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# **Carpentry**

***Release 1.0.1***

**Pradeep Khanal, Ashish Lamichhane**

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“Ultimately, literature is nothing but carpentry. With both you are working with reality, a material just as hard as wood.”

- Gabriel Garcia Marquez

Chapters:





## **INTRODUCTION**

I don't want to bore you with the story how we came to write this book. It's just a intention to provide a good resources for CTEVT and other technical students. I hope with our efforts and your help this book will grow and become a dear for all learners.

We're extremely interested in your feedback. The online version of this book will let you comment on any part of the book, and discuss it with other readers. We'll do our best to read all the comments posted there, and to respond to as many as possible. If you prefer email, please drop us a line at [binary.science98@gmail.com](mailto:binary.science98@gmail.com). Either way, we'd love to hear from you! We're glad you're here, and we hope you find Carpentry as exciting, fun, and useful as we do.

### **1.1 Authors:**

1. PRADEEP KHANAL
2. ASHISH LAMICHHANE



## CHAPTER 1: INTRODUCTION OF CARPENTRY

### 2.1 Introduction of tools/equipment

As a good workman is known by his tools, a good carpenter must know his tools/equipment for various jobs. Various hand tools used in wood work or carpentry shop are classified under following categories:

Table 1: Carpentry tools

S/n	Category of tools	Tools name
1)	<b>Measuring tools</b>	a) Folding rule b) Steel Rule c) Contraction Scale d) Inch tape e) <b>Squares</b> <ul style="list-style-type: none"> <li>• Speed Square</li> <li>• Try Square</li> <li>• Bevel Square</li> <li>• MITRE Square</li> <li>• Framing Square</li> </ul>
2)	<b>Marking tools</b>	a) Pencil b) Scriber or marking knife c) Marking gauge d) Mortise gauge e) Cutting gauge
3)	<b>Holding and supporting tools</b>	a) Work bench and bench hook b) Carpenter's vice or Clamping vice c) Hand Screw d) <b>Clamps</b> <ul style="list-style-type: none"> <li>• T-Clamp or bar</li> <li>• C-clamp</li> </ul>
4)	<b>Cutting tools</b>	a) <b>Saws</b> <ul style="list-style-type: none"> <li>• Rip saw</li> <li>• Tenon saw or back saw</li> <li>• Cross-cut saw</li> <li>• Panel saw</li> <li>• Coping saw</li> <li>• Compass saw or turning</li> <li>• Dovetail saw</li> <li>• Keyhole saw or Pad saw</li> <li>• Cross-cut saw</li> <li>• Bow saw</li> </ul> b) <b>Axes</b> <ul style="list-style-type: none"> <li>• Axe</li> <li>• Side axe</li> <li>• Adze</li> </ul> c) <b>Chisels</b> <ul style="list-style-type: none"> <li>• Firmer chisel</li> <li>• Beveled edge firmer chisels</li> <li>• Mortise chisel</li> <li>• Gauge chisel</li> <li>• Socket chisel</li> </ul>
5)	<b>Planning tools</b>	a) Wooden jack plane b) Iron jack plane c) Try square d) Smoothing plane e) Rebate plane f) Plough plane
6		<b>Chapter 2. Chapter 1: Introduction of Carpentry</b> a) Try square b) Pencil c) Scriber or marking knife d) Marking gauge e) Mortise gauge f) Cutting gauge

**Various types of powered tool/equipment required for carpenter are::**

- a) Nail gun
- b) Circular saw
- c) Drill (3/8 " to 1/2 " chuck)
- d) Reciprocating saw
- e) Extension cords

A tool in good condition is the primary requirement for fine carpentry. So great care should be given while maintaining the tools.

**Care and maintenance of tools:**

1. Store your tools and equipments properly in pegboards, toolboxes, bags, drawers or shelves.
2. Keep your tools in a dry place to protect from corrosion or rust.
3. Hang your garden tools above the ground.
4. Put silica gel packs or rust collector with the tools in drawers, bags or toolboxes.
5. Always store your power tools in their respective original cases.
6. Clean your tools after and before the job.
7. Sharpen your tools often with great care.
8. Inspect your tools in regular basis and repair them if they are not in right condition.

## **2.2 The importance of tools/equipment in carpentry trade made of stones in stone age**

Stone age refers to the early period of time which was approximately 3.3 million years ago, when people uses different tools and structures made out of stones.

Some of the tools in carpentry made of stones in stone age are as follows:

i) **Hammer stone**

- It is made of strong stone usually of sandstone, quartzite or limestone that doesn't break with ease.
- It was used throughout the world including Asia, Europe and Africa.

ii) **Cleaver**

- It was made from flakes that are formed after breaking down of a stone with a big U or oblong shape.
- It was used for crushing and cutting purposes due to its heavy weight.
- They were also used for digging up the soil and breaking bones and stones.

iii) **Chopper**

- The chopper was a sharp-edged stone made by breaking down a stone into flakes using a hammerstone.

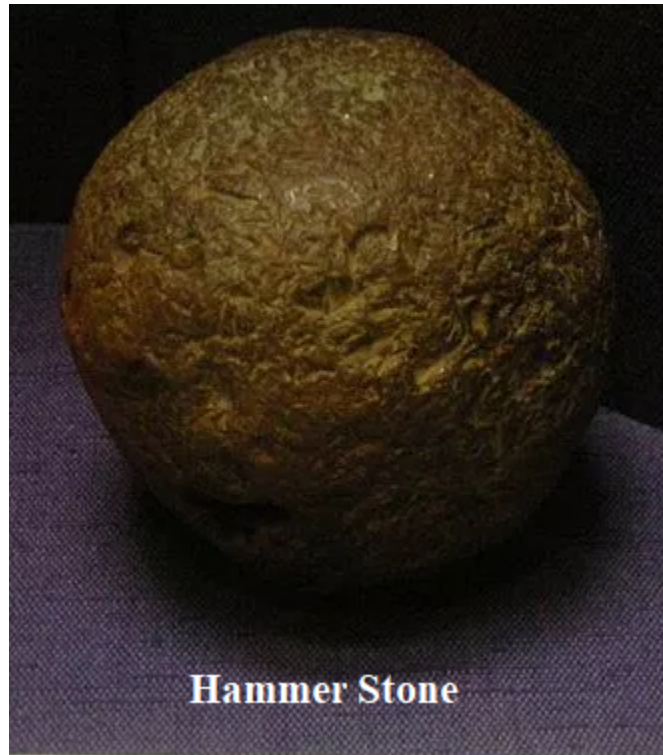


Fig. 1: Figure 1-1. Hammer stone

- It was used to cut plants and roots of the plants and to break bones of hunted animals.
- iv) **Axe**
- Axe was made with stone flakes. It was a stone whose one side was rounded suitable for holding and other side was flat and sharpened.
  - It was used for cutting branches of trees, roots and other domestic purposes.
- v) **Backed knives**
- It was double sided sharp blade with sword like structure made of stone.
  - It was a stone whose one end was flattened to be held in hand and other end was used for cutting things.
- vi) **Burin**
- Burin was stone tool made from flint flakes or blades.
  - It had sharp chisel-like edges and was used as needles and fish points.
- vii) **Scrappers**
- It was made from flake, when a stone was broken down.
  - It was used for turning raw hides or wood into tents. Clothing and other utilities.

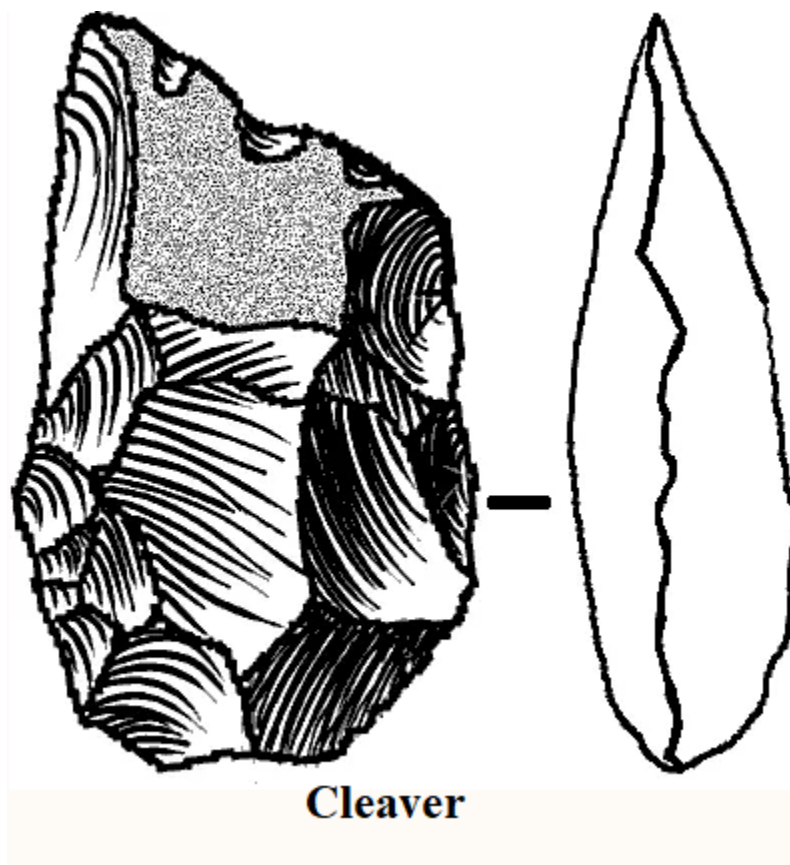


Fig. 2: Figure 1-2. Cleaver

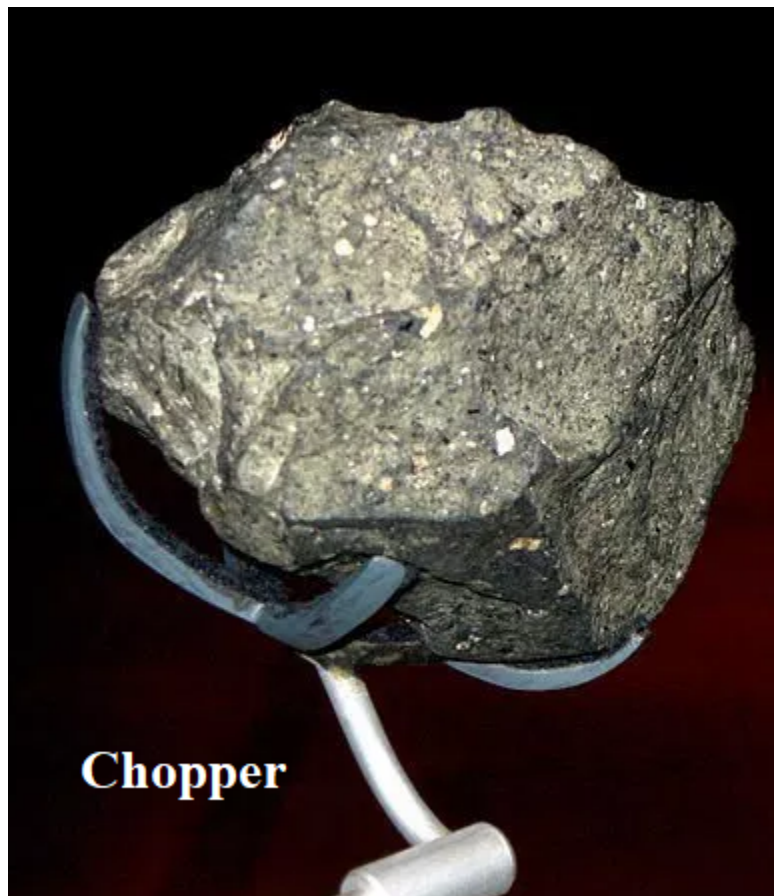


Fig. 3: Figure 1-3. Chopper





Fig. 4: Figure 1-4. Axe

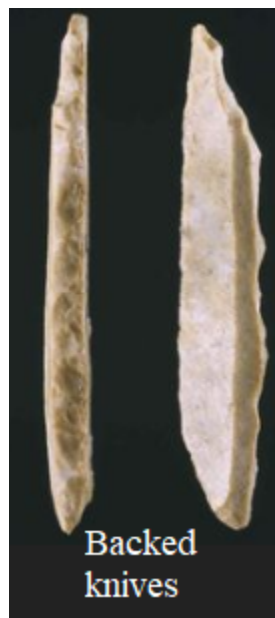


Fig. 5: Figure 1-5. Backed knives

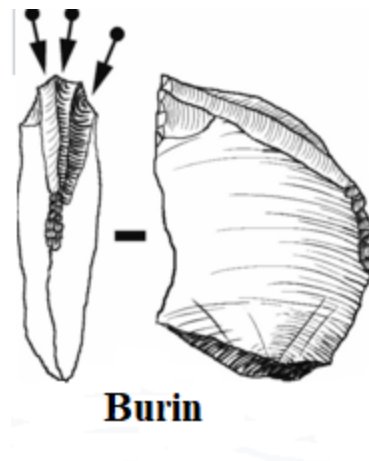


Fig. 6: Figure 1-6. Burin

- The edge was sharpened by banging off flakes with another rock or stone.

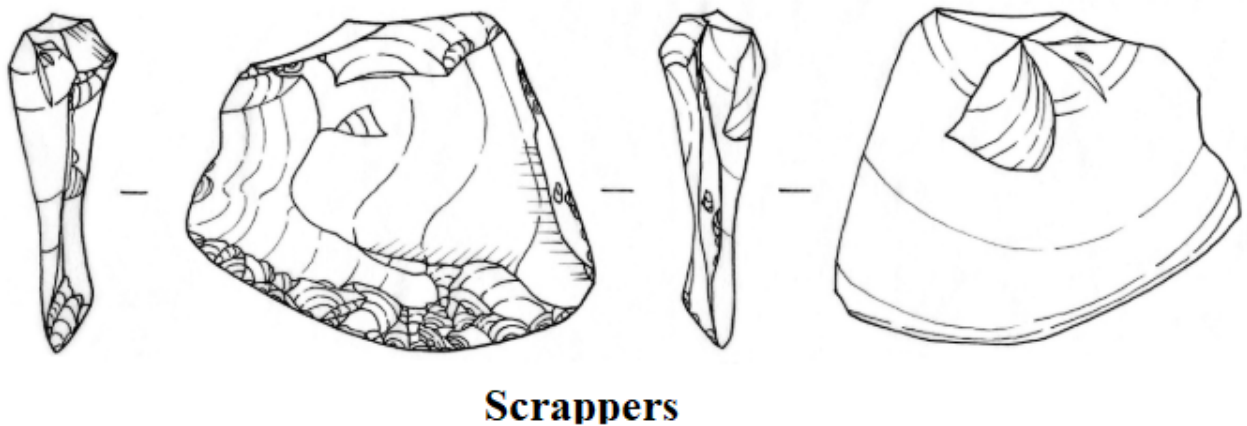


Fig. 7: Figure 1-7. Scrappers

## 2.3 Types of carpentry trades as per

### 2.3.1 1. Carpenter

#### a) Importance of carpenter

Carpentry is more of an art or craft constructing objects out of wood using specialist carpentry tools and techniques. The beautiful way of carving furniture has been in existence since the Stone Age when human carved out beautiful sculptures with stone tools. Carpentry has now entered the machine world where carpenters use machines to design and build different stuffs. Carpenter's expertise and talents covers multitude of different areas like setting foundations, indoor furniture, installing beams and other outdoor jobs. Without a carpenter our world would be incomplete, desks and benches in schools, sofas and

desks in offices, decorations in houses are available because of them. Similarly, Nepal has many heritage sites, temples and shrines reflecting the fine carpentry skills of our ancient era which still receives praise from all over the world.

## **b) Duty of carpenter**

**The important duty of any carpenter are as follows:**

- To convert low cost material into highly valuable items.
- A carpenter should develop skill according to demand of time.
- A carpenter must know how to properly maintain and operate traditional and modern tools.
- A carpenter should work with safety first principle and create safe environment for himself, others and tools as well.
- He should know to operate Personal Protective Equipment (PPE) very well.
- A carpenter should carry out variety of skills putting them together to change the area using furniture.
- A carpenter should practice with patience because it leads to a well-experienced and efficient carpenter.
- He must be able to read and understand blueprints
- He must take measurements calculating the size and amount of materials needed.

## **c) Scope of carpenter**

There are lots of opportunity to find a job as a carpenter. Popular jobs a carpenter can find in today's market are:

- Cabinetmakers and bench carpenter
- Woodworking machine setters, operators and tenders
- Sawing machine setters, operators and tenders
- Furniture finisher
- Pattern makers
- Model makers
- Trainer or guider
- Repair and others.

After the devastating earthquake in Nepal, most of the jobs available are remodeling or repairing old wooden structures. The job of small wooden carpentry jobs is declining due to popularity of using aluminium and other metal furniture (i.e. metal carpentry) in houses. However, Nepal is gaining international attention because of its handicrafts and wooden structures like statues, tundals, gifts and other decorative items. And carpenter can tap this opportunity to boost economy and hone skill.

#### **d) Furniture maker**

A furniture maker is a woodworker who specializes in making furnishings like tables, chairs, sofas and other residential and commercial consumers. He can work in a small, independent shop or in a factory for large-scale production of furniture. He can create his own designs from sketches, blueprints or drawing of other designers. A custom furniture maker meets with customer directly to discuss the design, size and type of wood with customer and then begin the furniture making process. On the other hand, factory employed furniture maker works from the design provided by the chief designer with mass-production in mind.

#### **e) Wood carver**

A wood carver is the one who master the art of fashioning or ornamenting objects of wood by cutting with a sharp handheld implement. A wood carver can use different tools and equipments especially chisels, mallet, carving knife and gouges seriously. Wood carving you see in windows, doors, pillars, walls of houses, temples and streets are fine examples of brilliance of wood carvers around you.



Fig. 8: Figure 1-8. Wood carved window

#### **f) Shuttering carpenter**

A shuttering carpenter is a one who specializes in creating falsework and shuttering, which are temporary structures used in the concrete pouring process. Falsework are wooden plates that are positioned and supported using rods and stakes and concrete is poured within the created molds. The molds will hold the concrete in place resulting in a solid and smooth structure.

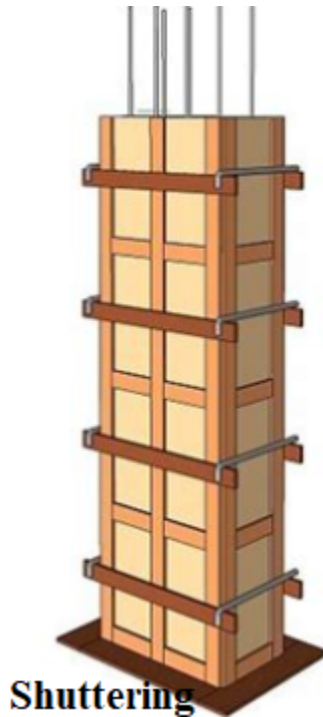


Fig. 9: Figure 1-8. Wooden shutter

### g) Construction carpenter

A construction carpenter is the one who construct, erect, install and repair structures and fixtures of wood, plywood and wallboard, using various hand tools and power tools.

### 2.3.2 2. Joiner

A joiner is a craftsman or carpenter especially a cabinetmaker who build thing by joining two or more pieces of wood. Carpenters construct the building wood elements on workshop while joiner joins the elements to give a shape of required item. Joiner mostly handles jobs like making doors or window frames, stairs and fitted furniture. Joiner should master in skills like gluing, nailing or screwing of the two pieces of wood. Joiner has the sound knowledge on different kinds of joints. The primary focus of joiner is to make the wood hold together securely and strongly; however, it can also be used a decorative feature.

### 2.3.3 3. Cabinet Maker

A cabinetmaker is a carpenter who specializes in making of cabinets from wood. A cabinet is a box like piece of furniture with small doors or drawers for storing miscellaneous items and best example is a wardrobe. A cabinetmaker builds on customer's specification by providing customer with blueprint or drawing of finished product to visualize how it looks like afterwards. A cabinetmaker differs from carpenter in the sense, he goes one step further by focusing on the finer details of the wood and what can be made out of it. This focus on minute details lead cabinetmakers towards the concentration on internal fittings such as kitchens, bookcases, tables, cabinets and benches On the other hand, carpenters focuses mostly of larger structural details like framing the house, building the deck, pergolas etc.

#### 2.3.4 4. Tree cutter and lumber products or (Producer)

Tree cutter is known by other names as woodsman and lumberjack. To grow a pound of wood, a tree uses 1.47 pounds of carbon dioxide and gives off 1.07 pounds of oxygen. Lumber or timber is the wood that is used for construction, building, paper or similar purposes and it has been shaped into logs or boards in the process of wood production. Lumber is usually sawed into standard lengths, widths, and thickness. So, this allows uniformity in planning structures and n ordering materials. Lumber products can be placed in three general categories:

- a) Stress-graded lumber
- b) Nonstress-graded lumber (Examples are Boards, lath, battens, crossarms, planks and foundation stock.)
- c) Appearance lumber

Stress-graded and non-stress lumber are preferred where structural integrity is primary concern whereas appearance lumber is preferred where appearance of lumber products is main concern. Following are the points to be considered when ordering lumbers or timbers:

- a) Quantity and Size (thickness)
- b) Grade
- c) Species or grouping of wood
- d) Condition of seasoning
- e) Surfacing and working
- f) Manufacturer

#### 2.3.5 5. Wood working machine setter-operator precaution

A wood working machine is an electrically powered wood machine used for processing wood. Production woodworkers must have knowledge on setup, operate and tend wood working machines that cut and shape components from lumber or plywood. The precaution while handling this machine are as follows:

- a) The circular saws must be safeguarded by avoiding cracked saw, using push-stick, covering top of the saw and using riving knife in direct line with a circular saw.
- b) **All the other machines like pendulum saw, plain band saw, planning machine, vertical spindle moulding machine and chain mortising machine must be provided with effective guard.**
- c) All tools, blades and cutting instruments of a wood working machines must be inspected regularly, properly maintained and kept clean.
- d) **If operator discovers any defects on machines, then defect must be reported to the proprietor.**
- e) Compressed air should not be used while removing sawdust and turning from machines.
- f) **Loose clothing and jewelry must be avoided while working.**
- g) Machines should not be left unattended.
- h) **Cleaning and repairing should be avoided while the machines is running.**
- i) Standing directly behind the stock that is being cut, planed or jointed must be avoided because it could lead to injury.
- j) **Working area must be dry and wired properly.**
- k) Use “push stick” to push material into cutting area.

- 1) **Ensure that all the electric equipments are grounded well.**

## 2.4 What's Next

Now you know carpentry tools and and scope of carpentry , you're ready to [learn about the wood](#) as construction material.





## CHAPTER 2: WOOD AS CONSTRUCTION MATERIALS

### 3.1 Temporary structure

Carpentry means the construction of timber with primary concern of strength. Temporary carpentry is the woodwork that is necessary in the execution of constructional work but does not form a permanent part of the completed building or structure. Temporary structure is mostly used in purposes like excavations and centering for arches. An excavation is used for inserting the foundations and foundation walling of a structure and also, for laying a drain and the provision of a basement. Ground tracing is done by laying down the excavation lines and centre lines on the ground before the excavation starts. After the foundation design is done then ground tracing plan or foundation layout plan is prepared with suitable scale and is fully dimensioned. During the erection of structures and arches, temporary supports are necessary until it can support itself and this type of support is known as centering. For example, temporary support for concrete works like floors, lintols, roofs are called as shuttering. Temporary structure is used in many areas like flat and curved arches, concrete floor and roof slabs, joggled lintols, domes and ornamental works.

Fig. 1: Figure 2-1. Temporary structure before construction

### 3.2 Structural medium (Permanent structure)

Carpentry is known for strength of wooden structure which are built to carry load or to resist pressure producing considerable stresses irrespective of type or class or surface finish of the wood. Some popular permanent structure made from timbers are partitions, floors and roofs.

Wood Lintel is a horizontal beam placed across the opening of doors and windows to carry part or whole load from the walling above. And it provides a convenient medium for fixing wooden frames within the opening.

Fig. 2: Figure 2-2. Parmanent structure

Ground floors in houses uses joists laid across short span, which is covered with boards so that the floor is raised above the earth. Joists are the timbers supporting boards and the boards are the thin slabs of wood laid upon the joists.

Roof is the covering of any structure especially in building. Its construction consists of supports and coverings. Coverings are the sheets of special felt corrugated iron, tiles, rubber preparations and other materials. With the help of roof members used in construction like rafter, jack rafter, purlin and wall plate, and roof accessories like eaves gutter, down pipe, roof boarding and tiles and slate batten, roof is constructed as an instance of permanent carpentry.

**Joinery is the process of joining or connecting two or more pieces of wood by using simple techniques of gluing, nailing or screw**

- Kitchen cabinetmaking

- Antique restoration and repairs
- Cupboard and stairs
- Window frames and sashes
- Furniture design and construction
- Office fit-outs

### **3.3 Furniture Making**

Furniture making is an art of converting timber into a useful as well as valuable furniture products like chair and tables. It requires artistic vision and experience with tool handling, wood selection and preservation. Furniture used for various purposes are designed and they are table and chairs, stool, desk and benches, couch, bed, drawers and cloth rack, kitchen cabinet, podium and so on.

### **3.4 Tools handle making**

First consideration for tools handle making is the shape and size of your tool handle. The ratio of overhang over the toolrest with respect to the overall tool handle length and heft need to be considered earlier. Similarly, geometry of shaft is also another factor to be consider while tool handle making. Also, you need to be sure that whether the tool will be permanently fixed in the handle or is removable. After that selected hard wood with straight grains is worked out in wood lathe to make the desired tool handle.

### **3.5 Sport goods**

Some of the sport goods make out of timber are bow and arrow, boats, skateboards, chess, cricket bat and stumps, carrom boards, scrabble, hockey bats, baseball bats, table tennis table and bats and so on.

### **3.6 Paper and cardboards**

A paper is a thin and flat material made by crushing or pressing together moist fibres of cellulose pulp generated from trees and grass. It is used for sketching and writing about the design of the workpiece. Cardboard is also a type of paper with greater thickness and superior durability. It is used to make containers in packaging industry. For example, paperboard is put in layer to create “corrugated container” which is used mostly in packaging products like noodles, biscuits, electronic devices and gifts.

### **3.7 Plywood makings**

Plywood is made of three or more thin layers of wood or ply bonded together adhesive. It can be made from any type of woods i.e. hardwoods or softwoods. Plywood are used mostly used in flooring, walls, kitchen cabinets, furniture, roof lining, ceiling, boats and so on.

## 3.8 Miscellaneous works

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### Fibreboard

Fibreboard is prepared by breaking down of hard or soft woods into fibres and then bonded together with wax, resin and heat to create a thick material. MDF (Medium Density Fibreboard) is the popular and strong fibreboard.

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### Chipboard

Chipboard is also called particle board which is prepared by bonding wood chips and shavings together with the help of resin. It is popular for making furniture.

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### Veneer

Veneer is a thin layer of wood taken from circumference of a tree and then bonded onto a dense piece of wood like fibreboard, chipboard and plywood. It is used for making high quality furniture.

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**There are lots of miscellaneous works a carpenter can perform with the help of timber and they are:**

- Jewelry box making
- Matches and candle stand making
- Utensils making like bowl and spoon
- Fence making
- Construction of residence

## 3.9 What's Next?

In [next chapter](#), we will learn about trees, their kinds and their growth.



## CHAPTER 3: TREE AND ITS GROWTH

In the previous chapter, we explained how to set up a Django project and run the Django development server. In this chapter, you'll learn the basics of creating dynamic Web pages with Django.

### 4.1 Importance of trees

- 1) First of all, Trees provides wood on base of which carpentry stands.
- 2) **There are various trees used for their medicinal properties.**
- 3) Trees absorbs the atmospheric carbon dioxide which slows global warming and gives out oxygen to support animal life.
- 4) **Trees makes place beautiful and helps to minimize sound pollution.**
- 5) Trees hosts complex ecosystem giving habitat to microbes, insects, lichen, fungi, birds, reptiles, indigenous peoples and other mammals.
- 6) **They store carbo, aid in regulating the climate, purify water and mitigate natural hazards like floods, landslides and desertification. Forests also contains roughly 90 percent of the world's terrestrial biodiversity.**
- 7) Trees boosts economy by means like fruits, rubber, ropes, medicines, paper, pencils, incense, oil, tourism and so on.
- 8) **Trees are only source of starch food for animals.**

## **Crown**

Gathers sunlight, makes food, filters air

## **Trunk**

Supports crown, Carries water and nutrient to trunk and carries food from crown to roots

## **Root**

Anchors tree, collects water and nutrients from soil, holds soil in place

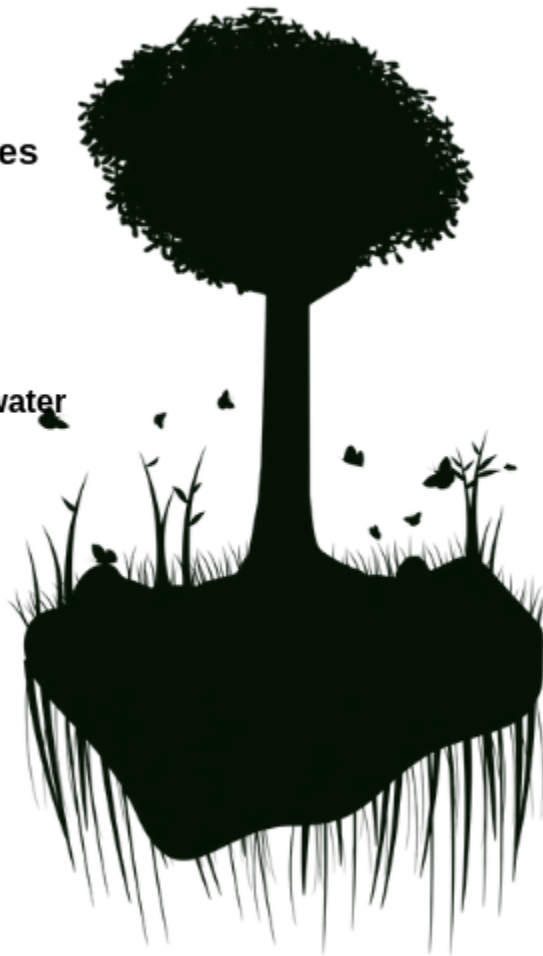


Fig. 1: Figure 3-1. A tree

## 4.2 Enemies of tree

- 1) Insects
- 2) Diseases
- 3) Fire
- 4) Natural disasters like storms, landslide, earthquake, lightening and so on
- 5) Deforestation

## 4.3 Conservation of forest

- 1) Development of programs which harmonize conservation of forests like controlled deforestation.
- 2) **Precautions should be considered to fight against Forest fires by making fire lanes, chemicals to control fires, clearing dry leaves and trees and awareness among people.**
- 3) Afforestation should be prioritized.
- 4) **Effective rules and regulation should be formulated and make sure of its strict practice to counter problems like deforestation and use of forest area for non-forest purposes.**
- 5) Awareness among people through mass media, street shows and books.

## 4.4 Plantation of a tree

Planting a tree is a lifelong investment. Plantation of a tree depends on type of tree selected, weather condition, selection of planting location and care provided during and after the plantation.

The steps of planting a tree are as follows:

- 1) **Prepare all the utilities required for planting a tree.**
- 2) Dig a shallow, broad planting hole which should be only deep as the root ball and twice or thrice time wider than the root ball.\*\*



Fig. 2: Figure 3-2. Plantation of a tree



- 3) **Then, remove the containers which holds the root ball and inspect it to straighten, cut or remove the circling roots.**
- 4) Place the tree straight in the hole by viewing from all directions confirming it is placed straight.
- 5) **Now, fill the hole gently and firmly to stabilize the base of root ball. Fill the remaining hole with soil to eliminate air pockets which could dry out roots.**
- 6) Stake the tree, if necessary. Because if the tree is not staked while planting, tree grows more quickly and develop stronger trunk and root systems.
- 7) **Mulch the base of the tree which involves placing materials or soil over the soil surface to maintain moisture and improve soil conditions.**
- 8) Water the plant regularly to keep soil moist but not water-logged.
- 9) **Avoid using fertilizers at the time of plantation.**
- 10) Avoid places with overhead lines and underground lines.

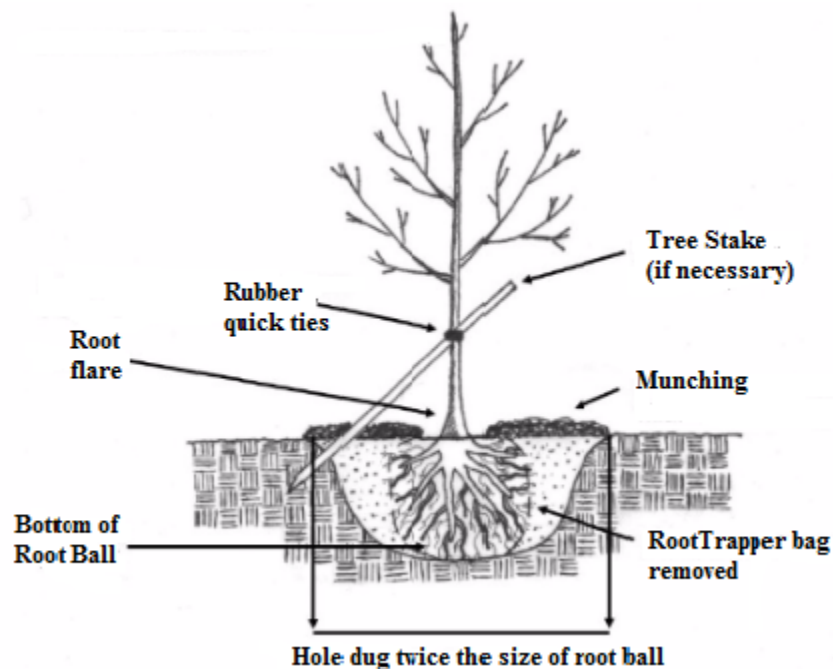


Fig. 3: Figure 3-1. Proper way of tree plantation

## 4.5 How a tree grows

In human and other animals, growth happens in most parts of the body like bones, skin and muscle but trees does not grows like that. Trees grows by producing new cell in limited places and the places where cell division occurs are called meristems.

There are three regions of a tree where growth occurs and they are:

- 1) **A tree's bark** Trunk diameter expands in size as a result of meristem caked vascular cambium. Therefore, it is also called cambial growth. The vascular cambium produces new xylem and phloem each year because of which trunk, branches and root continues to grow in size.
- 2) **A tree's bud** Tree height and branch lengthening begins with a bud. The cell division in apical meristem causes the height of tree where cell divides and elongates at the base of the bud to create upward growth in trees with a dominant crown tip.
- 3) **A tree's root tip** Roots also expand through the soil by growing at their tips because of apical meristem. The cell division in root tip produces more root cap cells which protects the meristem while pushing it through the soil.

Growth of trees can be further divided into two types:

### **I. Exogenous growth:**

In this growth, trees grows outward from the center by adding new layer of wood each year. Some example of trees with exogenous growth are Pine, Sal, Mango, Shisham etc.

### **II. Endogenous growth:**

In this growth, trees grow by adding new layer of wood on the inner side of the tree. Some example of trees with endogenous growth are bamboo, coconut, palms, cane etc.

## 4.6 Kinds of trees

All the trees available in the earth can be broadly classified into two types according to mode of their growth and they are:

- Exogenous trees
- Endogenous trees

### **I. Exogenous trees**

Trees of this group increase in bulk growing outer bark and annual rings are formed in the horizontal section. Timber used for engineering purposes mostly belong to this category. It is further divided into two sub-groups:

- 1. Conifers or evergreen trees** These trees remain evergreen and bear fruits in cone form with needle pointed leaves. Conifer is a Latin word, compound of conus(cone) and ferre (to bear), meaning “the one that bears cone”. These trees provide soft woods which are lighter, resinous and weak. Some conifers trees are cedars, firs, pines, redwoods, yews, mango, simal etc.
- 2. Deciduous or broad-leaf trees** Deciduous trees shed their leaves usually in autumn and grow of new leaves starts in spring. These trees provide hard woods which are strong, durable, non-resinous and heavy. Timbers used for various engineering purposes are yield from deciduous trees. Some deciduous trees are oak, maple, sal, Shisham, Kusum etc. Therefore, furniture made out of these trees are costly.

## II. Endogenous trees

This group is largely found in semitropical regions and have limited engineering applications. Endogenous trees grow inwards or end wards. Timbers from these trees can be used for piles (e.g. palms), small structures (bamboo). Some endogenous trees are bamboo, palms, dates, sugarcane, coconut etc.

## 4.7 Soft wood trees and its characteristics

The softwoods in general are the coniferous or cone-bearing trees (such as the various pines, hemlocks, firs, and cedar). It is not so that softwoods are necessarily soft, long-leaf southern pine and Douglas fir are harder than hardwoods like poplar and basswood. Softwoods are commonly used for joists, studs, girders and posts. Characteristics of softwood trees:

- 1) It has light weight.
- 2) It is light colored.
- 3) It has low resistivity against fire.
- 4) It has faster growth rate.
- 5) It is usually straight with fewer branches.
- 6) Annular rings are clearly visible by naked eyes.
- 7) It is soft or weak.
- 8) It has needle pointed leaves.
- 9) It has bigger fruits.
- 10) It is resinous in nature.

## **4.8 Hard wood trees and its characteristics**

The hardwoods are the non– cone-bearing trees (such as the maple, oak, and poplar). Hardwoods are commonly used for interior finish, flooring and furniture. Some examples of hard woods are oak, maple, sal, shisham, kusum etc.

Characteristics of hardwood trees:

- 1) It has heavy weight.
- 2) It is dark colored.
- 3) It has high resistivity against fire.
- 4) It has slower growth rate.
- 5) It is usually crooked with many branches.
- 6) Annular rings cannot be viewed by naked eyes.
- 7) It is strong.
- 8) It has bigger, wider and circular leaves.
- 9) It has smaller fruits.
- 10) It is non-resinous.

## **4.9 Characteristics of a good timber**

**The characteristics of a good timber are as follows:**

- 1) It should straight and close fibers.
- 2) It should be hard and heavy in weight.
- 3) It should have a uniform color.
- 4) It should have regular pattern of annular rings.
- 5) It should be sonorous upon stuck.
- 6) It should be fire-resistant.
- 7) It should not have shakes, dead knots and flaws.
- 8) It should have hard and compact medullary rays.
- 9) It should have surface with silky lustre.
- 10) It should be elastic in nature.
- 11) It should be durable in nature.
- 12) It should give sweet aroma from freshly cut surface.

#### 4.9.1 Characteristics of common Nepalese wood(Trees)

Table 1: Common Trees available in Nepal

S/n	Trees	Common Name	Density (kg/m3)	Uses
1	Red sandalwood	Raktachandan	785	It is used for craft items, incense sticks and furniture.
2	Shorea robusta	Sal	880- 1050	It is used for making furniture like door, window, wooden beam or pillar and plates using leaves.
3	Dalbergia sissoo	Sisau / shisham	750 - 800	It is used for manufacturing cheaper furniture, musical instruments, plywood and turned objects.
4	Mango	Aap	625	It is used for craft items, incense sticks and furniture.
5	Bombax / Simul	Simal	250 - 500	It is used for manufacturing matches, plywood, toys, tea chest and fruit crates.
6	Quercus leucotrichophora	Tikhe bhanjh / oak	6700	It is used for timber and fuel purposes.
7	Pine	Sallo	350 - 450	It is used in lumber and construction like frames, ceiling and flooring, craft, dye and papers.
8	Tectona grandis	Teak	630 - 720	It is used for manufacture of door, window, agricultural implement, shutters, furniture, cabinets, decorative flooring and wall paneling.
9	Ficus religiosa	Lahare pipal	443	
10	Acacia catechu	Khair	1010	It is used for manufacturing paints and furnitures (Timber from Khair is very strong, hard, steady and moderately rough.

**Note:** Similarly, the other trees available in Nepal are Neem, Babul, Rudrakshya, Banyan, Rosewood, Siris, Tooni, Kadam, Cheuri, Pear and so on.

## 4.10 What's next?

We'll dive into Django's template engine in the [next chapter](#).

## CHAPTER 4: METHODS CONVERSION OF LUMBER (LOG)

### 5.1 Definition and purpose

Conversion of wood or lumber can be defined as the process of cutting the wood into marketable forms like usable planks or boards. Before the wood is converted, it must be processed and seasoned first. The purpose of this conversion is to get most out of log minimizing waste and to convert big logs into hand-able forms. Log, balk, plank, board, batten and scantlings are some of the marketable forms of woods after conversion.

### 5.2 Methods of conversion

When logs are taken to the mill, they may be cut into variety of ways and they are:

1. **Through and through sawn (T and T)** Here, a number of parallel saw cuts are made into the log. It is also called plain sawn or slash sawn or flat sawn. It is a cheaper and faster method with very little wastage. Planks of maximum width are obtained. And it is not suitable for structural timbers because shrinkage tends to warp and split the boards
2. **Tangential sawn** In tangential sawing, boards or planks are sawn tangentially to the annual rings. Annual growth rings form an angle less than 45 degrees. The problem of rejection is reduced but cupping problem is still there.
3. **Rift or quarter sawn** In this conversion method, each log is ripped into quarters as shown in figure. Annual growth rings form an angle greater than 45 degrees. The defect of warping i.e. cupping is eliminated. Cupping is the warping of the plank away from the heart of the tree.

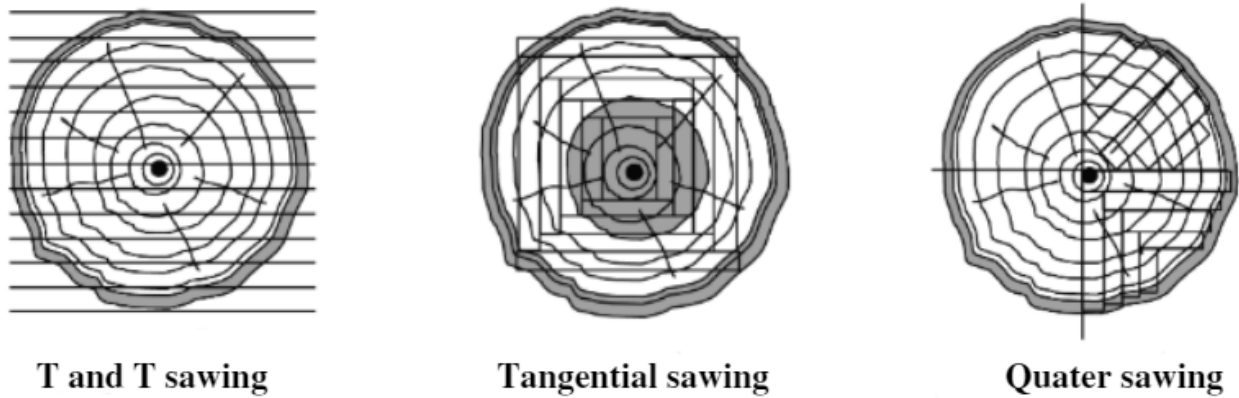


Fig. 1: Figure 4-1. Different methods of conversion

## 5.3 Cross-sections of a Trunk

A tree trunk consists of the following:

### 1) Outer bark

The bark is living and growing only at the cambium layer.

### 2) Inner bark

In some trees like hickories and basswood, there are long tough fibers (i.e. bast fibers) in the inner bark. In other trees like beech, these bast fibers are absent.

### 3) Cambium layer

This can be only one cell thick which are living and growing.

### 4) Medullary rays or wood fibers

These run radially from the center to the bark.

### 5) Annual rings

These are layers of wood.

### 6) Pith



This is at the very center.

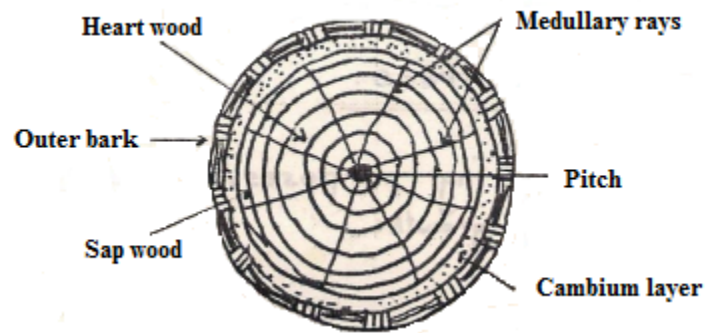


Fig. 2: Figure 4-2. Cross-section of tree trunks

## 5.4 What's next?

We'll dive into Carpentry tools in the [next chapter](#).



## CHAPTER 5: IDENTIFYING AND ENUMERATING AND HAND AND POWER TOOLS

### 6.1 Different hand tools

There are mainly two types of hand tools and they are layout tools and tooth edge cutting tools.

#### 6.1.1 1) Layout Tools

- a) **Scriber** Scriber is handheld tool which used to obtain accurate layout. It is used to scribe fine lines in metal surface.
- b) **Divider** Divider are used to draw circles, arcs and radii. The length of the divider must be equal and kept sharp.
- c) **Trammel** It is used for drawing circles, arcs and radii that are too large to draw by divider. It has three parts and they are beam, two sliding heads with scriber points and adjusting screw attached to one of the sliding head.
- d) **Hermaphrodite caliper** It is a handheld tool used to draw lines that are parallel with the edges of the workpiece. Similarly, it also helps to locate the centre of cylindrical workpiece.
- e) **Surface gauge** Surface gauge is use to layout lines at parallel position to the work surface.
- f) **Surface plate** Surface plate is a smooth flat table used as a horizontal reference plane for precision inspection and layout lines. Surface plates are made from granite or cast iron.
- g) **Combination square set** The combination square set is used for a number of layout operations. The set consists of blade (i.e. graduated rule), square head, protractor, and center head.

#### 6.1.2 2) Tooth edge cutting tools

- a) **Saw** Handsaw is the most popular tool in carpentry jobs. It has one flat and other sharp edge which is used to cut wood into pieces. It is available in two types and they are:
  - Straight line cutting saw
  - Curve line cutting saw
- b) **Shaving and shaping tools**
  - **Plane** It the traditional and popular tool for shaping wood. It is used for flattening, reducing thickness and making a smooth surface of any rough wooden workpiece.
  - **Chisel** It has a sharp cutting edge at one end and handle at another. It is mostly used for cutting or carving purposes.

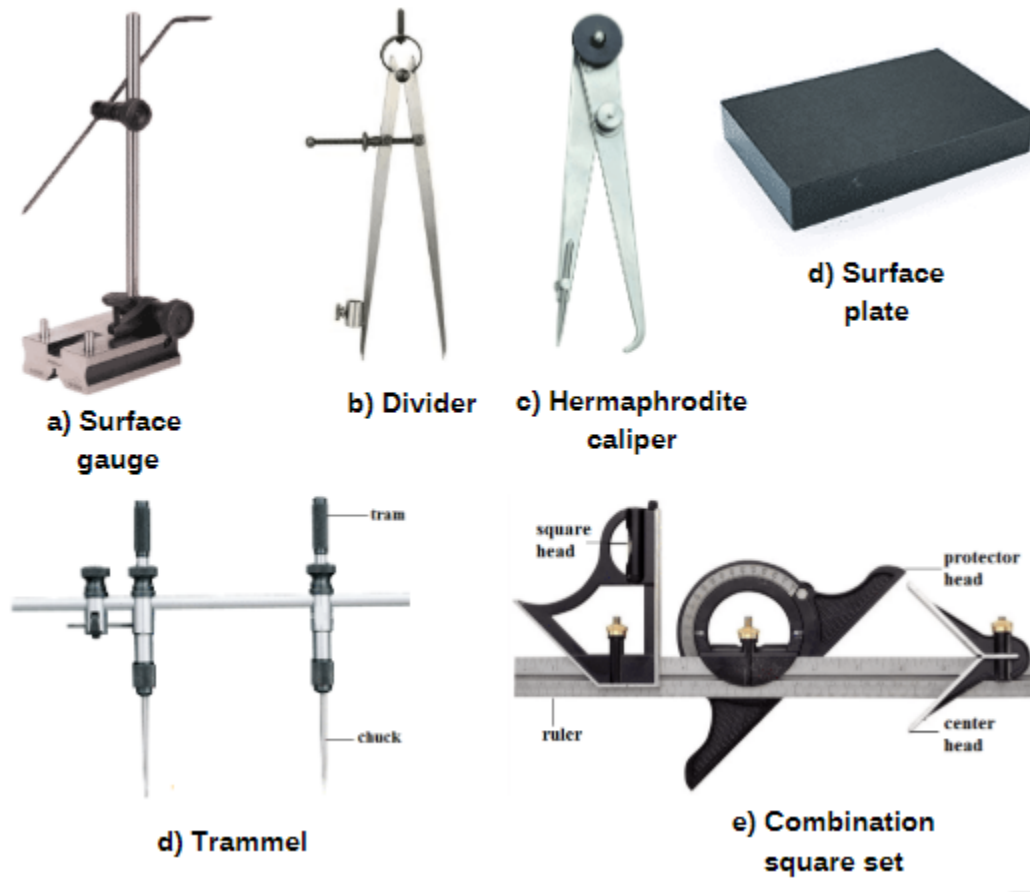


Fig. 1: Figure 5-1. Tools used for layout design



Fig. 2: Figure 5-2. Plane used for shaving and shaping woods

- **Utility knife** It is general or utility purpose knife used by carpenter to cut, trim, sharpen or draw lines \*



Fig. 3: Figure 5-3. Utility knife

- **Sandpaper** It is used to create and ultra-smooth surface of the workpiece. It is used in workpiece before applying lubricant or oil-based finish
- **File and rasp** Files and rasps are used for shaping wooden material. Both has coarse, individual teeth in the steel surface which is used for smoothing and shaping the lumber.

Some of the smooth facing tools are shave, jack plane, fore plane, trying plane, jointer, smooth plane, moulding and special plane. Similarly, other sharp edged cutting tools are paring chisel, firming chisel, framing chisel and side blade.

- c) **Drilling or boring** A hand drill is used to drill for tightening fasteners like screws and bolts. A boring machine is a hand driven machine which is used to bore holes in wooden workpiece. Carpenters use different tools like hand drill, hammer and a nail, chisel etc. for boring purposes. Different types of drilling tools are brad awls, gimlets, augers, twist drills, hollow augers, spoke pointers and reamers.



Fig. 4: Figure 5-4. Hand drill

- d) **Striking and driving** Striking tools are hand tool with weighted head attached to a handle which is used for striking purposes like inserting nails and bending nails. Driving tools are used to push or drive screws and bolts into the wooden surfaces with mechanical or manual force.
- Hammer and mallet
  - Nails and screws
  - Screwdriver
  - Punch
  - Hold fast

## 6.2 Different types of power tools

Different types of power tools available are listed below:

### 6.2.1 1) Saw

**Power saw** is used for cutting woods with ease. There are various types of saws available in market and some of them are:

- a) **Circular saw** It has toothed or abrasive disc or blade which cuts woods and other materials using a rotary motion.
- b) **Jig saw** It has an electric motor and a reciprocating saw blade and is used in making curves, intricate cuts in wood and other materials.
- c) **Reciprocating saw** This saw is used for quick cuts. It cuts wood through reciprocating (or push and pull) motion of the blade.
- d) **Miter saws** This saw has miter box fitted with guides for 45° and 90° cutting. It is mostly used in molding and trimming.
- e) **Table saw** It is used for ripping, crosscutting, mitering and beveling. It is not portable but has versatile features.



Fig. 5: Figure 5-5. Different types of power saw

### 6.2.2 2) Power drill

(Refer in bricklaying section 5.3)

### 6.2.3 3) Power Jointer

A power jointer is a tool used for making smooth and flat surface of warped, twisted or bowed wooden board. It is also used to straighten and square edge after the boards are flat.



**Power jointer**

Fig. 6: Figure 5-6. Power jointer

### 6.2.4 4) Nail Gun

A nail gun allows you to place nails faster and efficiently. It can be available in both electric or battery powered, and you can choose the one that suits you.



**Nail Gun**

Fig. 7: Figure 5-7. Nail Gun

### 6.2.5 5) Wood Router

It is a power tool which is used to rout out or hollow out an area of a relatively hard wood workpiece or other material. It is mostly used in woodworking and carpentry.



Fig. 8: Figure 5-8. Wood Router

## 6.3 The wood lathe machine

Woodturning is a type of woodworking used to create wooden objects on a lathe machine. A wood lathe is a power tool that allows to shape a piece of wood by rotating it on an axis and using various carving tools. It is used to for turning a piece of wood into desired shape like bowl, spindle, vase or other decorative items.

## 6.4 What's next?

We'll learn about various ways of timber seasoning in the [next chapter](#).





**Wood lathe  
machine**

Fig. 9: Figure 5-9. The wood lathe machine



## CHAPTER 6: TIMBER SEASONING

### 7.1 Definition and purpose

Seasoning of timber is the process of removing moisture or sap from freshly cut down trees. The percentage of moisture is very high in freshly felled trees which may cause problems like shrinkage and distortion. It is the initial step for timber utilization. The purpose of timber seasoning are as follows:

- 1) **To increase resistance against insects and fungus.**
- 2) To increase the durability and strength.
- 3) **To increase resistance against fire.**
- 4) To reduce the timber weight and make lighter.
- 5) **To minimize the distortion and shrinkage.**
- 6) To improve timber surface to be painted, polished and preserved
- 7) **To improve workability or working quality of timber.**

## 7.2 Object of seasoning

Properly seasoned timber will not crack, warp or shrink, if protected from weather. The main objectives for seasoning are as follows:

- 1) **To minimize the tendency of timber to shrink, warp and split.**
- 2) To make timber suitable for gluing.
- 3) **To make timber ease for workability.**
- 4) To reduce timber weight for transportation.
- 5) **To free timber from threat of fungi and insects.**
- 6) To boost strength and durability of timber.
- 7) **To increase insulating capacity (i.e. electrical resistance) of timber.**
- 8) To increase heat content. Heat content of green wood has a heat content or calorific value of only 6 to 7 MJ/kg. Dry wood has a calorific value of 16 to 19 MJ/kg. In addition to giving more heat, seasoned wood ignites more easily and burns better, with less smoke.
- 9) **To suit timber for various surface treatments like painting, polishing and preserving.**

## 7.3 Methods of seasoning

Seasoning of timber is done in either artificial or natural ways. Some of the seasoning methods are listed below:

### 7.3.1 1) Natural seasoning

#### a) Air seasoning

In this method of seasoning, sawn timber is stacked in a dry place about 30 cm above floor level and two pieces are kept about 40-50 cm apart which makes it possible for free circulation of air. It should not be kept in direct sunlight and in wet environment.

Advantages: Simple and cheaper and requires less attention.

Disadvantages: Very slow process, more space is required, threat of insects and fungi during seasoning.

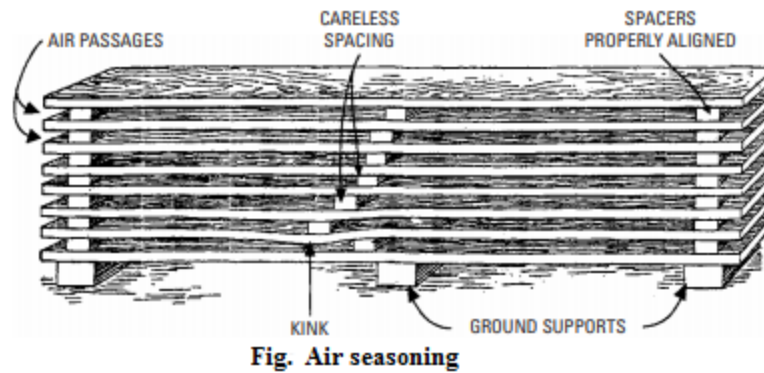


Fig. 1: Figure 6-1. Air seasoning

### b) Water seasoning

In water seasoning, logs are completely immersed in running stream of water for about one month. The sap, sugar, gum and other unnecessary materials are removed and replaced by water.

Advantages: Quick process, boosts drying process, shrink and warp problems are minimized and wood becomes less prone to insects or decay.

Disadvantages: Reduction in elasticity and durability

## 7.3.2 2) Artificial seasoning

### a) Kiln seasoning

In kiln method, the timber is seasoned under controlled environments with proper air circulation and ventilation system. The wooden pieces are stacked carefully in huge trollies and then placed inside the brick kiln according to wooden moisture level. Then, water is heated and resulting steam circulates inside and around the wood boards. With time, the amount of steam is reduced until the desired moisture level is achieved in wood. Although seasoning is done in lesser time (i.e. about 2 weeks), the quality of wood is inferior when compared with naturally seasoned wood.

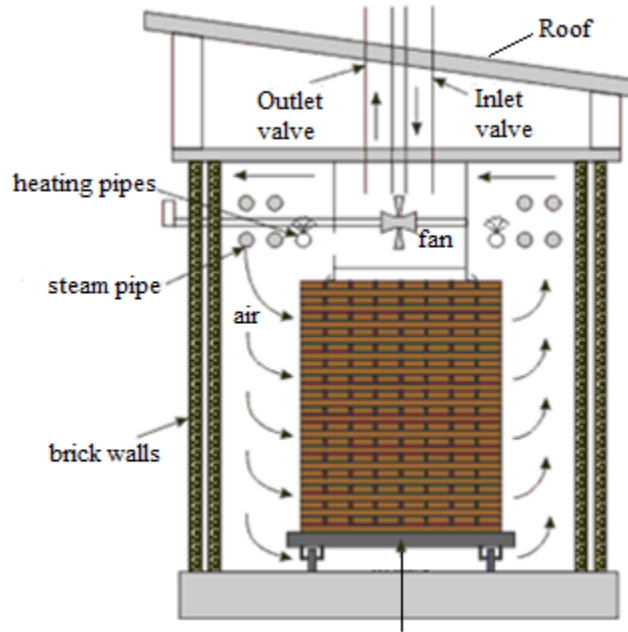


Fig. KILN Seasoning

Fig. 2: Figure 6-2. Kiln seasoning

### b) Chemical/salt seasoning

In chemical seasoning, the timber is totally submersed in a suitable salt solution which has the tendency to absorb water from the timber. Then, timber is allowed to dry after moisture content is removed. It reduces the chances of formation of external cracks because internal surface of timber dries before external surface.

### c) Electrical seasoning

In electrical seasoning, the timber is subjected to high frequency alternating currents. The resistance of timber is measured at certain interval of time. And when the required resistance is reached, seasoning process is stopped because resistance of timber increases by reducing moisture from timber. It works in a simple idea that *heat is produced when poor conductors are placed in the field of high frequency*. Although this process gives superior quality of timber, it is not commonly used because of its high cost and lack of control of moisture content.

## 7.3.3 3) Combined seasoning

In combined seasoning, combination of different seasonings is employed for better timber. For example, solar seasoning is the combination of air and kiln seasoning.

## 7.4 Moisture meter

A moisture meter gives approximate reading of moisture present in wood. It provides fast solution to determine which wood is suitable as per the requirement. The back of the meter or some pointer is placed over the surface of wood, then the moisture meter gives a record of the approximate moisture level present in that wood.



Fig. 3: Figure 6-3. Moisture meter

## 7.5 Calculation of moisture content in timber in percentage

The percentage of moisture content in timber is calculated using two ways.

- 1) Using meter
- 2) Using seasoning techniques

The formula to calculate the moisture content in timber is.

$$MC = [ ( WW - DW ) \times 100 ] / DW$$

Where, MC = Moisture content,

WW = Weight of wet wood and

DW = Weight of dry wood

For example, Find the moisture content of a tree whose weight before seasoning is 20 grams and after seasoning is 15 grams.

Here we have,

WW = 20 grams

DW = 15 grams

(continues on next page)

(continued from previous page)

MC = ?

We know that,

$$\begin{aligned} \text{MC} &= [ ( \text{WW} - \text{DW} ) \times 100 ] / \text{DW} \\ &= [ ( 20 - 15 ) \times 100 ] / 15 \\ &= [ 5 \times 100 ] / 15 \\ &= 33.33 \% \end{aligned}$$

Therefore, moisture content in given wood is 33.33 percentage.

## 7.6 What's next?

Now we will learn about different defects that hampers timber in [next chapter](#).



## CHAPTER 7: TIMBER DEFECTS

### 8.1 Definition and purpose

The defects found in manufactured timber have various causes.

- 1) Defects found in natural logs are shakes, knots and pitch pockets.
- 2) Defects caused by deterioration are rot and dote.
- 3) Defects caused by imperfect manufacture are imperfect machining, wane, machine burn and checks and splits from imperfect drying.

### 8.2 Shrinkage of wood

Shrinkage occurs during the process of drying or seasoning of the timber. All kinds of timber shrinks, regardless of type and method used. Some shrinks more than other timbers.



Fig. 1: Figure 7-1. Shrinkages on wood

Drying of green timber involves two stages which are **removal of free water filled in cell cavities** and **removal of moisture from cell wall**. The cells do not shrink in their length, hence there is negligible shrinkage in the length of timber after seasoning. Most shrinkage occurs in the direction of growth rings at right angle to the medullary rays which is known by tangential shrinkage. This shrinkage is about double of radial shrinkage and about hundred times of longitudinal shrinkage.

Similarly, if cells absorb water after seasoning then it begins to swell which ultimately increases size.

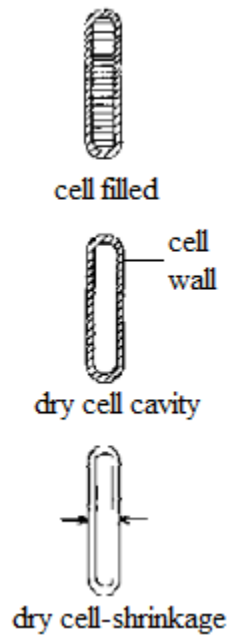


Fig. 2: Figure 7-2. Cell cavities

## 8.3 Defects caused by shrinkage

Shrinkage can cause defects like split, check and shake which are given below.

### 8.3.1 1) Bowing

It is the curvature formation in the direction of the length of the timber.

### **8.3.2 2) Twisting**

It is the distortion in which both ends do not lie on the same plane.

### **8.3.3 3) Cupping**

It is the curvature formation in the transverse direction of the timber i.e. edges do not align with the center of the wood.

### **8.3.4 4) Checking**

It is the crack which does not extend from one end to another but separated fibers.

### **8.3.5 5) Splitting**

It is a special type of check or crack that extends from one end to another.

### **8.3.6 6) Case hardening**

When outer surface dries faster than inner portion, stress developed in outer surface results in surface hardening. It is the condition where outer portion of wood is stressed in compression and the inner core is stressed in tension.

### **8.3.7 7) Radial shaking**

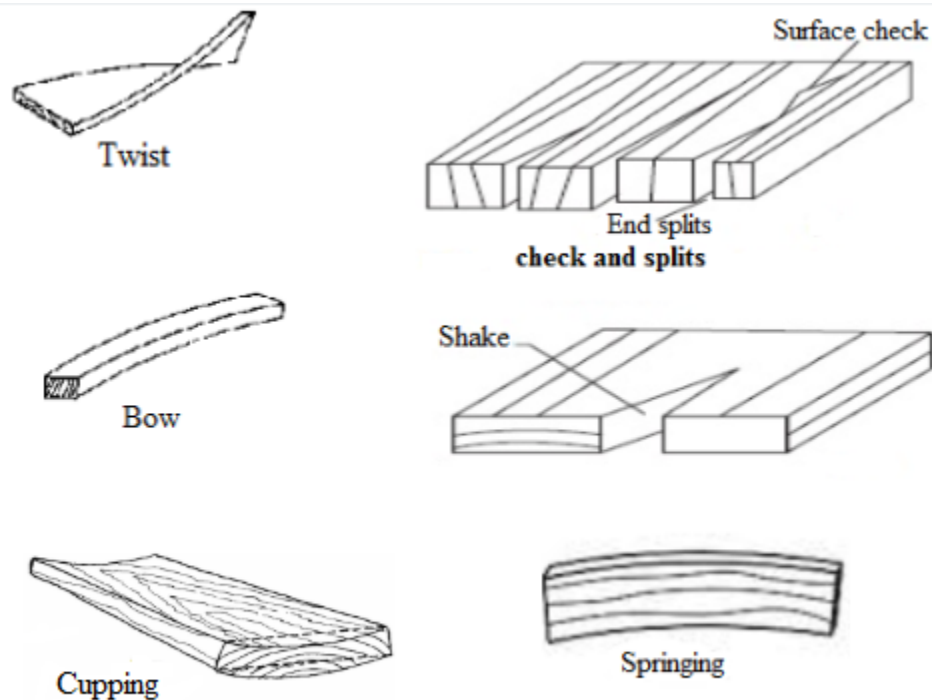
It occurs when felled tree are exposed to sun for seasoning (i.e. it results if seasoning is carried out too quickly). The cracks extends radially from bark to the pith through annual rings.

### **8.3.8 8) Collapses**

Rapid removal of free water from wood cell causes weaker cells to collapse. When cell collapses, it causes uneven thickness and wavy surfaces.

### 8.3.9 9) Springing

It is the board with flat in width but curves in length like a river going around a bend.



**Fig. Different defects caused by shrinkage**

Fig. 3: Figure 7-3. Different defects caused by shrinkage

## 8.4 Defects caused by nature (Natural defects)

### 8.4.1 1) Knots

When the bases of branches are cut off or broken from the tree. There forms a dark hard ring known as knots which receives nourishments from the stem for longer period of time. The continuity of wood fibres are broken by knots forming a weak point in a timber. There are two types of knots and they are:

#### a) Live knots

This kind of knots are fixed in wood and cannot be separate out from it. Live knots are free from cracks and decay which makes it suitable for carpentry uses. Tight knot is the initial stage of live knots.

### b) Dead knots

Dead knots are separated from wood body. So, it is not suitable for carpentry purposes. Loose knot is the initial stage of dead knots.



Live knot



Dead knot

Fig. 4: Figure 7-4. Live Knot and Dead Knot

### 8.4.2 2) Shakes

Shakes are the longitudinal separations in wood between the annual rings. Those longitudinal separations or cracks separates the fibres of wood making undesirable appearance. Different types of shakes are given below:

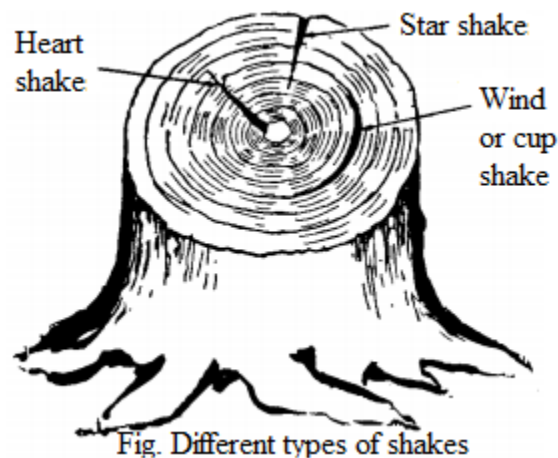


Fig. 5: Figure 7-5. Different types of shakes in wood

**a) Heart shakes**

This defect occurs mostly in overmatured trees due to shrinkage of interior part of tree or heartwood while approaching maturity. These cracks or splits are found at the centre of wood extending towards medullary rays or circumference of the wood.

**b) Ring shakes**

Ring shakes are formed due to winds. These cracks are formed as cavity on rings of the tree.

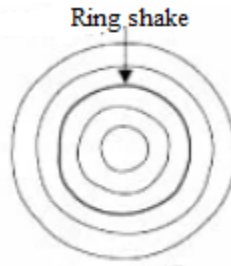


Fig. 6: Figure 7-6. Ring shake

**a) Cup shakes**

Cup shakes are formed due to excessive frost on sap when tree was not matured. It separates annual rings from one another.

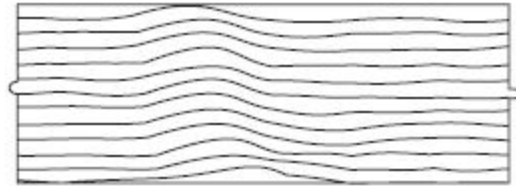
**b) Star shakes**

Star shakes defects are formed mostly due to severe frost and extreme heat of sun. It is usually confined to sapwood. These cracks are found widest at the circumference of wood extending towards centre of the tree.

Similarly, there are other shakes like peripheral shakes and twisted shakes.

### 8.4.3 3) Upsets or rupture

The upsets are crushed or compressed wood fibres which are formed due to improper felling of tree in its young age to wind.



**Fig. Upset**

Fig. 7: Figure 7-7. Upset or Rupture in wood

#### 8.4.4 4) Burrs or excrescences

Burls are formed due to injury of tree in its young age which makes it unable to form branches.

#### 8.4.5 5) Rind galls

The rind means bark and the gall means abnormal growth. The peculiar curved swelling found on the trees as shown in figure is rind gall. It appears due to improper cut off of branches.



**Rind gall**

Fig. 8: Figure 7-8. Rind galls in a tree



## 8.5 Defects caused by man made

### 8.5.1 1) Defects due to seasoning

- a) Twist
- b) Cup
- c) Bow
- d) Spring
- e) Split
- f) Check
- g) Case hardening
- h) Collapse
- i) Radial shakes
- j) Honey combing

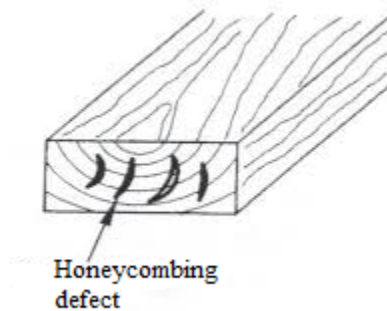


Fig. 9: Figure 7-9. Honeycombing defect in wood

Due to incorrect kiln seasoning, various radial and circular cracks are developed in the interior portion of timber. These cracks occur due to stress developed on inner surface of the timber when inner portion dries prior to external portion of timber. This stress developed causes the separation of the inner tissues of timber. For more details refer in section 7.3.

### 8.5.2 2) Defects due to conversion

#### a) Chip mark

This defect is caused when unwanted marks or signs are formed on finished surface of timber usually by planing machines.

#### b) Wane

This defect causes rounded edge (i.e. wane) in the timber on one side because of timber's original rounded surface.

**c) Diagonal grain**

This defect is caused due to carelessness while sawing of timber.

**d) Torn grain**

This defect is caused when small depression is formed on finished surface upon falling of a timber or when heavy things are dropped on finished surface.

## 8.6 Defects caused by diseases

### 8.6.1 1) Dry rot

Some fungi feed on the timber and converts it into dry powder form which is known as dry rot. Dry rot occurs in environments where there is no free circulation of air like basements. To prevent timber from dry rot, well-seasoned timber (i.e. moisture content less than 20 percent) free from sap should be used in area with well air circulation. Also, if timber is already affected by dry rot, the damaged portion should be removed completely and remaining portion should be treated with solution of copper sulphate.



Fig. 10: Figure 7-10. Dry rot defect in wood

### 8.6.2 2) Wet rot

Fungi causes chemical decomposition of timber and such decomposition converts timber into greyish brown powder. This process is known as wet rot. This kind of rot occurs in environments like damp, moisture and alternate exposure to wet and dry conditions. To prevent wet rot, well-seasoned timber covered with paint or preservatives should be used for both exterior and underground work.

Similarly, there are other kinds of fungi damage like brown rot, white rot and heart rot.

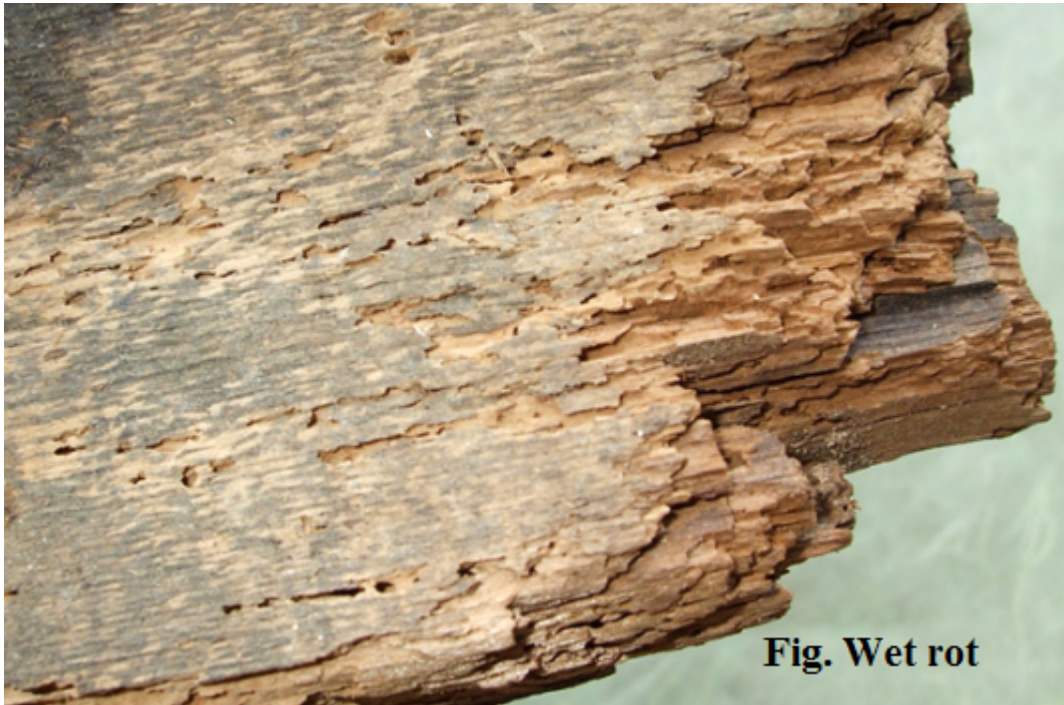


Fig. 11: Figure 7-11. Wet rot defect in wood

## 8.7 Reasons of timber decaying

There are various reasons that are responsible for timber decay and some of them are as follows:

1. **High moisture content**
2. Imperfect seasoning
3. **Attack from insects and worms**
4. Back stacking or storage of timber
5. **Alteration of dry and wet states**
6. Working with unseasoned timber

**7. Working with seasoned timber without suitable preservatives.**

Fungi is the main responsible factor for decay of timber. Fungi is a low-order plant which thrives on moisture, air, proper temperature above freezing point and food. So, proper seasoning is required.

## **8.8 What's next?**

Now we will learn about Insects and Wood borers that destroys timber in [next chapter](#).

## CHAPTER 08: INSECTS AND WOOD BORERS

### 9.1 Definition and purpose

There are different types of insects that feed on wood and wood products. Those pests that damages the wood should be identified and the necessary knowledge to control then is equally important. The wood destroying pests can be divided into four categories and they are carpenter ants, termites, bark beetles/ woodborers and powder post beetles.

### 9.2 Identify termites or white ants

#### 9.2.1 1) Termites

Termites are types of insects which forms a colony inside the timber and feeds on the core part of the timber rapidly. They do not disturb the outer layer of timber which makes them hidden until whole structure collapses down. Some trees like sal, cedar, teak, redwood and cypress show some resistant to termites.



Fig. 1: Figure 8-1. Termites on wood

### 9.2.2 2) Beetles

Beetles destroys the sap wood of the tree and makes a tunnel like hole in the bark of size about 2mm diameter. Timber is converted into flour like powder form and the hole are used by larvae of these beetles. Almost all hardwood trees are likely to be damaged by beetles.



Fig. 2: Figure 8-2. Beetles on wood

### 9.2.3 3) Marine borers

Marine borers are found in salty water or coastal areas. Although, they do not eat wood but makes large tunnels up to 25 mm in diameter to live inside it. No timber found in their area is completely immune from their attack. And the timber attacked by them loses its strength and color.

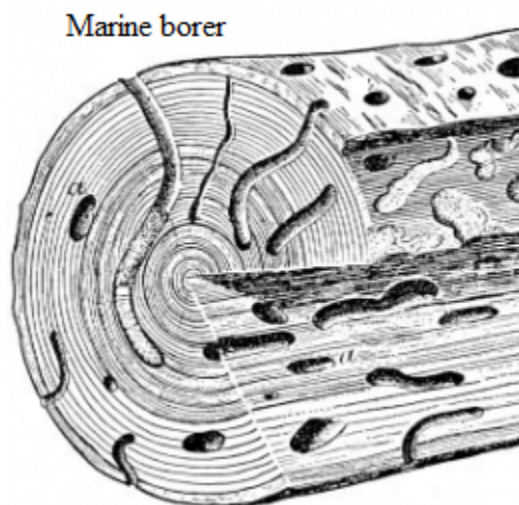


Fig. 3: Figure 8-3. Marine borers on wood

## 9.3 Removal of termites

There are various ways to remove termites from home and they are:

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### 1) Non-chemical method

This method discourage use of insecticides rather opts for physical barrier like steel mesh and sands of particular size.

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### 2) Chemical method

This method uses termiticides chemicals that does not pose risk to human health and environment but are effective on removing termites.

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### 3) Conventional barrier treatment method

This method is the soil-applied barrier treatment.

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### 4) Termite baits method

This method discourages any use of insecticides and rely on cellulose baits that contain a slow-acting insecticide. For example, use of poison bait which involves attracting foraging termites that will then spread the poison back in the colony.

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### 5) Wood treatment method

This method uses spray to wooden materials to protect from insects.

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### 6) Cleanliness

Removing mulch from around the home and placing timber effected by termites in direct sunlight.

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## 9.4 Reason of termites develop in homes

There are three types of termites that are found in homes and they are dampwood, drywood and subterranean. Termites need food (i.e. cellulose or wood), moisture and warmth to survive so, homes with wooden furniture can be their ideal stay.

Termites are born with distinct roles within the colony i.e. workers, soldiers and alates. Alates or swarmers are termites with wings capable of reproduction that leaves the nest to start new colonies.

Drywood termites enter into homes when alates or swarmers find a crevice in the wood. It digs little nest, seal themselves inside and begin to produce eggs to build up their colony. In order to control them, if you see any alates or its abandoned wings inside home then call the termite control specialist for inspection. Similarly, dampwood termites seek dampwood in homes. And subterranean termites seek the moist soil and wood in contact with ground. They also build mud tubes that connect soil and wood for protection against dehydration and route.

## 9.5 Control termites and white ants/insects by providing proper ventilation (air circulation to home)

Dampness and humidity are the common signs of poor ventilation in residential buildings. Dampness provides the perfect environment for termites and other pests to breed. A good sub floor ventilation maintains the moisture content of flooring. As fresh dry air enters from sub floor ventilation, it absorbs moisture vapors and takes it out from the building. A good ventilation controls the risk of termites and white ants/insects since they are active in moist environments. Similarly, the fungi, mould, rotting boards, bowing timber and lifting flooring can be prevented by ventilation as a result pests are also controlled.

## 9.6 Periodical carefulness of termites in building

Homeowner should regularly check the conditions inside the house as well as around it. High level of moisture should be reduced and any exposed wooden material in contact with soil should be covered. Examine exposed wood for hollow spots using screwdrivers or similar tools. Any broken inlets like window screens, imperfectly sealed plumbing lines, exterior cracks, door gaps etc. should be examined regularly. Being in contact with pest control expert for effective ways to encounter termite problems is a good idea. Wood debris or pile of firewood should be removed from location too near to home.



## 9.7 Preservation of wood

Preservation of wood is an art of increasing life of wood treating it with different preservation methods. The purpose of preservation of wood are:

- 1) **To protect wood from fungi and insects.**
- 2) To make wood durable.
- 3) **To bring good appearance in wood.**
- 4) To increase the life of wood.

There are different types of preservatives and they are:

### 9.7.1 1) Oil preservatives

The commonly used preservative is coal-tar or wood-tar. Coal tar is very effective and is applied on external surface of wood. Coal tar can be used with or without mixing with soluble oils.

### 9.7.2 2) Water soluble preservatives

This preservative is prepared by mixing toxic chemicals like zinc chloride, boric acid and copper chrome arsenic composition (It is also called Ascue where, Arsenic is 1part, copper sulphate is 3 parts and sodium dichromat of 4 parts) with water. This preservative is cheaper than oil preservatives. It is used when furniture preservation is of prime importance.

### 9.7.3 3) Organic soluble preservatives

It is the most effective preservative for timber. The solution is prepared mixing nepthol and phenol which is then applied in timber. It is costlier than other preservatives.

There are various methods of preservation which helps in preservation of timber and some are listed below:

- |                   |                  |
|-------------------|------------------|
| • Tarring         | • Abel's process |
| • Charring        | • Creosoting     |
| • Ascue treatment | • Fire proofing  |
| • Painting        |                  |

Similarly, there are various methods of preservative treatment applied for timber with desired moisture content and size.

- |  |
|--|
| a) Hot and cold bath<br>b) Pressure method<br>c) Surface application<br>d) Soaking method<br>e) Boucherie method |
|--|

The selection of preservative treatment depends upon the following factors:

- the type of timber;

- the permeability of the timber;
- the location where timber is to be used;
- the type of preservative is to be used;
- the cost of the process.

## **9.8 Hot and cold bath method**

The hot and cold bath method involves immersing the stack of timber into a tank full with preservatives (usually creosote). The tank is then heated to about 80-90°C and maintain that temperature for certain period. Afterwards, allow the tank to cool down until requires preventives is absorbed into the cells of timber. This method gives better depth of penetration up to 5cm. This method is expensive since it uses heat energy to heat up the preservatives.

### **Advantages:**

- 1) **It ensures sterilization of timber against fungi and insects**
- 2) Although it is expensive this method is the most effective non-pressure solution.
- 3) **It is used in areas with heavy termite presence.**
- 4) It can be used to treat timber with sapwood and heartwood.

## **9.9 Pressure method**

**The pressure method involves the timber being placed in sealed pressure vessel or cylinder and air being sucked out from the vessel.**

1. Fuel cell or Bethel process
2. Empty cell or Rueping process

In fuel cell process, the cells of timber are filled with preservative whereas in empty cell only the cell walls of timber are filled with preservative.

### **Advantages:**

- a) **It is used for treating timbers with low permeability.**
- b) It the most effective preservative treatment method.
- c) **It is used in places with fungi and insects.**
- d) It uses less preservatives.
- e) **It can be used to treat timber of different species.**
- f) It can be used to treat timber with sapwood and heartwood.

## 9.10 Defects caused by dampness

Damp problem can occur in places exposed with moisture such as rain, external gutters and water pipes.



Fig. 4: Figure 8-4. Dampness on wood

**The defects on timber caused by dampness are as follows:**

- 1) **It decays and disintegrate timber and support growth of fungus.**
- 2) It causes dry rot in timber.
- 3) **It causes warping of timber.**
- 4) It deteriorates the floor covering.
- 5) **It makes timber vulnerable to attack from insects and termite.**

6) It causes the blistering, flaking and bleaching of preservatives on timber like paint.

7) **It creates the unhygienic appearance of the furniture.**

## 9.11 What's next?

We now know about woods, tools and basics of carpentry. In [next chapter](#) , we will learn about wood carvings.

## CHAPTER 09: WOOD CARVING

### 10.1 Definition of carving

It is the art of fashioning or ornamenting objects of wood by cutting with different sharp handheld tools. Some examples of world-famous wood carvings are

- The Shigir idol (Russia, 11500 years old)
- Rottgen Pieta (Germany, 1300 CE)
- Holy Blood Altar (Germany, 1499-1504)
- Durbar squares in Kathmandu, Patan and Bhaktapur (Nepal, 1200 CE)
- Sky Cathedral (America, 1958) etc.
- Simraungadh

### 10.2 Process of carvings (Method)

Some methods of carvings are as follows:

1. Whittling
2. Relief carving
3. Chip carving
4. Chainsaw carving
5. Treen

### 10.2.1 1) Wood whittling

Whittling is an art of wood carving made out of raw wood using a whittling knife. Softwoods with straight grains are best for whittling.

- Straight Rough cut is made like sharpening pencils where blade is pushed away from yourself.
- Pull stroke or Pare cut is made by pulling blade towards you.
- Push Stroke is done by placing both left and right thumbs on the back of the knife blade where left thumb push blade forward and right thumb guide the blade through wood for detailed cuts.



Fig. 1: Figure 9-1. Wood whittling

### 10.2.2 2) Relief carving

Relief carving is the process of removing unnecessary wood from flat wooden panel in such a way that an art form appears to rise out of wood. It creates a sculpture with illusion of space and depth on a wooden surface. The depth of the carving distinguishes the relief carving; a high relief stand out from the surface with greater depth compare to low relief. Initially, use a pencil to draw a design onto the wood. The background should be started first by defining outline patterns with stop cuts. Then, use a gouge to carefully remove excess wood and establish relief or deepest part of the background.

### 10.2.3 3) Chip carving

Chip carving is a process of removing crust of material or chip with a chisel and mallet to reveal the inner layer. The difference

- Fine triangle chip carving pattern is created from triangular shapes.
- Free-form chip carving pattern is created by making fine cutlines of different shapes from various directions.



Fig. 2: Figure 9-2. Relief carving of Buddhist goddess Tara



**Fig. Chip carving**

Fig. 3: Figure 9-3. Chip carving on wood



#### 10.2.4 4) Treen carving

This type of carving means the carving of household items with wood. Some carving considered as treen are wooden plates, bowl and spoon and snuff boxes. It is replaced by silver, plastic and ceramics material in modern times but treen is one of the collectives due to its beautiful and tactile appearance.



Fig. 4: Figure 9-4. Treen carving on wood by man from Raute community

#### 10.2.5 5) Chainsaw carving

It is the modern version of woodcarving with the help of chainsaw. It involves a chainsaw and a wood piece. It started in 1950s and got big breakthrough during Lumberjack World Championships of 1980s. Different types of arts like decorates, chair, horses, tables, benches and bookshelf are created using this method.



Fig. 5: Figure 9-5. Chainsaw carving on wood

### 10.3 Illustration of ancient carving of Tundal and Shutters

Tundal are the ancient carved wooden pieces found just below the roof of temple, monastery or residencies in different artistic forms. Tundals are placed diagonally in beam to support the long-slanted roof. Most of the tundal in Nepalese society are carved representing the spirituality, sexuality and cultural norms practice in society. Objects carved in tundals can be animals, demigods, humans and natural elements. Tundal shows the event of particular subject in sequential pattern running from one corner. For example, the tundal in Lord Vishnu temple can show all of his incarnations in sequential order. Generally, Tundal is divided into three sections and they are upper, middle and lower. There is a popular belief in Nepalese community that the temple carved with tundal is not hit by lightning. Tundal symbolism and design pattern makes this ancient Nepalese artform an object of importance.

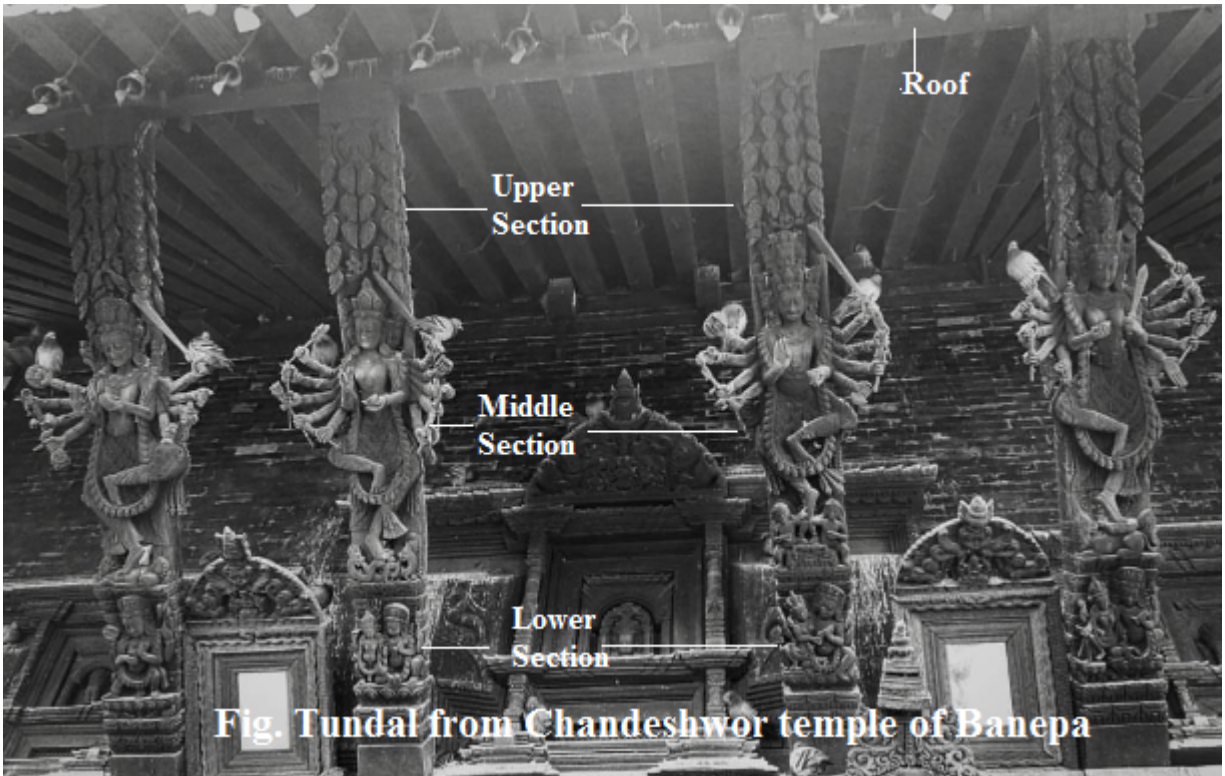


Fig. 6: Figure 9-6. Wooden tundal of Chandeshwor temple

## 10.4 What's next?

We'll dive into preserving and beautifying wooden items in the [next chapter](#).



## CHAPTER 10: PAINTING ON WOODEN SURFACES

### 11.1 Definition of wood primer

A wood primer is a preparatory coating used on interior or exterior unpainted wood before paint is applied on it. It provides penetration and sealing properties on wood and prevents paint from being absorbed on wood.

### 11.2 Definition of wood varnishes/enamel and French polish

#### 11.2.1 1) Varnishing

A varnish is a resinous matter dissolved in an oil (oil varnish) or in alcohol (spirit varnish) and other volatile liquid. Varnishing is a process of applying varnish to the surface of wood which leaves a hard, beautiful and transparent protective finish or coating.

Varnishing is done in violin, tables, guitar, chairs and kitchen cabinets.

#### 11.2.2 2) Enameling

Enamel paint gives a hard, glossy and opaque finish so it is perfect for coating surfaces that must endure humidity and high traffic surfaces found inside and outside homes. It provides excellent color retention and coverage. It is commonly used in wood surfaces because of its waterproof and rot resistant properties.

Enameling is done in doors, window frames, table and chairs, architraves and skirting

#### 11.2.3 3) French polish

French polish is not a material but a wood finishing technique. Its was named after two French brothers who invented the method of transferring Shellac onto wood. Shellac is the material used for finishing and results in a high gloss surface with mirror-like shine. This kind of technique is used in guitars and other wood instruments. Three ounces of shellac flakes is mixed with 1 pint of denatured alcohol, then the mixture is applied in the wooden surface with the help of cotton cloth.

### **11.2.4 4) Cleaning work piece**

Cleaning of work piece can be done in various ways and they are:

#### **a) Hot wash**

Hot wash is done with the solution prepared mixing a gallon of water with 2 tablespoons turpentine and 4 table-spoons of boiled linseed oil. Wring the soft clean cloth in the prepared solution and wash the wood. It removes soil, oil, and built up waxes and polishes.

#### **b) Ammonia wash**

Ammonia wash is done with the solution with 20 percent of ammonia and rest is water. Wring the clean rag and wipe the work piece surface. It discolors or clouds the wood finish.

#### **c) Mineral spirit wash**

Mineral spirit wash is done by applying paint thinner or mineral spirits on a clean soft cloth and rub that cloth on wood surface to dissolve polish, wax, oil and greasy grime. It does not dissolve paint and is cost-effective.

### **11.2.5 5) Sanding work piece**

Sanding is the process of removing materials from wooden surfaces in small amounts with an abrasive to create an even surface and enhance wood appearance. Sandpaper is commonly used for sanding purposes and are available in different grit sizes like coarse grit, medium grit, fine grit, very fine grit and micro grit. Always start with lower grit sandpaper before moving to higher grit sandpaper. Sanding of work piece is done manually or using a power tool called sander. Cleaning is necessary after the sanding is done.

### **11.2.6 6) Putty applying**

While repairing furniture or building from scratch, imperfections like nail holes are need to be filled using wood putty. Wood putty, also called as plastic wood is composed of wood dust, binder, diluent and pigment and it is applied after varnishing your workpiece. It is the best filling agent for outdoor furniture since it makes furniture resistant to shrinkage and effects from sun and rain. Care should be given while selecting the color of wood putty compare to the color of woodpiece.

### **11.2.7 7) Primering**

Primering is the process of applying primer in wooden surfaces which provides consistent base for topcoats of paint. It is must before applying paint in any wooden workpiece since it does not allow paint to soak into and helps to hide joints and prevents bleed-through from knots. Similarly, primer helps to seal mold stains and other discoloration to prevent them from showing through the finish coats of paints. Also, primer is necessary for making proper bond with the paint. Primers can be both oil-based primers and water-based primers used for various purposes.

### 11.2.8 8) Drying

Once you have painted your workpiece, time required for paint to dry depends in factors like type of paint used, thickness of paint coating, humidity and temperature of environment and ventilation system. When solvent evaporate from paint coating leaving the paint dry enough to touch although it is not 100% dry is called paint dry. Paint cure happens when paint coating reached its maximum hardness and is completely 100% dry. Water based or latex paint takes dry time of about 2 hours and cure time of about 30 days. And oil-based paint takes about 8 hours of dry time and cure time of about 30 days.

### 11.2.9 9) Thinner (Licened oil, Turpentile oil and Sprint)

Thinner is also known by its different names like diluent or filler. Thinner are normally used to remove oil-based paints from brushes, rollers, equipment and wooden surfaces. Paint thinner is used to thin or reduce the viscosity (i.e. the state of being thick and sticky) of paint. Similarly, thinner can also be used to prevent paint from hardening when it is left in open.

## 11.3 Identification of painting brushes/rollers

A good painting does not depend only on paint you used but also on painting brushes used. By applying right brushes and rollers, any job can be done easily with high-quality coverage and a better finish.

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**Note:** Painting brushes are categorized in two groups:

- 1) Brushes made of natural hair bristles which are used for oil-based paints.
  - 2) Brushes made of synthetic materials like polyester which are used for water-based paints.
- 

Similarly, you need to choose a brush with different shape and size according to your job.

- 1) Smaller angled brushes are used for cut and trim painting job.
- 2) Larger brushes are used for painting larger areas of woodpiece surface.
- 3) Flat brushes are used for molding painting job.

Before buying any brushes, you have to careful about its quality and workability. *Tug on the bristles of brush and if one or more bristles are pulled out, the brush is of low quality.* Also, hold the brush in different position to make sure it is comfortable to work with.

To paint larger surface in fast pace and with ease, paint rollers are chosen over brushes. A smaller roller is used for trimming or narrow area whereas larger rollers are used for larger areas like ceiling and floors.

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**Note:** Rollers are available as:

- 1) Short-nap roller is used in painting smooth wood workpiece.

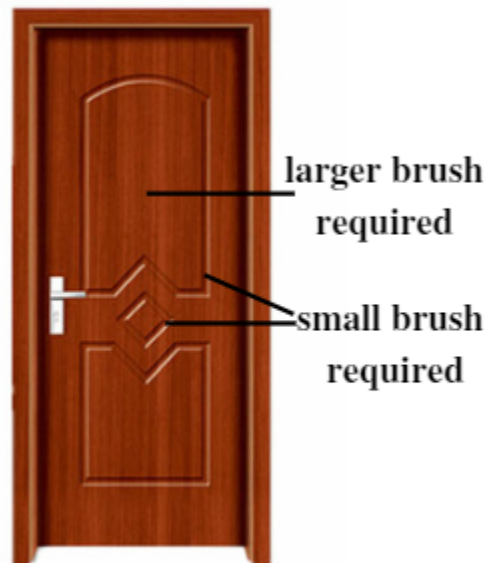


**Brushes**



**Roller**

Fig. 1: Figure 10-1. Brushes and paint roller



**Fig. A wooden door after painting**

Fig. 2: Figure 10-2. A wooden door after painting



- 
- 2) Longer-nap roller is used in painting wood with rough surface.
- 

Before buying any rollers, you need to consider to test its quality. *Squeeze the roller cover and if the roller cover quickly returns to its original shape then it is of high quality.* Likewise, you need to choose the paint roller with right thickness of the roller according to your project.

Paintings with brush and rollers can result in drips and brush marks, spray paint can be the ideal solution for that. Once the workpiece is gone through sanding, cleaning and premiering, paint is sprayed from medium distance using paint spray gun.

## 11.4 Safety precautions

The safety precautions needed to be followed by a painter are as follows:

### **Always keep these things in mind before painting:**

1. Always wear rubber gloves and apron while painting.
2. Never use paint and varnish remover around the flame since some are highly flammable.
3. If paint or other chemical touch your skin, particularly face, mouth and eyes, clean immediately with cold water and seek medical attentions as soon as possible.
4. Do not use turpentine or mineral spirits to remove paint from hand because they are absorbed through skin pores. Used soap and water for that purpose.
5. Make sure you have adequate ventilation and approved paint respirator. In case of dizziness, leave the painting area and get the fresh air.
6. Do not wear nylon, orlon or plastic clothing because these clothes generates static electricity which may spark and ignite paint vapors.
7. Do not paint during electrical storms.
8. Keep food and drinks away from workplace.
9. Do not smoke or use spark-producing tools in the vicinity of painting operations.
10. Give the painted workpiece enough time to dry and use only after it is dried or cured.
11. Keep children and pets away from painted area and equipment.
12. Wash the brushes and rollers properly after use and hang them safely.

## 11.5 What's next?

We'll dive into wood joints useful for a carpenter to manufacture or repair any furnitures in the [next chapter](#).

## CHAPTER 11: SIMPLE AND COMPLICATED WOOD JOINTS

### 12.1 Definition and purpose

A wood joint is a point in a wooden structure where components of structure are connected. The joints in wooden workpiece are made with the help of dowels, nuts, bolts, screws etc. Joints can be simple and complicated based on requirement.

The purpose of joint in woodworking is to join wooden parts together so that the overall structure remains stable.

The main function of wood joints are as follows:

- To support load transmission.
- To let the wood expansion and contraction with change in temperature and humidity.
- To provide suitable gluing surface for fasteners.

### 12.2 Types of joints

In order to obtain a successful design, you need to know the right woodworking joint and know how to make that joint in a right way. There are different types of joints available in carpentry work and they are:

#### 12.2.1 1) Lengthening joint

This type of joint is used when effective length of workpiece is needed to be increased. The types of lengthening joints are lapped joints, scarfed joints, fished joints, beveled halved joint, dovetail halved joint, keyed joint, wedged joint and screwed joint.

### 12.2.2 2) Widening joint

This type of joint is used when width of workpiece is needed to be widen. The types of widening joints are rubbed joint, slot screwed widening joint, dowel joint, biscuit joint and tongued and grooved joints.

### 12.2.3 3) Framing joint

Framing joints are used to terminate or to change the direction in wooden structures. The types of framing joints are mortise and tenon corner joint, rafter scarf joint, butt joint hammer beam truss detail and pegged bladed scarf joint.

## 12.3 Miscellaneous joints

### 12.3.1 1) Cross half lap joint

A half lap joint is formed by fitting two boards (with half of their material removed) together perpendicularly in such a way that the joint does not add thickness at the joint. It is used while building furniture like dressers and desks.

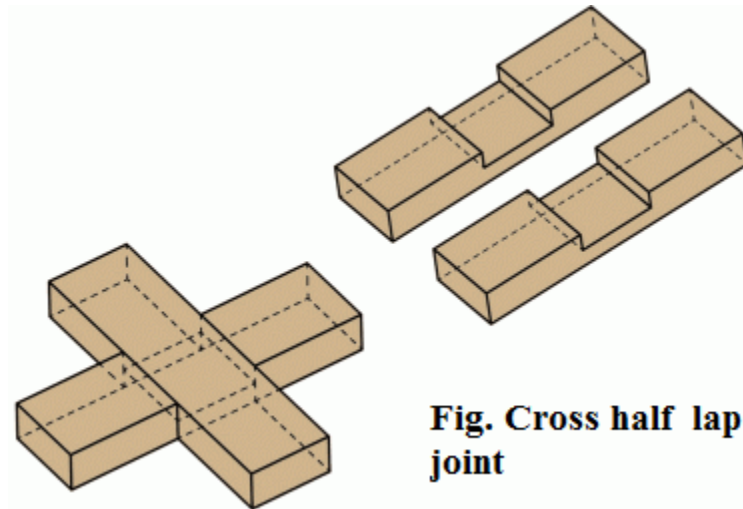


Fig. 1: Figure 11-1. Cross half lap joint

### 12.3.2 2) Dovetail half lap joint

This joint is formed by two boards (with half of their material removed) of equal thickness where one board with a dovetail is fitted into a corresponding mortise in the second board. It is used when more strength is needed. It is used in building jewelry boxes, dovetail drawers and cabinets.

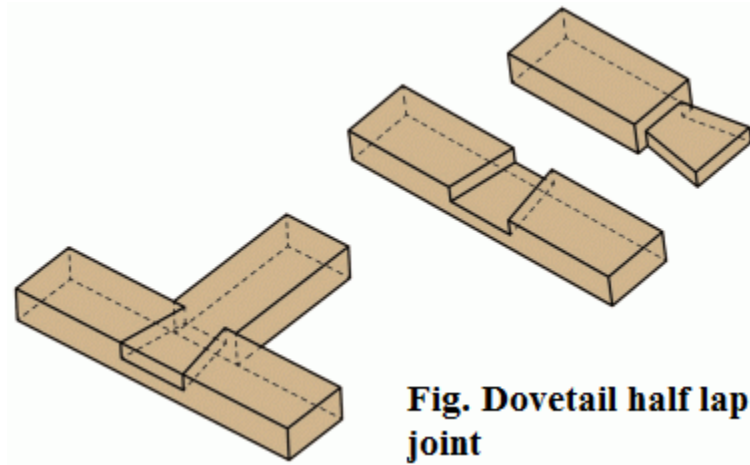


Fig. 2: Figure 11-2. Dovetail half lap joint

### 12.3.3 3) Dado joint

A dado joint is formed by a three-sided channel cut across the grain of one workpiece. Another mating workpiece is placed to fit into the slot. It is one of the strongest woodworking joints which can be made with the help of table saw or router. It is used to build cabinet and bookshelves.

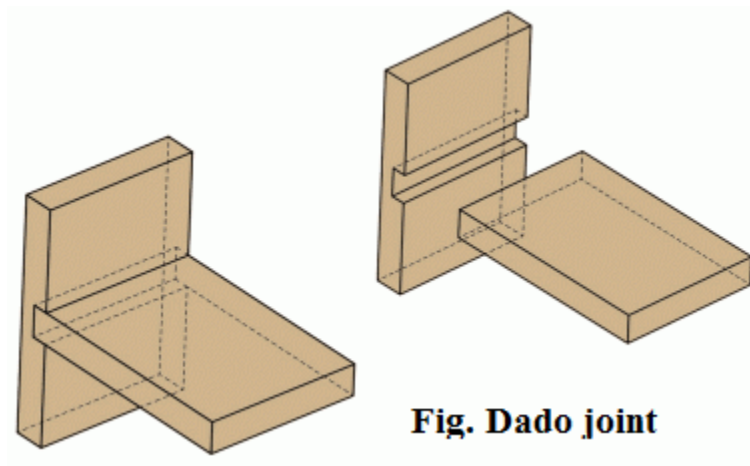


Fig. 3: Figure 11-3. Dado joint

### 12.3.4 4) Mitred joint

Two or more members are cut at different angles and this type of members are joined together to form mitred joint. It is used mostly in photo frames.

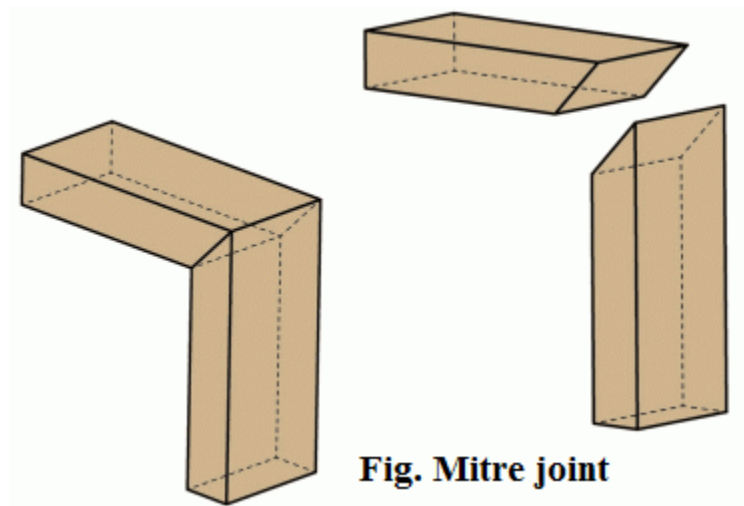


Fig. 4: Figure 11-4. Mitred joint

## 12.4 Types of beam hangers

A beam is made of solid lumber one or more pieces usually placed horizontally to the ground. Joists are the lumber pieces attached to beam in order to frame the structure and also to handle pressure. Beam hangers are used to attach joists with a beam in any structural construction. Sometimes, beam hangers are also known by joist hangers.

### 12.4.1 1) Face mount hanger

In face mount hanger, face nails are installed with at least half of the required fasteners in the top half of the header. The supported member hangs either partially or entirely below the header.

### 12.4.2 2) Top flange hanger

In top flange header, face nails must be driven straight so that they penetrate through the corner of the joist and into the header.

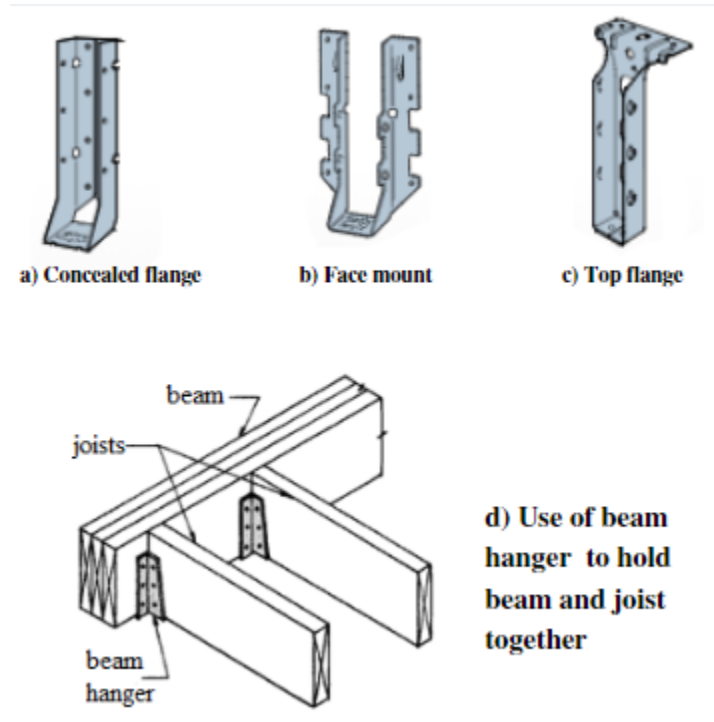


Fig. 5: Figure 11-5. Use of beam hanger to hold beam and joist together

### 12.4.3 3) Concealed flange hanger

It can be used to attach the joists to the beam in such areas where it is difficult or impossible to do so. It provides strong and attractive connection

## 12.5 Use of gusset plates in framing of frame construction

Gusset plates are made of wood, metal or steel which is used to connect beams and girders to column. Wood gusset are used for wooden truss constructional works and they are generally made of plywood. Similarly, steel gusset is used in steel structural buildings and in wood beam construction.

Gusset plates are used mostly in framing of frame construction.

- 1) A **gable-end overhang** can be framed by ordering a gable-end truss which placed to permit lookouts to rest on top of it and run to the top chord of the next truss.
- 2) A **hip roof** can be framed with roof trusses using a step-down system. It uses a series of intermediate trusses and a glider truss which carries the load of a series of common jack truss. A hip jack truss is

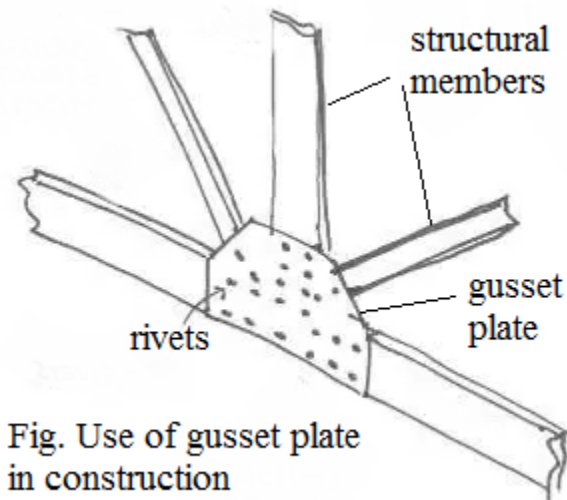


Fig. 6: Figure 11-6. Use of gusset plate in construction

used to form the runs from the hip grider truss to corner of the building.

## 12.6 Uses and application of:

### 12.6.1 1) Lengthening joint

#### a. Table scarf joint

It is the method of joining two wooden members end to end as shown in figure. It is preferred over other wood lengthening joints because it results with barely visible glue line.

**Its applications are:**

- To connect or elongate lumbers in big constructions
- To connect the wooden beams.
- For construction of barns and sheds.



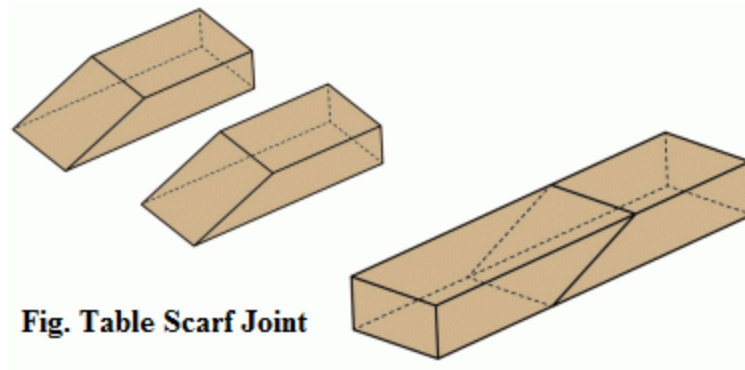


Fig. 7: Figure 11-7. Table scarf joint

### b. Spliced joint

It is also the method of joining two wooden members end to end as shown in figure. It is preferred over other wood lengthening joints because it results with stronger joints.

#### Its applications are:

- To join lumber structure end to end.
- To make joints where mechanical fasteners like bolts are used.
- To construct the building materials like skirting and architrave from smaller offcuts of timber.
- To make interlocking surface so that joint resist being pulled apart.



**Fig. Half lap splice joint**

Fig. 8: Figure 11-8. Half lap spliced joint

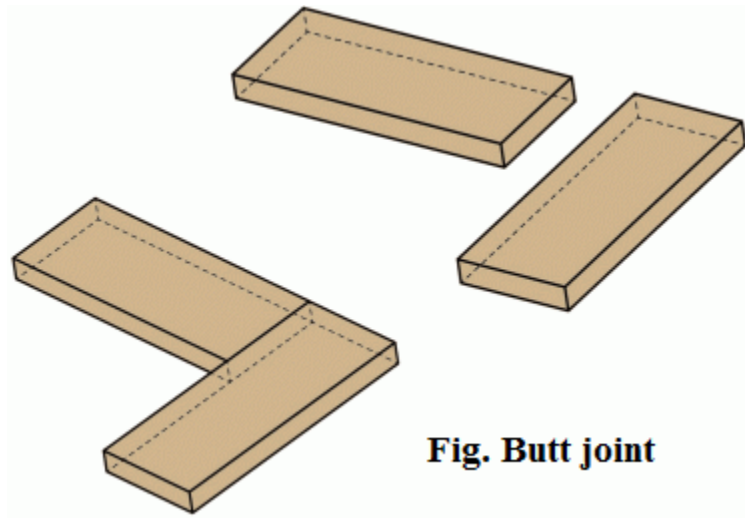
## 12.6.2 2) Widening joint

### a. Butt joint

A butt joint is formed by placing ends of two members together without any special shaping or cuts. It is the simplest joint as well as the weakest. So, butt joints are used with reinforcements.

**Its applications are:**

- It is used in framing in constructions of door, table or chair legs, face frames etc.
- It is used in wood toys.
- It is used in carcass construction like cabinet and drawer boxes.
- It is used in panel assembly.



**Fig. Butt joint**

Fig. 9: Figure 11-9. Butt joint

### b. Tongued and grooved joint

A tongued joint is formed by joining two members together where one member has a slot or groove cut all along the edge and other member has a deep ridge or tongue cut all along the edge. It is used to form wider panels from narrower boards. It provides a tight fit with plenty of surface area for adhesives.

**Its applications are:**

- It is used where seasonal expansion and shrinkage of timber occurs due to moisture and temperature.
- It is used to form wider panels from narrow boards like table tops, doors and architectural paneling.
- It is used for strip flooring or plywood flooring.
- It is used in floorboards, lining boards, wood paneling and table tops

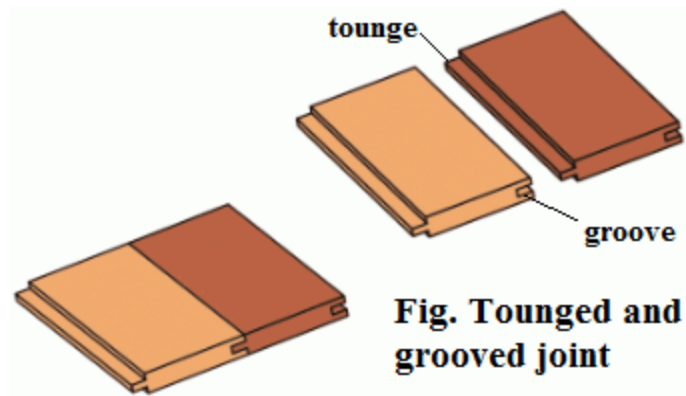


Fig. 10: Figure 11-10. Tongued and grooved joint

### c. Dowel joint

Dowels are round wooden pins of small diameter made from hard wood used to strengthen a joint. Dowels are dipped in glue and driven at a tight fit into dowel holes. Dowel joints are formed by inserting the dowels in dowel holes which are drilled with perfect alignment so that dowels are fitted in straight fashion.

**Its applications are:**

- To construct the furniture like doors, windows, photo frames and tables.
- It is used to strengthen the joints like butt to hold wood members more strongly.
- Dowels are thick and sturdy than nails which makes them less prone to breakage.
- It is used to build cabinets, wooden shelves and racks.

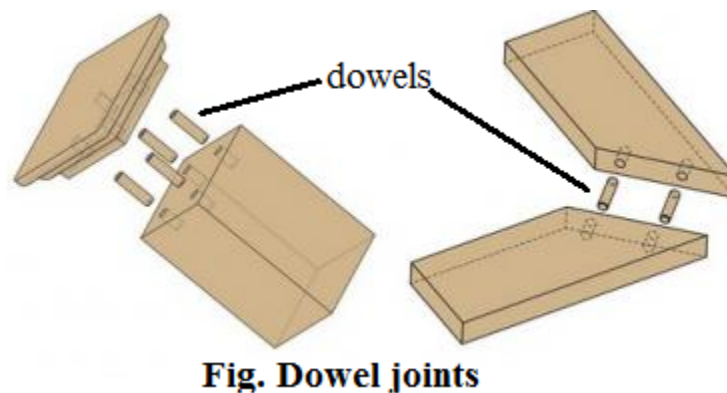


Fig. 11: Figure 11-11. Dowel joint

### 12.6.3 3) Framing joint

#### a. Dovetail bridle joint

Bridle joints are formed when a tenon on one member is joined with a mortise in the other member of workpiece. It is similar to mortise and tenon joint except tenon and mortise are not cut in full width in bridle joint.

**Its advantages are:**

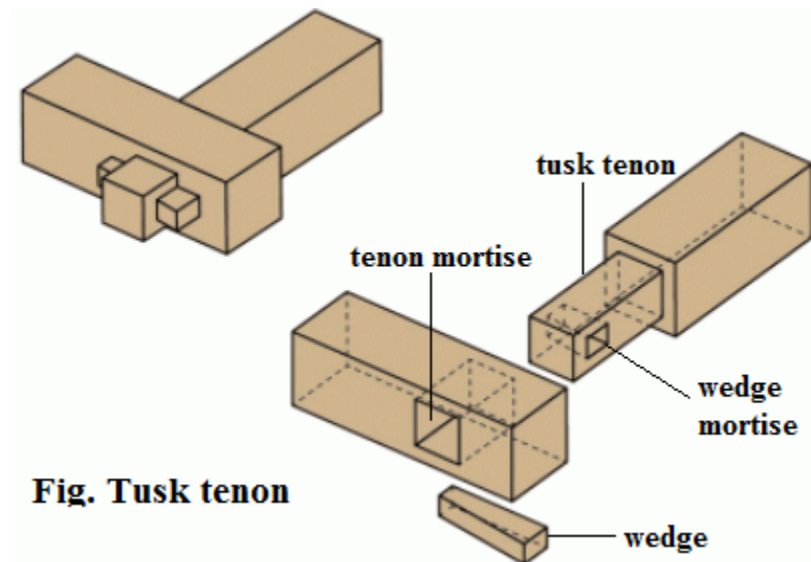
- It is used in constructing different frames.
- It is used in making furniture like chairs and tables.

#### b. Tusk tenon joint

To join two different members of wooden workpiece, a tusk tenon is passed through a tenon mortise and a wedge is place in wedge mortise to make joint stronger.

**Its applications are:**

- It is used in construction to join one beam to another.
- It is used for making things like doors, tables, windows and beds.



**Fig. Tusk tenon**

Fig. 12: Figure 11-12. Tusk tenon joint

## 12.6.4 4) Rail joint

### a. Stub mortise and tenon joint with hunch

A mortise and tenon joint are formed when rectangular end (the tenon) of one member fits into a rectangular hole (the mortise) of another member having the same size. It is the most commonly used joint. Stub mortise means the mortise that does not pass through the wood member.

**Its applications are:**

- This joint is used for construction like building bridges, monuments, shelters and temples.
- This joint is used for making furniture like tools, sculpture, tables, railings and doors.

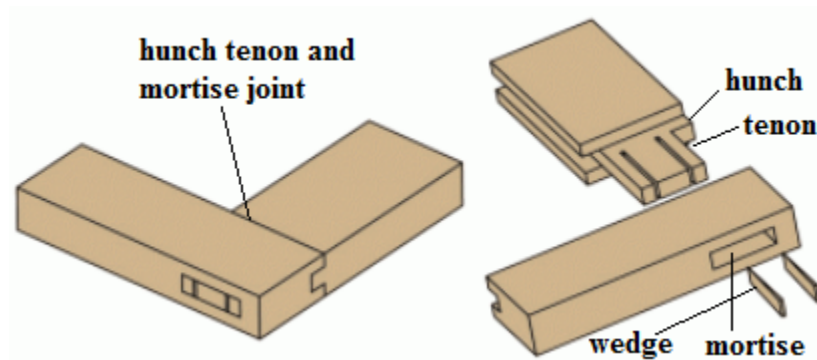


Fig. 13: Figure 11-13. Mortise and tenon joint

### b. Housing joint

Housing joint are by joining two members where one member has a slot in the surface wide enough to fit the second member to fit in as shown in figure. The second member or shelf is then glued or nailed with dowels. For clean finish you can apply stopped housing joint.

**Its applications are:**

- It is used to make back of drawers because it is strong withstands stress from many directions.
- It is used for fibreboard joints like partile board.

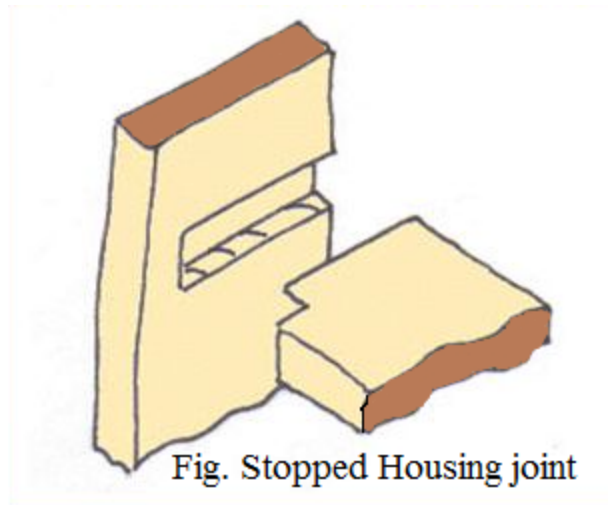


Fig. 14: Figure 11-14. Stopped housing joint

## 12.7 What's next?

In [next chapter](#), we will learn about plywood and how they are made.

## CHAPTER 12: PLYWOOD

### 13.1 Definition

Plywood is a glued wood panel where several thin layers of wood or veneer or plies are cemented together. Wood veneers are thin slices or sheets of quality woods like teak. The outer plies are called faces, the inner plies are called cores and the plies just below the faces (both front and back face) are called crossbands. Lumber, veneer or particleboard can be used as the core. The plywood varies based on thickness, species, grade of wood and number of plies used. The quality of plywood depends upon the glue used, quality of different layer of veneer, the order of layer placement in the panel and the control of gluing condition during gluing process.

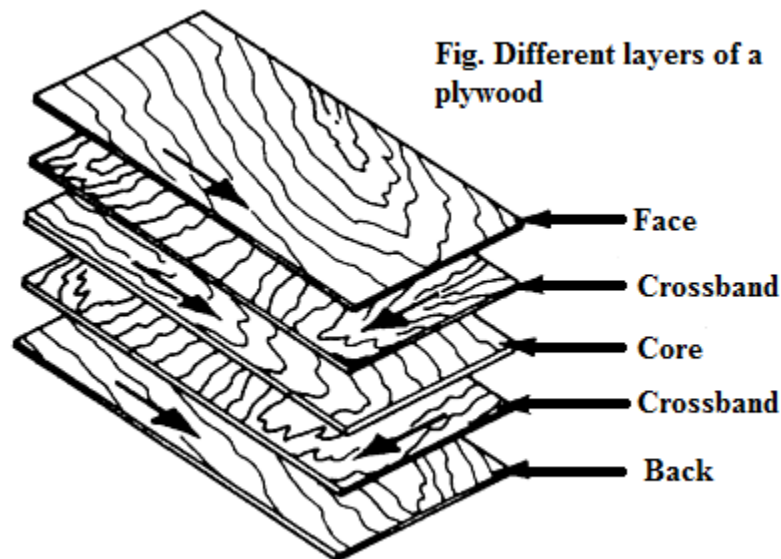


Fig. 1: Figure 12-1. Different layers of plywood

Plywood are made in two different ways:

- Hot pressing method uses large hydraulic presses to press the required number of plies together
- Cold pressing method can be operated within room temperature.

Plywood are used mainly in furniture construction, doors and windows, flooring and ceilings, partitions, fencing, makes packages and boxes, aircraft construction and so on.

## **13.2 Types**

There are numerous ways in which plywood is classified and these classifications are based on various aspects of plywood such as wood used, the number of piles it has, suitability for indoor and outdoor use and grading. Two types of plywood based on wood are as follows:

1. Hardwood plywood
2. Softwood plywood

### **13.2.1 1) Hardwood plywood**

Hardwood plywood is generally used where strength, stiffness and constructional convenience are more important than appearance. Most of the hardwood plywood production is intended for interior or protected uses. This type of plywood is made from angiosperms or flowering plants like birch, gurjan or teak. Applications of hardwood plywood are used in constructing musical instruments, furniture, sports equipment, floor/wall/roof of vehicles or containers and so on.

### **13.2.2 2) Softwood plywood**

Generally, softwood plywood is used for constructional and industrial uses where appearance is more important than appearance. Face and back of softwood plywood are selected with clear natural finishes or with pigmented finishes. It is made from gymnosperms or non-flowering plants that have enclosed seeds like pinecones, fir, spruce, redwood etc. Its applications are in home constructions, fencing, packages and boxes and constructing internal parts of vehicles.

## **13.3 Sanding**

Sanding is the process of making rough plywood surface into smooth or polish surface by rubbing it with sandpaper or a mechanical sander. To give appearance of real wood you need to apply protective polyurethane or stain the plywood. But sanding of plywood to obtain smooth surface is necessary before you proceed for coating. Follow the following steps to sand the plywood:

1. Make sure there is not any dirt or dust present in plywood surface.
2. Make sure you have sand papers with various grits.
3. Employ 180- grit sandpaper and stroke or pass it over plywood surface in the grain direction up to 3 or 4 times.



4. Now employ 200-grit sandpaper to sand the plywood 3 to 4 stokes. It smoothens the lines created by 180-grit sandpaper.
5. Again, sand the plywood with 220-grit sandpaper and make up to 2 stokes. It gives the extra smooth plywood surface as final finish before applying coatings.
6. Finally, clean the plywood surface with clean cloth to remove the dust formed when sandpaper was rubbed in plywood surface.

## 13.4 Properties of plywood

Some properties of plywood are as follows:

1. It has high resistance to splitting, cracking and warping.
2. It has light weight and uniform tensile strength.
3. It is available in different sizes.
4. It is cost effective and easy to work with.
5. It has smooth surface and better appearance
6. It provides high thermal and sound insulation.
7. It can be used as fire resistance employing chemical coating.
8. It does not corrode.

## 13.5 What's next?

This will be the end of our journey. To dive deep in the carpentry field there are lots of resources available...



## SEARCH FOR ANY TOPIC

- search

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