Workshop Manual

Department of Mechanical Engg.

Poornima Group of Colleges

Index

LAB ETHICS

Do's FOR THE LAB	DON'T FOR THE LAB
1. Do take an interest in your work.	1. Do not wear loose Fitting cloths while operating machine.
2. Do learn your shoulder responsibility.	2. Do not be afraid to wear goggles.
3. Do keep your mind on the job.	3. Do not touch moving parts, belts or rotating tools.
4. Do become acquainted with the function of the machine.	4. Do not take work measurement in a haphazard manner.
5. Do keep your machine properly lubricated.	5. Do not waste time by working to a finer degree of accuracy than the sketch call for.
6. Do learn sincerely from the instructions.	6. Do not touch any live wire.
7. Do wear uniform in the workshop.	7. Do not drop the tools.
8. Do keep tools properly in the case.	8. Do not leave running machine unattended.
9. Do keep clean the tools after finishing work.	9. Do not touch levers, switches of the machine till you are fully aware of operation.

IMPORTANT INSTRUCTIONS FOR THE STUDENTS

1. Always wear uniform in the workshop. Never wear loose clothes.
2. Never walk bare footed inside the workshop, use of rubber sole closed shoe is recommended.
3. Never operate any machine unless you do not know how to operate it.
4. Never touch moving parts, belts or rotating tools.
5. Defective equipment and tools should not used for any work.
6. Never touch any switch, knob or lever of the machine without knowing it.
7. Silky clothes catch fire soon, never come to the workshop wearing such clothes.
8. Do not touch any live wire inside the workshop.
9. In case of any fire, the electric supply should be disconnected.
10. Always keep in mind about the position of fire extinguishers and first aid box.
11. Always read the first charts carefully while beginning in the workshop.
12. Make sure that your work is not affecting anybody in the workshop.
13. Always try to learn sincerely from the instructions.
14. Always keep your mind on the job.

List of jobs to be made in the workshop practice

Carpentry Shop:

1. T – Lap joint
2. Bridle joint

Foundry Shop:

1. Mould of any pattern
2. Casting of any simple pattern

Welding Shop:

1. Lap joint by gas welding
2. Butt joint by arc welding
3. Lap joint by arc welding
4. Demonstration of brazing, soldering & gas cutting

Machine Shop Practice:

1. Demonstration of various machine tools such as Lathe, Shaper, Milling, Grinding and Drilling

Fitting Shop

1. Finishing of two sides of a square piece by filing
2. Making mechanical joint and soldering of joint on sheet metal
3. To cut a square notch using hacksaw and to drill a hole and tapping

Sheet Metal Shop

Making of Funnel using sheet metal

CARPENTRY

The carpentry deals with the constructional work such as making roof, floors, partitions etc. of a building by means of wood with the help of carpentry tools.

TIMBER: The timber is the material used for carpentry and joinery work, which is obtained after seasoning & preservation process? The following technical terms relating to timber must be clearly understood:

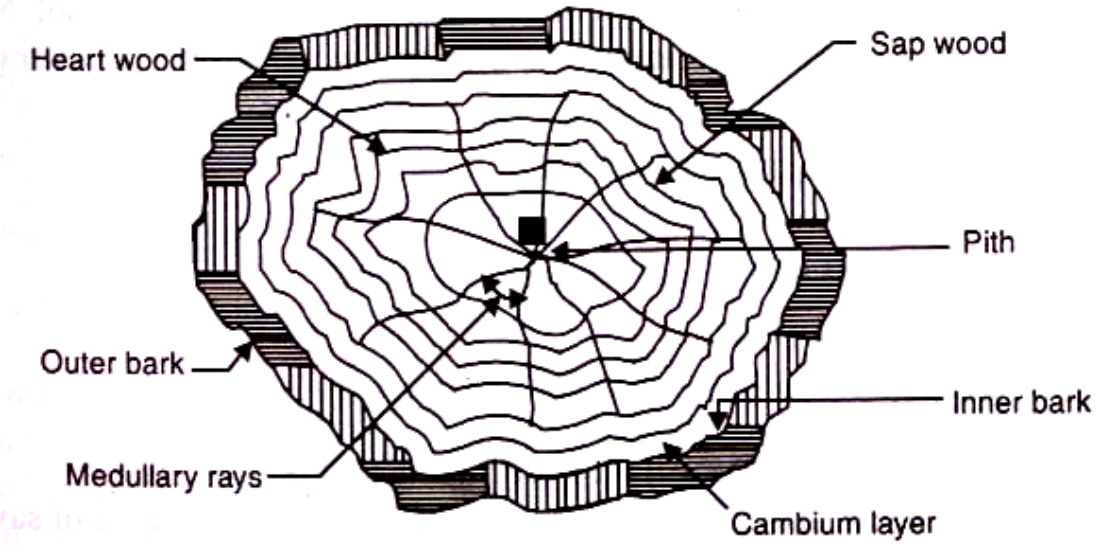


Fig. 9.1. Cross-section of an exogenous tree.

ADVANTAGES OF TIMBER:

1. It is easily available and can be quickly transported by simple means.

2. It is very easy to be worked on with tools.

3. It is lighter and stronger than most of the materials used in construction work.

4. It is a non-conductor of heat and electricity.

5. It responds very well to painting and polishing etc.

TYPES OF TIMBER:

Soft wood: It is widely used for building construction work. These are resinous light in colors and weight, easy to be worked, have good tensile resistance but week across the fibers.

Hard wood: It is widely used for doors, furniture, joinery etc. It is non-resinous, dark in colors and heavier in weight and have well tensile as well as shear resistance. So it is difficult to be worked.

SEASONING OF WOOD: The seasoning of wood is the process of drying wood or removing moisture or sap, present in a freshly felled tree, under controlled conditions. The common methods are commonly used for seasoning of timber.

NATURAL SEASONING OR AIR SEASONING: This method of seasoning the wood is simple and cheap, but it is very slow and extends over years depending upon the type of wood and its cross section. The soft wood and their sections dry up easily whereas hardwood and thick sections take more time.

ARTIFICIAL SEASONING OR KILN SEASONING: This method of seasoning is the quickest of all the commonly used wood seasoning process. It keeps the moisture content under control. This process is carried out in a chamber under controlled temp. And humidity conditions with proper air circulation and ventilation system. Usually, steam is used for this purpose. The seasoning is started at comparatively lower temperature and higher humidity. The conditions are changed as the timber dries. At the end of seasoning, the air is fairly hot and humidity is low. The required humidity level is maintained to avoid warping and cracking of wood. The drying of wood at uniform rate is well maintained by circulating air.

DEFECTS IN TIMBER:

1. Defects developed during the growth of a tree.

2. Defects occurring during conversion, seasoning or use

3. Defects due to the action of fungi and insects

NATURAL DEFECTS:

1. **Knots**: The impression left behind by the broken limbs or branches later appear as knots.

2. **Shakes**. When the tree is not cut even after attaining full maturity the cohesion between the wood grains is lost due to evaporation of jumps, moisture, resins and oils etc.

(A) Heart shakes (B) Star shakes (C) Cup shakes

3. Irregular grains or twisted fibers: Such defects occur due to twisting of tree in different directions due to the blowing wind.

4. Rind or galls burls: These are the wounds created by the irregularly broken or cut branches at the place where they part off.

QUALITIES OF GOOD TIMBER:

1. It should have straight fibers.

2. The wood obtained from near the pith is always better than the rest of the tree.

3. It should be free from knots.

4. It should not possess natural defects.

5. On sawing, it should give a sweet smell.

6. It should not carry sudden change in colors; such a change is always a sign of disease.

7. It should have regular annual rings.

8. It should not clog the saw teeth during sawing.

9. It should be strong and heavy.

10. It should not split when are driven into it.

11. It should have high resistance to shock and stresses.

12. On striking, it should give a clear sound.

13. On planning, it should give silky luster and bright appearance.

14. It should have a dark colors.

15. It should be easily workable.

16. It should not warp or twist after seasoning.

17. It should respond well to polishing and painting.

18. It should have high resistance to fire.

PRESERVATION OF TIMBER: In order to protect the timber from internal decay and attack of insects like white ants, some chemical preservation are used to increase the life of timber and to make the timber structures durable. A good preservative should have the following requirements:

PRESERVATIVES: Tar oil, Water soluble chemical salts, Organic solvent chemicals

METHOD OF APPLICATION OF PRESERVATIVES:

1. Brush and spray method. 2. Dipping or soaking treatment

3. Pressure treatment

WOOD WORKING HAND TOOLS:

A broad classification of these tools according to their use is as follows.

1. Marking and measuring tools. 2. Holding and supporting tools

3. Cutting tools
4. Planning tools
5. Boring tools
6. Striking tools
7. Miscellaneous tools

Marking and measuring tools:

Four fold box wood rule, Steel Scale, Inch Tape, Construction Scale

Try square: It is used for measuring and setting out dimensions, testing the finish of a plane surface, and checking of right angle.

Straight edge: It is used for testing the trueness of surfaces and edges.

Bevel square: It is used for setting, duplicating, testing and comparing angles and bevels.

Scriber or Marking knife: It is mainly used for locating and marking points and scribing lines on wood surface.

Marking gauge: It is made of wood and is a very prominent tool for marking. Scribing (along the line of desired distance) is made possible with the help of thumbscrew.

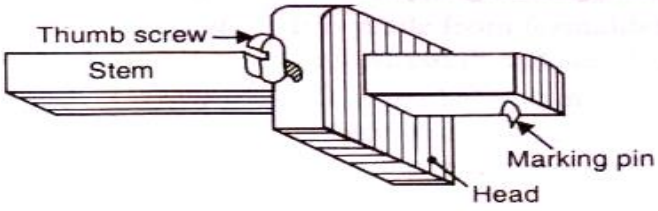


Fig. 9.9. Marking gauge.

Holding and supporting tools:

Carpentry Vice: It is a heavy table of rigid construction on which two or four vices are fitted on opposite sides to hold the jobs during the operation.

Sash cramp: The specific use of this tool is in holding the glued pieces tightly or holding firmly two or more unglued pieces for fitting dowels or doing other operations on them in assembled position.

Clumps and screws: Various types of clamps and screws are used by carpenters for holding and supporting wood pieces in position for carrying out different operations.

'C' clamp, Hand screw

Cutting tools:

Types of saws:

1. Ripsaw: It cuts the wood along the grain. It is used for smaller and medium work.

2. Panel saw: It is the most commonly used handsaw. It is mainly used for cutting panels for the door shutters.

3. Compass saw: It carries a tapered blade. The blade is quite flexible and, thus it can be used easily for taking straight or curved cuts on outside or inside of the wood.

4. Keyhole saw: This saw is very useful in internal and intricate work.

5. Cross cut saw: It is primarily designed for cutting across the grains of wood but is used as a general purpose saw in woodwork.

6. Tanoan saw or back saw: It is used for finer work than the rip saw, panel saw or cross cut saw. The main use of this saw is in taking short straight cuts, such as for tenons.

7. Dovetail saw: It is also used for finer work, particularly for cutting tongues for dovetail joints.

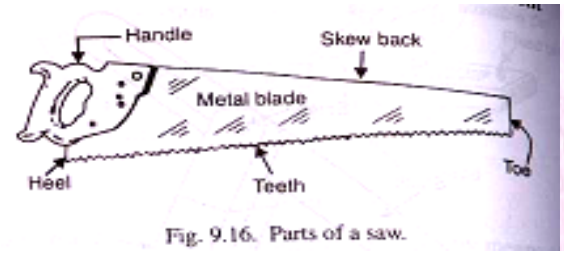


Fig. 9.16. Parts of a saw.

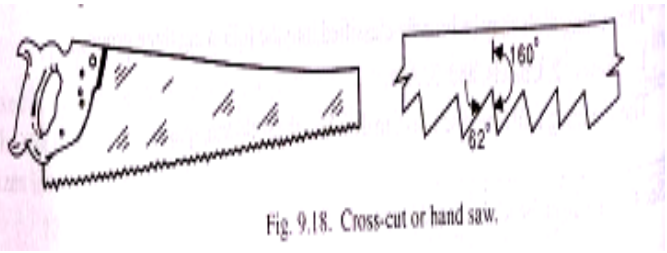


Fig. 9.18. Cross-cut or hand saw.

Types of chisels:

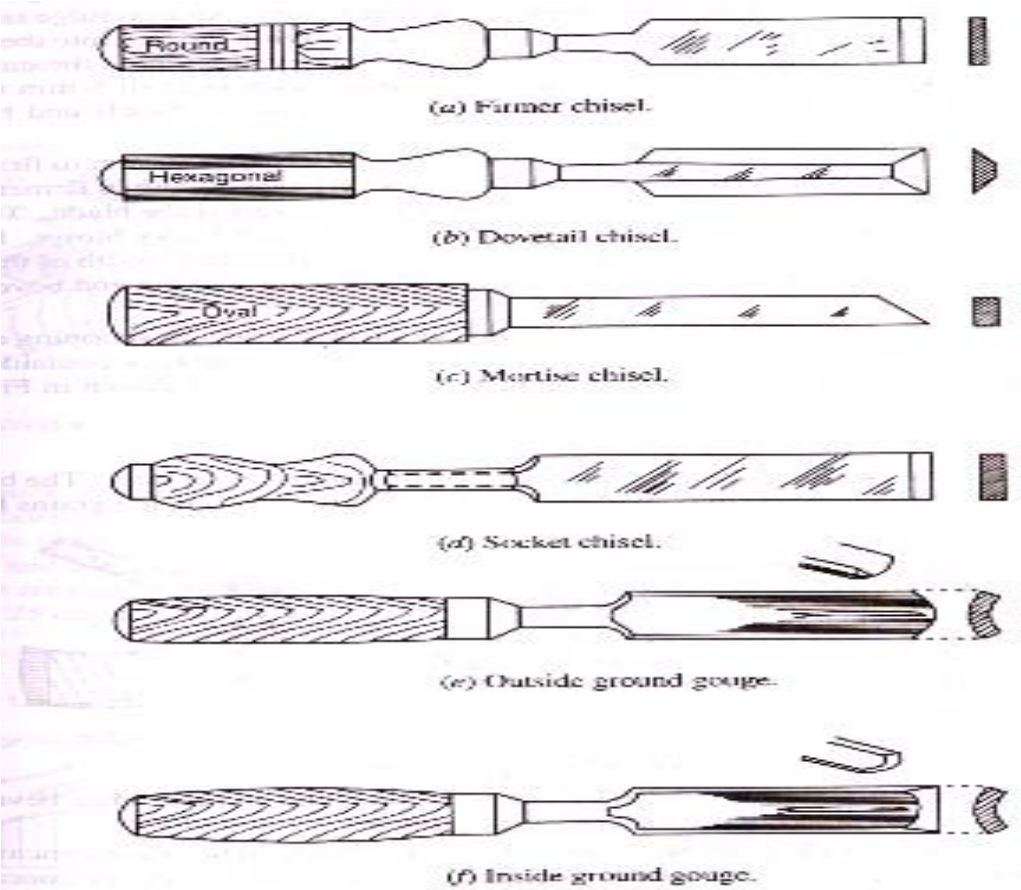
Firmer chisel**: It is a general-purpose chisel and is use for taking wider cuts and finishing flat surfaces inside the grooves.**

Dovetail chisel**: The beveled shape enables reduction of blade thickness on the sides due to which it can enter sharp corners to finish them.**

Mortise chisel**: It is use or taking heavy and deep cuts resulting in more stock removal, as in case of making mortises.**

Socket chisel: When a very heavy stock removal is to be done by the chisel, it is bound to result in splitting of the wooden handle due to heavy blows on its top. To prevent this, such chisels are provided with a socket type construction at their top in place of the tang.

Gouge chisel: It carries a hollow curved blade for finishing curved surfaces.



(a) Firmer chisel.

(b) Dovetail chisel.

(c) Mortise chisel.

(d) Socket chisel.

(e) Outside ground gouge.

(f) Inside ground gouge.

Fig. 9.27. Types of chisels.

PLANING OR PARING TOOLS:

1. **Wooden jackplane:** It is the most commonly used plane. The main cutting part (Blade) is made by High Carbon Steel. This is cutter remain at 45 degree angle with the sole.

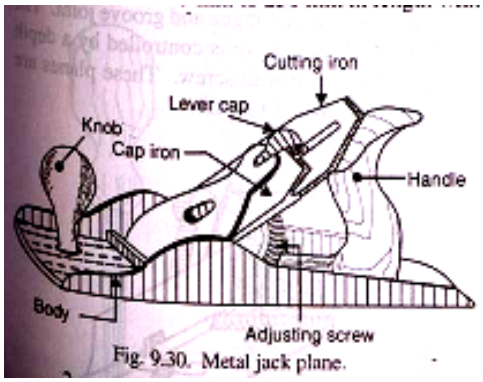


Fig. 9.30. Metal jack plane.

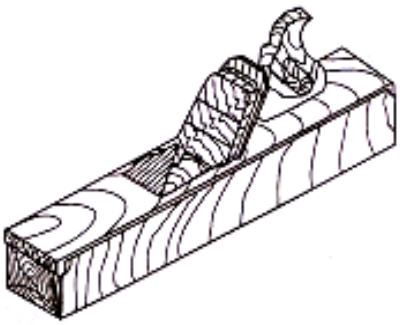


Fig. 9.31. Trying plane.

2. **Steel jackplane**: It is also used for the same purpose as a wooden jackplane, but it gives a better finish than the latter. It is more rigid than others and has longer life than others, but is equally costly also.

STRIKING TOOLS:

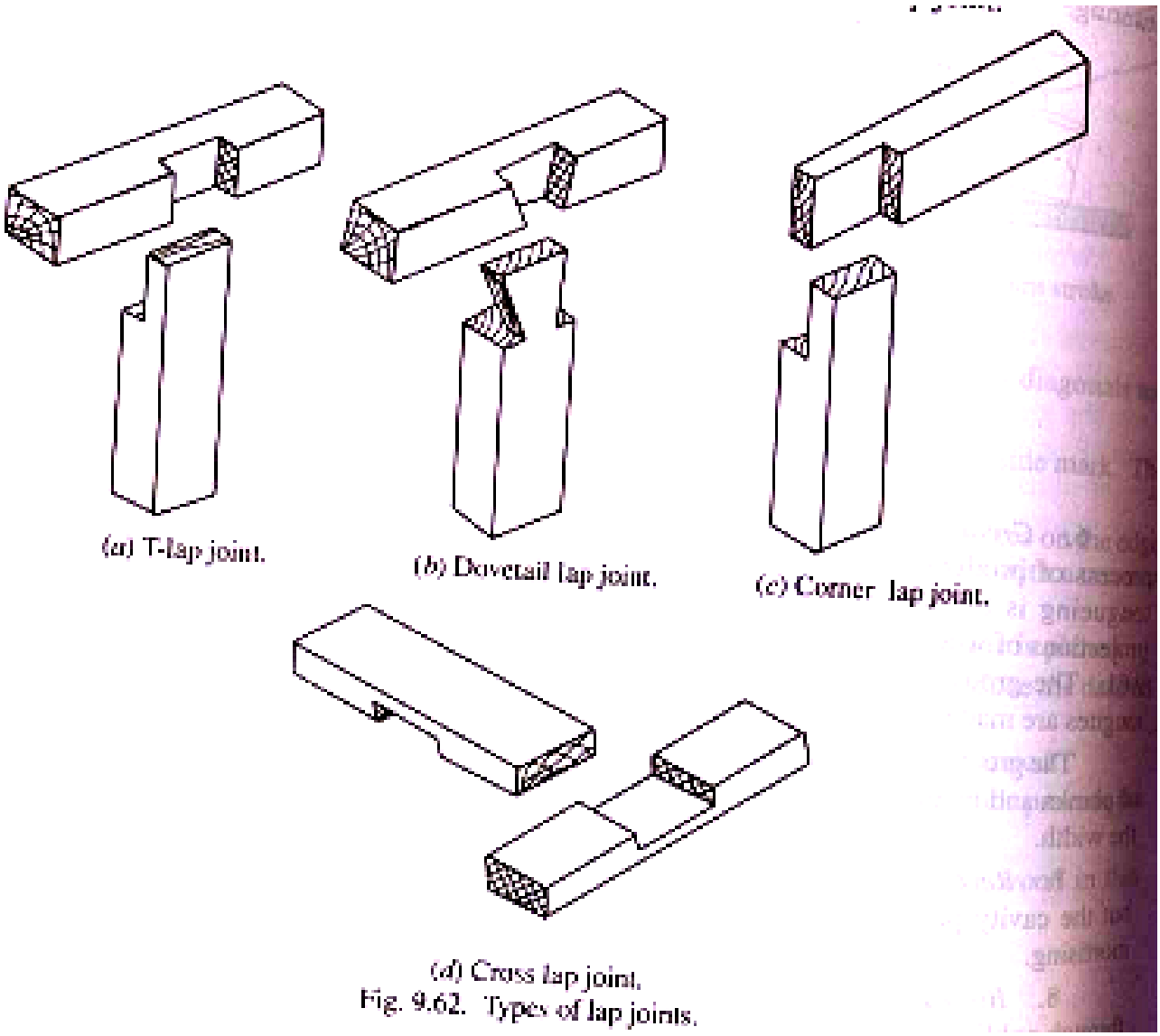
1. Mallet: It is used for striking the cutting tools, which have a wooden handle.

2. Claw hammer: It consists two faces.

1. Striking face used for striking purposes

2. Claw used for extracting nails out of the wood.

TYPES OF JOINTS: Lap joints, Butt Joint, Bridle Joint, Corner Joint.



(a) T-lap joint. (b) Dovetail lap joint. (c) Corner lap joint.

(d) Cross lap joint.

Fig. 9.62. Types of lap joints.

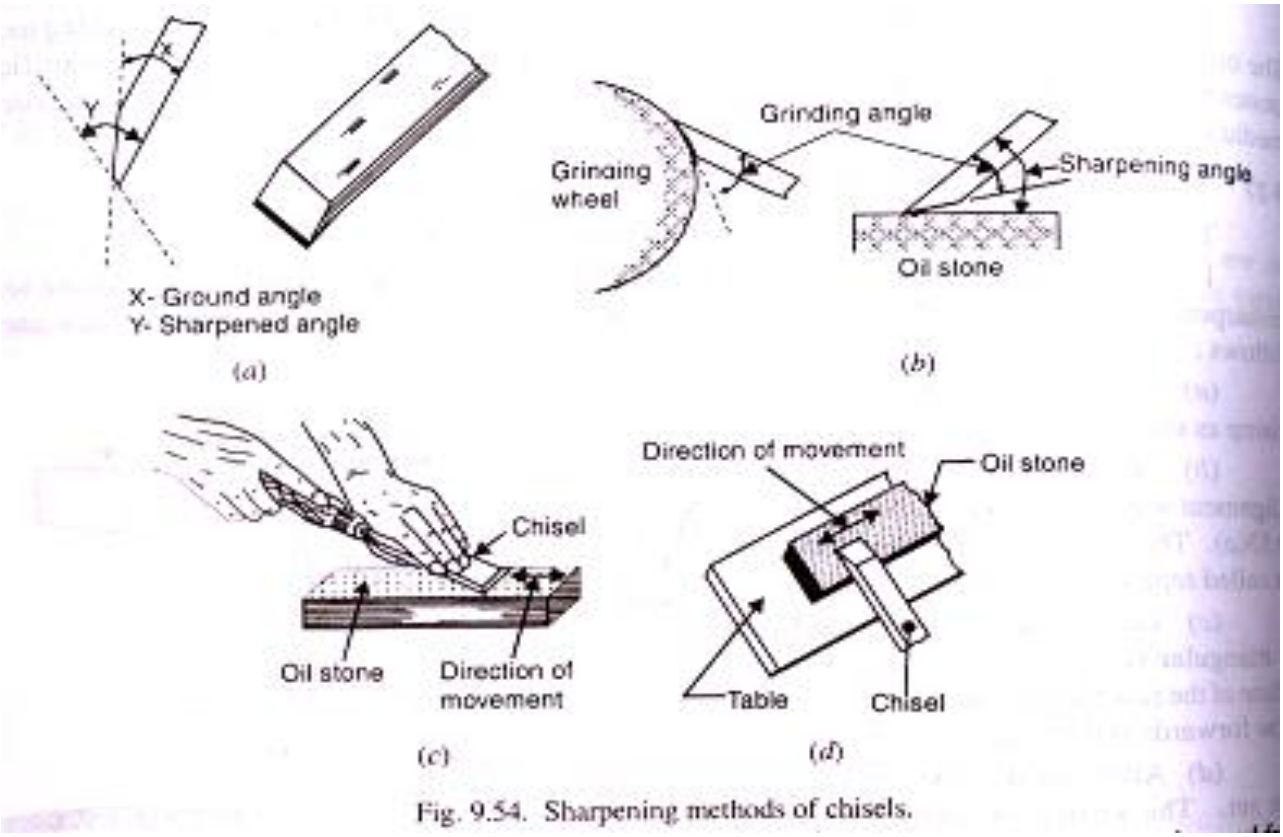


Fig. 9.54. Sharpening methods of chisels.

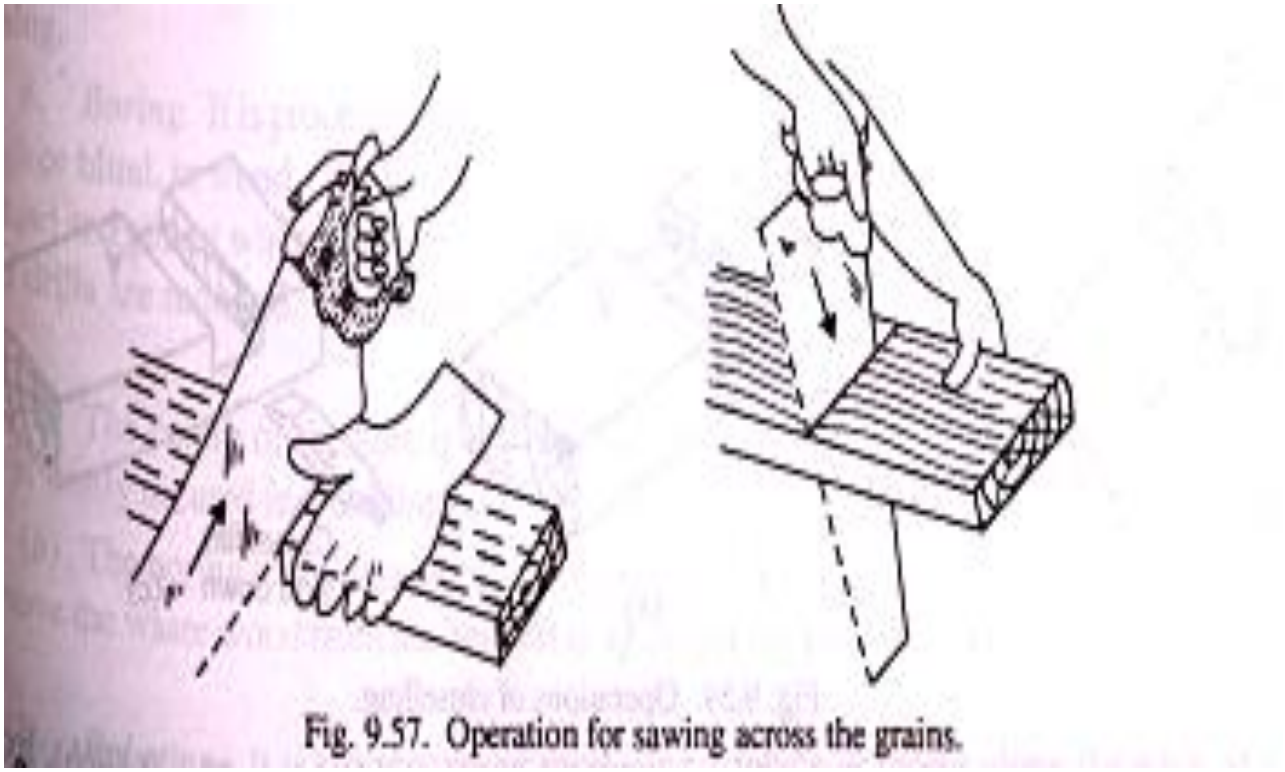


Fig. 9.57. Operation for sawing across the grains.

EXPERIMENT No. 1

Object:-To prepare a T lap joint/Bridle joint as per drawing.

Tools & equipments: Try square, scale, pencil, carpentry vice, marking gauge, hammer, screwdriver, measuring tools etc.

Materials: Wooden piece.

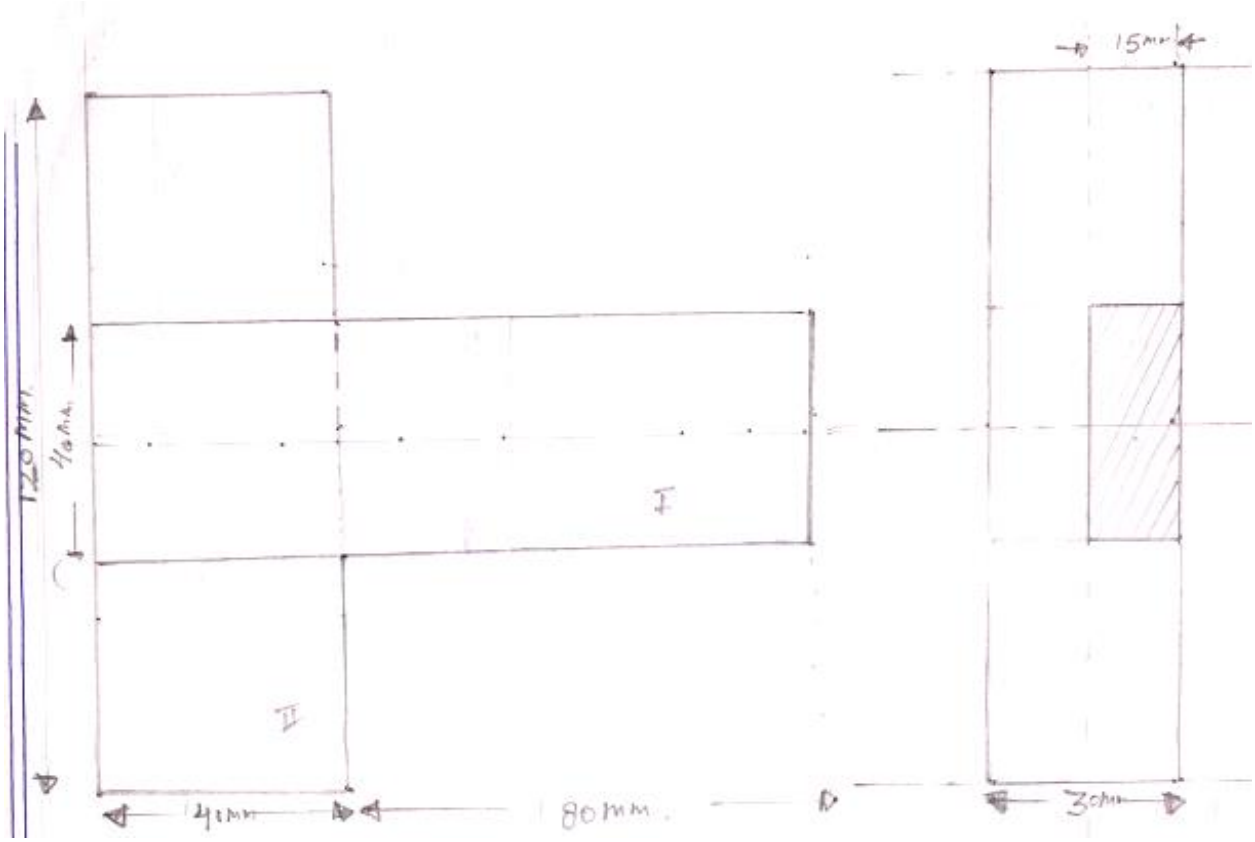
Procedure:

1. Collect tools & material from workshop store.
2. Plane the piece of in rectangular shape as per dimensions.
3. Mark the exact location on the surface where the joint in to be made.
4. Hold the job on carpentry vice.
5. Make groove of required width and depth.
6. Select the type of fastener (nails, screw, wooden pin)
7. Hold piece to be joined in their respective position.
8. Check the joint.

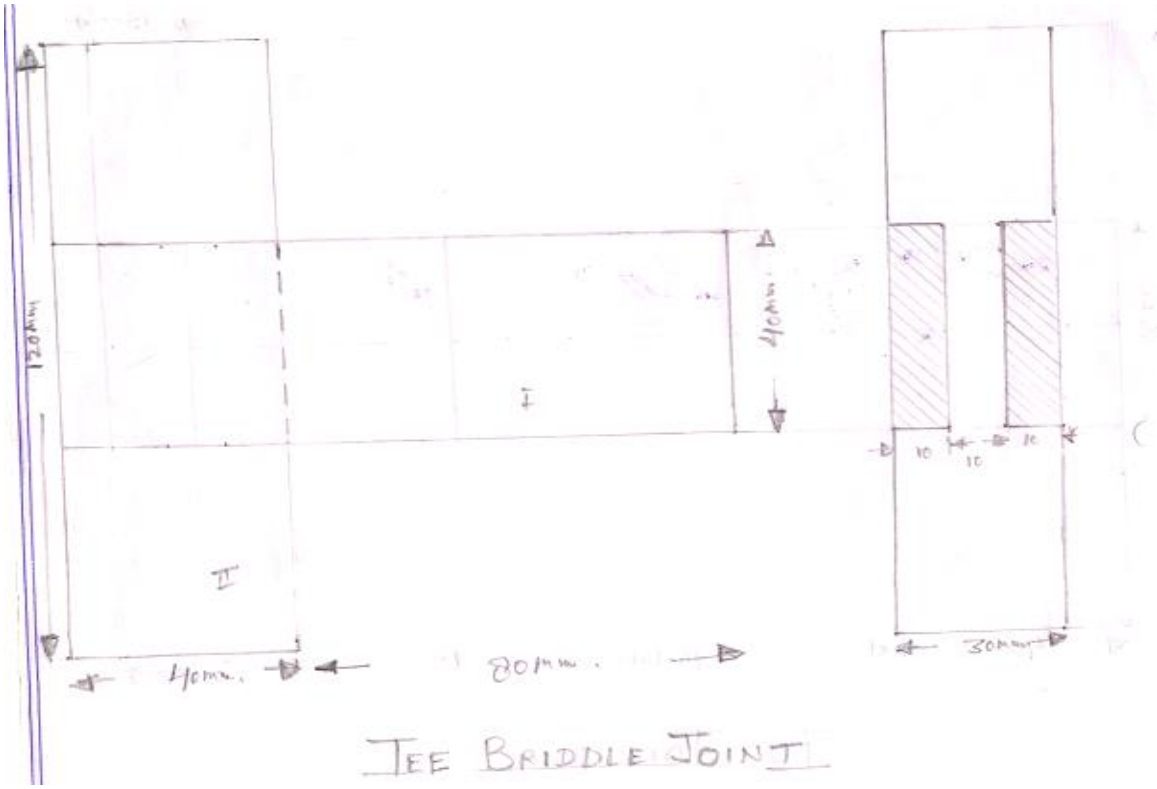
Result: T lap joint / bridle joint as pre given dimension has been made.

Safety precautions:

1. Use properly sharpened tools.
2. Use seasoned wood.
3. Tools should be in proper conditions.
4. Don’t place the wood against the direction of grains.
5. Grip of vice should be strong while material is being worked.



T- LAP JOINT



TEE BRIDDLE JOINT

VIVA VOCE

Q. What is carpentry?

Q. What is timber and their advantage?

Q. What are the main defects in timber?

Q. What are the carpentry tools used in carpentry shop?

Q. What are different types of joints?

Q. What is seasoning and advantage of seasoning?

Q. What is preservation of timber?

Q. What are the methods uses for preservation?

Q. What are the cutting tools used in Carpentry Shop?

Q. What are the Measuring tools used in Carpentry Shop?

Q. What are the Striking tools used in Carpentry Shop?

Q. What are the holding and clamping tools used in Carpentry Shop?

Q. What are the planning and drilling tools used in Carpentry Shop?

Q. What are the materials used in cutting tools used in Carpentry Shop?

Foundry Shop

Introduction

Foundry deals with the process of making casting in moulds prepare by patterns. The pattern making deals chiefly with the construction of patterns. A pattern may be defined is a model or replica of desired casting which moulded in sand forms an impression called mould.

Pattern Materials

The modern pattern making employs the use of materials that can be easily shaped and are durable. The type of pattern material chosen depends upon the following factors:

a) The design of casting,
b) The number of castings to be produced,
c) The type of casting and moulding process used in foundry, and
d) The degree of accuracy and surface finish required.

Following are the commonly used materials for pattern making:

1. Wood: It is widely used material for patterns. It is used when small number of castings is to be produced. The wood as a pattern material has the following advantages and disadvantages.

Advantages:

a) It is cheap and light.
b) It can be easily worked and shaped as desired.
c) It can be cut and fabricated into numerous forms by gluing, bending and carving.
d) It is easily planned and sanded to smooth surface and can be preserved fairly for a long time with shellac.

Disadvantages:

a) It has the tendency to wear out by the constant contact with damp sand.
b) Since it can not withstand the continuous abrasive action of sand, therefore it is unsuitable for repetition work.

2. Metal: When large number of castings is required, the pattern is made of a metal. The metal patterns are more durable, have longer life and produces moulds to a close dimensional accuracy. Following materials are commonly used for pattern making:

Cast Iron, Brass, Aluminum and its alloy, Plaster, Plastics, Wax.

Types of patterns

The type of pattern to be used for a particular casting depends upon many factor like the bulk of casting, type of moulding process, number of casting required. The following types of patterns are commonly used:

- Solid or Single piece pattern
- Match Plate Pattern
- Split pattern
- Cope and drag pattern
- Loose piece pattern
- Gated Pattern
- Skeleton Pattern

Foundry Tools

1. **Showel:** It consists of Iron pan with a wooden handle. It can be used for mixing and conditioning of sand.
2. **Trowels:** These are used for finishing flat surfaces and corners inside a mould. Common shapes of trowels are Square and Pan Shape.
3. **Lifter:** A Lifter is a finishing tool used for repairing of the mould and removing the loose sand from the mould.
4. **Riddle:** It is used for ridding of sand to remove the hard pieces from the moulding sand.
5. **Strike off bar:** It is made of wood or iron to strike off the excess sand from the top of a box after ramming. Its one edge made beveled and the surface.
6. **Vent wire:** It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle of loop at another end. It is used to make small holes for exit of gases and streams during casting.
7. **Draw Spike:** It is a tapered steel rod having a loop or ring at its one end and a sharp point at the other end. It is used for tap and draw pattern from the mould.
8. **Rammers:** Rammers are used for striking the sand mass in the moulding box to pack it closely around the pattern. Generally two types of rammers are used flat and Peen.
9. **Slicks:** They are used for repairing and finishing the mould surfaces and edges after the pattern has been drawn.
10. **Mallet:** It is a like a mallet as that used in sheet metal work. It is used for driving the draw spike in to pattern and hammering of foreign particles of moulding sand.
11. **Swab:** It is fiber brush used for moistening the edges of sand mould which are contact with the pattern.
12. **Bellow:** It is used to blow the loose unwanted sand from the surface of mould.
13. **Sprue pin:** It is a tapered rod of wood or Iron which is embedded in the sand and later withdrawn to produce a hole called runner.
14. **Moulding Box:** The moulding boxes are used in sand mouldling may be made of wood or steel. They consist of two parts. The upper part is called Cope and lower part is called Drag.
15. **Moulding board:**- The moulding board is to provide support moulding box or pattern during the mould making. It is made by wood.
16. **Crucibles:** They are made of refractory material and are similar in shape to the ladles. They are used for metal melting.
17. **Electric Furnace:** Furnace is used to provide heating material up their pour point/ Melting point.

Properties of Moulding Sands

Some of the important properties of moulding sand, for obtaining good mould nad castings mentioned below:

Strength: The mould's ability to maintain its shape and resists erosion caused by the molten metal; it depends on grain shape, adhesive qualities of the binder, and other flow of.

Permeability: The capacity of the mould to allow hot air and gases from the casting operation to pass through the voids in the sand.

Thermal Stability: The ability of the sand at the surface of the mould cavity to resist cracking and buckling upon contact with the molten metal.

Collapsibility: The ability of the mould to give way and allow the casting to shrink without cracking the casting; it also refers to the ability to remove the sand from the casting during cleaning.

Reusability: The sand from the broken mould be reused to make other moulds.

Constituents of Moulding Sand

The principal constituents of moulding sand are:

1. Silica sand
2. Binder
3. Additives, and
4. Water

(A) Silica Sand: Silica Sand (SiO_2) contains water for a long time and is suitable for a wide working range. It helps to patching and finishing operations of the mould. It is very cheap as compare to other sand. Mostly used for cast iron and non ferrous metals coasting.

(B) Binders: The purpose of adding a binder to the moulding sand is to impart it sufficient strength and cohesiveness so as to enable it to retain its shape after the mould has been rammed and the pattern withdrawn. However, it produces and adverse effect on the permeability of the sand mould. Most commonly Bentonite clay is used in moulding sand as binder.

(C) Additives: Additives are those materials which are added to moulding sand to improve upon some of the existing properties or to impart certain new properties to it. The commonly used Coal dust.

(D) Water: The clay content added to the foundry sand will not give the required strength and bond until a suitable quantity of water is added to it. This quantity of water varies from 2 to 8 percent according to different requirements.

Mould Classifications

Moulds are classified as follows:

1. Sand Moulds: Depending upon the type of sand used, there are different types of moulds, namely,

Greensand : Greensand moulds are made of a mixture of sand, clay, and water, the word 'green' referring to the fact that the mould contains moisture at the time of pouring, Greensand moulds possess sufficient strength for most applications, good collapsibility, good permeability, and good reusability and are the least

expansive of the moulds. They are the most widely used mould type, but they are not without problems. Moisture in the sand can cause defects in some castings, depending on the metal and geometry of the part.

Dry sand moulds: A dry-sand mould is made using organic binders rather than clay, and the mould is baked in a large oven at temperatures ranging fro m20°C to 316°C. Oven baking strengthens the mould and hardens the cavity surface. A dry-sand mould provides better dimensional control in the cast product compared to green sand moulding. However, dry-sand moulding is more expensive, and the production rate is reduced because of drying production rates.

Skin dried mould: In a skin-dried mould, the advantages of a dry-sand mould are partially achieved by drying the surface of a greensand mould to a depth of 0.5 to 1 inch at the mould cavity surface, using torches, heating lamps, or other means. Special bonding materials must be added to the sand mixture to strengthen the cavity surface.

DEFECTS IN CASTINGS

The defects in castings may be due to pattern moulding box equipments moulding sand cores getting system or molten metal. Some of the defects &their reasons are discussed below.

Mould shift: it results in mismatching of the top & bottom parts of casting. Misalignment of pattern parts due to worn or damaged pattern.

Core shift: It is an abnormal variation of dimensions which are dependent on core position misalignment of cores in assembling cored moulds by using incorrect size of chaplet.

Swell: it is an enlarged of the mould cavity by molten metal pressure resulting in localized or general enlarged of casting. Insufficient ramming of sand, insufficient weighting of mould during casting pouring of molten metal too rapidly or too hard

Sand wash: It usually occurs near ingrates as rough lamps on surfaces of casting sand that has been washed away appers on upper surfaces of castings as rough holes or depression this is reasons soft ramming of sand, weak sand, poor pattern, insufficient draft.

Shrinkage: It is crack in the casting or dishing on surfaces of castings which results from unequal contraction of metal during solidification ,improper location size of gates ,inadequate risers, lack of directional solidification incorrect metal composition incorrect pouring temperatures.

Hot tear: It is an internal or external ragged discontinuity in the metal casting resulting from hindered contraction occurring just after metal has solidified ,abrupt change in section inadequate filleting of inside corners &improper placement of chills, improper pouring temperature.

Sand blow or blow hole: It is an excessively smooth depression on the outer surface of casting this defect is also called blow holes, high moisture content in moulding sand, low permeability of sand, hard ramming of sand defective getting system.

Experiment no. 2

(RTU 3-4)

Object:- To prepare Aluminum casting with the help of given wooden pattern.

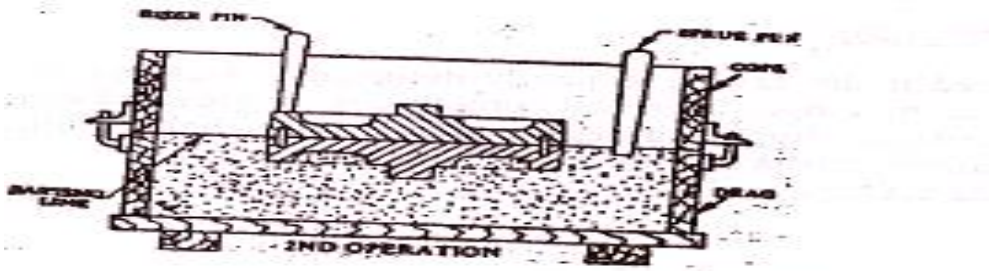
Tools and Materials:- Moulding sand, Aluminum , Mallet, Riddle ,square trowel, pan shape trowel, Moulding board, moulding box, parting of sand, flat rammer, side rammer, strike off bar, spirit level, solid pattern, sprue pin, riser pin, vent rod,slick,lifter,gate cutter.

Procedure:-Collect tools and material from workshop store. Take appropriate composition of moulding sand. Prepare moulding sand. Take moulding flask and pattern. Prepare mould, make runner, gate. Keep aluminum in the electric furnace, raise temperature of aluminum up to 820· C, so that solid aluminum changes into the liquid aluminum. Switch off supply to furnace. Pour molten metal into the mould through sprue hole till the cavity is full. Allow it to cool and thereafter take out the casting after breaking moulding sand.

Result:- Aluminum casting as per given wooden pattern has been prepared.

Safety Precautions:

1. Do not wear gauntlet/gloves.
2. Do not permit water to collect on the floor around a furnace.
3. Do not throw dump/wet metal into furnace.
4. Cover the floor under cupola by a thick layer of sand to avoid splashing.
5. Blow air through a crucible furnace before start.
6. Store crucible in warm dry place.
7. Thoroughly heat the ladles before use.
8. DO not move in backward direction while pouring molten metal.
9. Keep feet at a safe distance from the mould.
10. DO not place face directly over runners or risers while pouring.



MAKING A GREEN SAND MOULD (2nd STEP)

VIVA VOCE

Q. What is foundry?

Q. What is pattern and types of pattern?

Q. What are foundry tools?

Q. What are types of moulding sand?

Q. What are the contents of moulding Sand?

Q. What are the properties of moulding sand?

Q. What is composition of green sand?

Q. What are the types of furnace?

Q. What is melting point of aluminum?

Q. What are the materials for pattern making?

Q. Which type of sand or Clay use to generate propertied of hardness and binding?