

Carpentry

✓ Carpentry is the process of shaping timber, using hand tools. The products produced are used in building construction, such as doors and windows, furniture manufacturing, patterns for moulding in foundries, etc. Carpentry work mainly involves the joining together of wooden pieces and finishing the surfaces after shaping them. Hence, the term *joining* is also used commonly for carpentry. A student studying the fundamentals of wood working has to know about timber and other carpentry materials, wood working tools, carpentry operations and the method of making common types of joints.

6.1 Materials Used in Carpentry

Basic materials used in carpentry shop are timber and plywood. Auxiliary materials used are nails, screws, adhesives, paints, varnishes, etc.

6.1.1 Timber

✓ Timber is the name given to wood obtained from exogenous (outward growing) trees. In these trees, the growth is outward from the centre, by adding almost concentric layers of fresh wood every year known as *annual rings*. After the full growth, these trees are cut and sawed to convert into rectangular sections of various sizes for engineering purposes.

Timber is available in market in various shapes and size. The common shapes and sizes are given below:

1. *Log*: This is the trunk of the tree which is free from branches.
2. *Balk*: This is the log after sawing roughly to square cross section.
3. *Deal*: This is the log after sawing into rectangular cross section of width about 225 mm and thickness up to 100 mm.
4. *Plank*: This is the timber piece having width more than 275 mm and thickness 50 to 150 mm.
5. *Board*: This is the timber piece below 50 mm in thickness and above 125 mm in width.
6. *Batten*: This is the timber piece below 175 mm in width and thickness between 30 mm to 50 mm in thickness.
7. *Scantlings*: These are timber pieces of various assorted and nonstandard sizes other than the types given above.

6.1.2 Classification of Wood

✓ The timber used for commercial purposes can be divided into two classes as *soft wood* and *hard wood*.

Soft wood

A soft wood is light in weight and light coloured. They may have distinct annual rings but the medullary rays (radial lines) are not visible and the colour of the *sap wood* (outer layers) is not distinctive from the *heart wood* (inner layers). These woods cannot resist stresses developed across their fibres; hence, not suitable for wood working.

Hard wood

In this type of wood the annual rings are compact and thin, and the medullary rays (radial lines) are visible in most cases Figure 6.1. Hard woods are nearly equally strong both along and across the fibres. Hard wood is the material used for wood working.

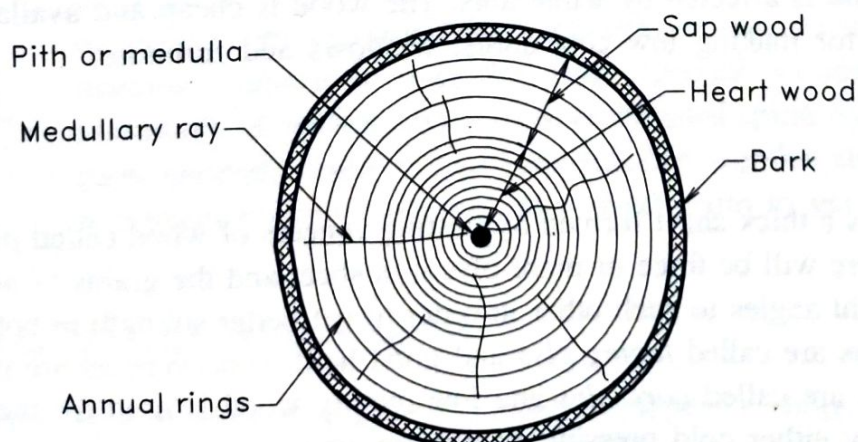


FIGURE 6.1

Cross-section of a hexogenous tree.

6.1.3 Indian Timber

There are a number of types of hard wood and soft wood available in India, which are suitable for carpentry work. Some of the popular names and a brief description of them are given below.

Teak: This is a strong hard wood suitable for almost all important carpentry works. It has brown colour, is comparatively light in weight and easy to work. Shrinking during drying is little and can be easily seasoned. Highly finished and polished surfaces can give very good smoothness and appearance. Due to all these advantages, teak wood is commonly used for costly furniture, doors and windows. Teak is available in all over India and has small difference in material, properties and appearance from place to place.

Sissu: This is a dark brown, tough and durable hard wood. It is considered as one of the best Indian woods suitable for furniture. This wood is available in northern and central India.

Sal: This is a heavy, dark-coloured, close-grained hard wood. It is extensively used for building works as well as for railway sleepers. They grow abundantly in forests all over India. Seasoning of this wood is very slow and the wood working is hard.

Mahogany: This is a hard wood having red brown colour. The grains are fine and have wavy shape. Since the wood contains resinous oil, insects cannot attack the wood. They are largely found growing in Himalayas. For pattern making and cabinet work, mahogany is very commonly used.

Deodar: This is a light-coloured coarse grained wood used for carpentry work. Furniture, doors and windows, railway sleepers, etc. are built using this wood. They are seen in central and northern parts of India.

Babul: This wood is pale red to brown in colour, hard and close-grained. It is used for making agricultural implements, body of carts, tool handles, etc. The wood grows all over India and is readily available for use.

Mango: This is a soft wood of inferior quality. It can decay when exposed to wet weather and is affected by white ants. The wood is cheap and available all over India and used for making low cost doors, windows and furniture.

6.1.4 Plywood

Plywood is a thick sheet formed by pasting veneers of wood called *plys* together using glues. There will be three or more *plys* in a sheet and the grains of adjacent layers are kept at right angles to each other in order to get better strength in both directions. The outer layers are called *facing plys* and good hard wood veneers are used for that. The inner ones are called *core plys* and low quality wood is used for them. The plywood is made by either cold pressing or hot pressing.

Plywood can be used as solid board or stock which are having uniform thickness. Since the grains are oriented in perpendicular directions, plywood has better strength in both directions. It can be made in very large sheet size without joints. Plywood sheets can be bent to shapes of different designs. Decorative surfaces can be obtained by using costly attractive facing plys like teak wood. Due to the above advantages plywood sheets are very widely used for making furniture, boxes, doors, cupboards, etc.

6.1.5 Auxiliary Materials

There are a number of materials, other than timber, used in carpentry work. A brief description of them are given below:

1. *Screws*: Screws of different sizes and head forms are commonly used for fixing metallic fittings like hinges, tower bolts, etc. and for screwing parts strongly. They are made in steel or brass and is screwed to wood using screw drivers.
2. *Bolts and nuts*: To join heavy wooden parts, bolts and nuts of standard size are commonly used.
3. *Nails*: Wire nails having different head forms are used for reinforcing glued joints and fastening different parts. They may be made of brass, copper or mild steel.
4. *Dowels*: A dowel is a wooden pin made out of bamboo or similar wood by the carpenter. It is used to secure wooden joints tightly by inserting through drilled holes across them.
5. *Adhesives*: To join parts having large area of surfaces, glues of different types are used. After applying the glue on the surface to be joined, the parts are kept in assembled position and secured tightly using clamps till drying or curing is complete. Some of the adhesives used in wood work are animal glue, casein glue, resin glue, vegetable glue, contact cement, etc.
6. *Surface coatings*: After finishing the carpentry work, the surfaces of wooden parts are protected from moisture and weather by applying varnish, polish or oil paint. They can give better appearance also. *French polish* is the coating material commonly used for fine finished wooden parts. This consists essentially of *shellac* dissolved in methylated spirit. Synthetic enamel is the oil paint generally used to coat semi-finished wooden surfaces. A primer of this is applied initially, followed by enamel paint to get the finished surface.

6.2 Tools for Wood Working

There are a number of hand tools used in carpentry shops. They can be classified according to their uses mentioned below.

1. Measuring and marking tools
2. Cutting tools
3. Striking tools
4. Planing tools
5. Work holding devices
6. Miscellaneous tools

6.2.1 Measuring and Marking Tools

Rules

For measuring and setting out dimensions, various types of rules are used in carpentry shops. They include the following:

1. *Steel rule:* A stainless steel rule of length 30 cm or 60 cm.
2. *Fourfold box-wood rule:* This is a wooden scale consisting of four pieces joined together by hinges. The total length is usually 60 cm.
3. *Flexible measuring rule:* For measuring large dimensions as well as curved or angular surface dimensions, these tape type rules are used. When they are not in use, the tape is coiled into a small compact circular case.

Straight edge and squares

To measure straightness as well as the perpendicularity of surfaces or edges, the following types of tools are used.

1. *Straight edge:* This is a machined flat piece of wood or metal having perfectly straight and parallel edges.
2. *Try square:* This consists of a rectangular steel blade fixed rigidly to a hard wood stock or cast iron stock. The size varies from 150 to 300 mm according to the length of blade (Figure 6.2).

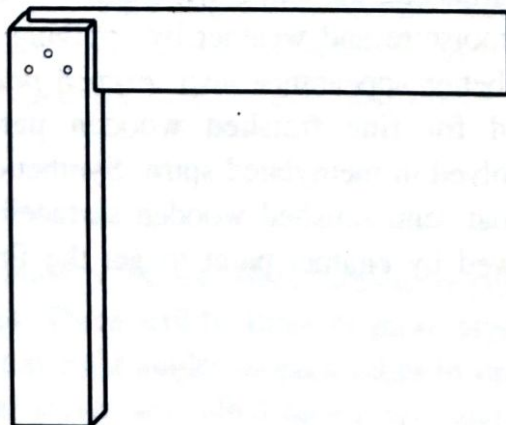


FIGURE 6.2

Try square.

3. *Mitre square:* For measuring 45° , a mitre square made of metal is used. The length of the blade is usually 200 to 300 mm.

4. *Bevel square*: For setting, duplicating, testing or comparing angles, a bevel square is used. It is similar to try square with a difference that the blade can be swivelled to any angle and fixed by screwing a wing nut.
5. *Combination square*: This is a combination of a square, 45° bevel, set square, rule, straight edge and centre finder, similar to the one used in fitting shops (Refer to Chapter 3).

Scriber or marking knife

To convert the pencil lines drawn on the wooden surface into deep scratch lines on the surface, the marking knife is used. They are made of steel with a sharp point at one end and a flat blade at the other end as shown in Figure 6.3(a).

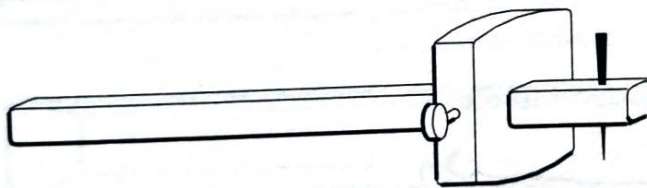
Gauges

Gauges are used to mark lines parallel to the edge of a wooden piece. It mainly consists of a wooden stem sliding inside a wooden stock. The stem carries one or more steel marking points at one end. The stock position on the stem can be varied and fixed rigidly by tightening the thumb screw. To mark a line parallel to an edge, the gauge stock is held firmly against the edge and pushed along it, pressing the steel pointer to the surface. Depending on the purpose, the gauges can be grouped as mentioned below:

1. *Marking gauge*: [Figure 6.3(b)] To mark single line.
2. *Mortise gauge*: To mark two parallel lines.
3. *Cutting gauge*: To cut thin section to get straight strips (up to 3 mm) instead of marking parallel to the edge.



(a) Marking knife



(b) Marking gauge

FIGURE 6.3
Marking tools.

Miscellaneous measuring tools

In carpentry shops there are many measuring and marking tools other than the types explained above. Some of the frequently used tools are given below:

1. *Wing compass*: It is used to mark circles, arcs etc.
2. *Trammel*: This is a beam compass to mark large size radius.
3. *Divider*: It is used to divide and mark dimensions.

4. *Spirit level*: It is used to check the horizontality of flat surfaces.
5. *Plumb bob*: It is used to check the verticality of a surface.

6.2.2 Cutting Tools

Saws

Saw is a cutting tool which has teeth on one edge and cutting is effected by reciprocating motion of the edge relative to the workpiece. There are different types of saws depending on the shape, size, use and direction of cutting motion. If the cutting occurs during the forward motion, such a saw is called *push type*, whereas in pull type the cutting occurs during backward motion. Commonly used types of saws are briefly explained below.

1. *Cross cut saw (Hand saw)*: It is used to cut thick wooden pieces across the grains (Figure 6.4). Cross cut saw has about 3 to 4 teeth per cm with a saw length of about 650 mm.

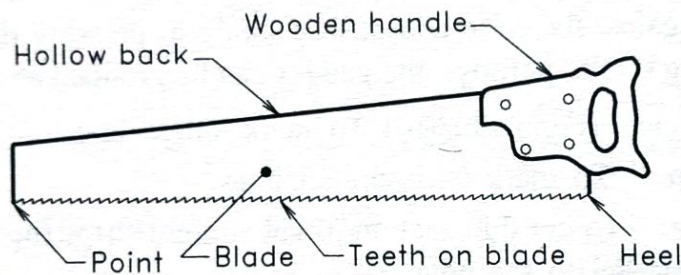


FIGURE 6.4
Cross cut saw.

2. *Tenon saw (Back saw)*: This saw is used for short straight cuts (Figure 6.5). It has a parallel blade of 25 to 40 cm length and 6 to 10 cm width. The number of teeth per cm length ranges from 5 to 8. In order to avoid bending of blade during sawing, the blade is provided with a reinforcing strip at the top.

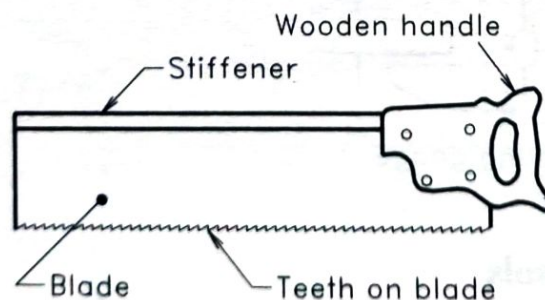


FIGURE 6.5
Tenon saw.

3. *Rip saw*: It is a saw similar to hand saw used to cut wood along the grains.
4. *Panel saw*: This is similar to cross cut saw having finer blade and teeth, used for cutting panels of doors or similar pieces.
5. *Compass saw*: This is a saw having tapered blade which is narrow, long and flexible. It is used to cut along straight or curved lines.

6. *Dove-tail saw:* This is a saw of fine type like tenon saw, used to take fine and accurate cuts. The back side stiffener is provided in the saw.
7. *Key hole saw (pad saw):* This is the smallest type of saw used to cut key holes or the starting of any interior cut.
8. *Bow saw:* This saw has a narrow blade on a wooden frame of the shape of a bow. It is used to cut along sharp curves.
9. *Coping saw:* This saw has a narrow blade held in tension by a spring metal frame. It is used to cut small radius curves in thin wooden pieces.

Chisels

A large number of chisels are used in carpentry shops for cutting wood to get different desired shapes. The common types of chisels used are briefly explained below.

1. *Firmer chisel:* They are the most common and general purpose chisel used by a carpenter [Figure 6.6(a)]. They have flat blade of about 15 to 50 mm width and 125 mm length.
2. *Bevelled edge firmer (dove-tail) chisel:* These chisels are used for fine and delicate works as well as for cutting corners [Figure 6.6(b)].
3. *Mortise chisel:* These chisels are used for heavy and deep cuts to remove a large quantity of wood. These chisels have width of about 15 mm, but the blade thickness may range from 6 to 15 mm [Figure 6.6(c)].
4. *Gouges:* These are chisels with curved sections. They are used to cut curved shapes of internal or external type.

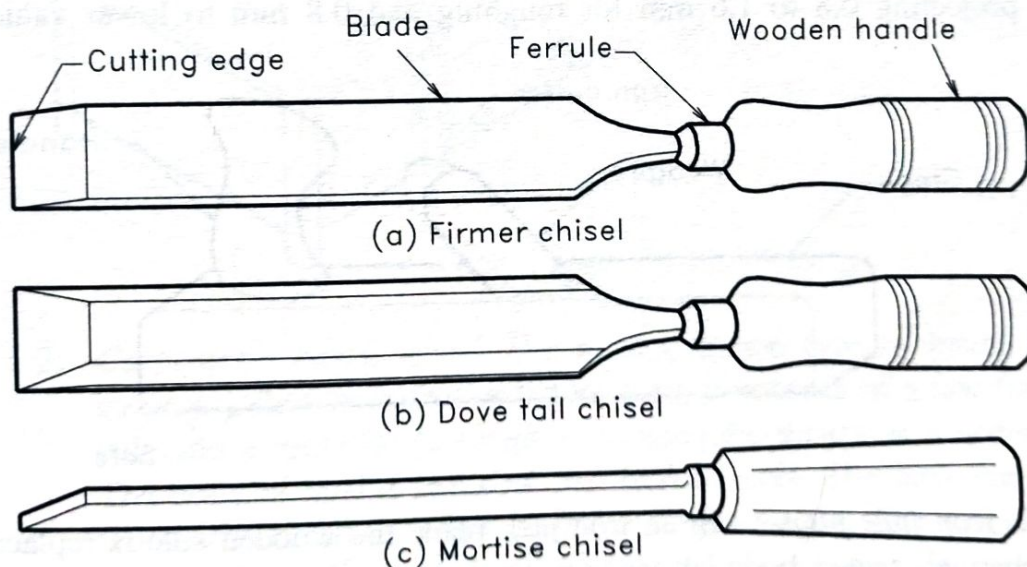


FIGURE 6.6
Chisels.

6.2.3 Striking Tools

1. *Mallet:* This is a wooden-headed hammer of round or rectangular cross section. The striking face is made flat as shown in Figure 6.7(a). Mallet is used for striking the cutting tools and has wooden handle.

2. *Claw hammer:* This is a hammer having steel head and wooden handle. The flat face of the head is used to drive nails and the claw portion for extracting nails out of the wood [Figure 6.7(b)].

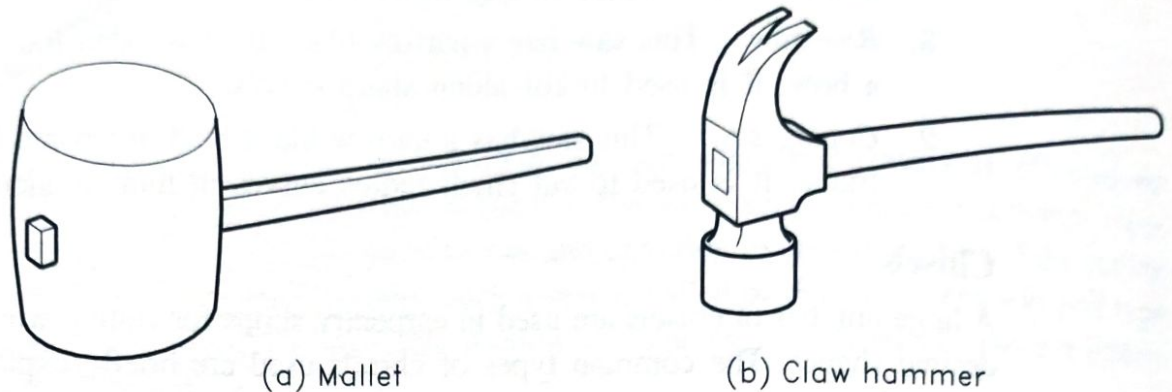


FIGURE 6.7
Striking tools.

6.2.4 Planing Tools

To smoothen the flat wooden surfaces, planing tools are used. Depending on the size and construction and the surface finish obtained, planes are classified into the following categories.

1. *Wooden jack plane:* This is the most commonly used plane in carpenters shops. The main part of a wooden jack plane is a wooden block called *sole*, to which a steel blade having knife edge is fixed at an angle with the help of a wooden wedge. The angle of the blade is kept about 45° to the bottom surface of the blade (Figure 6.8). The size of the blade is taken as 50 to 75 mm. The knife edge of the blade is kept projecting 0.8 to 1.6 mm for roughing and 0.8 mm to lower value for finishing.

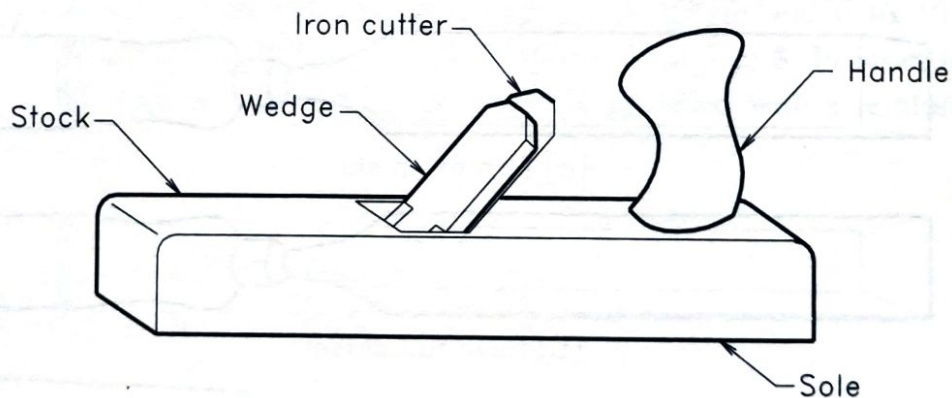


FIGURE 6.8
Wooden jack plane.

2. *Iron jack plane:* In an iron jack plane the wooden sole is replaced by a cast iron channel-shaped body. A wooden knob in the front side and a wooden handle at the back side are fixed on the sole for pushing with two hands. The working principle is the same as that of wooden jack plane. Iron jack plane can give better finish, more life and fast stock removal, but the cost is higher than that of a wooden jack plane.
3. *Soothing plane:* A soothing plane is practically a wooden plane of smaller size, used for smoothening and finishing operations. Its length varies from 200 to 250 mm.

4. *Special planes:* There are a number of types of planes used for special applications. A list of the important ones are given below:

- (a) *Trying plane:* It is a large size plane to get fine flat surface.
- (b) *Rebate plane:* It is used to make recess along the edge of a piece.
- (c) *Plough plane:* It is used to make groove for fitting panels.
- (d) *Router plane:* It is used to finish the bottom of a groove.
- (e) *Circular plane:* It is used to smoothen circular surfaces.

6.2.5 Work Holding Devices

1. *Work bench:* This is a table of heavy size and rigid construction made of hard wood. The size ranges from 50 to 180 cm in length and about 90 cm in width. Two or four carpenters can work at a time on this work bench. Carpenter's vice and bench-hook are fixed on the edge and top respectively as shown in Figure 6.9.

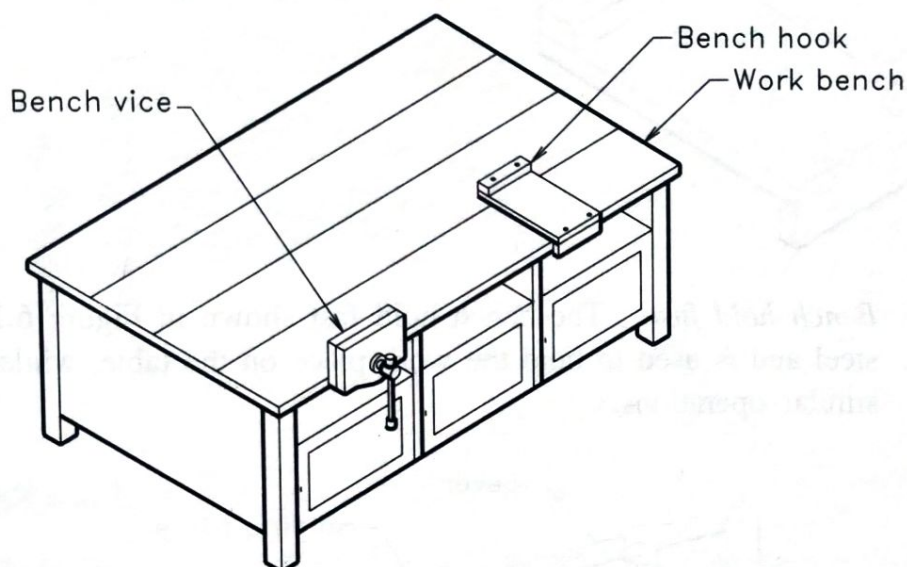


FIGURE 6.9
Work bench.

2. *Carpenter's bench vice:* The most common type of bench vice used in a carpentry shop is shown in Figure 6.10. It consists of a jaw fixed on the table side and a movable jaw kept in position by means of a screw and a handle. The body of vice is made of cast iron or steel. The jaws are lined with hard wood which can be renewed when it is damaged. The screw works inside a fixed half nut which can be engaged or disengaged by operating the lever. By pulling the lever the nut is disengaged from the screw allowing the jaw to move fast. When the lever is released, the nut engages and the screwing action is obtained.
3. *Bench stop (hook):* A bench stop or hook is a wooden block of shape as shown in Figure 6.11. This is placed on the edge of the work bench in order to prevent the workpiece moving forward, while planing or chiselling.

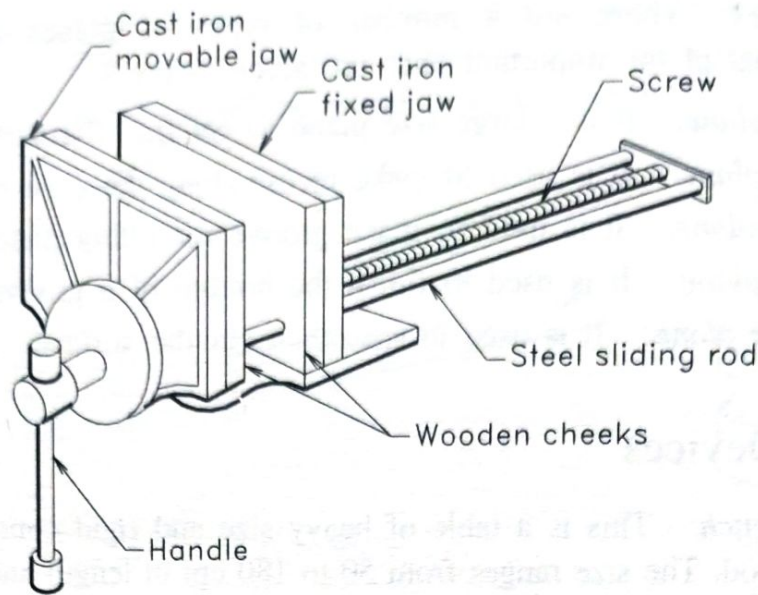


FIGURE 6.10
Bench vice.

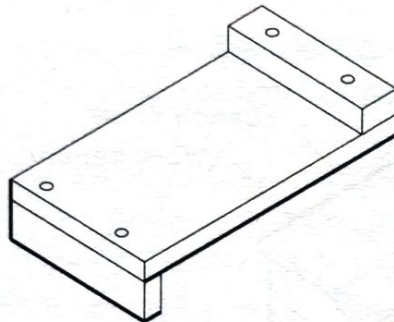


FIGURE 6.11
Bench hook.

4. **Bench hold fast:** The bench hold fast shown in Figure 6.12 is made up of steel and is used to hold the work piece on the table, while doing cutting or similar operations.

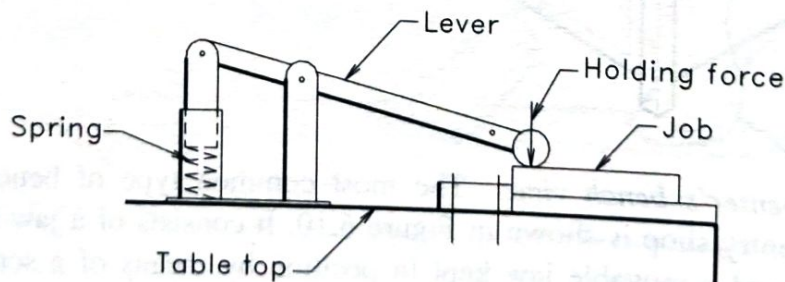


FIGURE 6.12
Bench hold fast.

5. **Sash (bar) clamp:** This is made of a bar of steel, two jaws and a screw as shown in Figure 6.13. The work is clamped between jaws by rotating the screw using the handle. It is used for clamping glued pieces tightly or holding the workpieces of large size together for various operations.
6. **C or G clamp:** The clamp of the shape of letter C or G is used to clamp short pieces together as the bar clamp. Figure 6.14 shows a typical form of the clamp.

FIGURE 6.13
Sash (Bar) clamp.

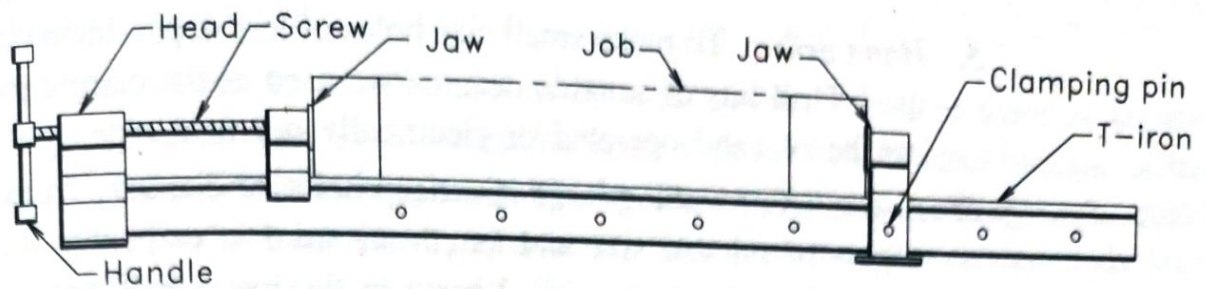
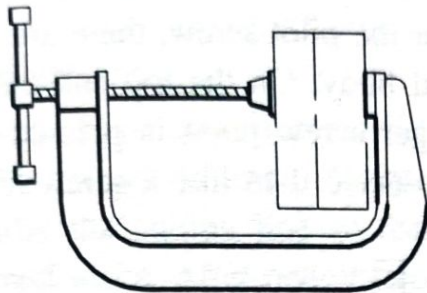


FIGURE 6.14
C or G clamp.



7. *Hand screws:* Figure 6.15 shows the general form of a hand screw. It is used for clamping or holding pieces tightly for various carpentry operations or pasting sheets together.

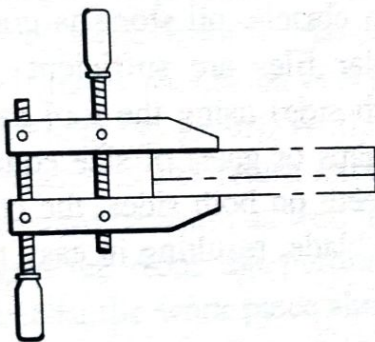


FIGURE 6.15
Hand screw.

6.2.6 Miscellaneous Tools

There are a number of tools other than the types explained above, which are used in carpentry shops to meet the requirements. The frequently used tools of this group are given below.

1. *Rasps and files:* Rasp is a rough file used to remove wood from the surface, corners, etc., resulting very rough surface. Ordinary files are used to smoothen such surfaces.
2. *Sand paper:* This is a thick paper coated with sharp-edged sand or glass particles of fine type on one side of it. When the sand paper is rubbed on the surface, a thin layer of wood is removed resulting smooth surface. The grades of them are denoted by numbers as 00, 1, etc.
3. *Pincer:* This is a tool similar to pliers and is used while screw is extracted from or driven into the wood.
4. *Screw drivers:* They are used to drive wood screw into or from the workpiece.

5. *Hand drill:* To make small size holes of less depth, hand drills are commonly used. Drill bits of suitable designs are used as the cutting tool. The hand drill can be of hand operated or electrically operated type.
6. *Auger:* For making large size deep holes of diameter from 8 mm to 25 mm, augers of suitable size and length are used in carpentry shops. It consists of a steel bar carrying a fluted body in the lower half and a rod on the upper half Figure 6.16. The bottom end of the fluted body is provided with a screw point, which acts as a pivot. Near the pilot screw, there are two cutting edges formed by the end of the twisted body. On the top end there is the wooden handle. To make a hole, the auger screw point is pressed to the wood and rotated with two hands slowly to drive it in like a screw and form the hole.

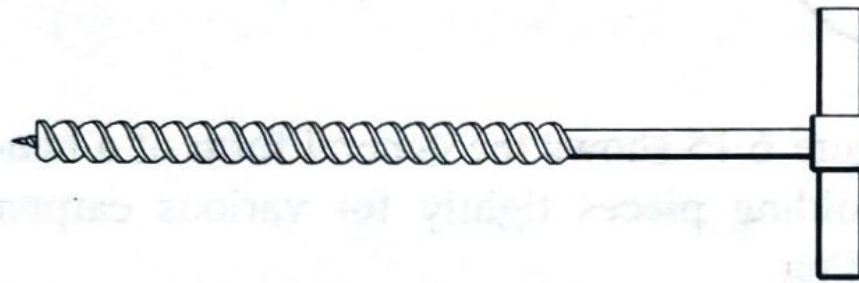


FIGURE 6.16

Auger.

7. *Tools for sharpening:* To sharpen chisels, oil stone is commonly used. For sharpening the saw teeth, triangular files are sufficient. The teeth are set (bending the alternate teeth on each side) using the tool called *saw-set*. This tool is basically a steel plate with gaps or gates of size equal to the thickness of the saw blade. By bending the teeth on both sides, the cutting slot become slightly wider than the thickness of blade, resulting in easy movement of saw.