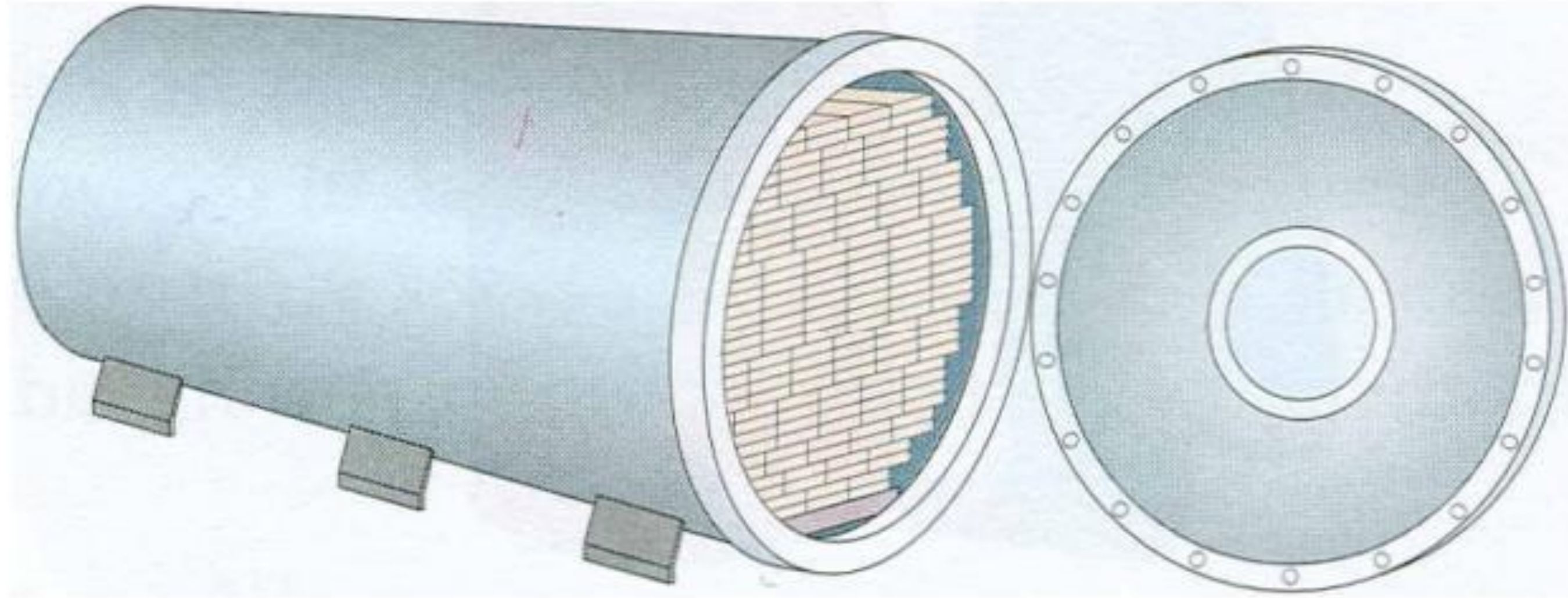
PRESSURE TREATMENT

The most effective method of applying preservative is by forcing the preservative into the wood under pressure.

This pressure can come from inside (vacuum) or outside (pressure).

The timber is put into a treating cylinder.

- The air is sucked out of the cylinder and held for a few minutes to let all the air come out of the wood.
- The cylinder is then flooded with preservative while the vacuum is held. The vacuum is released allowing the preservative to take the place of the air in the wood.
- Then pressure is applied forcing the preservative into the wood.
- A final vacuum is applied for a short time to remove any excess preservative, this is done so that no preservative is wasted.



Pressure treatment chamber

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