section of a log.

It is generally understood that heartwood is the only part of the tree which should be converted for use, as sapwood is more prone to attack from wood-destroying organisms. If sapwood is properly treated with an effective preservative, it is as durable as heartwood, similarly treated, when used under conditions favourable to decay. The difference in colour between sapwood and heartwood is most important when choosing wood for joinery, the decorative value of which depends on the dark colour and grain of the heartwood. Treating with preservatives is useless and staining is very difficult, as sapwood absorbs stain more readily than heartwood and takes on a much darker shade. Therefore, for all joinery work it is better that sapwood be eliminated altogether.

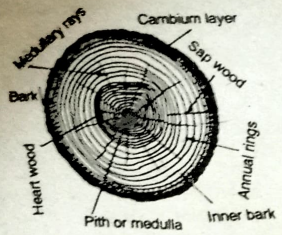


Figure 10.1 Cross section of a log

10.3 GRAIN IN WOOD

The word *grain* as applied to wood is indeterminate in its meaning. Conversationally it refers to the appearance or pattern of the wood on any of its cut surfaces. The figure or pattern of a wood is due to variations of ring growth and of colour in the wood, together with the influence of knots. This pattern is preferably not referred to as "grain".

An *open-grained wood* such as oak has minute pores over its exposed surface. In standard wood-finishing methods, these pores are leveled with a coat of filler. A *close-grained wood* such as fir or pine has no such pores in its surface.

The grain of the wood also refers to the direction of the cellular or fibrous structure of the wood, which is the longitudinal direction. Timbers for structural use must be so cut that the grain runs parallel to the length of the timber ; otherwise there is a marked reduction in strength.

In a traverse section the log of wood looks like a series of concentric circles due to annual rings. The tangential plane is a plane at a tangent to these circles ; the radial plane follows a diameter and passes

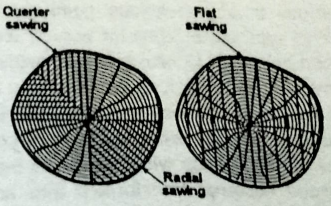


Figure 10.2 Methods of cutting logs

through the centre. Planks sawed tangentially to the annual rings are termed *flatsawn*. Giving a *flat grain*, while radially cut planks are termed *quarter-sawed*, giving an *edge grain*. If the annual rings are approximately at 45° to the face of the plank, the condition is called *angle grain*. *Cross grain* refers to a plank whose fibres are not parallel to the long axis of the plank. Figure 10.2 shows the methods of cutting logs.

10.4 SEASONING OF WOOD

The advantages of seasoning are that it makes the timber lighter in weight, more resilient, and less liable to twist, warp, and split. It is also in a better condition to retain its size and shape after being made into a piece of joinery. Wood increases in strength, hardness and stiffness as it dries. There are two methods of drying or seasoning :

Natural seasoning : This is also known as *air drying*. In this method the balks (roughly squared logs) are stacked under cover with spacers in between, so that a free circulation of air is provided all round them. This method is slow, but gives the best results. A further period of seasoning should take place after the balks are sawn up and converted into planks or boards. This is to help dry out the interior of the timber which has been exposed by sawing.

Artificial seasoning : In the *artificial seasoning* method, the period of seasoning is very much reduced, a matter of two or three weeks being sufficient, according to the size or species of timber to be seasoned. The timber is stacked on a special truck and wheeled into a chamber which is then sealed. Hot air is circulated by fans, and a certain amount of steam is added in order to retain the correct humidity. Samples are tested at intervals to ascertain the percentage of moisture remaining in the timber. Seasoned timber still contains a proportion of moisture, which varies from 16 to 22 per cent according to the seasoning conditions, and this need not be dried out any further if intended for use out-of-doors.

If used for interior work or in a heated atmosphere, the timber should be further conditioned, that is, dried in warm-air kilns, or stored in a similar atmosphere to that in which it will be fixed, until the moisture contents is brought down to the region of 8-12 per cent.

Moisture content is the ratio of amount of water in a sample, and the dry weight of the wood sample itself, expressed as a percentage.

10.5 COMMON DEFECTS IN TIMBER

Seasoning defects : As the moisture evaporates during seasoning, shrinkage of the timber takes place. If a balk is dried too quickly, splits and cracks will appear. Shrinkage in the length is negligible, but it is more

pronounced in the direction of the annual rings.

Sapwood shrinks more than *heartwood*, so that a board cut from the outside of a log will shrink more, and have a greater tendency to warp, than one cut from the centre. The timber stored after felling the tree will also undergo the above shrinkages and may show *radial splits* in dry and hot environment.

Timber which has been stored in a damp atmosphere should not be converted into a piece of joinery and then fitted into a warm room. The result will be rapid shrinkage, warping, twisting and splitting.

Due to uneven drying during seasoning, the timber may warp or twist. Fig.10.3(a) shows three types of defects : crook, bowing and end splits.

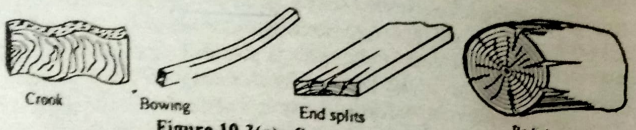


Figure 10.3(a) Seasoning defects

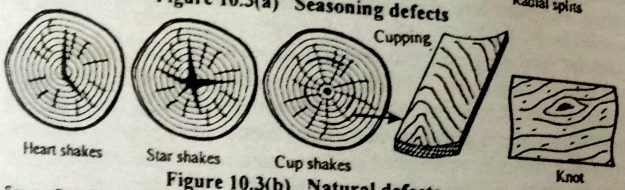


Figure 10.3(b) Natural defects

Source: Petit Tom, 1977,Woodwork Made Simple, Heinemann, London

Natural defects : Heart shakes are single splits occurring in the standing tree and cannot be seen till the tree is felled. A number of such shakes radiating from pith is known as *star shakes*. If annual rings separate, cup shake is formed. The growth of branches also form a knot distorting the grain of the timber. Fig. 10.3(b) shows some of the natural defects.

Pitch is another defects in the timber when resinous materials accumulate with in the wood.

Defects due to destructive agents : These defects include *worm holes* and *fungi-decay*. Wormholes are small holes in the wood caused by insects (termite, marine-borer and beetles) boring through the wood.

There are number of wood destroying *fungi* which attack standing timber, felled timber and conditioned timber.

Defects due to manufacturing/cutting : Some of the manufacturing defects are (1) cross grain, (2) machine burn.

Cross-grained wood is defined as wood in which the cells / fibres run at an angle with the axis, or sides, of the piece.

Machine burn is usually caused by planer blades that are dull or spur and can be seen as dark streaks along the face of the boards.

ISO classification : The ISO (The International Organisation for Standardization) classifies the defects as per ISO 2299-1986. These are :

2.1 Knots, 2.2 Shakes, 2.3 Irregularities of wood structures and abnormal colourisation of wood, 2.4 Defects caused by fungi, 2.5 Defects caused by insects, 2.6 Sawing defects and deformation.

Each of the classes is further divided to subclasses and each of the subclasses is further divided in sub-subclasses.

10.6 CLASSIFICATION AND CONVERSION OF WOOD

CLASSIFICATION

Timbers, for commercial purposes, are divided into two classes : (1) soft wood, and (2) hard wood. These two terms however, have no reference to the hardness of the wood and they are only two botanical classifications.

Soft woods belong to conifers which have long narrow leaves. They contain turpentine and resinous matters in their cells. The average soft-wood contains about 42 per cent cellulose, 25 per cent hemicellulose, 30 per cent lignin and 3 per cent miscellaneous items. Lignin also known as 'wood glue' holds the other items together in the wood. It can be converted into vanillin or other resinous materials useful for foundry mould. Soft woods are light in weight and light coloured, have distinct annual rings but no visible medullary rays, and the colour of the sapwood is not distinctive from their heartwood. The fibres are generally coarse but straight, and hence, capable of resisting direct axial stresses ; but they cannot resist any kind of stress developed across their fibres and the timber gets splitted easily.

Hard woods belong to broad-leaved trees. An average hard-wood consists about 45 per cent cellulose, 25 per cent hemicellulose, 23 per cent lignin and 7 per cent miscellaneous items. The annual rings are more compact, thin and less distinct, but the medullary rays are visible in most, and in some cases very pronounced. Hard woods are darker in colour, comparatively heavy. The fibres are fine grained, compact, properly bonded, and often found very straight. So hard woods are nearly equally strong both along and across the fibres and can resist axial stress as well as transverse strain, shock and vibration quite satisfactorily.

Non-resinous or hard woods like Sal, Pyingads and Ash, which do not readily catch fire, are sometimes classed as *refractory* ; and the resinous or soft wood like Deodar. Pine, and Fir, which readily catch fire and burn because of the presence of resinous matter, are classed as *non-refractory*.

CONVERSION

After a tree is felled it is stripped of its branches and is then known as "log". The cutting of the log into usable pieces of timber is called conversion. The following are the common market forms of timber :

Log is the felled tree after being trimmed.

Balk is the log squaring up.

Planks	: 275 to 450 mm wide and 75 to 150 mm thick.
Deals	: Unto 225 mm wide and 50 to 100 mm thick.
Batten	: Unto 135 mm thick and over 150 mm wide.
Quartering	: 25×25 mm^2 unto 150×150 mm^2 stuff.
Scantling	: Odd-cut stuff, such as 75 mm × 50 mm, 100 mm × 50 mm, 100 mm × 75 mm, etc.

10.7 COMMON VARIETIES OF INDIAN TIMBER

Indian timbers most commonly used for various wood-works are as follows:

Babul. The wood is pale red to brown in colour, close-grained, hard and tough, but elastic, and takes a good polish. They grow abundantly all over India and are used for bodies of carts and wheels, agricultural implements, tool-handles, etc.

Mahogany. The wood is of red brown colour, very durable when kept dry. Usually, it has fine, wavy grains, and uniform colour, It contains resinous oil which prevents attack of insects. They are available in Himalayas and used for pattern-making and cabinet work.

Mango. The wood is of inferior quality, coarse and open grained and of deep gray colour. They decay readily when exposed to moisture and are greedily eaten by white ants. They are largely found all over India, and being plentiful and cheap, widely used for common doors, windows, and furniture.

Sal. The wood is of a dark brown colour, hard, close-grained heavy, resistant to white ants and durable. It seasons slowly, is hard to work and does not take a high polish, They grow abundantly in the forests at the foot of the Himalayas—in U.P., Bihar, and Assam—also in Central India and South India and largely used for constructional purposes.

Sissu. They wood is dark brown in colour, tough , durable and has well-marked coarse grains. It is one of the best Indian woods for joiner's work—tables, chairs, and other furniture and is widely distribute in Northern and Northern and Central India.

Teak. The wood is brown in colour, straight-grained, and is fragrant when freshly cut, very strong and durable, yet light and easily worked. It shrinks little, takes a smooth polish, and can be seasoned quickly. They are available in large quantities in Burma, Malabar and Central India, and suitable for practically every description of work.

10.8 CARPENTRY TOOLS

In order to successfully work different forms to accurate shapes and dimensions, the wood-worker must know the use of a large number of tools. The principal types which are manipulated by hand are described and illustrated below :

1. Marking &measuring tools.
2. Cutting tools.
3. Planing tools.
4. Boring tools.
5. Striking tools.
6. Holding & miscellaneous tools.

10.9 MARKING AND MEASURING TOOLS

Marking and measuring tools have been developed in order that true and accurate work may be assured. The commonest of such tools are :

Rules. Rules of various sizes and designs are used by wood workers for measuring and setting out dimensions, but they usually work with a *four-fold box-wood rule* ranging from 0 to 60 cm. This is graduated on both side in millimetres and centimetres, and each fold is 15 cm long. All the four pieces are joined with each other by means of hinged joints which make the scale folding.

For larger measurements carpenters use a *flexible measuring rule* of *tape*. Such rules are very useful for measuring curved and angular surfaces. When not in use, the blade is coiled into a small, compact, watch-size, case.

Straight edge. The straight edge (Fig. 10.4) is a machined flat piece made of wood or metal having truly straight and parallel edges. One of the longitudinal edges is generally made leveled. This is used to test the trueness of large surfaces and edges.

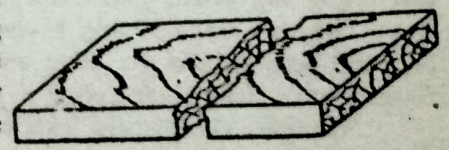


Figure 10.4 Straight edge

Try square. Try squares (Fig. 10.5) are used for marking and testing angles of 90°. It consists of a steel blade, riveted into a hard wood stock which has a protective brass plate on the working surface. Another type is the all-metal square, with steel blade and cast iron stock. Sizes vary from 150 to 300 mm, according to the length of the blade.

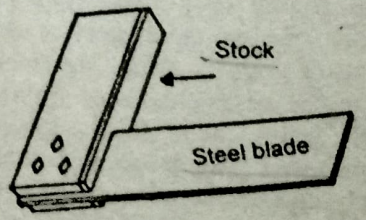


Figure 10.5 Try square

Mitre square. Mitre squares (Fig. 10.6) are used to measure an angle of 45°. They are made of all metal with a nickel-plated finish or with a steel blade, and an ebony or rose-wood stock. The blade varies from 200 mm, 250 mm and so on to a maximum of 300 mm long.

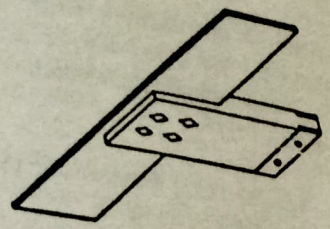


Figure 10.6 Mitre square

Bevel square. The bevel square shown in Fig. 10.7 is similar to the try square but has a blade that may be swivelled to any angle from 0 to 180°. This tool is adjusted by releasing with a turn screw of suitable size in a machine screw running in a slot in the blade.

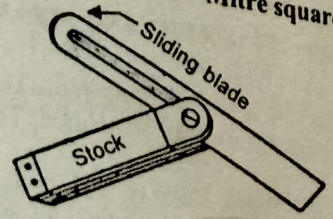


Figure 10.7 Bevel square

Combination square. Some wood workers prefer a combination square which is similar to the combination set used in bench work. It is a combination of a square, 45 - degree bevel, set square, rule, straight edge, and centre finder.

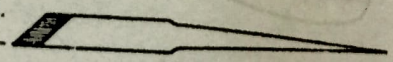
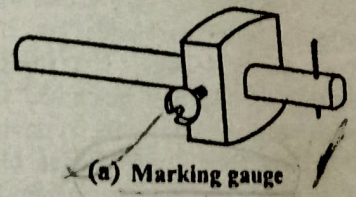


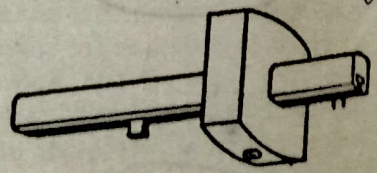
Figure 10.8 Marking knife

Marking knife. Marking knives (Fig. 10.8) are used for converting the pencil lines into cut lines. They are made of steel having one end pointed and the other end formed into a sharp cutting edge.

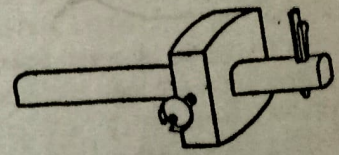
Gauges. Gauges are used to mark lines parallel to the edge of a piece of wood. It consists of a small stem sliding in s stock. The stem carries one or more steel marking points or a cutting knife. The stock is set to the desired distance from the steel point and fixed by the thumbscrew. The gauge is then held firmly against the edge of the wood and pushed along the sharp steel point marking the line.



(a) Marking gauge



(b) Mortise gauge



(c) Cutting gauge

Figure 10.9 Gauges

The *marking gauge* (Fig.10.9a) has one marking point. It gives an accurate cut line parallel to a true edge, usually with the grain. The *panel gauge*, is longer than the marking gauge, and is used to gauge lines across wider surfaces.

The *mortise gauge* (Fig. 10.9b) has two marking points-one fixed near to the end of the stem and the other attached to a brass sliding bar. These two teeth cut two parallel lines, called mortise lines.

The *cutting gauge* (Fig. 10.9c) has a cutting knife held in position by a wedge so that its projection may be varied for the depth of the cut. This gauge is useful for gauging fine deep lines for such joints as dovetails on wide wood, for cutting the edges of grooves, for inlaying, cutting through very thin stuff to make small strips, and cutting small rebates.

Wing compass. Wing compasses are composed of two finely pointed steel legs which are set to the desired position and held by a set screw and quadrant. They are used when stepping off a number of equal spaces, marking circles or arcs, and when scribing parallel lines to straight or curved work.

Trammel. The trammel is a form of beam compass, with a wooden beam, to take in work that is beyond the scope of a compass.

Divider. Dividers have both points sharpened in needlepoint fashion for dividing out centres.

Caliper. Calipers are used for measuring outside and inside diameters etc., especially where the sectional measurements cannot be taken.

Spirit level and plumb bob. These are used for testing the position of large surfaces. The spirit level tests for horizontal position. The plumb bob tests for vertical position . A combination of these two gives a right angle, and they are used where a try square would be far too small.

10.10 CUTTING TOOLS

Cutting tools include saws, chisels, and gouges.

Saws. The saw is probably the most abused of woodworking tools, chiefly because inexperienced users force it too much. When cutting across the grain, a different action is required from the saw teeth than when ripping with the grain. Therefore, different types of saws are used, as one type cannot do both jobs successfully. A saw is generally specified by the length of its blade measured along the toothed edge, and pitch of teeth, expressed in millimeters. Fig. 10.10 shows the different types of saws in common use.

Rip saw. Rip saws are used for cutting along the grain in thick wood. The blade is made of high grade tool steel, and may be either straight or skew backed. It is fitted in a wooden handle made of hard wood by means of rivets or screws. Rip saws are about 700 mm long with 3 to 5 points or teeth per 25 mm.

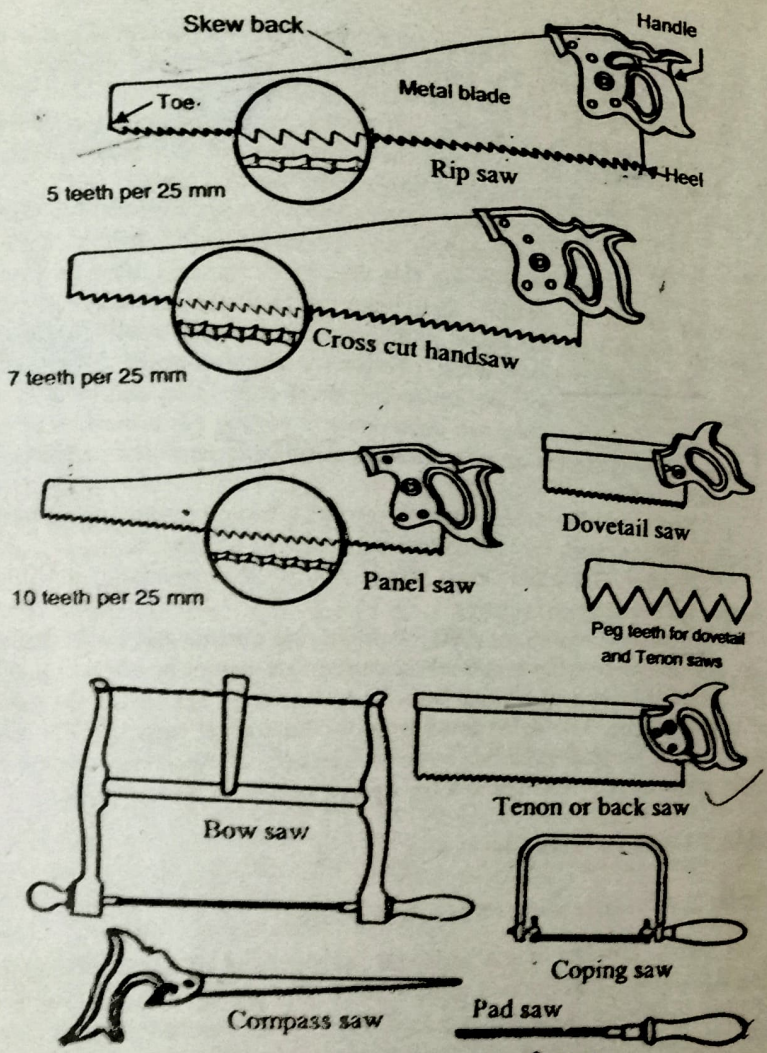


Figure 10.10 Different types of saws

The front or leading edge of the tooth forms a right angle with a line joining the points, and should be filed squared across the saw, with no bevel on front or back of the tooth. The action of these teeth is that of a series of chisels, which tear out shavings each equal to the width of a tooth.

The teeth are bent alternately, one to the right, the next to the left.

Bending the teeth in this manner is called "setting in saw". Please refer Section 14.11. The set of a saw provides clearance to prevent the blade from binding during the sawing operation.

Cross-cut saw. Cross-cut saws, or "hand saws" as they are sometimes called, are used for cutting *across* the grain in thick wood. They are 600 to 650 mm long with 8 to 10 teeth per 25 mm. The action of the teeth is that of a series of knives which sever the fibres and force out the waste wood in the form of saw dust.

Panel saw. A panel saw is about 500 mm long with 10 to 12 teeth per 25 mm and is very much like the cross-cut saw. It has a finer blade and is used for fine work, mostly on the bench. This is often used for ripping as well as cross-cutting. The teeth have slightly more hook than those of a cross-cut saw.

Tenon or back saw. This saw is mostly used for cross-cutting when a finer and more accurate finish is required. The blade, being very thin, is reinforced with a rigid steel back. Tenon saw blades are from 250 to 400 mm in length and generally have 13 teeth per 25 mm. The teeth are shaped in the form of an equilateral triangle and are sometimes termed "peg" teeth.

Dovetail saw. A smaller version of the tenon, this saw is used where the greatest accuracy is needed and fine shallow cuts are to be made. The number of teeth may be from 12 to 18 per 25 mm, while the length may vary from 200 to 350 mm.

Bow saw. The bow saw consists of a narrow blade. 250 to 350 mm long held in a wooden frame. The blade is held in tension by twisting the string with a small wooden lever. These saws are used for cutting quick curves, and, as the handles revolve in their sockets, the blade can be adjusted to any desired position when in use.

Coping saw. The coping saw has a very similar blade, held rigid in spring-metal frame. The blade is tensioned by screwing the handle. This saw is used for small radius curves.

Compass saw. The compass saw is used for sawing small curves in confined spaces and has a narrow tapering blade about 250 to 400 mm long, fixed to an open-type wooden handle. There are two types of compass saw, one having a fixed blade and the other with three interchangeable blades of different widths.

Pad or keyhole saw. This is the joiner's smallest saw, the blade being about 250 mm long. The blade of the pad saw is secured to the handle, through which it passes, by two screws. This arrangement allows the blade to be adjusted to the best length required according to the work. This saw is used for cutting key holes, or the starting of any interior cuts.

Chisels. Wood chisels most commonly in use include firmer chisels, either square of bevel edged, paring chisels, and mortise chisels.

They are usually specified by length and width of the blade.

Firmer chisel. The firmer chisel(Fig. 10.11) is the most useful for general purposes and may be used by hand pressure or mallet. It has a flat blade about 125mm long. The width of the blade varies from 1.5-50 mm.

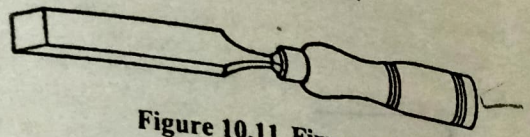


Figure 10.11 Firmer chisel

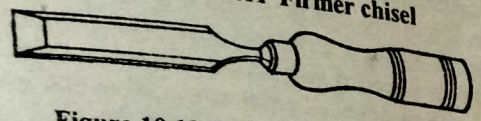


Figure 10.12 Beveled edge firmer chisel

Beveled edge firmer chisel. The beveled edge firmer chisel (Fig. 10.12) is used for more delicate or fine work. They are useful for getting into corners where the ordinary firmer chisel would be clumsy.

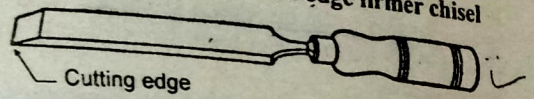


Figure 10.13 Paring chisel

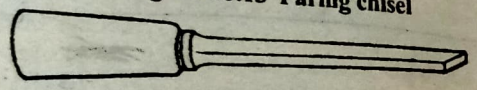


Figure 10.14 Mortise chisel

Paring chisel. Both firmer and beveled edge chisels when they are made with long thin blades are known as paring chisel (Fig. 10.13). This is used for shaping and preparing the surfaces of wood and is manipulated by the hands. The length ranges from 225 to 500 mm and width from 5 -50 mm.

Mortise chisel. The mortise chisel shown in Fig. 10.14, as its name indicates, is used for chopping out mortises. These chisels are designed to withstand heavy work. They are made with a heavy deep (back to front) blade with a generous shoulder or collar to withstand the force of the mallet blows on the oval-sectioned handle. Many mortise chisels are fitted with a leather washer at the shoulder to absorb the hard shocks of the mallet blows. Blades vary in width from 3-16 mm.

Gouges. Gouges (Fig. 10.15) are chisels with curved sections and may be either inside or outside ground. Inside ground gouges are used in exactly the same way for inside curved edges as a chisel would be for straight one ; outside ground gouges are used for curving hollows. Outside ground gouges are known as *firmer gouges* and inside ground gouges are called *scribing gouges*. When the later are made long and thin they are *paring gouges*. Gouges are made to a large number of different curves for different work, and the size ranges from 6 mm, with intermediate sizes to a maximum of 40 mm wide.

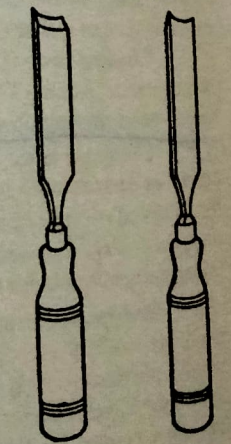


Figure 10.15 Gouges

10.11 PLANES

The plane can be likened to the chisel fastened into a block of metal or wood, and its blade cuts exactly like a wide chisel. The planes, in general use, are the jack, trying, and smoothing planes, and are known as bench planes. Besides, there are other planes which are used for special work.

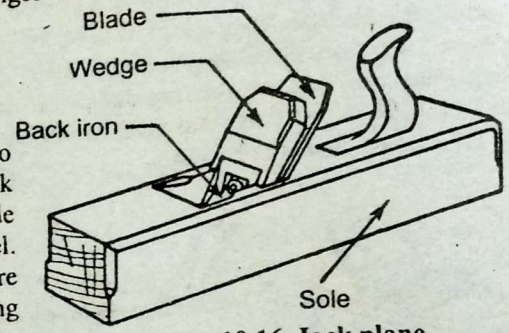


Figure 10.16 Jack plane

Jack plane. A jack plane shown in Fig. 10.16 is the commonest and is used for the first truing-up of a piece of wood.

It consists of a block of wood into which the blade is fixed by a wooden wedge. The blade is set at an angle of 45° to the sole. On the cutting blade another blade is fixed called cap iron or back iron. This does not cut, but stiffens the blade near its cutting edge to prevent chattering and partially breaks the shaving as it is made. It is the back iron which causes the shavings to be curled when they come out of the plane. Some types of planes do not have a cap iron. Jack planes are obtainable from 350 to 425 mm in length and with blades 50 to 75 mm wide.

Trying plane. The trying plane (Fig. 10.17) is a finishing plane, and is set with a very fine cut . It is used for producing as true surface or edge as possible, and is set to cut a shaving as thin as the smoothing plane. The length of the plane varies from 550 to 650 mm and the section of the body is 85 mm by 85 mm, with irons 60 mm wide.

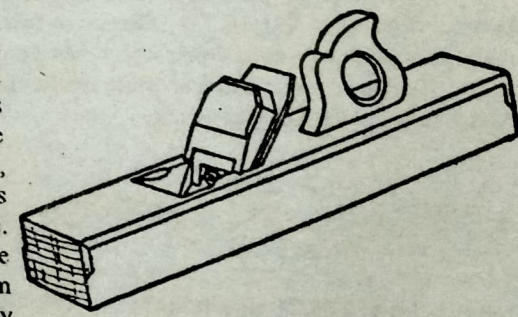


Figure 10.17 Trying plane

Smoothing plane. The plane (Fig. 10.18) is similar in action to a jack plane, except that it is set to cut a much thinner shaving. A smoothing plane, as its name indicates, is used for smoothing or finishing after a jack plane. The cutting edge of the latter is slightly curved, but a smoothing

plane has a straight cutting edge. It is 200 to 250 mm long having a blade of 70 mm wide.

Rebate plane. A rebate is a recess along the edge of a piece of wood ; this forms a ledge which is used for positioning glass in frames and doors. The rebate plane shown in Fig. 10.19 is used for sinking one surface below another, and shouldering one piece into another. The blade is open at both sides of the plane, and must be perfectly straight at the cutting edge. Widths range from 12 to 50 mm.

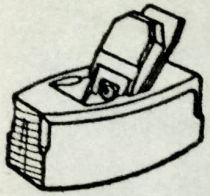


Figure 10.18 Smoothing plane

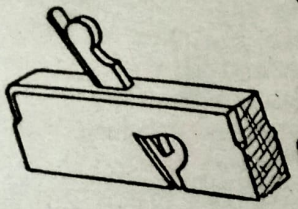


Figure 10.19 Rebate plane

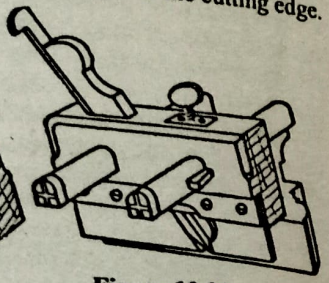


Figure 10.20 Plough plane

Plough plane. Where a panel is needed in a door it is used to fit it into a groove, not into a rebate. The plough plane illustrated in Fig.10.20 is used to cut these grooves. The depth of groove is controlled by a depth gauge which is fixed on the body of the plane and operated by a thumbscrew. These planes are usually supplied with eight to nine blades, vary in width from 3 to 15 mm and, of course, they are all interchangeable.

Spokeshave. This is a form of small plane used for cleaning up quick curves (See Fig.10.21) .There are two types, one which has a flat sole for outside curves and one which has a curved sole for inside curves.

Now-a-days, spokeshaves are made of iron, and some have a screw adjustment for the amount of cut.

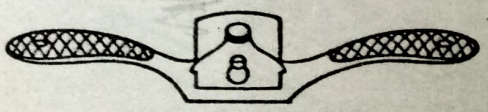


Figure 10.21 Spokeshave

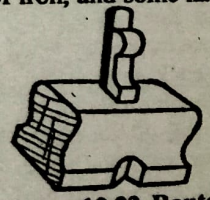


Figure 10.22 Router

Router. The router plane (Fig. 10.22) does not resemble other planes. This is used for cleaning out and levelling the bottom of grooves or trenches to a constant depth, after the bulk of the waste material has been taken out with saw and chisel.

Metal plane. Metal planes serve the same purpose as the wooden planes but facilitate a smoother operation and better finish. The body of a

metal plane is made from a gray iron casting, with the side and sole machined and ground to a bright finish. The thickness of the shaving removed is governed by a fine screw adjustment, and a lever is used for adjusting the blade at right angles. A metal jack plane us shown in Fig. 10.23

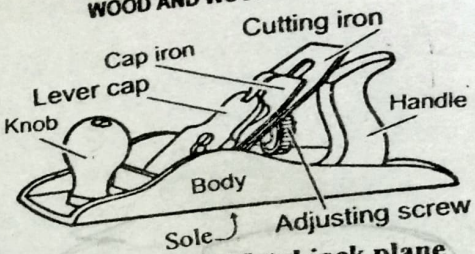


Figure 10.23 Metal jack plane

Special plane. In addition to those described above there are a number of special planes used by the woodworker to do special work. They include *compass* or *circular plane* for planing curves ; *bull nose rebate plane* for cleaning into rebates and corners inaccessible with other planes ; *shoulder plane* for planing across the end grain or hardwood shoulders ; *block plane* for planing small parts, especially when model making ; and *moulding plane* for producing a particular size and shape of moulding.

10.12 BORING TOOLS

Boring tools are frequently necessary to make round holes in wood, and they are selected according to the type and purpose of the hole. They include bradawl, gimlet, brace, bit and drill.

Bradawl and gimlet. The bradawl and the gimlet illustrated in Fig. 10.24 are hand-operated tools, and are used to bore small holes, such as for starting a screw or large nail.

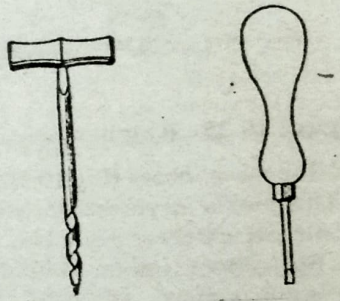


Figure 10.24 Bradawl & gimlet

Brace. The brace is a tool used for holding and turning a bit for boring holes. It has two jaws, which grip the specially shaped end of the bit. There are two types of braces in common use – ratchet brace and wheel brace. The *ratchet brace* is most useful for turning bits and drills of all kinds, being adaptable (a) for working in confined situations, and (b) for when the cut is particularly heavy and it is desirable to pull the handle through a quarter-turn only. A ratchet brace is shown in Fig. 10.25.

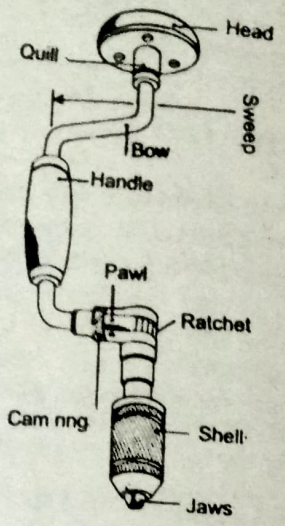


Figure 10.25 Ratchet brace

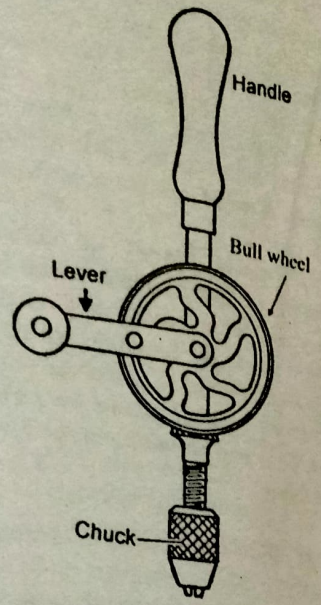


Figure 10.26 Wheel brace

The *wheel brace* (Fig.10.26) is used to hold round and parallel-shanked drills. This tool is invaluable for cutting small hole, accurately and quickly.

Bit. Most other forms of boring tools consist of "bits". The common types of bits used are shown in Fig. 10.27 and described below :

Shell bit. This bit is used for boring holes unto 12 mm diameter and which do not require a high degree of finish or size.

Twist bit or auger bit. It has a screw point and a helical or twisted stem. This bit produces a long, clean, and accurate hole either with or across the grain. This may be obtained in sizes from 6 to 35 mm diameter. The shorter type is called "dowel" bits and is used for preparing true and accurate holes to receive dowels.

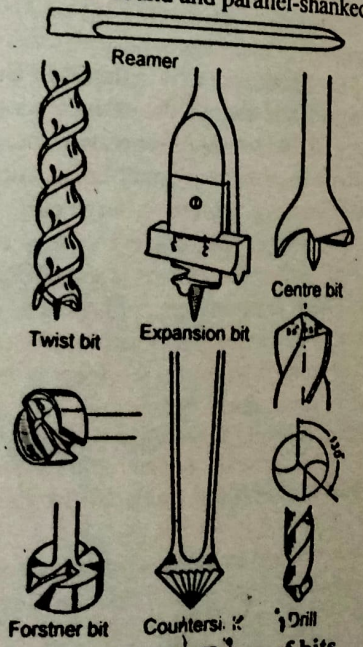


Figure 10.27 Types of bits

Expansive bit. In an expansive bit the main cutter can be adjusted to varying diameter within a certain range. It is fixed to the desired mark on the scale, and clamped in position by the plate and screw. Expansive bits are made in four sizes with interchangeable cutter for boring holes from 12 to a maximum of 125 mm diameter.

Centre bit. The centre bit is the most common. It is used for forming shallow holes across the grain. Centre bits produce an accurate and clean hole and may vary from 3 to 35 mm in diameter.

Forstner bit. It is extremely useful for sinking clean hole partly through a piece of wood and for cleaning out recesses. It has a small centre point for commencing and is then guided by its outer rim.

Countersink bit. It is used to shape a hole to fit the head of a countersunk headed screw.

In addition to the foregoing there are, of less importance, *nose bit, spoon bit, lip* and *spur bit, screw driver bit,* etc.

Drill. Morse drills are very convenient for making screwholes, especially when used with a wheel brace. This is adapted for drilling holes when wood working bits would be spoiled.

Reamers are tapered bits shaped like shell bits and used for enlarging holes.

10.13 STRIKING TOOLS

Striking tools include hammers and mallets.

Hammer. Engineers use ball-peened hammers, woodworkers cross-peened and claw hammers. The *Warrington hammer* shown in Fig. 10.29 is the type mostly used for bench work and all light Jobs. The head is cast steel, the face and peen being tempered ; the shaft which is wedged tightly into the head is made of wood or bamboo. These hammers are identified by size numbers and weight, No. 00, 200 gm up to No. 6,550 gm.

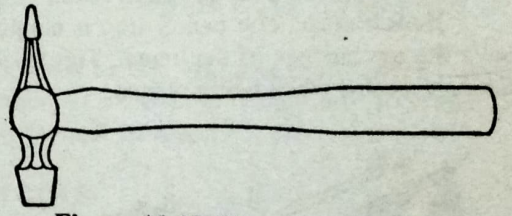


Figure 10.28 Warrington Hammer

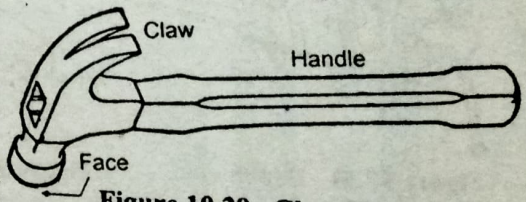


Figure 10.29 Claw Hammer

The carpenter more often favours the *claw hammer* (Fig. 10.28) because it serves the dual purpose of a hammer and a pair of pincers. The claw is used for pulling out any nails accidentally bent in driving. These hammers are made in numbers sizes from 1 to 4, weighing 375, 450, 550 and 675 gm.

Mallet. The mallet shown in Fig. 10.30 is a wooden-headed hammer of round or rectangular cross-section. The striking face is made flat to the work. A mallet is used to give light blows to the cutting tools having wooden handle such as chisels, and gouges.

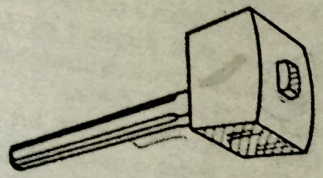


Figure 10.30 Mallet

10.14 HOLDING TOOLS

To enable the woodworker to cut his wood accurately, it must be held steady. There are a number of tools and devices to hold wood having its own purpose according to the kind of cutting to be done.

Bench vice. The bench vice illustrated in Fig. 10.31 is the most commonly used. Its one jaw is fixed to the side of the table while the other is kept movable by means of a screw and a handle. The whole vice is made of iron and steel, the jaws being lined with hardwood face which do not mark and which can be renewed as required.

Bench stop. The bench stop is simply a block of wood projecting above the top surface of the bench. This is used to prevent the wood from moving forward when being planed.

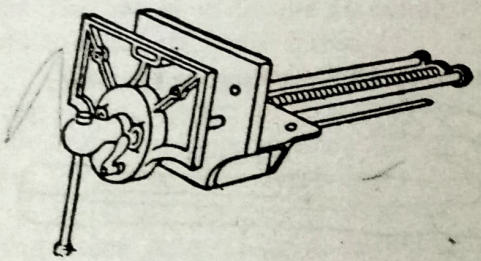


Figure 10.31 Bench vice

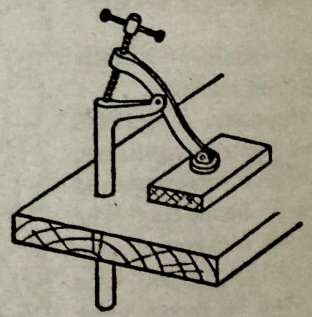


Figure 10.32 Bench holdfast

Bench holdfast. The bench holdfast shown in Fig. 10.32 is made with a cast iron pillar, square-cut screw threads on a steel bar, with a light vice handle and a drop-forged steel arm. By boring a series of holes through the top of the bench, holdfasts can secure the work in any desired position. This is useful for holding a piece of wood down on the bench when a vice is not advisable.

Sash cramp. The sash cramp or bar cramp in Fig. 10.33 is made up of a steel bar of rectangular section, with malleable iron fittings and a steel screw. This is used for holding wide work such as frames or tops.

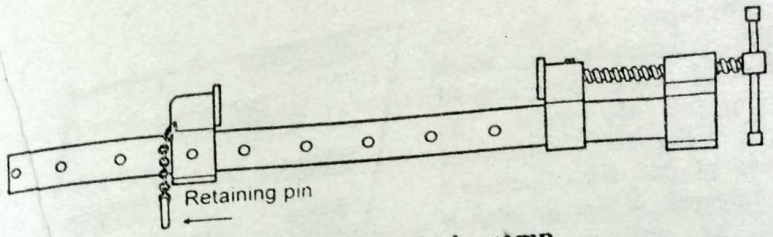


Figure 10.33 Sash cramp

G-cramp. The G-cramp in Fig. 10.34 is used for smaller work. It consists of a malleable iron frame that can be swivelled and a steel screw to which is fitted a thumbscrew.

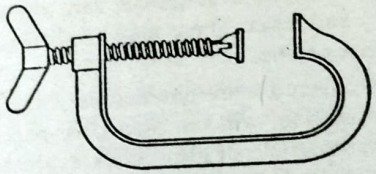


Figure 10.34 G-cramp

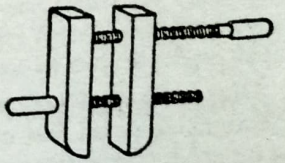
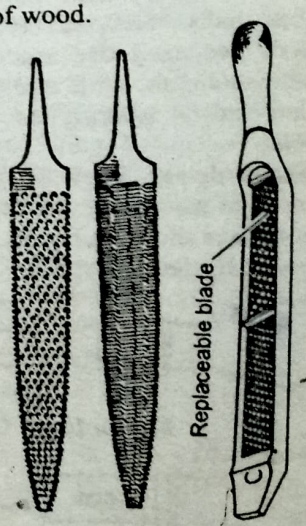


Figure 10.35 Hand screw

Hand screw. The hand screw in Fig. 10.35 is used where a wider area of pressure than that provided by a G-cramp is required. It consists of two steel screws fitted to two jaws made of wood.

10.15 MISCELLANEOUS TOOLS

Rasps and files. These are useful for cleaning up some curved surfaces. For instance, certain concave shapes are so small that the spokeshave cannot enter them and here a file is invaluable. Scratches left by the file can be removed with the scraper and glass paper. Surform tools introduced by Stanley Tools contain many small cutting teeth, each of which acts rather like a chisel or small plane. The teeth are not inclined to choke easily. The blades are disposable and when blunt must be replaced. Flat, convex and round blades are available. Illustrations are given in Fig. 10.36.



Rasp File Surform tool

Figure 10.36 Rasp, file and Surform tool

Scraper. As its name implies it scrapes (or, more accurately, cuts) very small shavings off the wood. The scraper in Fig. 10.37 consists of a piece of thin steel, hardened and tempered. A fine edge is made by pushing over or burnishing the edge of the metal to form that what is called a "burr"

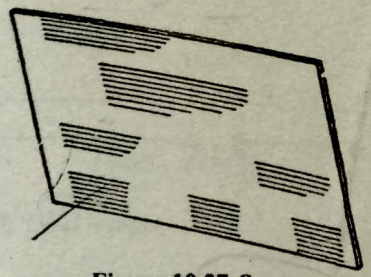


Figure 10.37 Scraper

Oilstone. An oilstone is an essential part of a carpenter's kit of tools. Oilstones may be either natural or artificial. The best-known varieties of stones are carborundum, Washita, Turkey and India. These may be obtained in various grades known as coarse, medium, or fine.

Glass-paper. Where a surface is covered with innumerable minute imperfections so small that no other cutting tool will do, then glass-paper should be used. It consists simply of small particle of glass stuck to sheets of paper ; it is the sharp edges of these particles which cut the wood. Glass-paper is made in varying grades according to the size of glass particles. These grades are denoted by numbers such as 00, 1, etc.

Pincer. The pincer in Fig. 10.38 is mainly used for pulling out nails, tacks, etc. It consists of two arms one arm has a ball end and the other arm has a claw end for levering out small tacks.

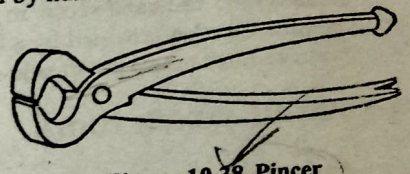


Figure 10.38 Pincer

Screw driver. Screw drivers are used for screwing or unscrewing screws used in woodwork. These may be obtained in various shapes and sizes but the one shown in Fig.10.39, known as a "cabinet screw driver", is considered to be the best type.

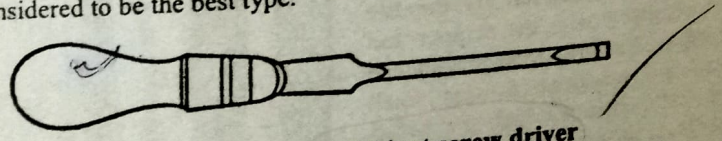


Figure 10.39 Cabinet screw driver

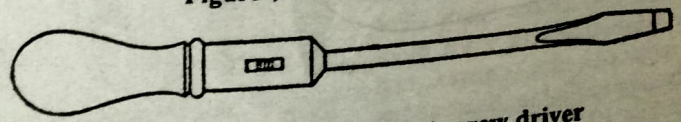


Figure 10.40 Ratchet screw driver

The *ratchet screw driver* (Fig. 10.40) is very useful for turning screws through a few degrees in awkward and confined spaces.

10.16 SETTING AND SHARPENING OF TOOLS

Saws. Saws are re-set by slightly bending each tooth the first tooth one way, the next the opposite way and so on. This is done so as to make the cut wider than the thickness of the blade, and ensure that it clears the sides of the cut as it passes through. A tool called *saw set* is used for this. There are different methods of setting the teeth of a saw but one by using a *gate* or *lever type hand set* is very common. It is shown in Fig. 10.41 and consists of a steel plate and handle. Along the edge of the plate are gaps or gates numbered according to the gauge or thickness of various saws. In use a suitable gap is slipped over the tip of a tooth, which is then bent over by using the handle of the set as a lever. The amount of set depends upon the type of work being done. Green or damp timber will require that the teeth have plenty of set, whilst dry wood requires less.

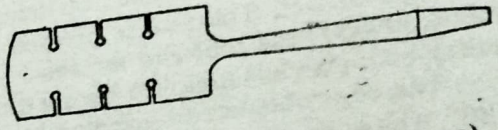


Figure 10.41 Saw set (gate type)

Normally, saws are sharpened after setting. A double-ended, single cut, three-cornered file, of suitable section size is the usual type of file used for sharpening saws. Great care must be taken to maintain the angle of the teeth as well as any cutting angle on the leading edge of each tooth. The saw is held with the tooth projecting about 3 mm. Before commencing to file the teeth it is a good plan to pass a flat file lightly along the tops of the teeth to put the points in a straight line. The teeth can then be filed individually.

Planes. The setting or cutting adjustment of planes is most important. The efficient working of planes depends on several factors :

1. The angle at which the blade is set in the body of the plane fixes the *cutting angle*. In the case of planes with a back iron these are 47.5° and 42.5° respectively.
2. The space between the cutting edge and the body of the plane has an important bearing on its working qualities. Coarse working planes, e.g., jack planes need at least 3 mm gap so that a thick shaving can bend easily through the opening. This gap may be as small as 0.4 mm for very thin shaving.

3. The back iron is set 3 mm to 0.4 mm from the cutting edge, depending upon the coarseness or fineness of the work. The nearer the back iron can be set to the cutting edge the better.
4. The distance between the cutting edge of the blade and the sole of the planes, called the *cut*, is kept from 0.8 mm to 1.6 mm for heavy cut and below 0.8 mm for fine cut. Of course, this depends on the quality of wood to be cut.

To obtain fine cutting edges of planes, a grindstone and an oilstone are used.

The bevel is first obtained by being ground on a rotating grindstone at an angle of 25°. The tool is pressed lightly against the wheel which revolves towards the tool and the latter is moved sideways. Wet or dry grinding both may be employed during the operation.

The edge obtained in grinding is very uneven because the particles of grit which do the cutting are larger in a grindstone. The edge is, therefore, brought to a fine condition by being rubbed on an oilstone using oil. But instead of rubbing the whole of the ground bevel, the chisel is raised slightly so as to give a slightly larger angle of about 30 to 35°. The smaller angle of 25° is known as the "grinding angle" and the larger one as the "sharpening angle". They are shown in Fig. 10.42.

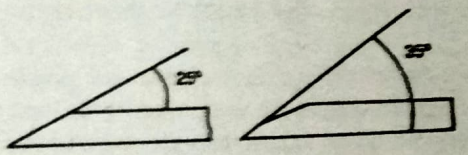


Figure 10.42 Approximate grinding and sharpening angle

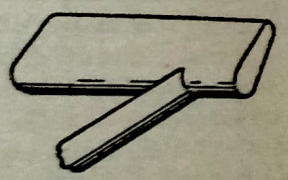


Figure 10.43 Oilstone slip

Chisels. Chisels are sharpened in the same way, but more care will be needed to keep the edge square.

For the sharpening of gouge, shaped stones (Fig. 10.43) called oilstone slips are used.

Bits. Centre bits and twist bits may be re-sharpened by filing with a small flat fine-toothed file, care being taken to maintain the cutting angle already on the tool.

10.17 CARPENTRY PROCESSES

Carpentry and joinery work involve a number of hand operations to finish the work to the desired shape and size with required accuracy. The following is the principal processes used in wooden construction :

1. Marking.
2. Sawing.
3. Planing.
4. Chiselling.
5. Boring.
6. Grooving.
7. Rebating.
8. Moulding.

10.18 MARKING

Marking is the process of setting out dimensions on a piece of wood for producing the required shape. These dimensions can be measured from an existing model or can be set out from the drawing prepared for the purpose. Each dimension is taken out with a folding rule which is the most convenient for general use, and is set out with the help of various instruments such as caliper, try-square, marking knife, marking gauge, etc. When marking a size the pieces are first planed true and square and then marked according to the desired dimension. The trueness of the surface is tested every time with the straight edge or the blade of the try-square or the steel rule. A zig-zag pencil mark is made on the true surface to distinguish it from the other faces.

10.19 SAWING

Sawing is one of the basic operations carried out in a carpentry shop. A wood is required to be sawn along the grains or across the grains and in many shapes such as straight inclined or curved. To start the cut, the thumb of the left hand is placed against the blade. This steadies the blade, enabling it to start in the right place, and prevents any accident in the event of the saw jumping. One or two short movements are first given, taking care that the saw works in the right direction and then full, easy strokes are applied to cut the wood. A point to note in all sawing is that the cut is made on one side of the line already marked and that is on the waste side, as in Fig. 10.44. A saw should never be forced and it is kept moving steadily for nearly its full length. Its own weight plus the slightest pressure is all that is needed.

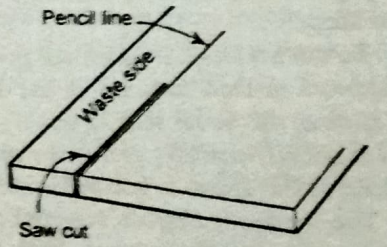


Figure 10.44 Sawing to pencil line

10.20 PLANING

Planing is the operation of truing up a piece of wood by a planer. This is known as "facing and edging", and the future success of most pieces of work is dependent on this preliminary operation being properly carried out. A properly planed surface should be perfectly straight in all directions, parallel in width and thickness, and with edges square to the face. This is achieved by carrying out the following sequence of operations.

First choose what apparatus to be the best face. Next plane off the rough surface with the jack plane, taking off as little as possible, but at the same time attempting to plane the surface by taking more off the high parts. Each time the pressure is applied on the forward stroke and relieved on the return stroke. At the start of the stroke, maximum force is applied to the handle for driving the plane. This force is balanced by pressing the other hand on the tip. For heavy work the pressure on the tip is applied with the palm of the hand, but for light work the tip is held in hand with the thumb on the top and the two centre fingers at the bottom of the sole. As planing proceeds, the material should be checked to see if it is straight across the face. This may be done with a try-square or by using the edge of the jack plane.

10.21 CHISELLING

Chiselling is the process of cutting a small stock of wood to produce the desired shape.

To cut horizontally with the grain the chisel is held slightly tilted to one side and pushed forward in the direction of the grain. For roughing down to size, the bevel side is down ; for the finish cut the bevel side is up. To chisel horizontally across the grain, the work is clamped in the vice. The blade of the chisel is grasped with the thumb and forefinger to act as a brake. The handle is slightly lowered down and chiselled from both sides to avoid splintering the corners. With the chisel held flat the high spot in the centre is removed. In vertical chiselling across the grain the chisel is controlled with the left hand pressing firmly on the blade of the chisel and resting on the wood. The chisel is tilted slightly to one side to give a shearing cut. In rounding or shaping a corner, chiselling should commence at the edge of the board and work round to the end, that is, with the grain, otherwise the corner of the chisel will bite into the grain and split the wood. Firmer chisels are used for heavier work and should be hit with the mallet ; in fact, the mallet should be used on all chisels and gouges whenever necessary.

A mortise and a tenon which are made in almost all wooden constructions can be produced with the chisel and mallet. A *tenon* is the

projected part of a piece of wood and is cut squared and finished to the desired size to suit the corresponding *mortise*, which is a recess, through or blind, of any shape except round, cut on the wood.

10.22 BORING

Boring is the process of producing round holes, through or blind, in the wood. This boring can be done straight or inclined to suit the type of work. While boring, the work is firmly secured in a holding tool in order to avoid production of an eccentric hole. Small holes can be made by using a bradawl and gimlet, but large holes require braces and bits or drills. These bits and drills should be turned constantly in one direction and withdrawn at intervals, to remove the waste core, by turning in the opposite direction and exerting an upward pull. When using the brace and twist bit to bore rather deep holes, the direction of the bit should be carefully checked at the start. The bit should be guided by sighting either with the try square or small straight edges. The operator must stand in a suitable position while boring in order to do this sighting. Correct marking and location of the centre are also very important to produce a hole of the correct size.

10.23 GROOVING

The grooving is a term which is almost always used with the term tonguing. These are operations of making grooves and tongues that are usually cut on the edges of planks and boards to join them together to form big boards of large width. A groove is a channel cut to any shape, and a tongue is the corresponding projection formed to fit into it. Actual application of grooves and tongues can very well be seen in drawing boards, floor boards, wall partitions and in other articles where considerably large sizes are needed. The groove is cut with a plough plane, and a tongue with tonguing plane or a moulding plane.

10.24 REBATING

Rebating is the process of making a rebate or recess taken out of the edge of a piece of wood. Examples of the rebate are : that part of the door frame in which the door fits, or the recess in a window sash which contains the glass. A rebate is made by a rebating plane. Rebates which are too wide for the rebate plane may be worked by running a few grooves with the plough plane to the correct depth, and then cleaning out the bulk of the waste with mallet and chisel.

10.25 MOULDING

Moulding is the process of cutting concave, convex and other curved surface along the length of a piece of wood. This is done by a moulding plane ; fixing a cutter iron of the shape required. Moulding work is done for preparing photo-frames and other decorative works.

10.26 CARPENTRY JOINTS

Constructional woodwork can be divided into two main classes : framework and carcase work. In framework, typical joints used, are the various *halving joints, mortise* and *tenon joints*, and *bridle joints*.

Carcase work is characterized by box-like shapes of solid wood or laminboard. Typical joints used, are *butt* or *rubbed joint*, *dowel*, *tongue and groove*, and the *screw* and *slot joint* ; other joints include *dovetail joints*, and *corner joints*.

Before any joints can be attempted it is necessary to prepare the stuff. This means planing the wood to size and getting four true surfaces.

Halving joint. The aim of this joint is to secure the corners and intersections of the framing, and at the same time keep all the face flush, that is, in the same plane. The halving joint, also termed a *half-lap joint*,

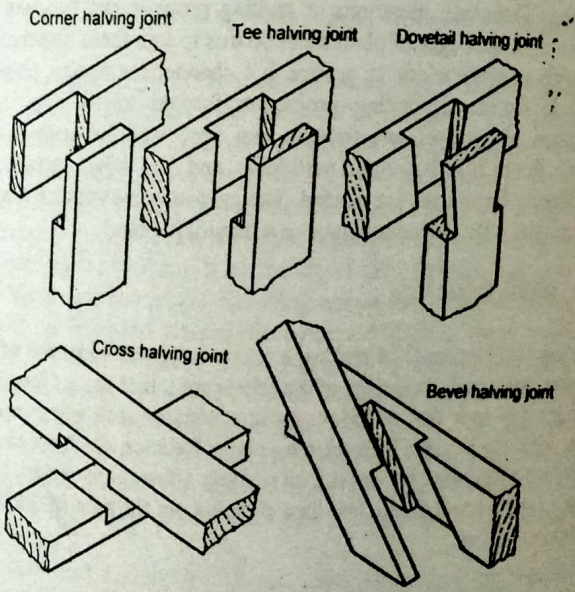


Figure 10.45 Halving joints

may be usefully employed in many types of framing where strength and appearance are of secondary consideration. Various forms of halving joint are shown in Fig. 10.45.

Mortise and tenon joint. This family of joint is a large one and is probably the commonest used by the woodworker. It consists of a rectangular peg (tenon) fitting into a rectangular hole (mortise). Various forms of mortise and tenon joints are illustrated in Fig. 10.46.

In making these joints the tenon is made by shaving only, except that in very wide ones the shoulders may be finished with a plane. After preparing the stuff the position of the tenon and mortise is squared on the

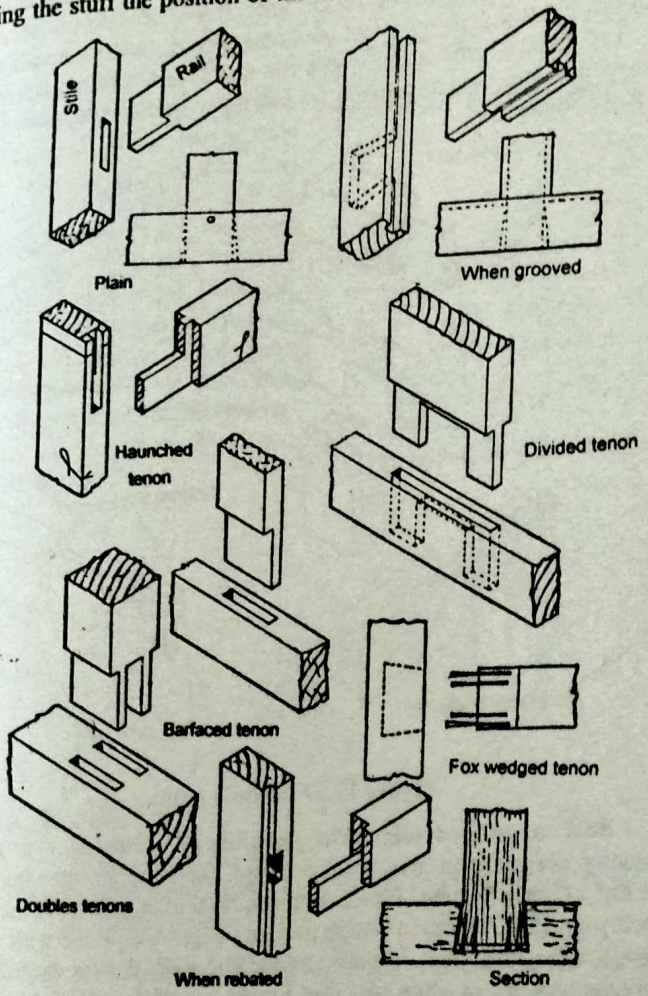


Figure 10.46 Mortise and tenon joints

wood with the pencil and then cut to prepare the pieces for making joints.

Two tools have been developed solely for making the joints : (1) mortise chisel, and (2) mortise gauge. For general framing work the width of a mortise is about one-third the thickness of the material to be mortised, and the length should not exceed six times the width.

Bridle joint. This form of joint is really the reverse of the mortise and tenon joint and is often called the open mortise and tenon. Different forms of bridle joints are shown in Fig. 10.47

The marking out is the same as for the through mortise and tenon joint, except for the placing of the cut lines. It will be noticed that there is no mortise, but two grooves ; and what was a tenon now becomes a slot.

The joint is often used where the members are of square or near-square section and thus unsuitable for making a mortise and tenon joint of good proportions.

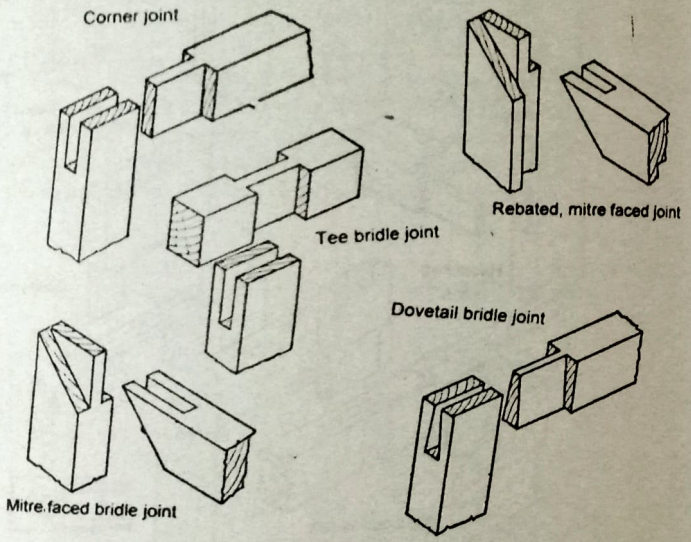


Figure 10.47 Briddle joints

Butt or rubbed joint. The fastening of boards edge to edge is frequently necessary to give a wider board, for example, drawing board, table top, counter top, etc. The commonest form of edge joint is the butt or rubbed joint (Fig. 10.48) in which two true edges are joined with glue. If properly done, this joint is very strong. For stuff thicker than 25 mm, additional strength is often provided by the use of dowels or screws and slots. The rubbed joint is made by planing the two edges true with a trying plane.

Dowel joint. The dowelled joint is often used as farming joint in the place of the mortise and tenon joint. This may be used to advantage in many cases, such as the joints in circular work, butt jointing two edges or positioning movable fittings. A typical dowel joint is shown in Fig.10.49.

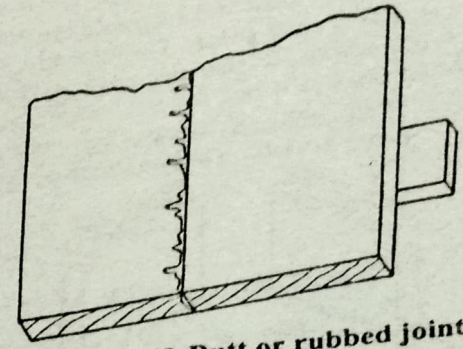


Figure 10.48 Butt or rubbed joints

Tongue and groove joint. Commercially machined boards for edge to edge jointing, such as drawing boards, floor boards, and match boards, are tongued and grooved. the tongues are used to provide extra support and additional gluing surface. These may be either self-tongues or loose as shown in Fig. 10.50. Self-tongues are prepared by cutting a tongue on one edge and a suitable groove on the other with the aid of a matching plane. In those tongues, both edges are trued and then plough grooved.

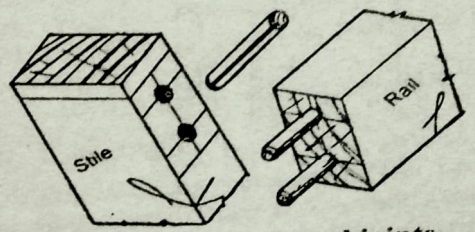


Figure 10.49 Dowel joints

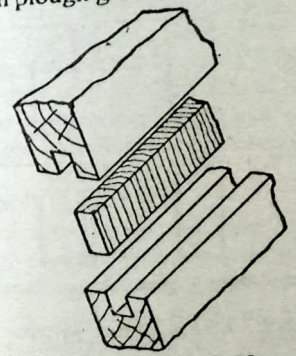


Figure 10.50 Self tongue or loose tongue

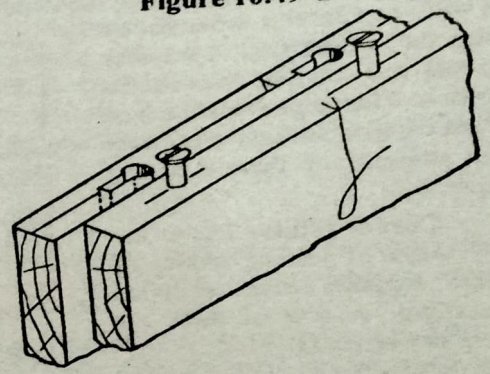


Figure 10.51 Screw and slot joint

Screw and slot joint. Where two pieces are to be secured secretly and glue may not be advisable, screw and slot joint can be used. One piece carries the screw, while the other piece has slots cut in it (Fig. 10.51) to

take first the head and secondly the body of the screw.

Dovetail joint. The dovetail joint is probably the strongest of all corner joints. It was primarily a joint intended to take a strain in one direction, but it has several variations and many applications, particularly in making box or carcase-like constructions—form small boxes to large pieces of furniture. Various forms of dovetail joints are shown in Fig. 10.52.

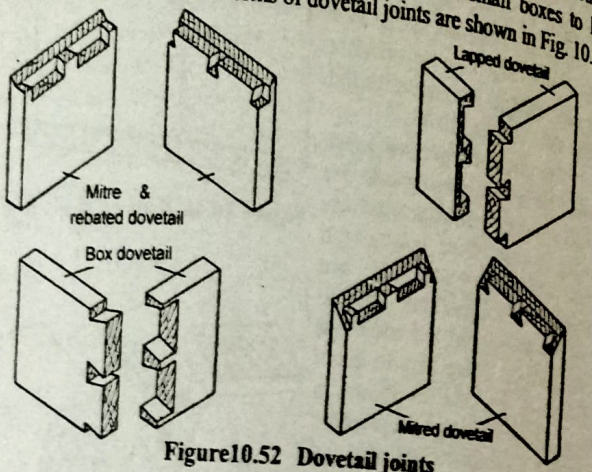


Figure10.52 Dovetail joints

There are two methods of this : one is to cut the pins first and then mark the sockets from them, and the other is to cut the sockets first. In the first method the marking out may be done neater, but each piece must be delt with separately, whereas by cutting the socket first, a number of pieces may be delt with in one operation, This is perhaps the best method, as the sockets are easier to cut straight and there is saving of time.

Corner joints There are many ways of joining angles or corners together other than by dovetailing. A few of these are shown in Fig.10.53.

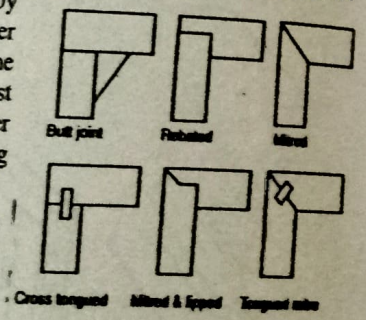


Figure 10.53 Corner joints

10.27 WOODWORKING MACHINES

Modern carpentry shop, in addition to the hand tools described earlier, requires the use of some power-driven machines, particularly where large-scale production is to be obtained. The size and capacity of the machines used depend on the size of the general run of the work to be done. Machines chosen for carpentry shop must be well built, and their accuracy should be dependable. They should be well guarded to protect the worker from the hazards of operation. The machines commonly used are briefly described below.

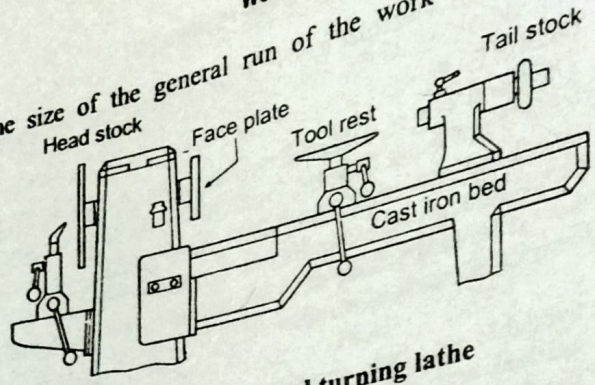


Figure 10.54 Wood turning lathe

WOOD WORKING LATHE

The woodworking lathe is one of the most important machines used in a carpentry shop. This is employed primarily for turning jobs in making cylindrical parts. However, by suitably manipulating the tools, tapers, radii, and other irregular shapes can also be easily turned.

It resembles the 'engine lathe' most frequently used in the machine shop, and consists of a cast iron bed, a head stock, tail stock, tool rest, live and dead centres, and a speed control device (Fig. 10.54). The drive, in modern lathes, is individual motor driven ; and a cone pully on the head stock spindle is connected by a belt to a cone pully on the motor shaft.

In practice, the workpiece is either clamped between two centres or on a face plate. Long jobs are held between the centres and turned with the help of gouge, skew chisel, parting tool, etc. Generally, the lathe is supplied together with a number of accessories for making it useful for a variety of jobs. The size of a woodworking lathe, as in the engine lathe, is usually specified in terms of the so-called "swing" of the lathe and the maximum distance between centres.

CIRCULAR SAW

Probably the second most important single machine in a carpentry shop is the circular saw. It can be used for ripping, cross cutting, mitering, bevelling, rabbeting, and grooving.

Although there are many types of circular saws such as universal saw, variety saw, bench saw, the basic working parts are common to all. Each has a flat surface or table upon which the work rests while being cut, a circular cutting blade, cut-off guide, and a ripping fence that acts as a guide while sawing along the grains of the wood. The circular saw usually has provisions for tilting the table upto an angle of 45° to enable the machine to cut at different angles required during mitering. levelling, etc.

The size of a circular saw is determined by the diameter of the saw blade.

BAND SAW

The band saw is designed to cut wood by means of an endless metal saw band that travels over the rims of two or more rotating wheels. Other parts of a band saw are frame, table, saw guides, saw tensioning arrangement, etc. Although the number of operation that can be performed on a band saw is less than those of a circular saw, it is most useful for making curved or irregular cuts in wood.

The band is available in two models, vertical and horizontal. In the former, two wheels are arranged side by side and the table is mounted underneath. In the latter model, illustrated in Fig.10.55, the wheels are arranged one above the other in a vertical plane below the table and the band passes through the table. As in the case of the circular table, angular cuts are obtained by tilting the saw table. The size of the band saw is specified as the distance from the saw band to the inner side of the frame. This distance is roughly equal to the diameter of the wheels.

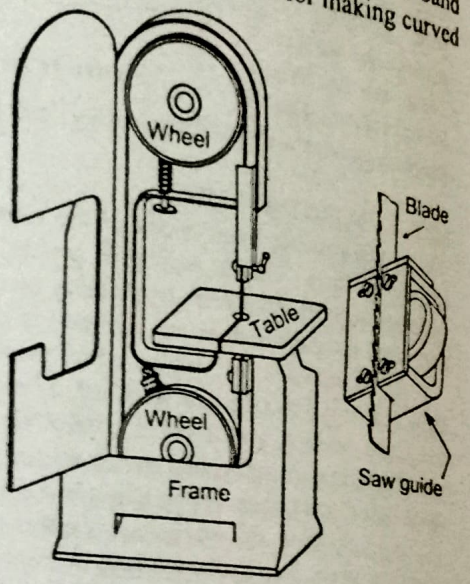


Figure 10.55 Band saw and guide unit

JIG SAW OR SCROLL SAW

The jig saw, which is also known as a scroll saw, is used for making intricate and irregular cuts on small jobs. On thin wooden pieces, jig saw can cut in a curvilinear path. The machine is actually a type of band saw of much smaller size and specially adapted to irregular work.

It consists of a base, frame, table, upper and lower chucks, guide assembly, and blade. Chucks hold the blade with its teeth pointing downward. The blade resembles a hand hacksaw blade in regard to its shape. The blade reciprocates vertically up and down and shapes the wood. The table of the jig saw can be tilted for angular work. The special feature of the saw is that it can be used to cut inside curves. A jig saw is specified by its blade-to-arm distance.

JOINTER

A jointer is used for planing straight edges and surfaces of boards. In practice, it performs the work of a hand planer and is capable of producing a true surface with sufficient accuracy and speed.

In consists of a frame, table, feed rollers, revolving head fitted with two or three cutter knives. With the help of feed rolls, the plank is fed to the cutter head which removes the wooden chips as the board advances and makes its surface smooth and plane. By means of an adjustable fence, the jointer can also be used for angular and level cuts. A jointer is specified by the length of the cutting blade.

WOOD PLANER

The wood planer is designed for planing large and heavy stock at a comparatively faster rate. The boards to be planed are fed by means of feed rolls along a table against a revolving cutter head. The cutter head is mounted on an overhead shaft which is adjustable for regulating the depth of cut . The table of the planer is much wider and longer than that of a jointer for accommodating large and heavy stock.

MORTISER

A mortise is a square slot cut in the direction of depth for the purpose of making a mortise and tenon joint in a wooden piece. The mortising machine is used for cutting mortise and tenon joints which are very laborious and time consuming operations. There are three types of mortisers, namely (1) hollow chisel mortiser, (2) chain mortiser, and (3) oscillating bit mortiser.

The *hollow chisel mortiser*, the most commonly used machine, consists of a revolving spindle carrying an auger bit at the bottom end. The auger bit rotates at a high speed inside a hollow chisel of square section. When the chisel is forced into the wood, the bit bores a square hole by the sharp end of the chisel. the auger bit and chisel thus work together and perform boring of a square hole. The depth of the mortise is regulated by means of an adjustable depth stop. The spindle is

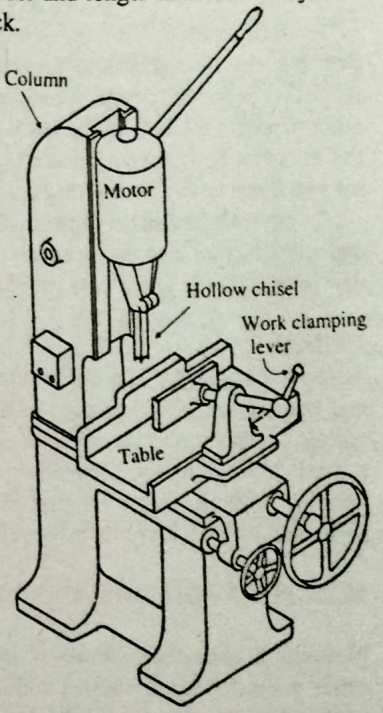


Figure 10.56 Power mortiser

rotated by an electric motor, and tool-feed is obtained by pressing foot-lever. This is illustrated in Fig. 10.56.

The *chain mortiser* is primarily used for making mortises in doors and windows. It carries an endless chain which has saw type teeth on its outer surface. The chain revolves around a guide bar and cuts the stock. The mortise of the desired length is produced with round bottom corresponding to the profile of the revolving chain.

The *oscillating bit mortiser* carries a oscillating router bit and produces comparatively small mortises suitable for small cabinet and chair work.

SANDING MACHINES

Sanding is the operation of finishing wooden items after they have been machined. Essentially, a sanding machine performs a sand papering job to produce a uniformly sanded surface. Three common types of sanding machines are :

1. belt sander. 2. spindle sander. 3. disc sander.

Belt sander. It has an endless cloth backed abrasive belt which runs over two drums and is used for sanding and shaping flat surfaces. One of the drums is rotated by an electric motor and serves as the driver, while the other supports the belt and keeps it in proper tension. For sanding work by the abrasive belt, the workpiece is supported by an adjustable table that may be tilted to any desired angle.

Spindle and disc sanders. They are employed for curved surfaces and use abrasive disc and vertical abrasive spindle. During operation , the disc or the spindle as the case may be, rotates and performs the work.

GRINDER

A small tool grinder is a must for all woodworking shops for sharpening and shaping various tools used in the shop. The grinder has two grinding wheels fastened on to the two ends of a rotating spindle which is driven by a small electric motor. Generally, one of the wheels is used for coarse grinding while the other for fine grinding. Sometimes one of the wheels, particularly which is softer, is provided with a wet-grinding attachment.

10.28 PLYWOOD AND VENEER MANUFACTURING

Plywood is basically made up of an odd number of thin layers of wood, called veneers bonded together with an adhesive (synthetic or natural). The veneers are placed on each other in such a way that grain of each alternate layer crosses the adjacent layer at right angle. The plywood becomes extremely strong, stable, rigid for such arrangement of veneers. It is having high resistance to impact also.

The number of veneers used in making plywood is never less than three and may be as many as 15. The art of veneer peeling and slicing has been refined with minimum thickness of 0.2 mm and maximum of 6 mm now possible.

Fig. 10.57 shows some varieties of plywood.

When the middle veneer is thicker than the outer ones, the board is known as *stout-heart*. Boards with more that three laminates are known as *multiply*. Standard plywood may have thickness ranging from 3 mm to 25 mm. But thinner or thicker plywood can be manufactured for special purposes.

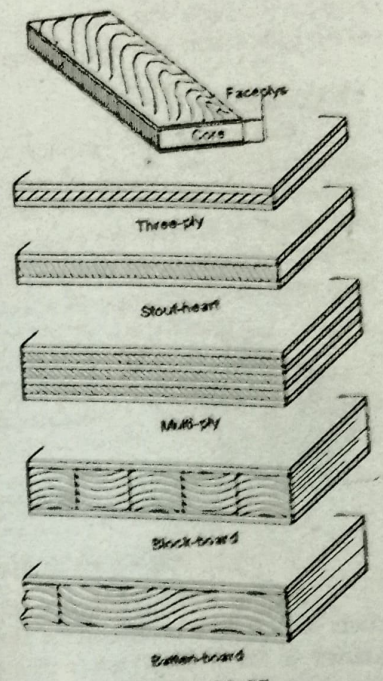


Figure 10.57

Block boards are manufactured in similar length and width as plywood and in thickness of 12, 16, 18, 24 and 25 mm. The core consists of 25 mm wide wooden strips and outer faces are good quality veneers of thinner sections (1-3 mm). In *batten board* the core is more than 40mm wide.

Chipboard is manufactured from fine wood particles or wood wastes from other timber-processing systems, bonded together with synthetic resin glue under heat and pressure. *Oriented-strand-boards* (OSB) are engineered, mat-formed panel products made of strands from small diameter round wood logs and bonded by phenol-formaldehyde under heat and pressure. They are stronger than chipboards and meet nearly all the specifications of ply-wood.

Plywood Manufacturing. The manufacture of plywood consists of nine steps and are shown in Fig.10.58.

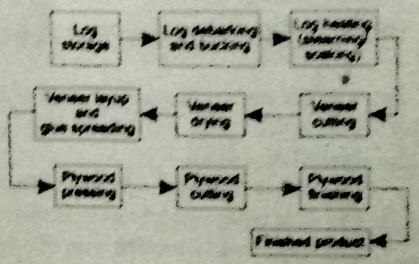


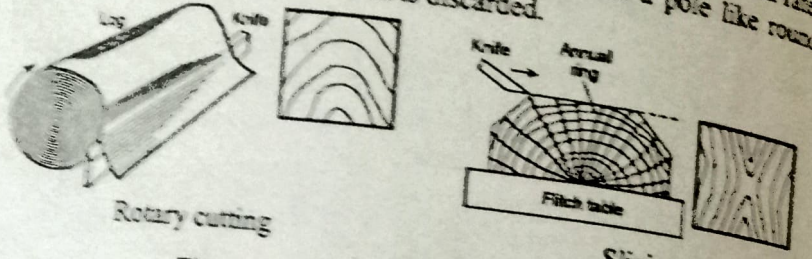
Figure 10.58 Process of manufacturing of plywood

As veneers are made from softwood and hardwood only, the log is first *debarked* i.e. outer bark is removed. In the next step the log is cut to appropriate length, known as *bucking*. The

logs cut in length wise (known as *blocks*) are heated around 95°C using hot water bath, steam heat or hot water spray to soften the logs for veneering.

VENEERING

Rotary cutting : For most applications, the veneers are peeled from cylindrical blocks (logs) of good girth and clear straight grains. The veneers are peeled rotary fashion (rotary cutting) from the block by a long knife fitted to a lathe-like machine. The knife advances at a uniform rate, peeling the veneers of constant thickness. At the end a pole like round body remains containing pith which is discarded.



Rotary cutting Slicing

Figure 10.59 Methods of veneering

Slicing : For producing decorative, high quality veneer, a veneer slicer is used. In this method the block is first cut diametrically in two parts known as flitch. The flitch is then mounted on the flitch table and sliced. Fig.10.59 shows the methods of veneering using *flat slicing* method.

Veneer drying and other operations : Veneers so produced contain high level of moisture, and thus are sent to a drier to dry them in the range of 150°C to 250°C. Once the veneers reach the desired level of moisture content, they are cut to size and conveyed for *layup* operation, where a thermosetting resin is spread evenly on the veneers either by a glue spreaders on a spray system. Assembly of the plywood panels must be done such that the grains of alternate layers are at right angle.

The assembly is then hot pressed, cut in size and the edges trimmed. The face and back may be sanded if necessary.

10.29 AUXILIARY MATERIALS USED IN CARPENTRY

Some of the materials utilised in carpentry operations are :

1. Nail (Fig. 10.60)
   (a) Hand-wrought – forged by hand from hot iron.
   (b) Cut nails – cut from iron strip by machine.
   (c) Cast nails – molten iron run into moulds.
2. Wood Screws (Fig.10.61)
3. Raw plugs : Used to fix items like cabinet, mirrors , racks etc. on walls.

4. Wood preservatives.
5. Glue and adhesives.
6. Wood polish.

Wood preservatives : Wood deteriorates by exposure, moisture, human contact, airborne pollutants and the effects of time. Wood preservatives are used to minimise the *deterioration*. These can be divided into two general

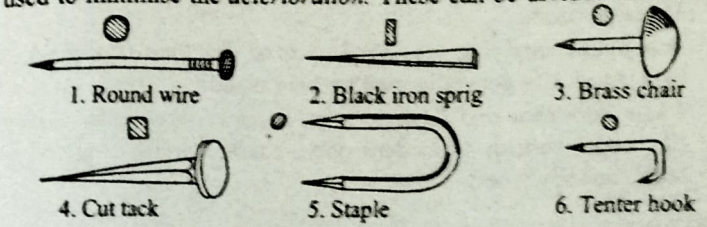


Figure 10.60 Types of nails

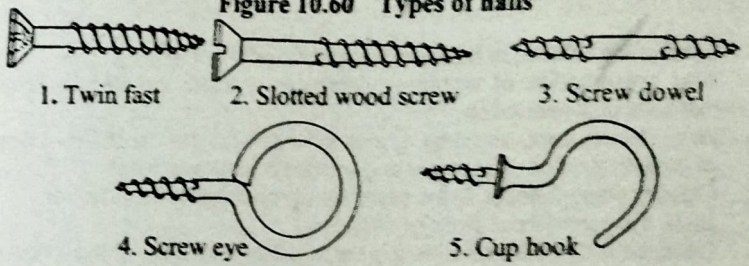


Figure 10.61 Wood screws

classes : (1) Oil borne preservatives such as creosote and petroleum solutions of pentachlorophenol and (2) Water-borne preservatives that are applied as water solutions.

Coal-tar *creosote* is a black or brownish oil made by distillation of *coal tar* that is obtained after high temperature carbonation of coal. Its various advantages include : (a) high toxicity to wood-destroying organism; (b) ease in application; and (c) relative low cost.

Glue and adhesives : Glues and adhesives are used to strengthen the bond of wooden parts after the joinery is made. They are :

1. Animal glue derived from the bones and hides of animal.
2. Casein derived from milk.
3. Synthetic resins urea-formaldehyde formulation.
4. Aerodux resorcinol-phenol-formaldehyde resins which can be used as gap-filling adhesive in wood joints, preventing fungus and insect attack.
5. Polyvinyl acetate, cold setting resin glue used for furniture assembly.

Wood polish : A large number of wood polishes in the form of liquid and paste are available in the market. They increase the look of the wooden

parts / furniture and prolong (shelf) life of the items. The types of wood polishes are :

1. *French polish :* made by dissolving shellac in methylated spirits with hardening additives.
2. *Oil polish:* linseed oil, to be applied in numerous coats till a desirable finish.
3. *Wax polish:* applying successive coats of wax directly applied on bare wood. It is generally used for hard wood.
4. *Clear varnishes and lacquers :* may include traditional varnish like copal varnish or modern polyurethane varnish. Applied on warm and dry wood.

REVIEW QUESTIONS

1. What is the difference between hard wood and soft wood ?
2. Why preservation of timber is necessary ? Describe in brief a few methods of preservation.
3. What do you understand by "grains in wood" ? State the different types of grain that wood possesses and explain their characteristics.
4. Classify wood defects. Draw sketches of natural defects in timber.
5. State the commercial sizes of timber.
6. Describe with neat sketches the construction and uses of the following : (a) Tenon saw, (b) Bow saw, (c) Key-hole saw, (d) Firmer chisel, (e) Socket chisel, (f) Wooden jack plane, (g) Iron jack plane, and (h) Smoothing plane.
7. What is "setting" of saw teeth ? Why is it done ?
8. Sketch and describe giving uses of commonly used : (a) holding and supporting tools, (b) striking tools, (c) bits and braces.
9. What do you understand by the term "Joinery" ? What are the different joints used in wood working ? Describe any two with neat sketches.
10. Sketch and describe the following joints made in a carpentry shop : (a) Mortise and tenon joint, (b) Lap dovetail joint, (c) Briddle joint, (d) Through dovetail joint, (e) Rafter joint, and (f) Notching joint.
11. What is the specific use of wood turning lathe? (b) Sketch and describe its working in detail.
12. Sketch and describe in brief the construction and working of the following : (a) Circular saw, (b) Jig saw, (c) Band saw and (d) Jointer
13. What are the common types of mortising machine used in wood working ? Describe the working of a hollow chisel mortiser.
14. What are machine sanders? How does a belt sander differ from a disc sander ? Which sander will you prefer and why ?
15. Name various wood preservatives. Describe one briefly.
16. Write in brief the making of plywood.
17. How veneers are prepared? Write one method in full.
18. Write short notes : (1) OS boards and chipboards. (2) Block boards.