

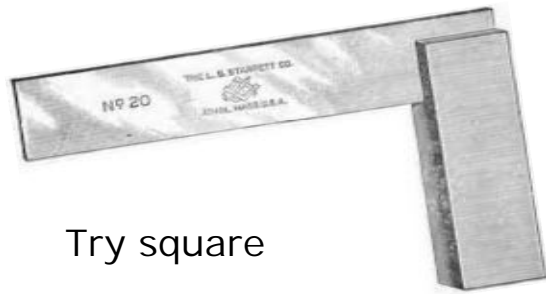
FITTING PRACTICES

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Hand Tools



Try square



blades

Files



Punch



Bench Vice



Hacksaw



Chisels



Drill

Advantages of Hand Tools

- Hand tools are less expensive to purchase, maintain and replace.
- No or less electricity required so it can be used at the places having unreliable power supply.
- With hand tools, less time is required to setup and pack up the equipments.

Fitting

“Fitting is the assembling together of parts and removing metals to secure the necessary fit “

It is final and precision finishing/assembly of components to mate properly

- The operations commonly employed in fitting work are,
 1. Marking
 2. Filing
 3. Chipping
 4. Sawing
 5. Drilling
 6. Reaming
 7. Tapping

Classification of various processes can be grouped as under

- Measurement
- Marking out
- Work holding
- Tool holding
- Material removal
- Joining
- Forming
- Assembly & dismantling
- Drawing Reading/blue print reading

Marking Out

- The surface of work to be marked out are usually treated with chalk. After the coat is dried the work is positioned for marking out.
- Marking out consists of marking on the job a series of definite lines or position. This lines act as a guide to the fitter who will have to work on the job after it has been marked out.
- All marking out should be done with reference to true edges or surfaces, preferable to at right angle or with reference to certain datum lines.
- Boundary marks, which later are to be cut away, are made permanent by lightly dot punching along their length.

Measurement

Dimensional parameters / Geometrical Properties

Length

Flatness

Parallelism

Angles

Relative Positions

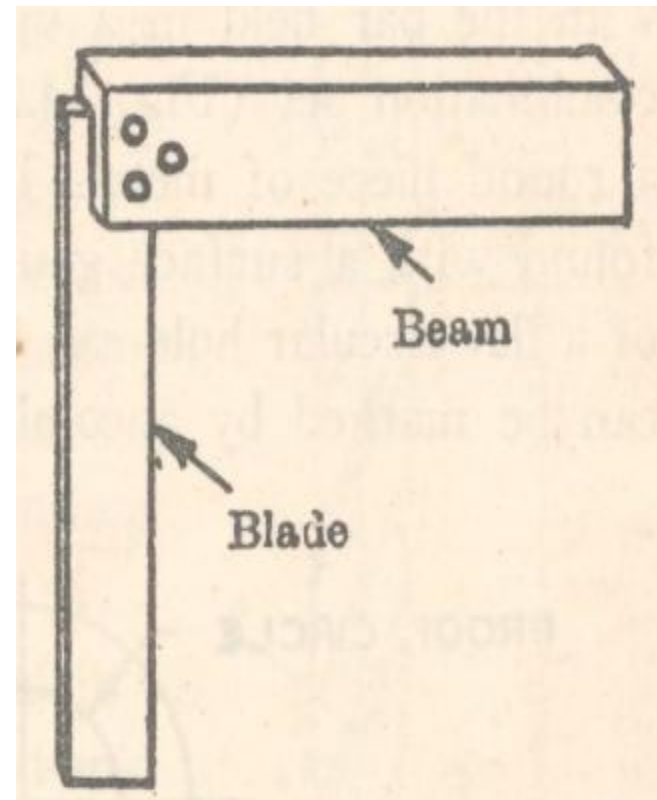
Surface Roughness

Roundness & Concentricity

Accuracy of Form

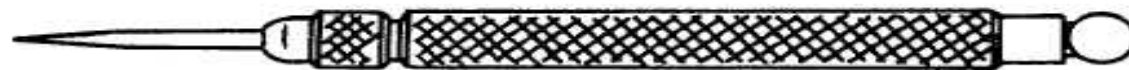
Try Square

- This is used to check right angles to an already trued edge or surface and also for laying out work.
- The squareness of any square may be tested by placing the beam of the square against a straight edge with the blade resting on smoother surface.



Scriber

- Scriber is piece of hardened steel about 150 to 300 mm long and 3 to 5 mm diameter pointed one or both ends like a needle to scratch a line.
- The bent end is used to scratch line in places where the straight end cannot reach.



SINGLE POINT POCKET TYPE

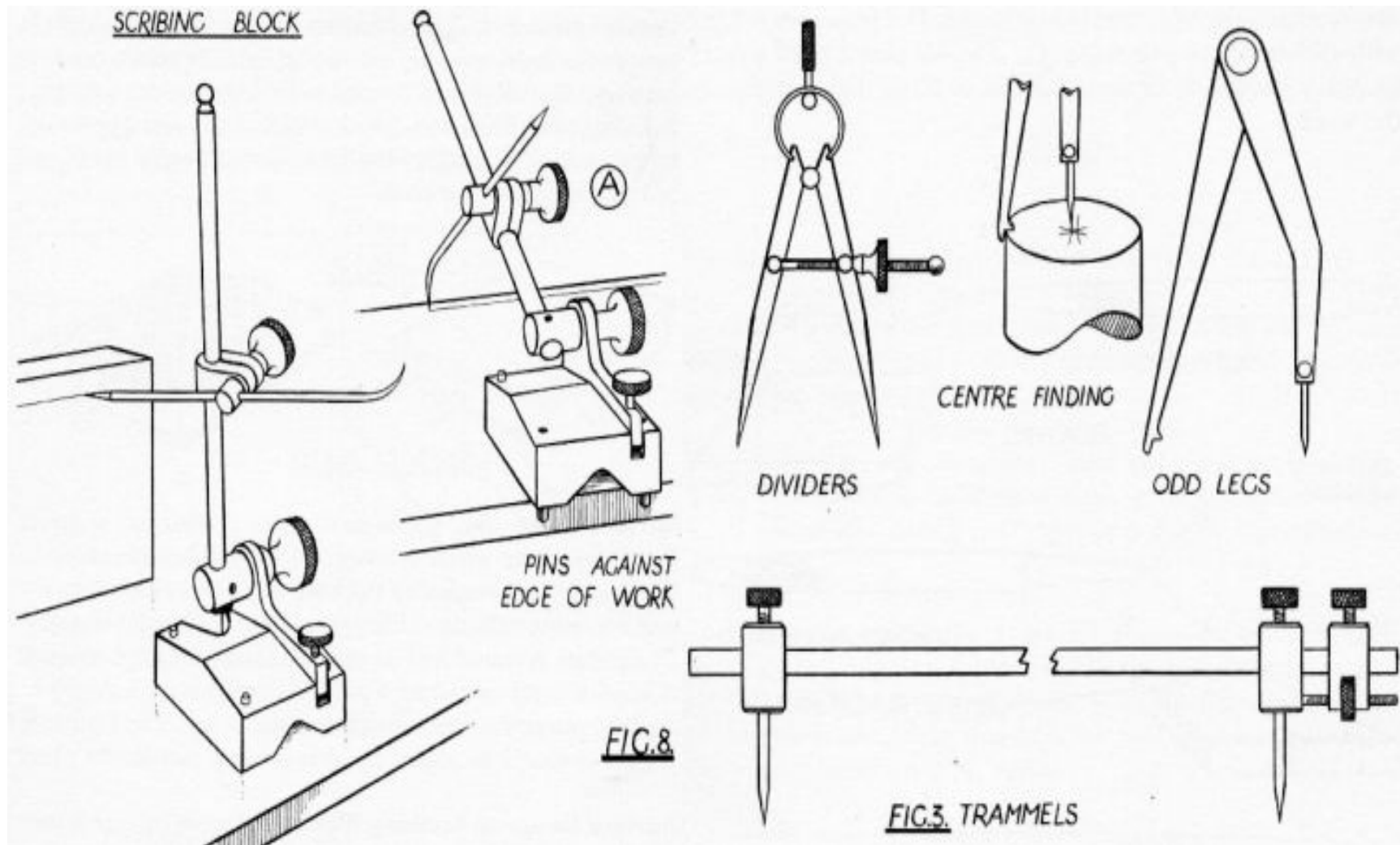


SINGLE POINT



BENT POINT - STRAIGHT POINT TYPE

Other Marking Out Tools



Chisel

- A chisel is a tool with a characteristically shaped cutting edge of blade on its end, for carving or cutting a hard material such as wood, stone, or metal. The blade of chisel are made of metal with a sharp edge on it.



Wood working by chisels

Chisel

- Chisels used in metal work can be divided into two main categories:
hot chisels and cold chisels.



Bull point chisel

Cold chisel



Cold Chisel



Hot Chisel Centered Point



Hot Chisel Offset Point

Chisels are classified as per shape

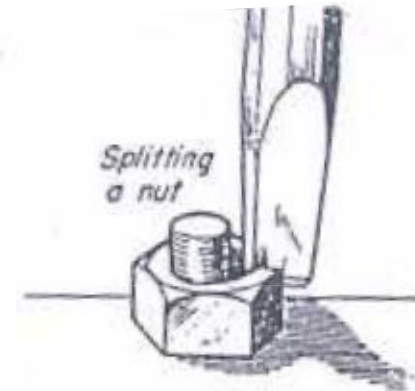
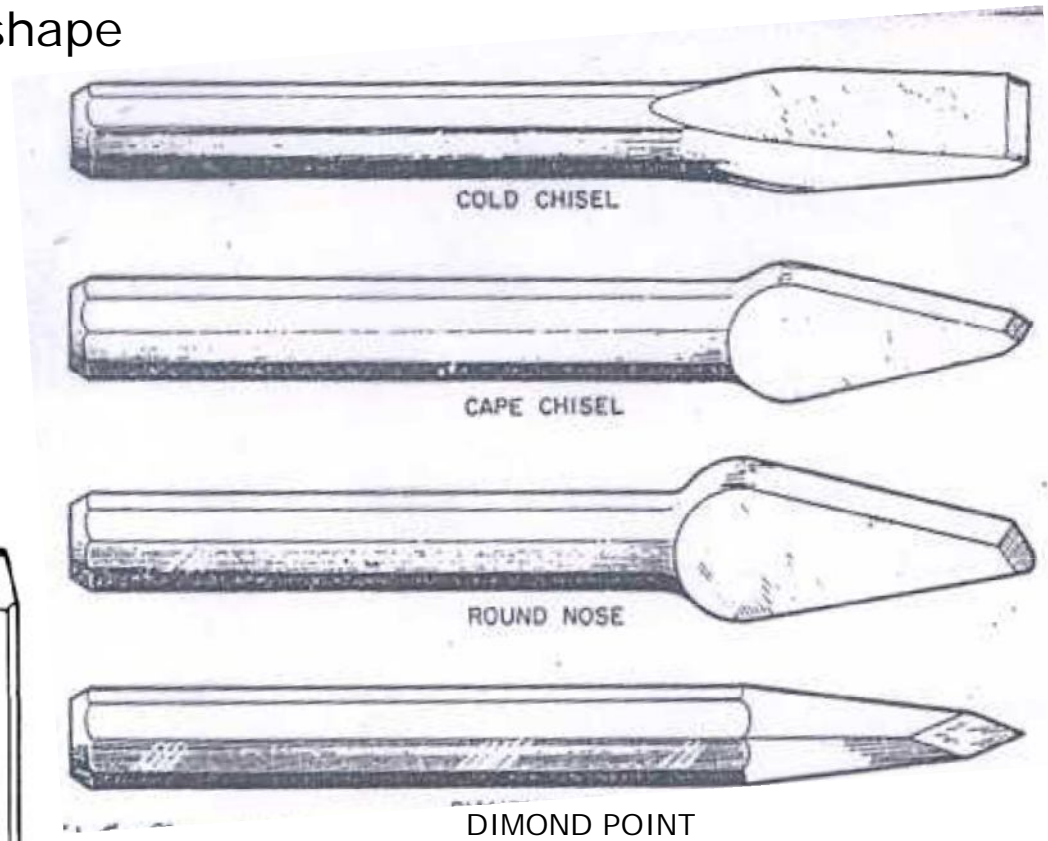
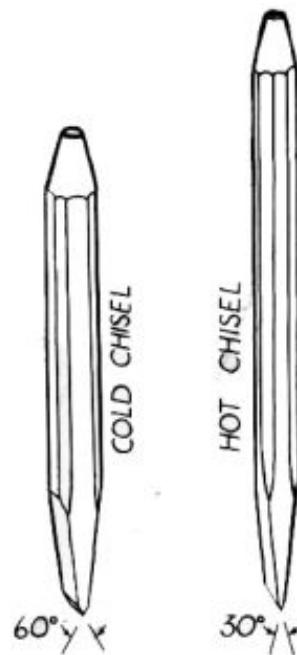
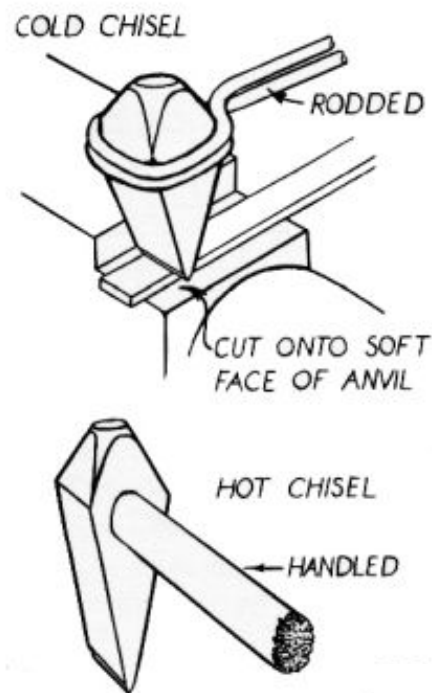
Flat

Cross- cut

Half round

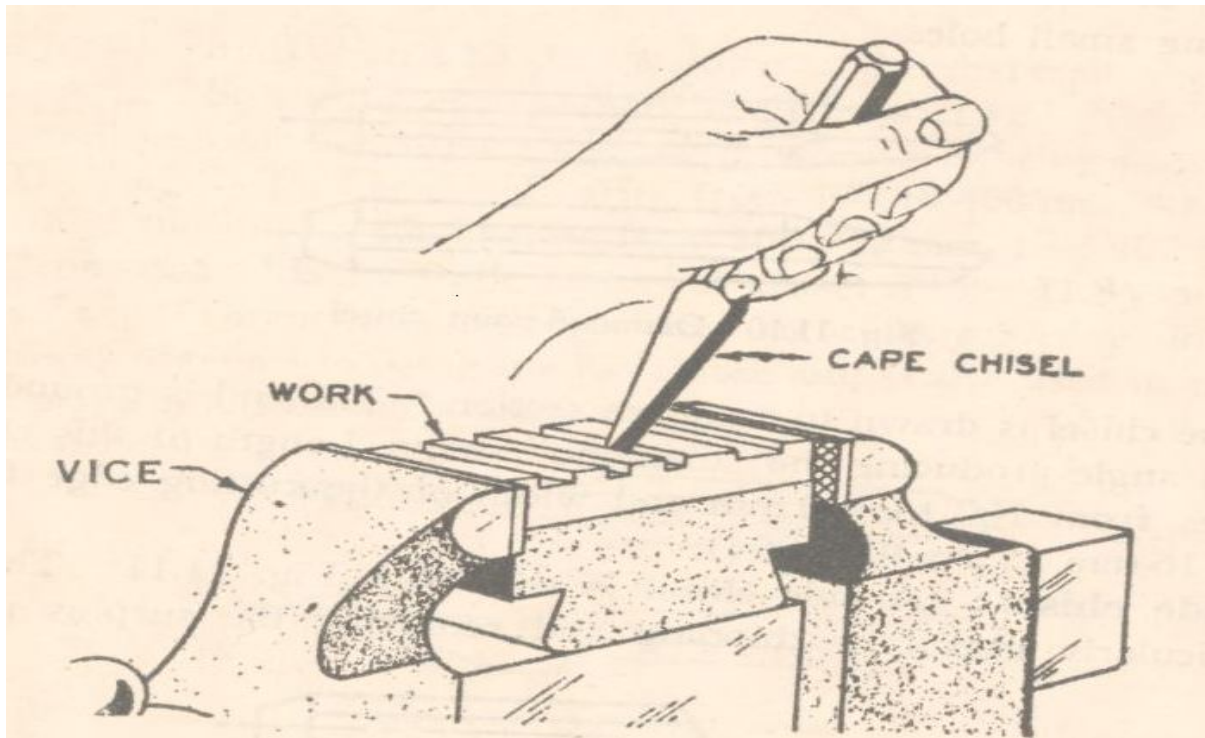
Diamond point

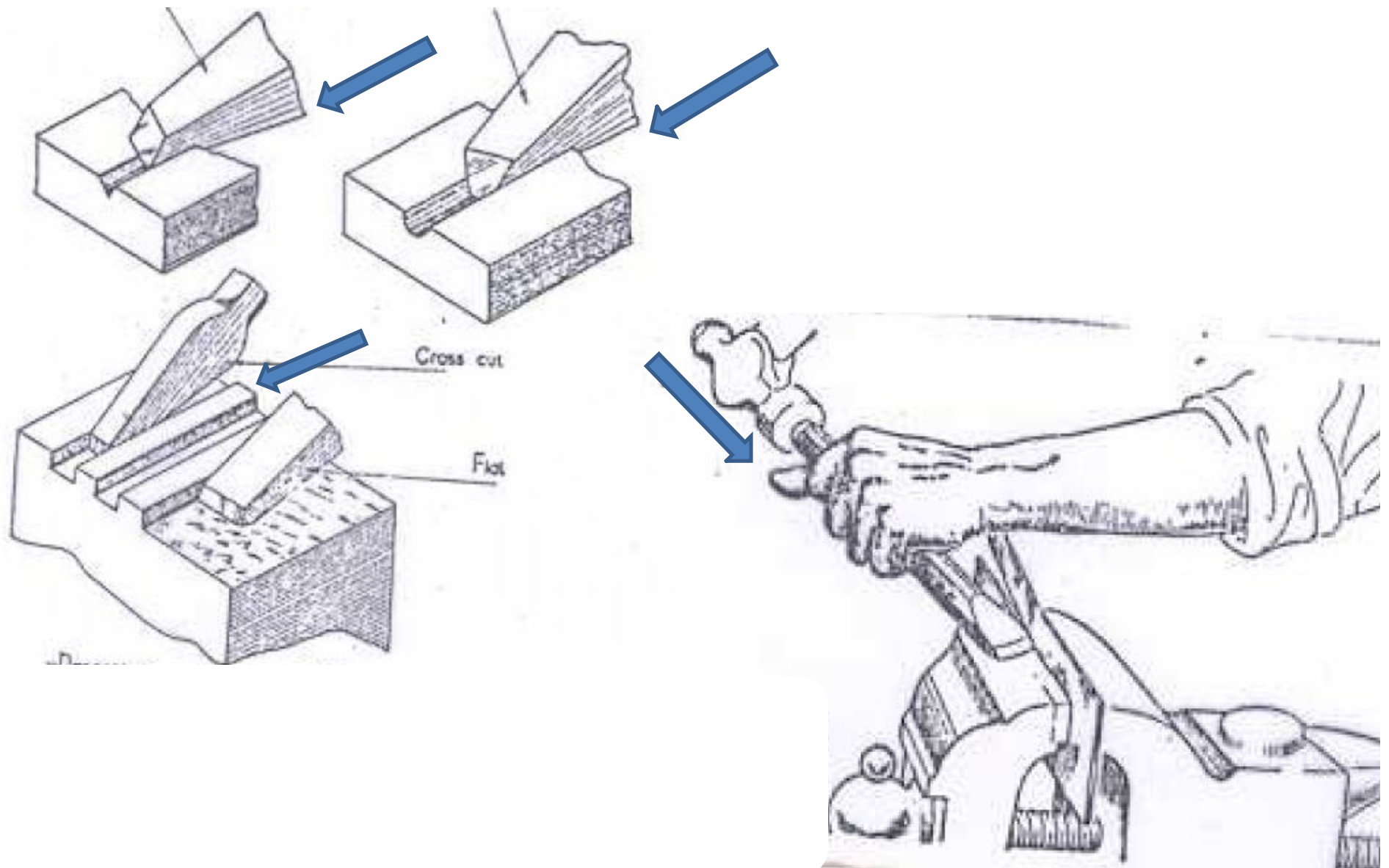
Side chisel



Chipping

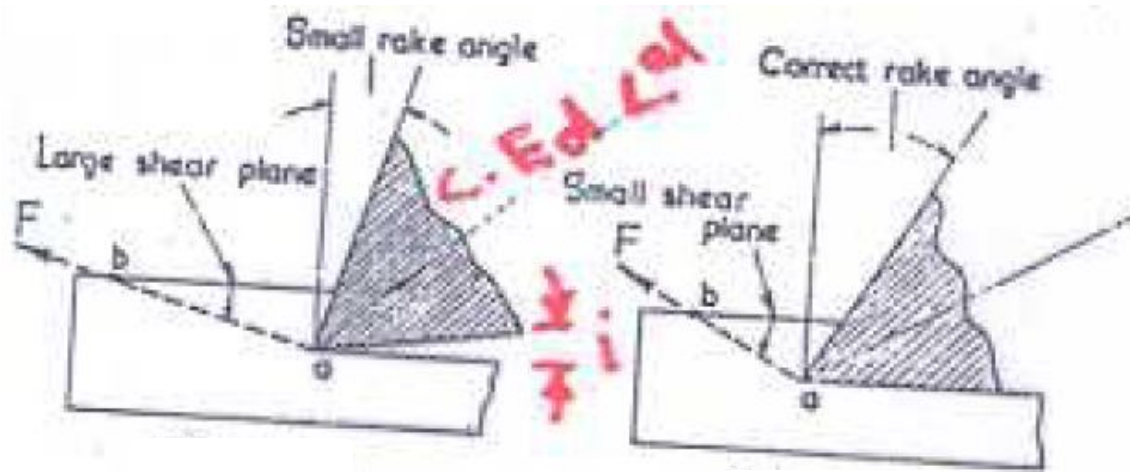
- Chipping is the process of removing thick layer of metal by means of cold chisel.
- In chipping, work the job is firmly held in a vice and the metal is removed by striking the chisel on the surface of the work piece by a hammer.





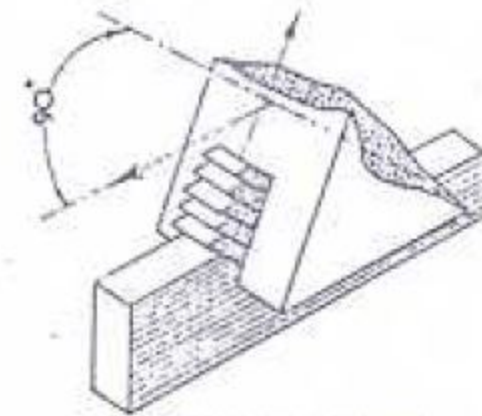
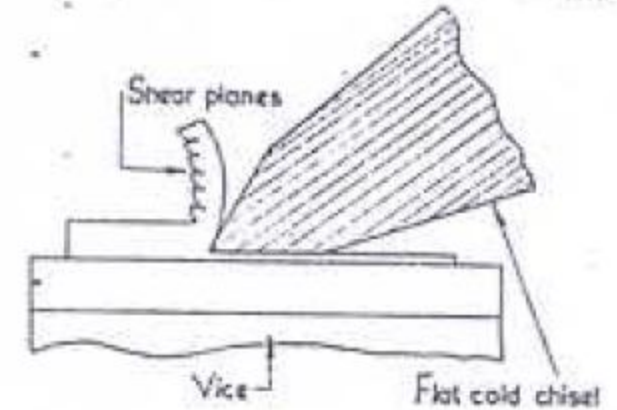
Use of chisel for different applications

Principle of Working of Chisel and Formation of Shear Plane

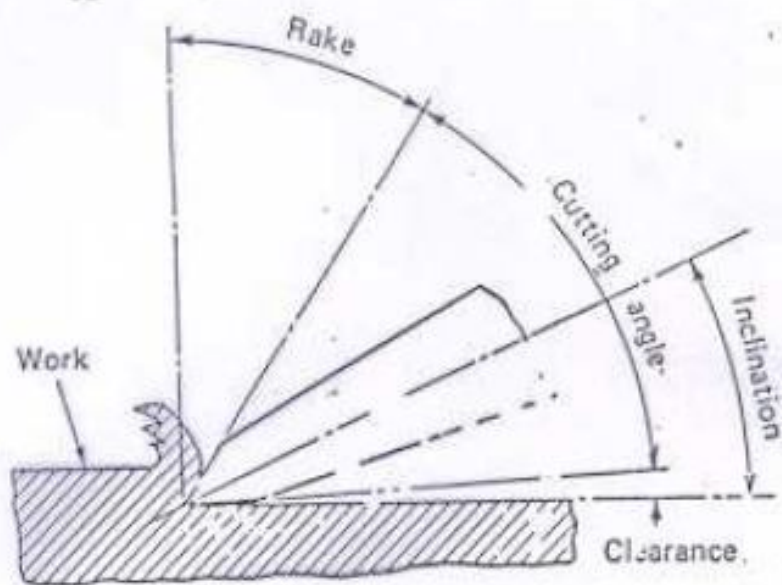


Chisel lifted

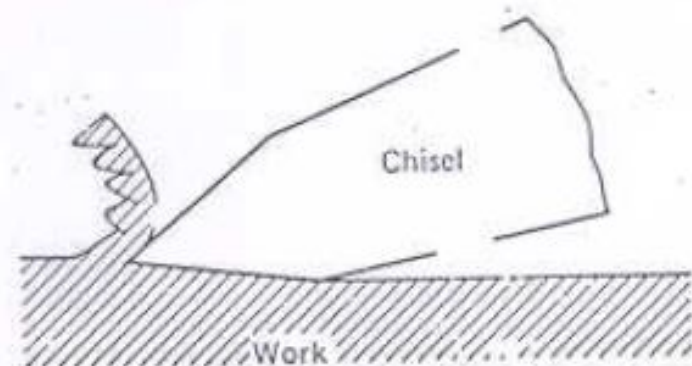
Chisel correct



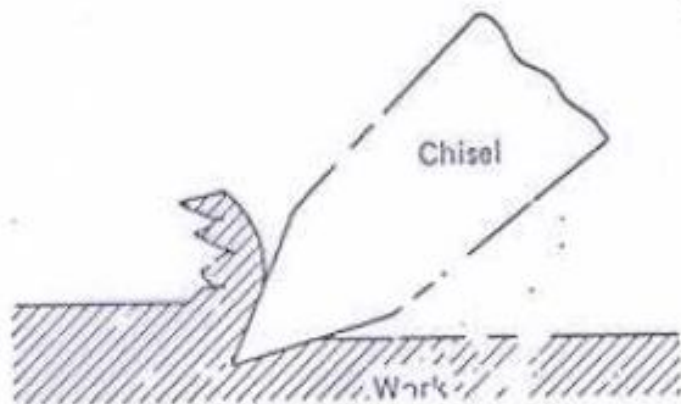
Material	Point Angle	Angle of inclination
Cast iron	50°	37°
Mild steel	55°	34.5°
Medium carbon steel	65°	39.5°
Brass	50°	32°
copper	45°	29.5°
Aluminium	30°	22°



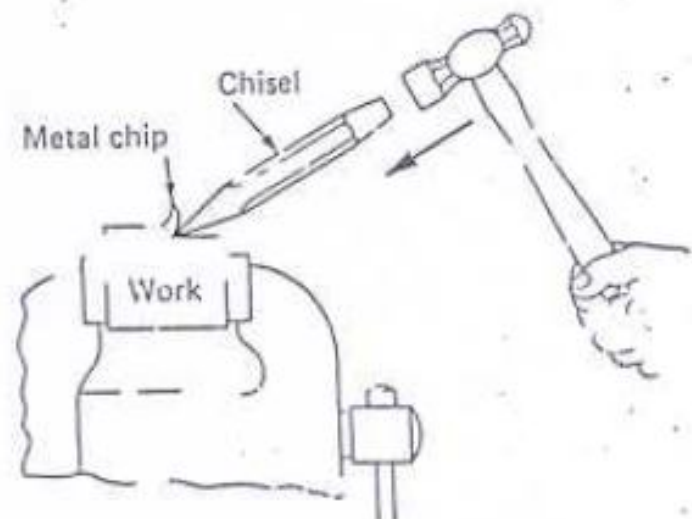
(a) CUTTING ACTION OF CHISEL



(b) ANGLE OF INCLINATION TOO SMALL
CHISEL POINT RISES



(c) ANGLE OF INCLINATION TOO GREAT
CHISEL POINT DIGS IN



(d) CUT TOWARDS FIXED JAW OF VICE

Effect of angle of inclination on chiseling

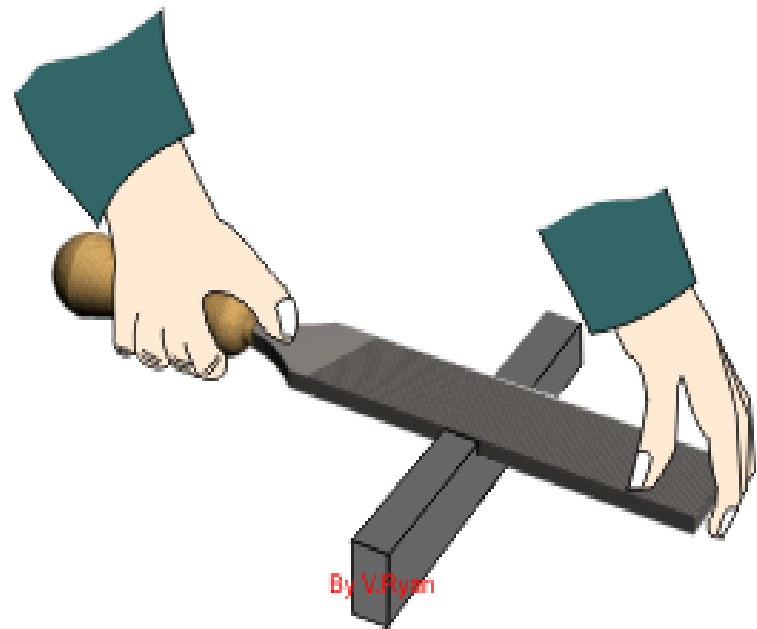
Basic Precautions When Using a Chisel

- Secure work so that it cannot move in any direction.
- Keep both hands back of the cutting edge at all times.
- Do not start a cut on a guideline.
- Start slightly away from it, so that there is a small amount of material to be removed by the finishing cuts.
- Never cut towards yourself with a chisel.
- Make the shavings thin, especially when finishing

Filing

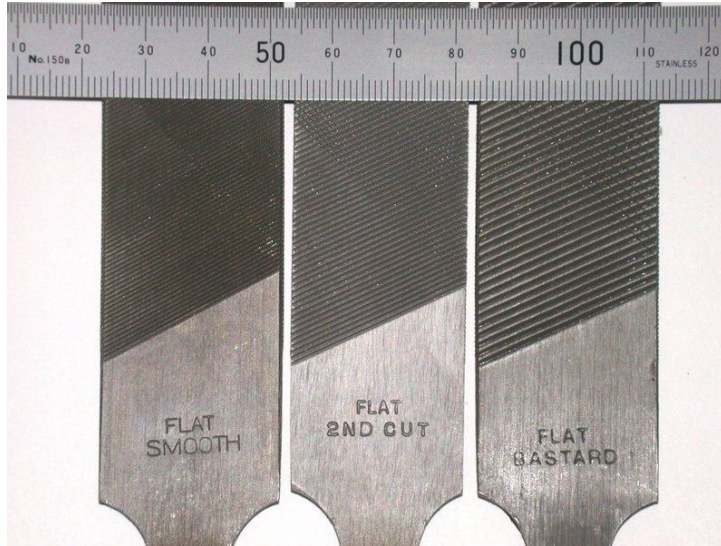
" A file is a metalworking and woodworking tool used to remove the burr from cuts and clean the face of the cuts and finish the final shape of work piece "

- Accuracy : 0.02 to 0.05 mm
- It should be noted that file cut only on the forward stroke, hence if required the file can be lifted off the work for the return stroke.

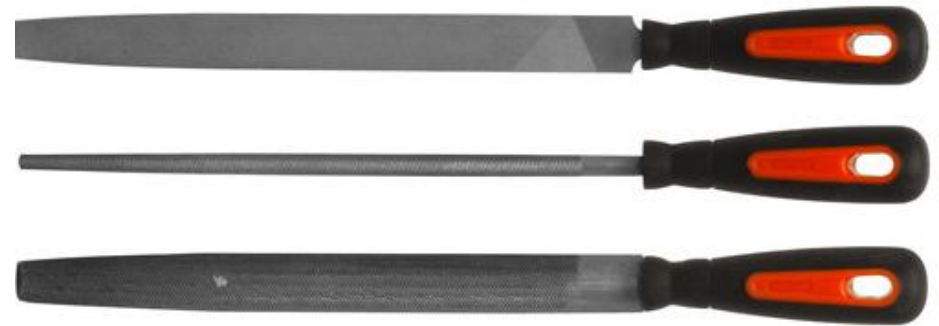


Holding position of file

Types of File



Mill files



Joint round edge files

GRADE	Teeth/25mm	TPI	USE
Rough	12-20	20	Rapid removal of large amount of material
Bastard	14-40	25	Rapid removal of medium amount of material
Second cut	25-52	30	Removal of smaller amount of material before finishing
Smooth	35-62	40	Smooth surface finish
Dead smooth	60-88	50 To 60	Special work with smooth & accurate finish
Super Fine	100-170	100<	Super finishing

Files are classified as

Size- Fine work-100 to 200 mm

Heavy-200 to 450 mm

Type or cut of teeth

Single

Double

Cross section/ Sectional forms

Flat, square, pillar, round, triangular, half round, knife edge

Spacing of teeth

Rough

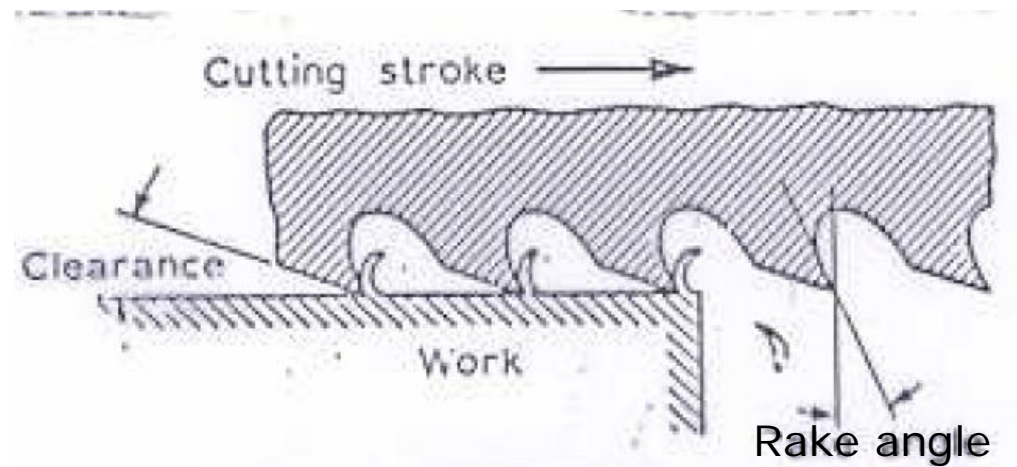
Bastard

Second cut

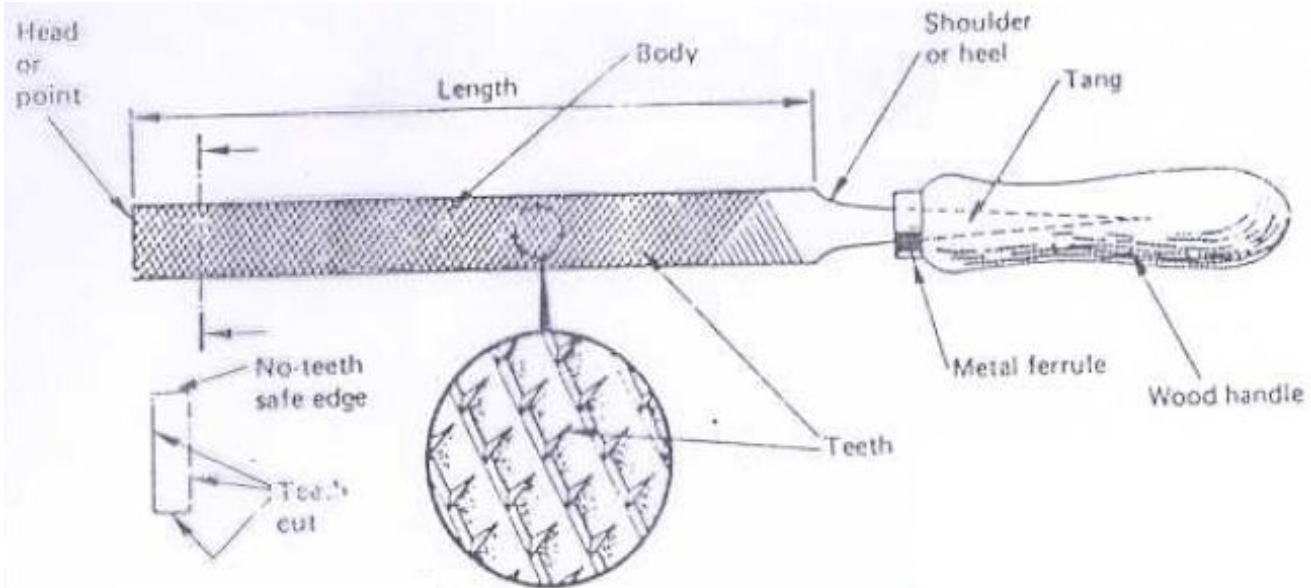
Smooth

Dead smooth

Super smooth



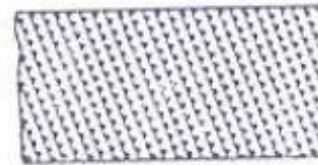
Cutting principle of a file



Single cut
For soft materials
Wood, lead, soft brass



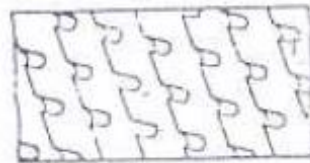
Single cut
For hard materials
Steel, cast iron



Double cut
For hard materials
Steel, hard brass



Rasp
For soft materials
Wood, leather



Millenicut
For very soft materials
Plastic, aluminium



Square

Round

Warding

Half Round

Three Square

Hand

Types of Needle file



Different types of riffler files



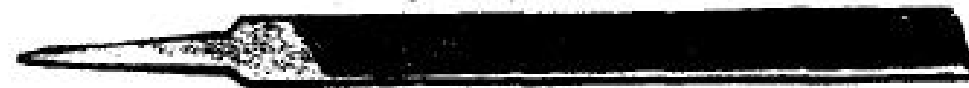
FLAT FLOAT



ROUND



HALF ROUND



SPECIAL CROSSCUT



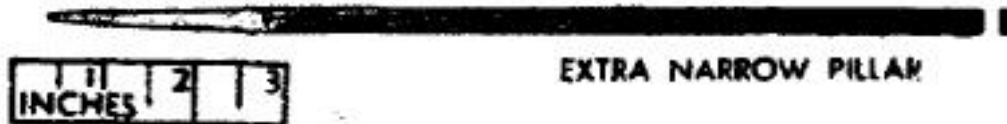
MILL



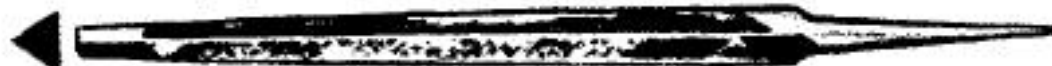
HAND



SQUARE



EXTRA NARROW PILLAR



TRIANGULAR TAPER



TRIANGULAR THREE SIDED



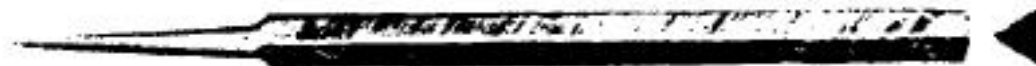
PILLAR



FLAT



CURVED TOOTH

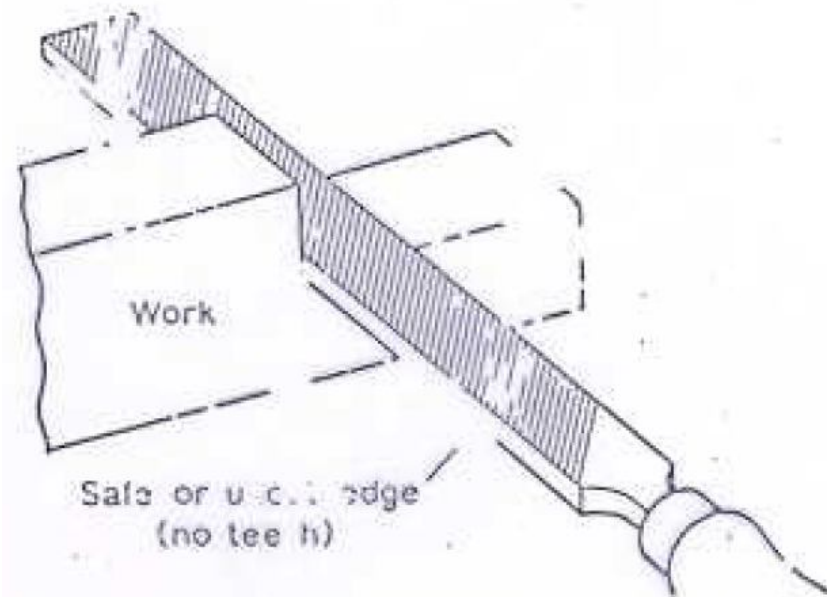
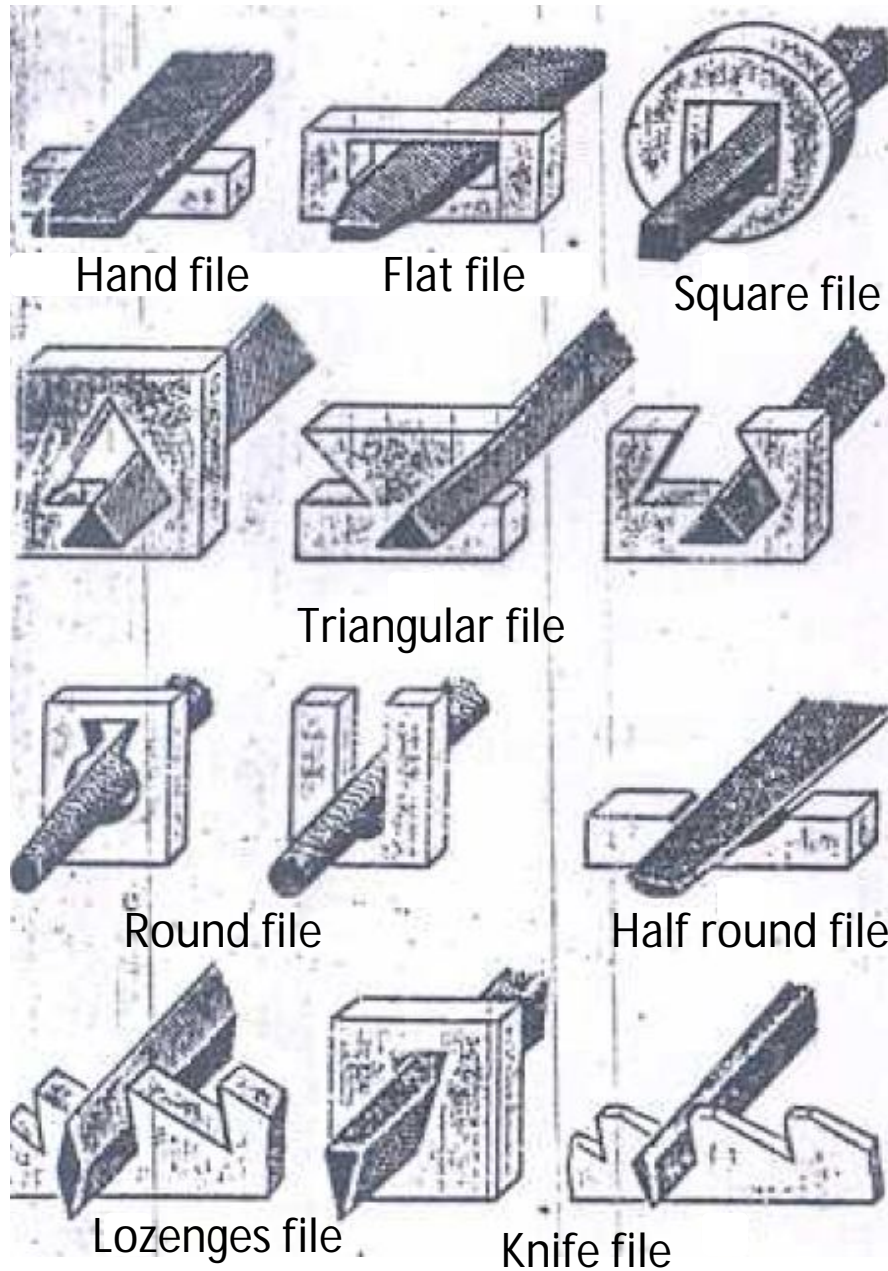


TRIANGULAR BLUNT HANDSAW



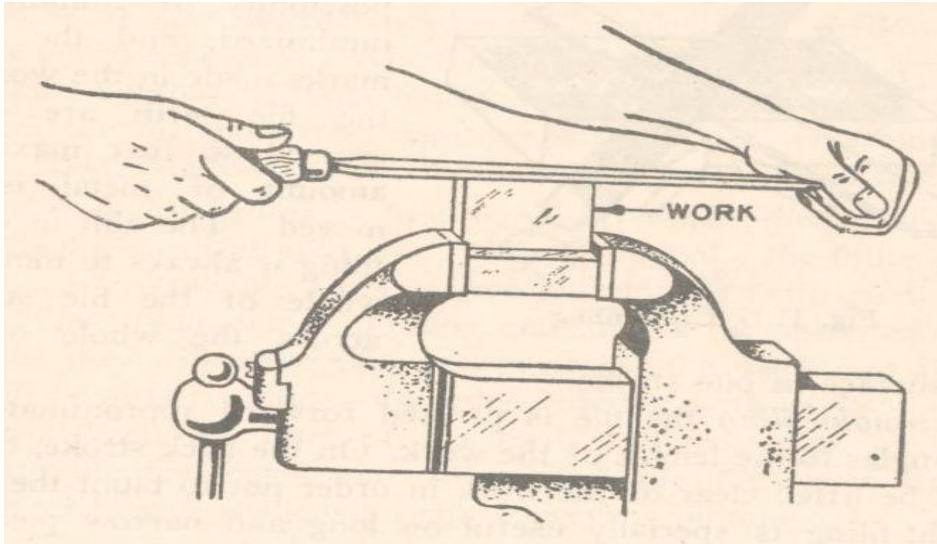
KNIFE

Applications of Different Files



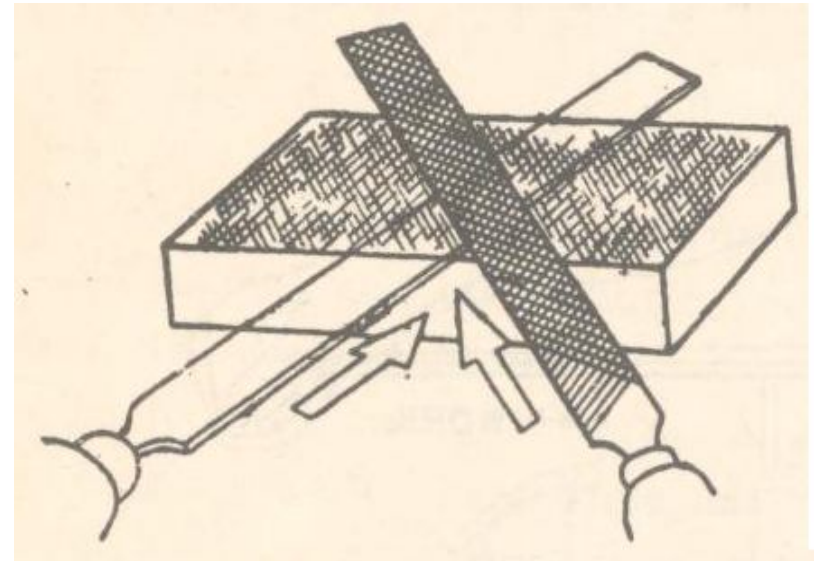
Some files have a safe edge which allows filing to take place without damaging another finished face

Methods of Filing



Straight Filing

- The file is pressed forward approximately at right angle to the length of the work
- Used for narrow pieces

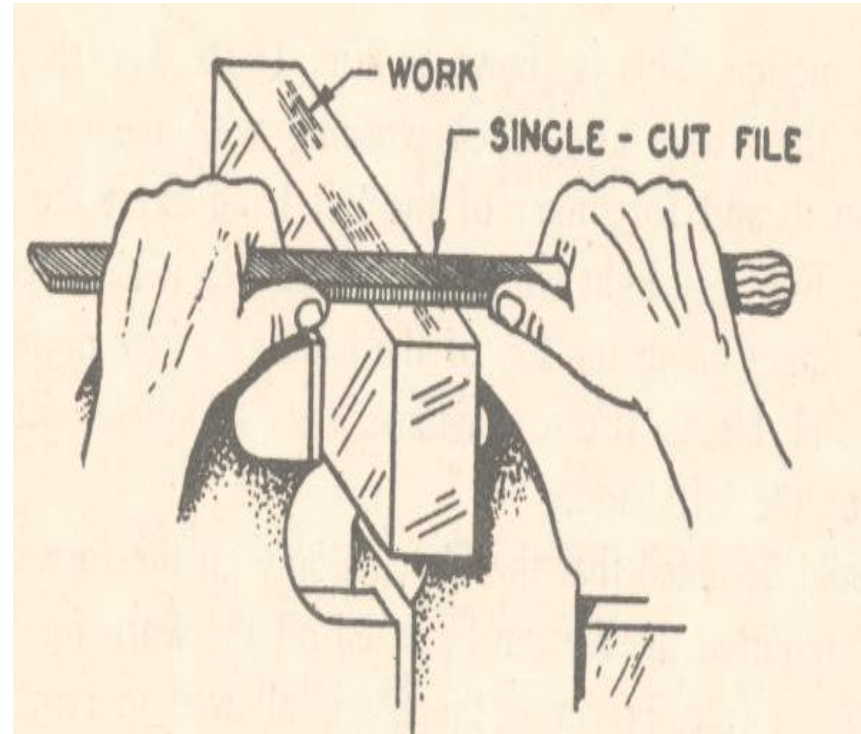


Cross Filing

- The file strokes run alternately from the left to the right and from the right to left
- Maximum amount of material removed

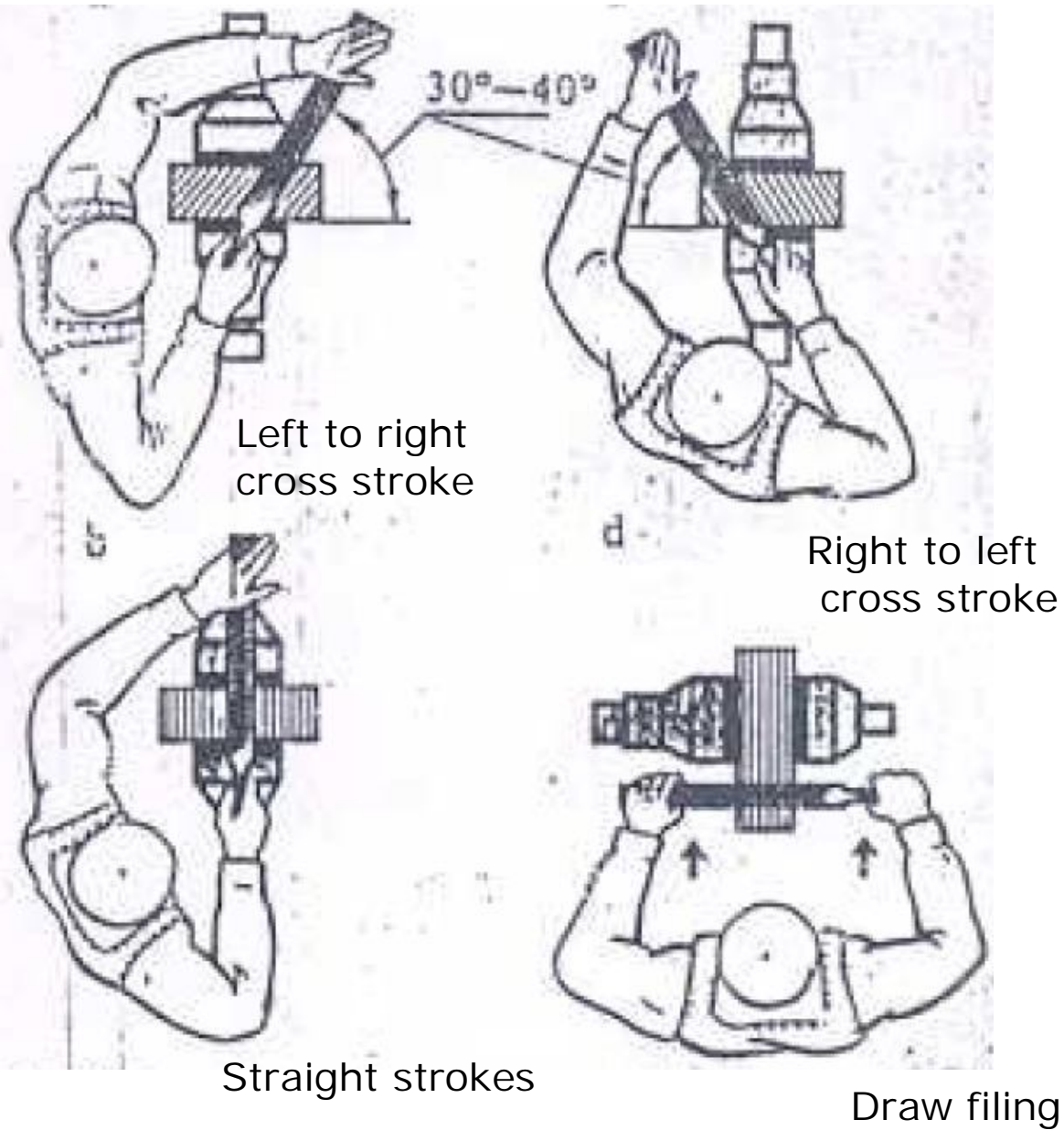
Methods of Filing

- In draw filing, the handle of file is not held. Instead, both hands are placed close together on the blade.
- It does not move much material but a smoother cutting action is achieved than cross and straight filing.



Draw Filing

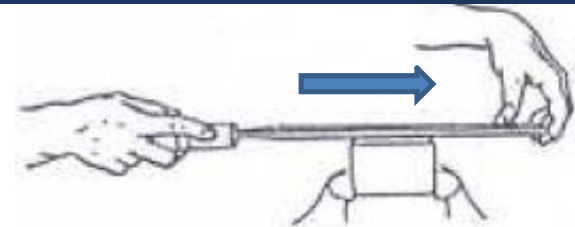
Different Filing Positions



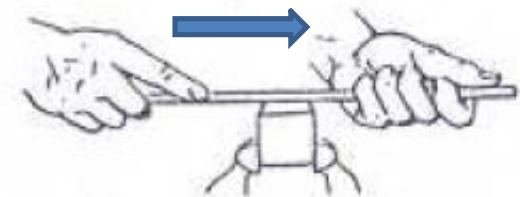
Different Grips for Filing



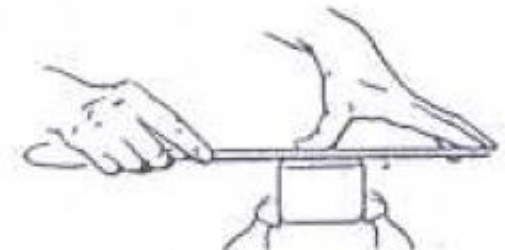
Hand position in draw filing



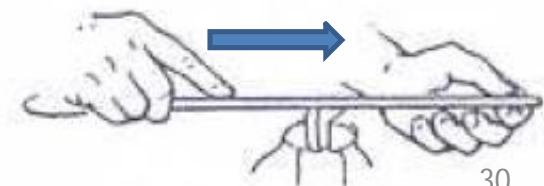
Normal filing



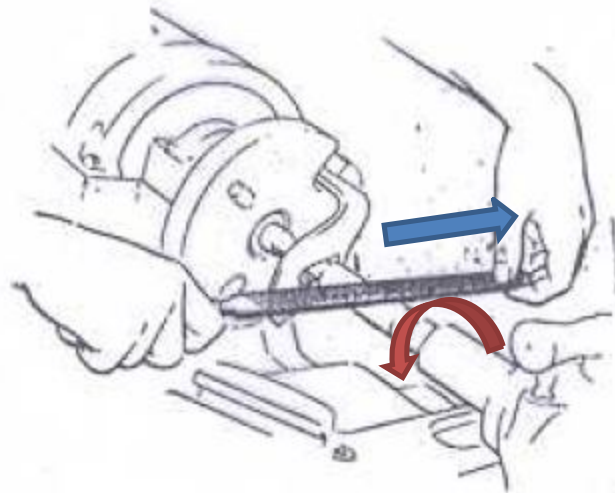
Heavy stock removal



Flat filing



Precision work



Lathe filing requires long-angle file
File must be stroked, not just pressed on the rotating job

Precautions During Filing

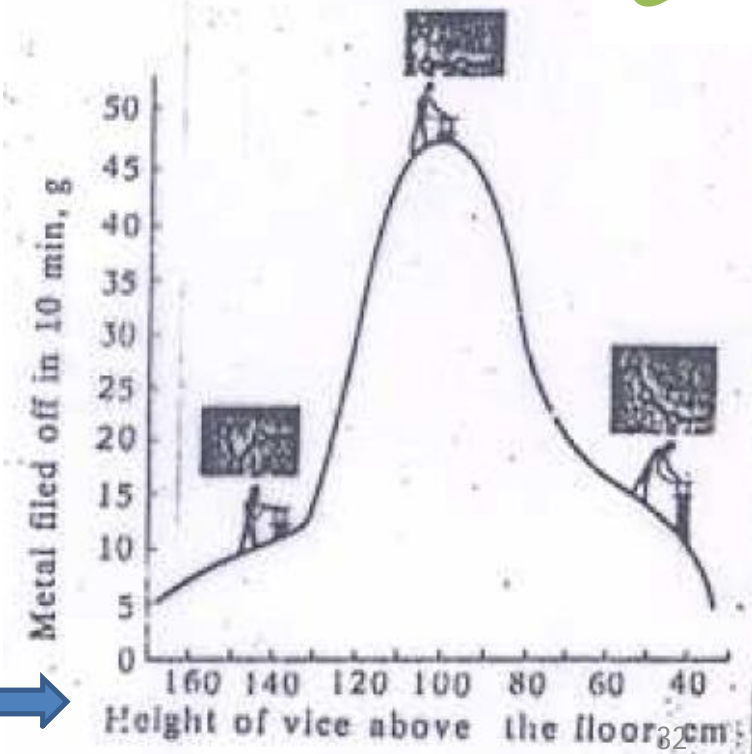
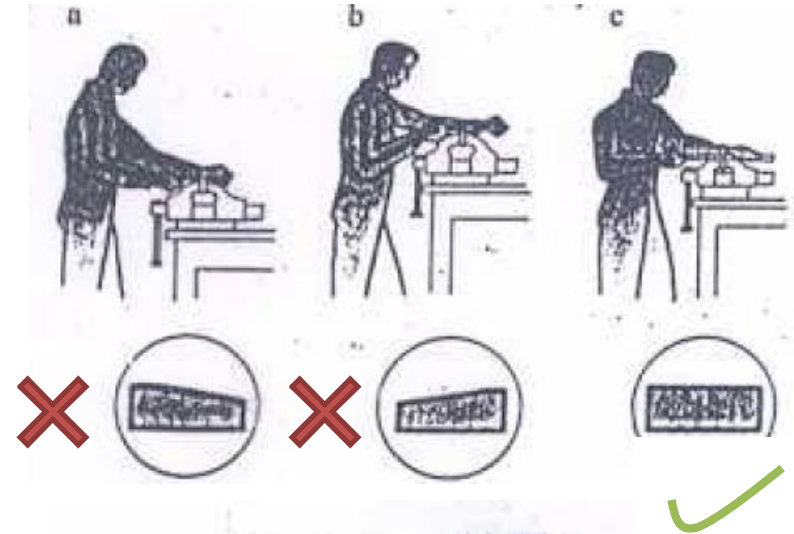
- Files are brittle and should be placed thoughtfully in the bench well in such a way that they do not rub or knock against other tools.
- Make sure that the handle is firmly fixed to the file.
- New file is used for soft material like copper, brass etc. because the file teeth become clogged with particles of metal.



Height Adjustment of a Vice



Setting height of the vice

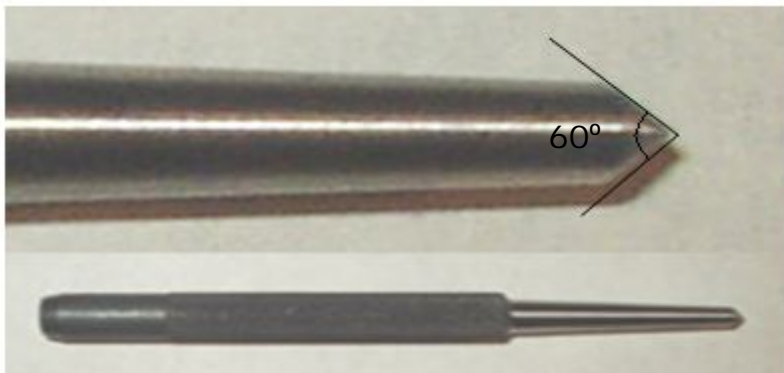


Relationship between productivity and height of vice



Punch

- A punch is used in a bench work for marking out work, locating centers etc.
- Prick Punch : Sharply pointed tool , Punch angle $\sim 40^\circ$
Used to make small punch marks on layout in order to make them last longer
- Centre Punch : Punch angle $\sim 60^\circ$
Used only to make the prick punch makes larger at the centers of the holes that are to be drilled



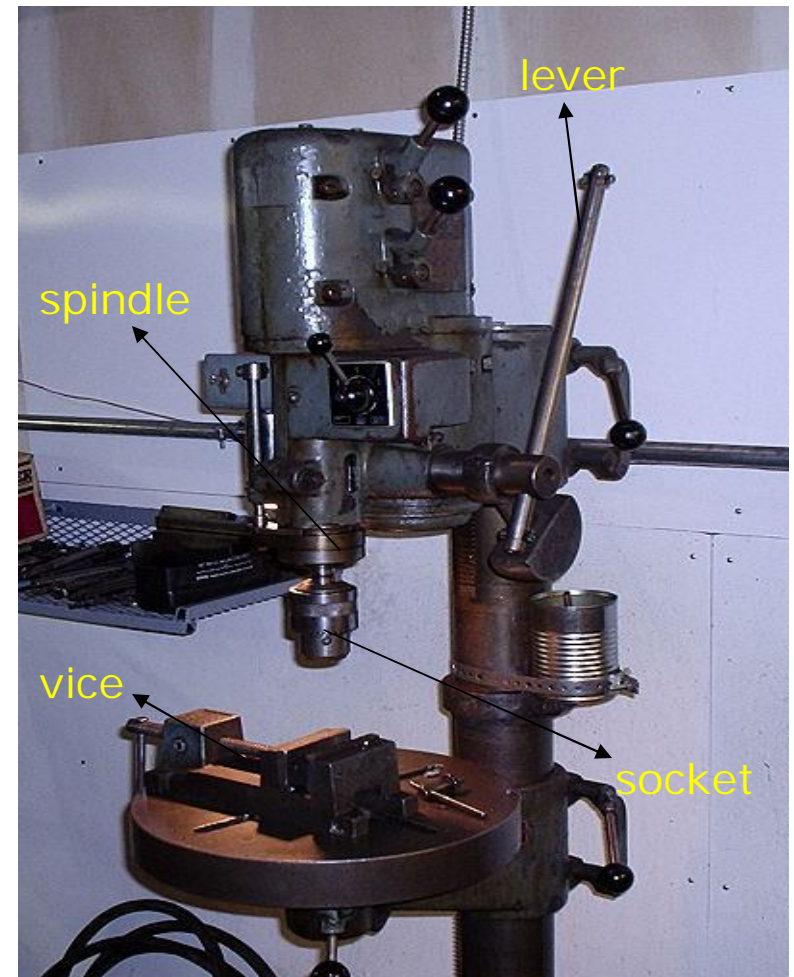
Centre Punch



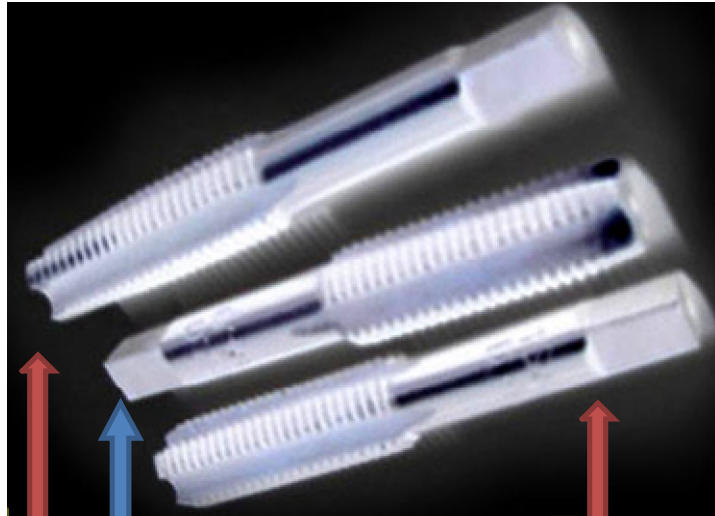
Prick Punch

Drill

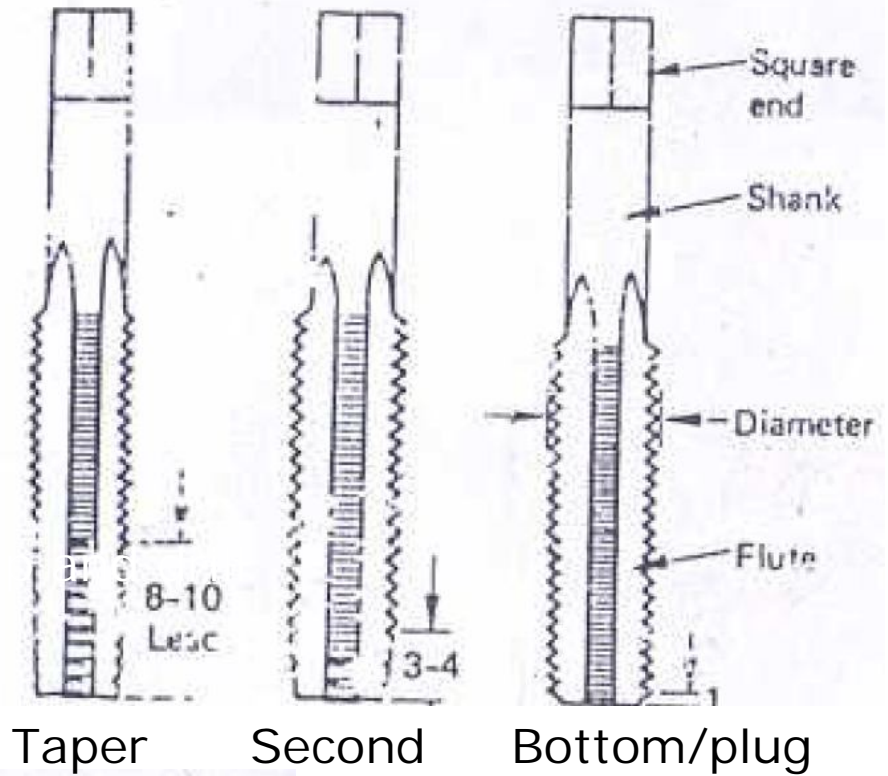
- Drill is the tool for making holes in a metal piece. This is done with the help of drilling machine.
- The socket containing the drill is fitted in the machine spindle and the spindle is lowered by the hand lever to lightly touch the centre mark of the job already marked out for drilling.



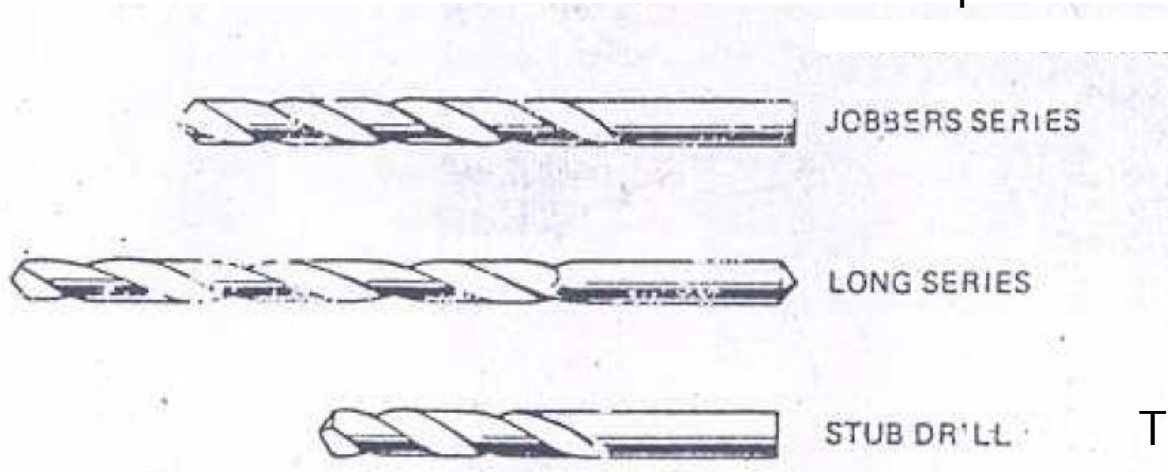
Types of Tap and Drill



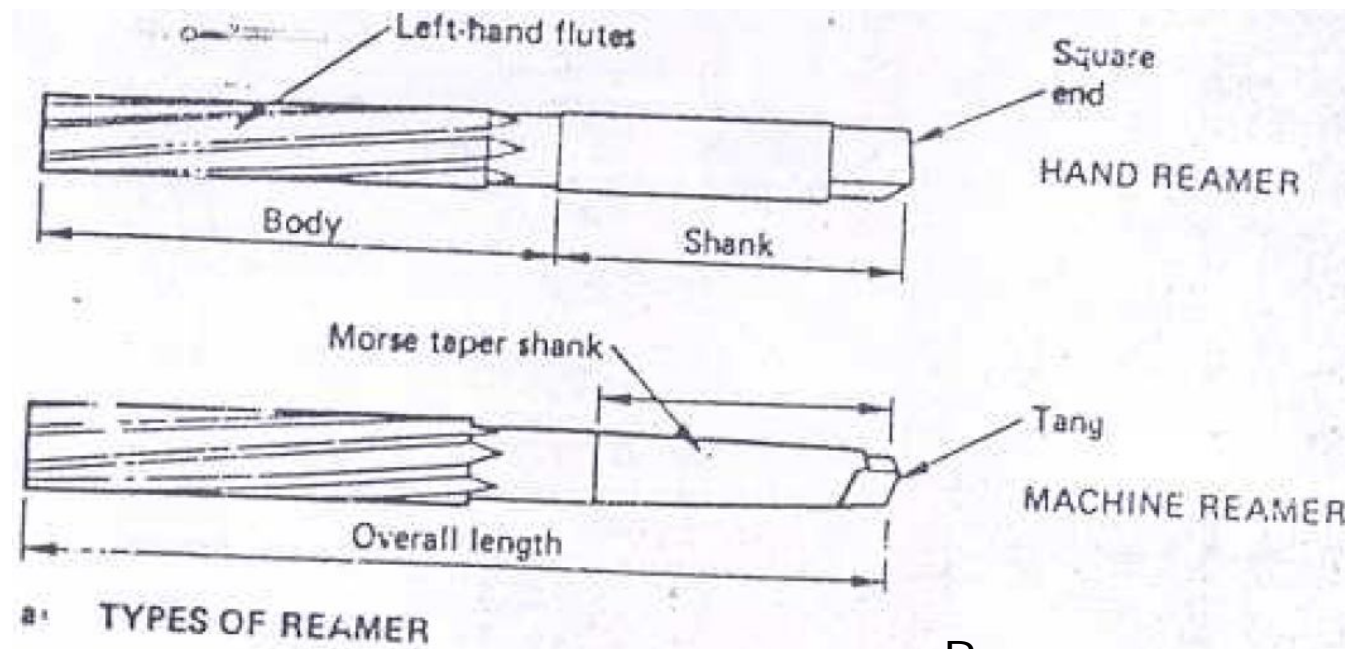
Taper Second Bottom/plug



Taper Second Bottom/plug



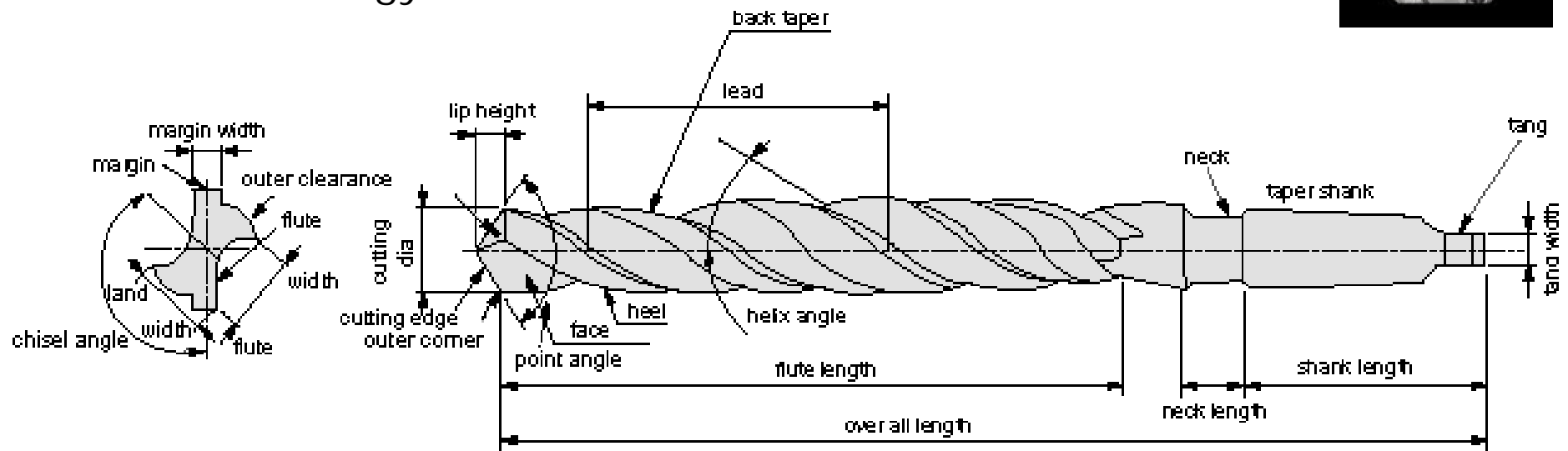
Types of twist drill



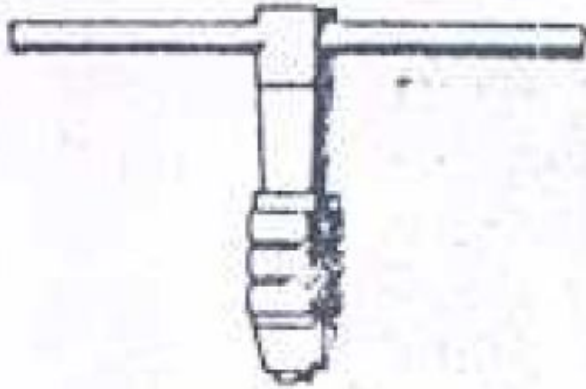
Reamer



Drill terminology



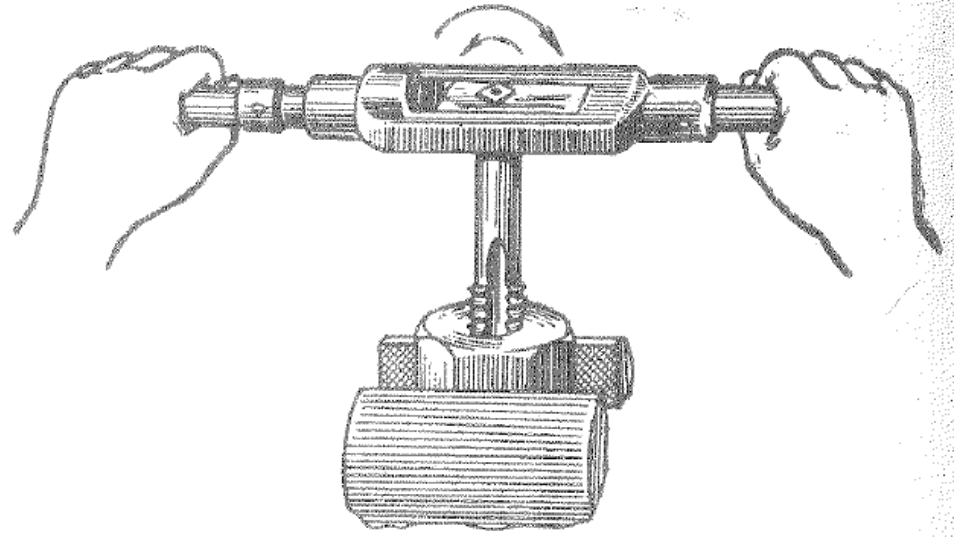
Types of tap wrench



CHUCK TYPE



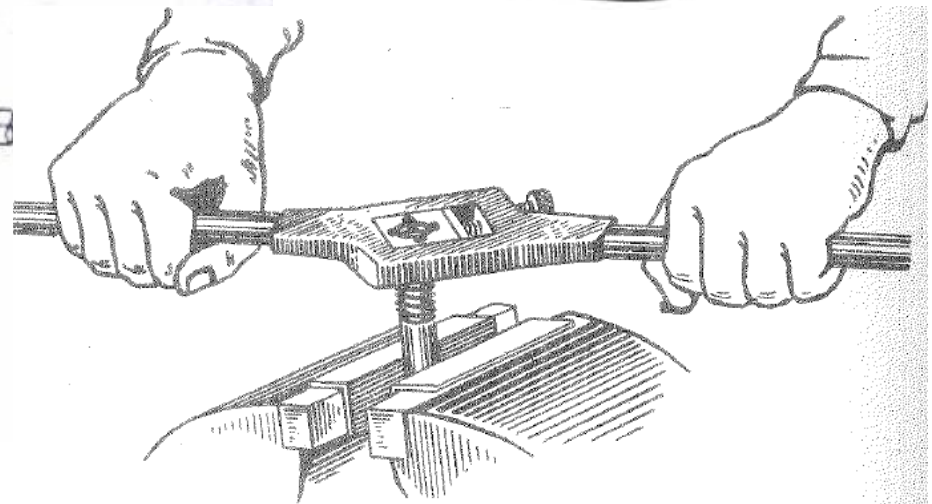
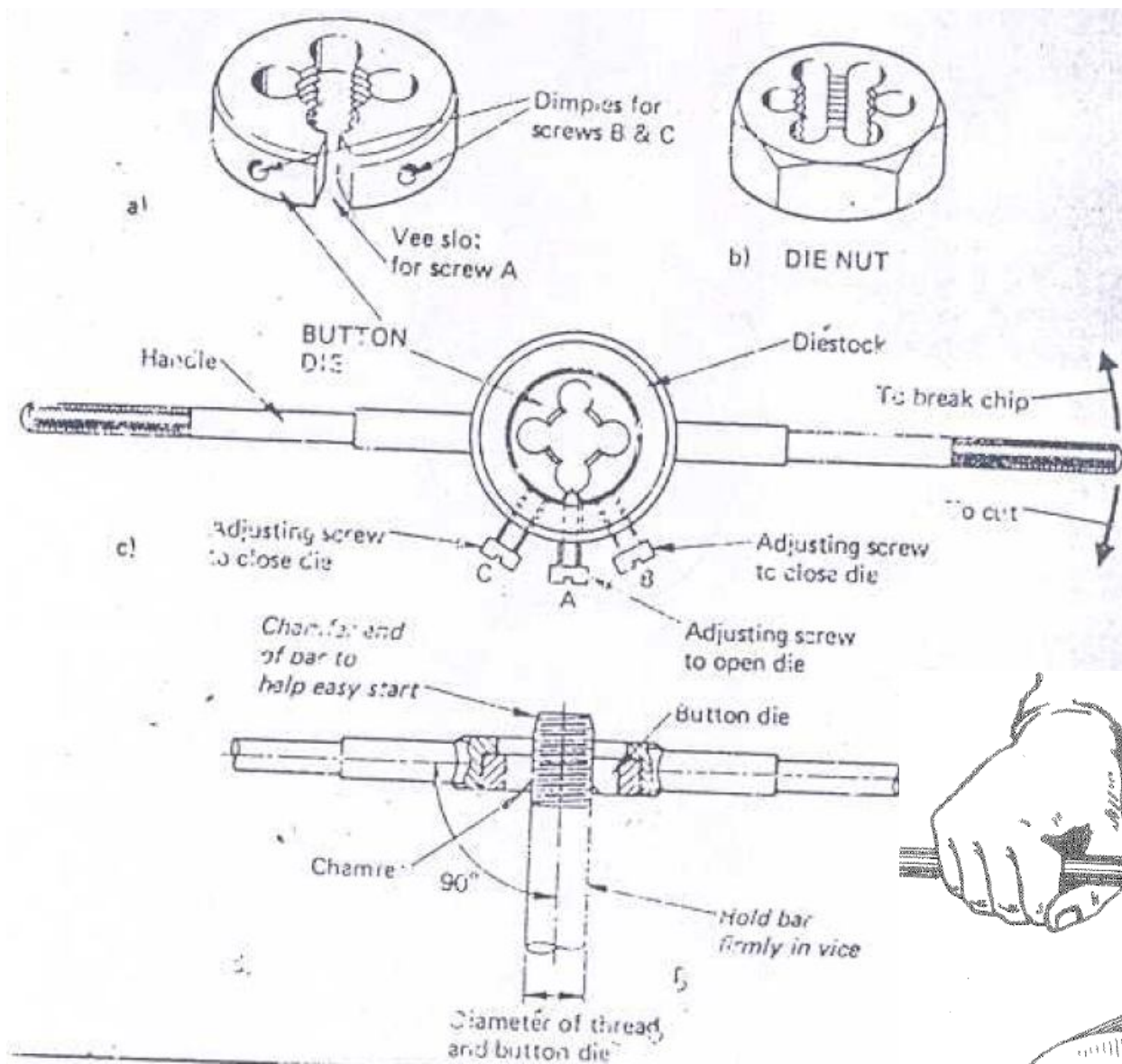
BAR TYPE

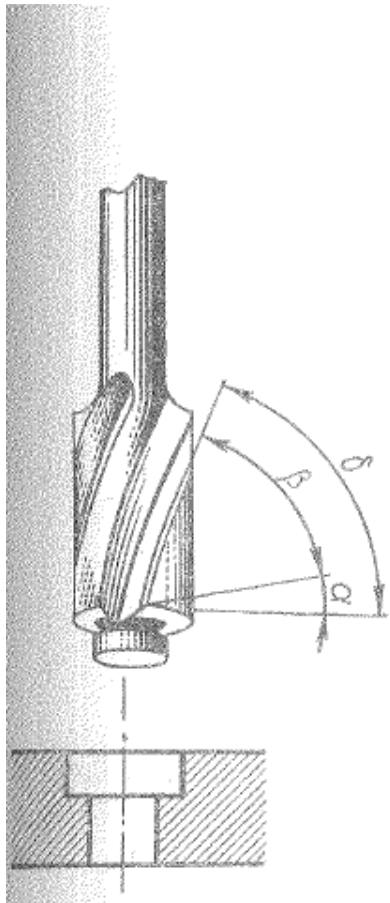


AMERICAN TYPE

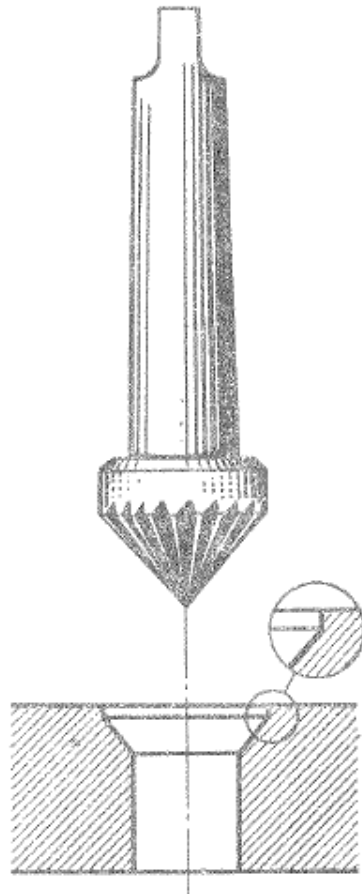


Use of dies for external threading

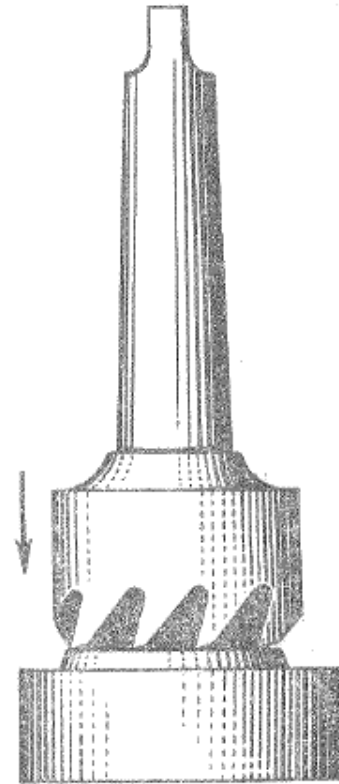




Counter boring



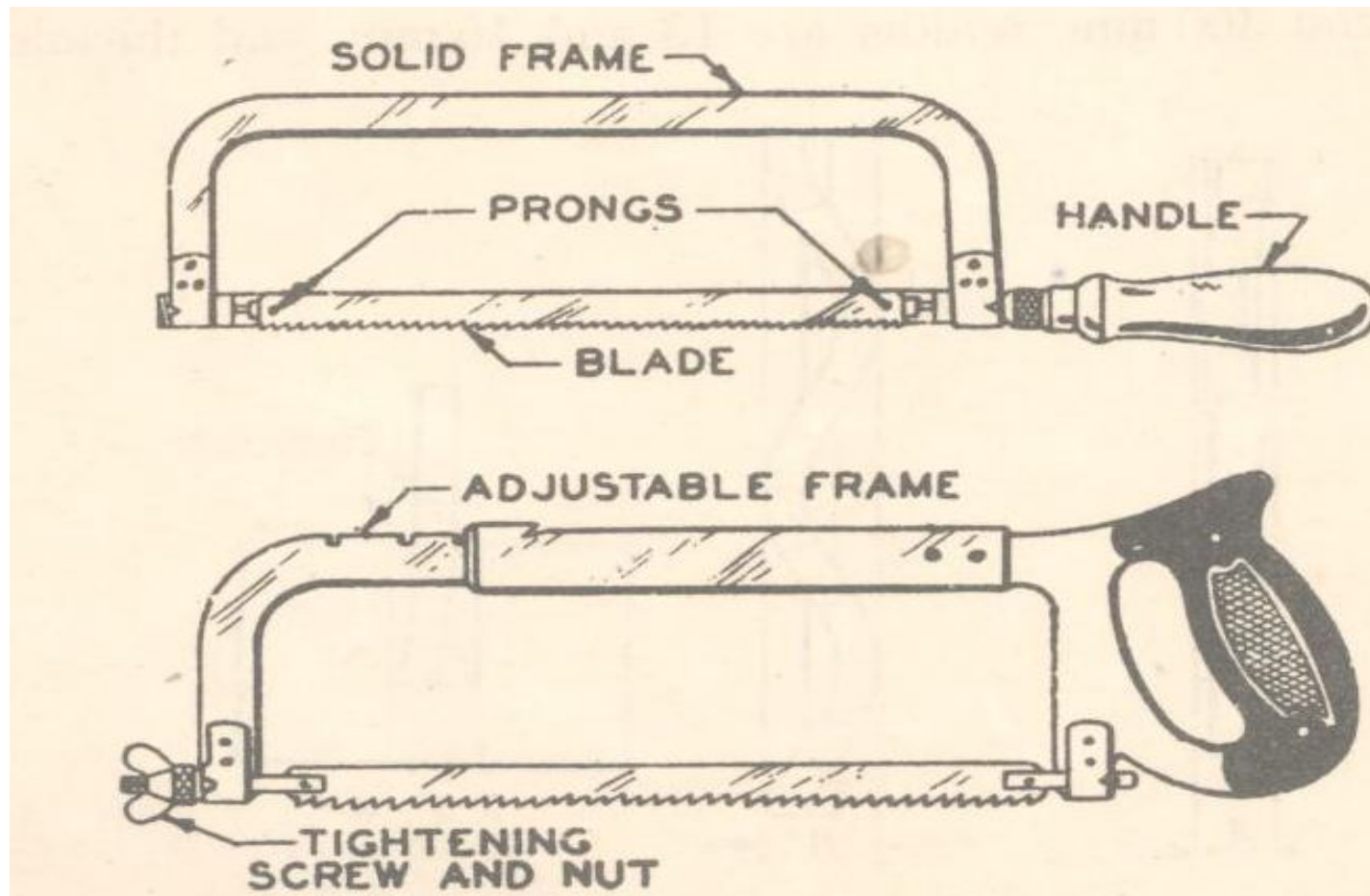
Counter sinking



Spot facing

Hacksaw

- The hacksaw is used for sawing.
- A hand hacksaw consists of a frame, handle, prongs, tightening screw, nut and blade.

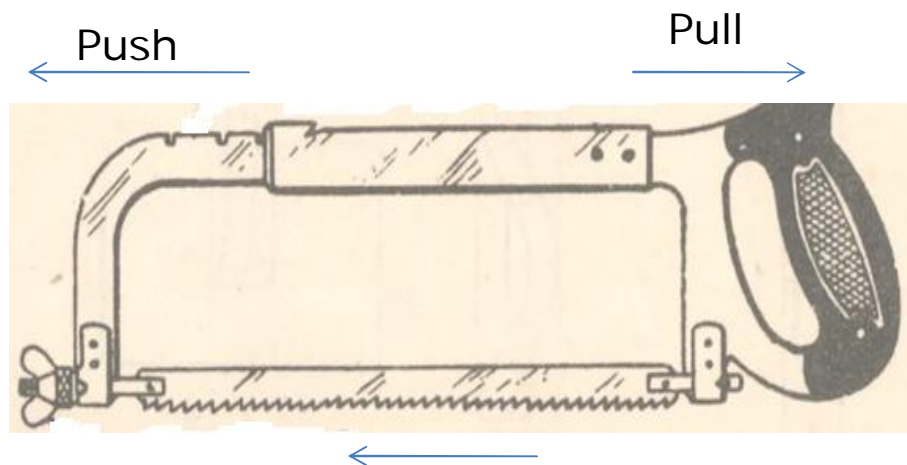


Hacksaw

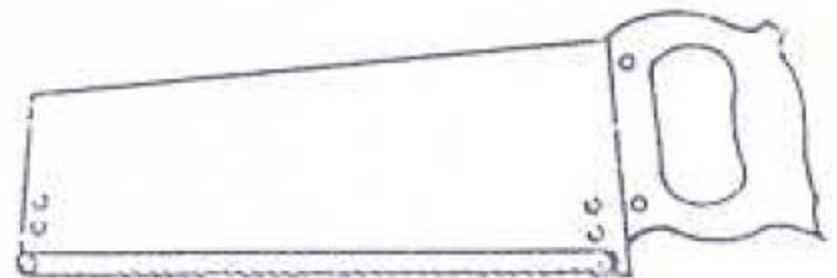
- The frame is made to hold the blade tightly, they are of two types.
- *Solid frame* in which the length cannot be changed and
- *Adjustable frame* which can be lengthened or shortened to hold blades of different length.
- For hand operation, the common lengths are 250 to 300 mm, width are 13 to 16 mm and thickness are 0.63 to 0.8 mm.
- The pitch is varied from 1.0 mm to 1.8 mm.

Hacksaw Blades

- The blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting action on either the push or pull stroke.
- More effective cutting takes place during push

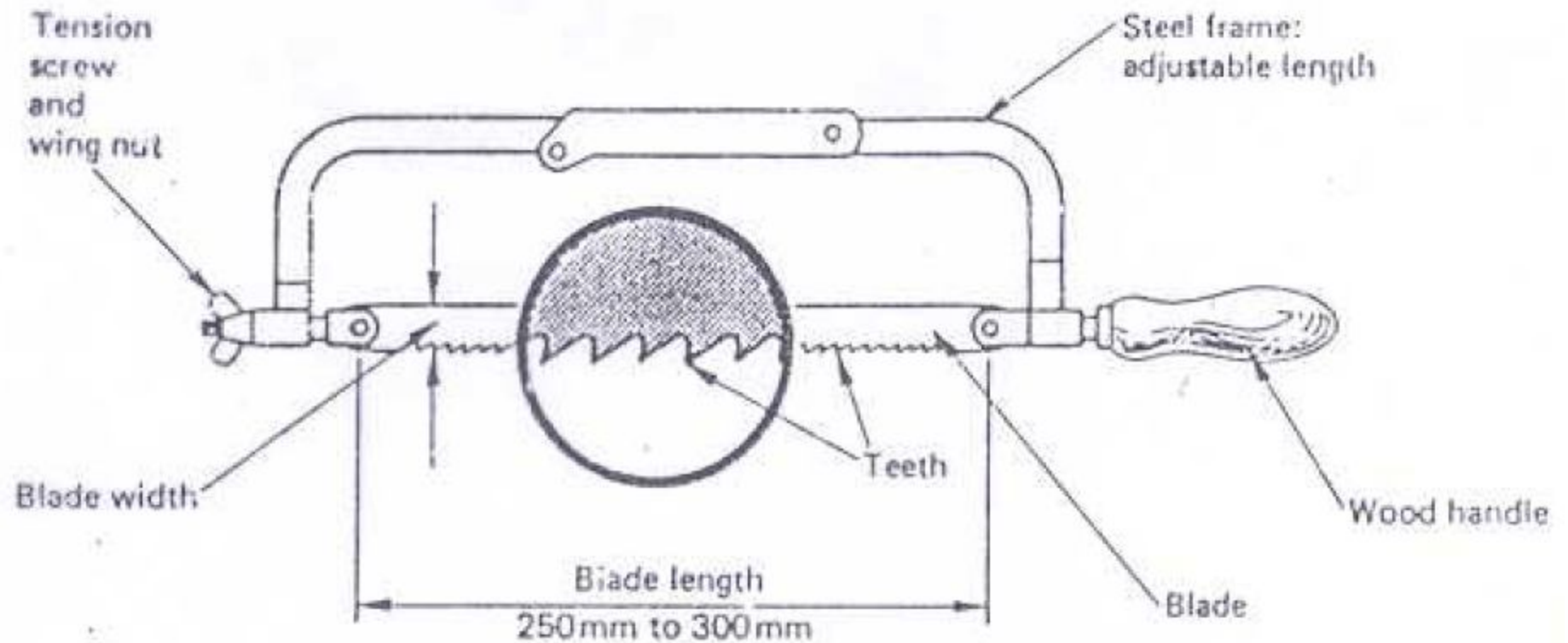


Adjustable saw 250mm-300mm
for general sawing purpose

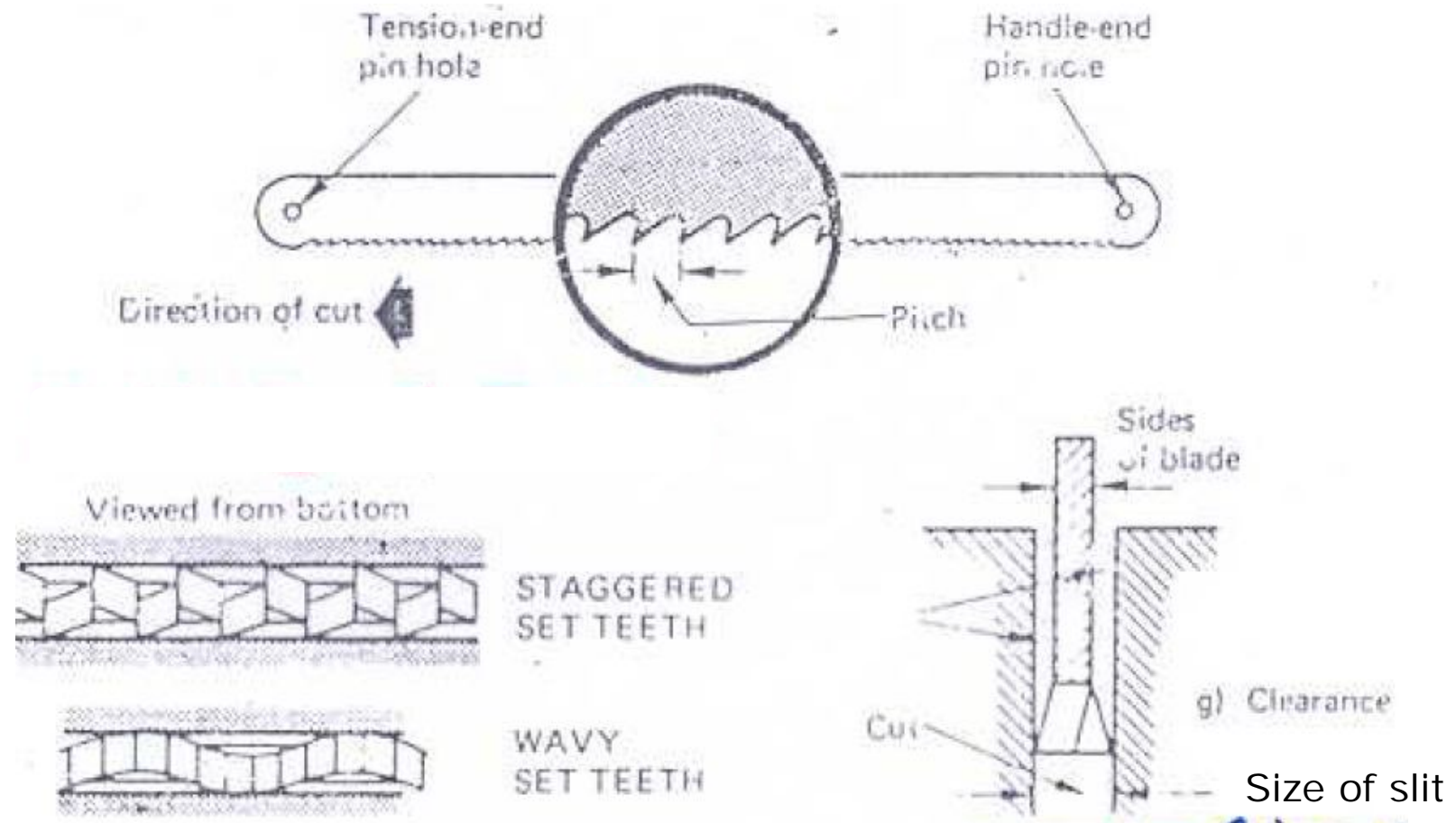


Sheet saw uses 300mm blades
for cutting up large sheets

Parts of a hacksaw



Setting of Saw Teeth

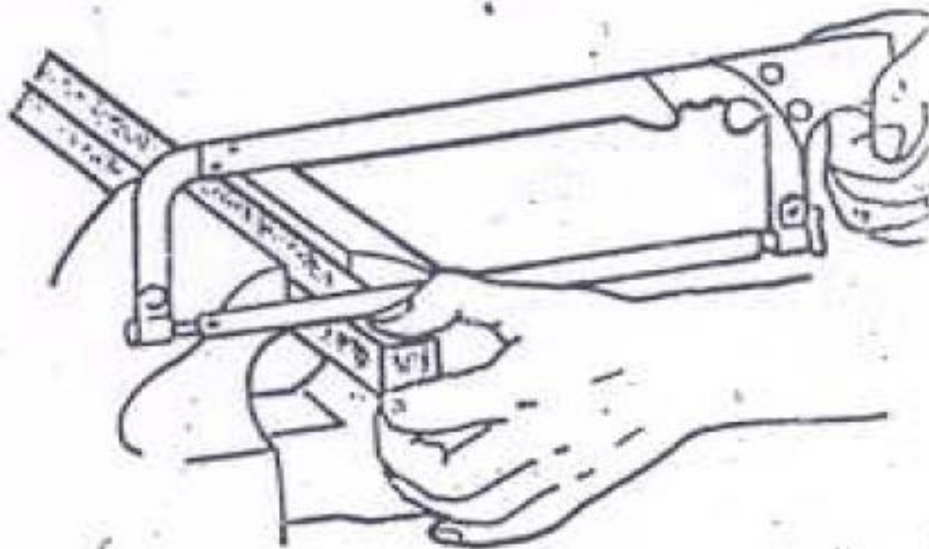


Precautions During Sawing

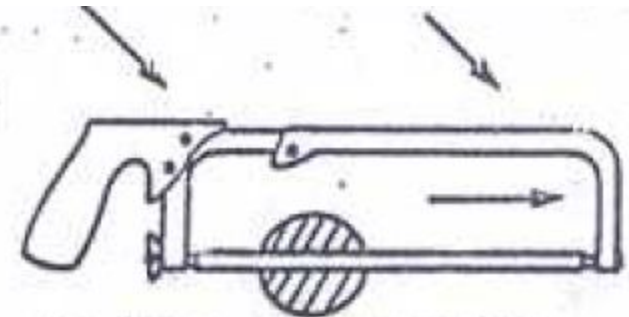
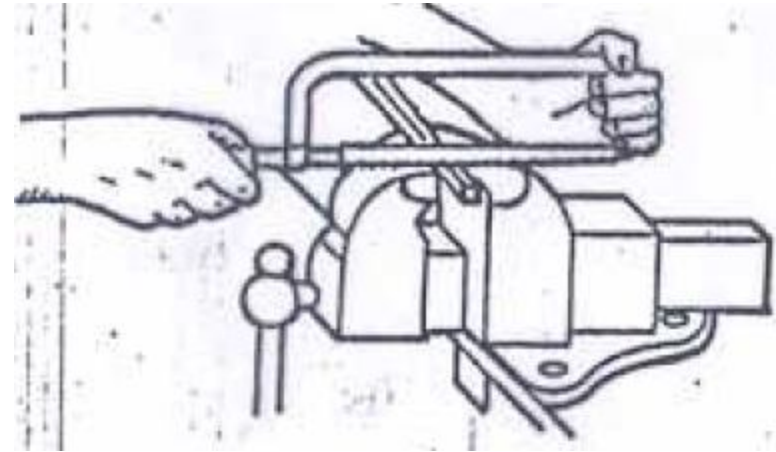
- Make sure that blade is fitted firmly into the frame, screwed tightly so that it does not wobble or whip sideways during the cutting process.
- The strokes should be full and complete during each of the forward and the backward strokes so that the cutting is finished more efficiently and faster. This method also causes less wear and tear and prolongs the life of the blade.
- New blades should be preferably used on softer materials first until they become a little dull. The cutting procedure using new blades in a hacksaw should always be slower to avoid sudden heating which may cause them to lose the correct temper they own.



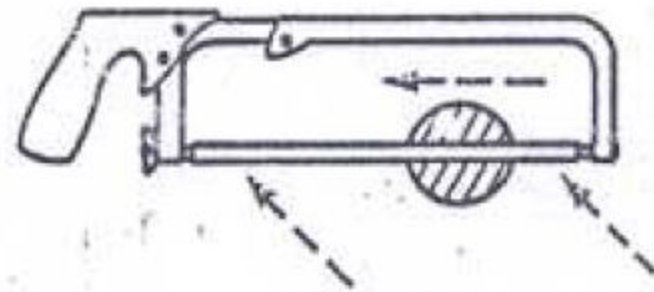
Correct position for hacksaw holding



Guiding the blade to start the cut

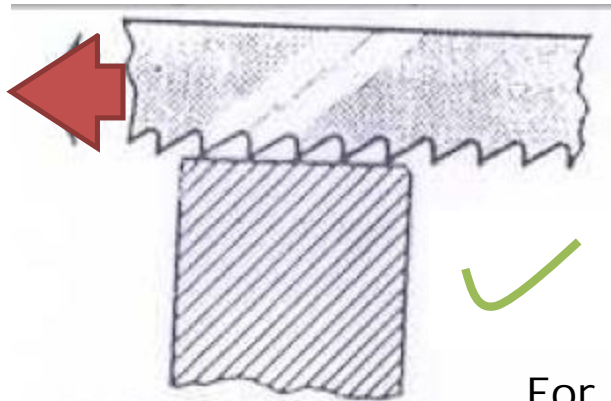


(A) FORCES APPLIED DURING CUTTING STROKE



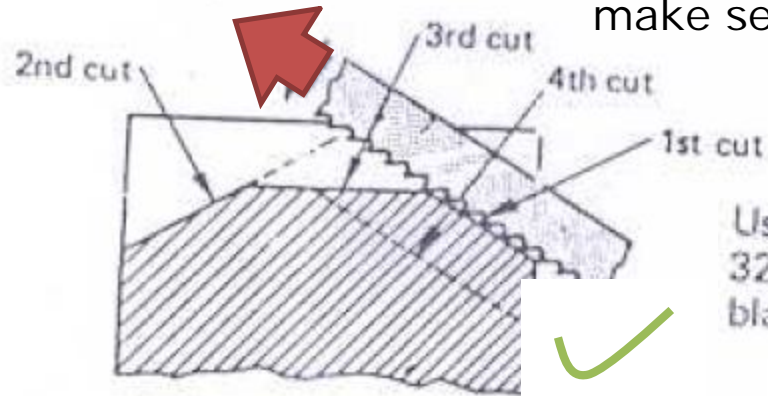
(B) FORCES RELEASED (BLADE RAISED) ON RETURN STROKE

Good Practices for Sawing



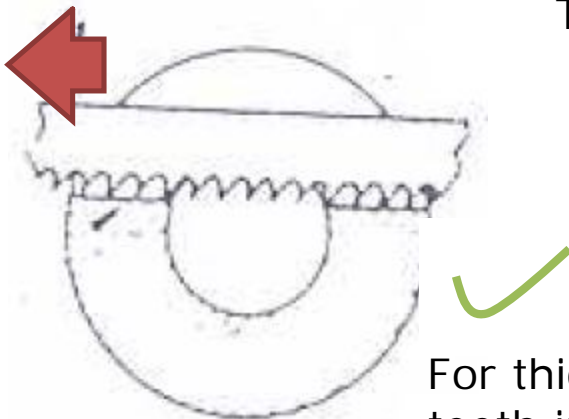
More than three teeth in contact

For thick material
make several short cuts

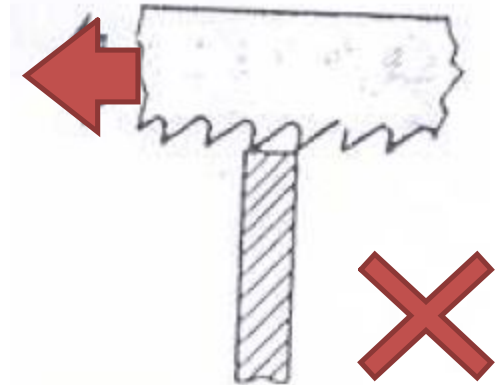


Use
32 teeth
blade

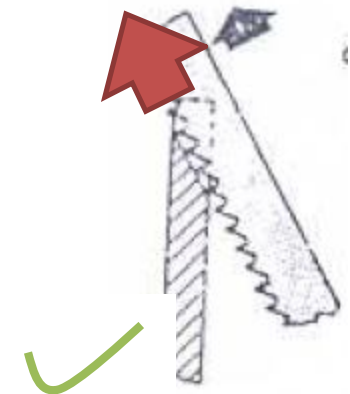
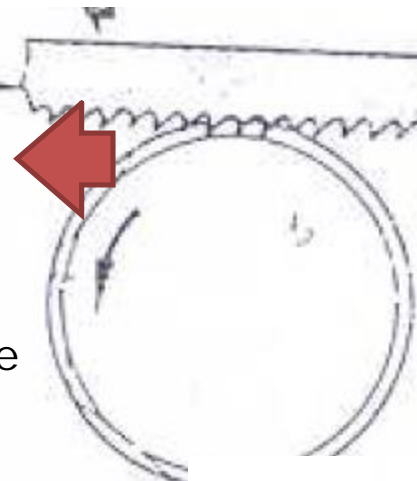
Thin walled tubing
make several cuts
by turning the tube



For thick walled tubing more than three
teeth in contact



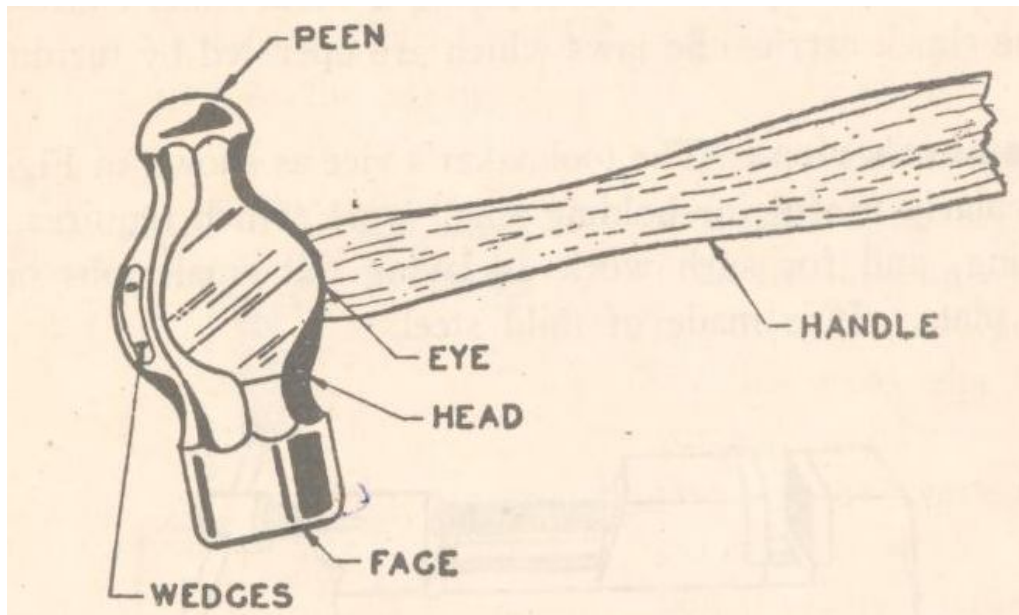
One teeth in contact
prevents cutting



Use 32 teeth
blade saw at
an angle with
more teeth in
contact

Hammer

- A **hammer** is a tool meant to deliver an impact to an object.
- The most common uses are for driving nails, fitting parts, forging metal and breaking up objects



Ball peen hammer



Claw hammer

Types of Hammers

Hammers are specified by weights

Different types of hammers are

A. Ball peen hammer

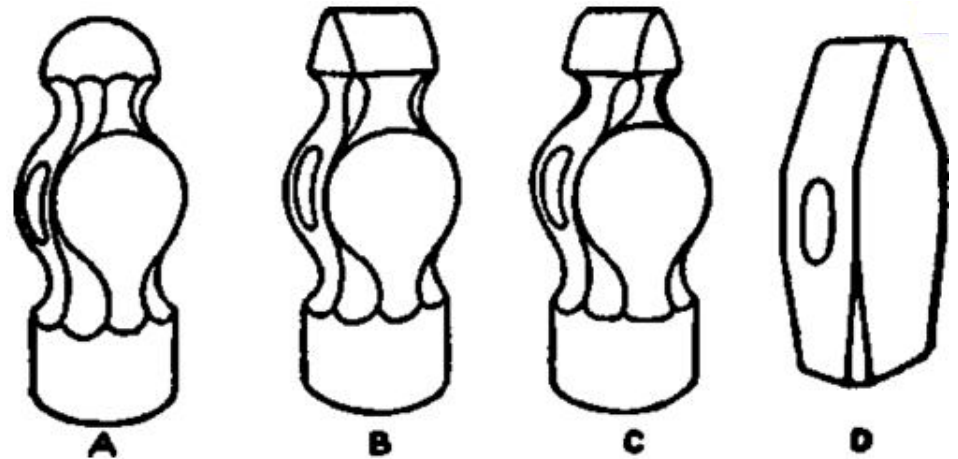
B. Straight peen hammer

C. Cross peen hammer

☐ Sledge hammer

☐ Soft hammer or mallet

☐ Claw hammer

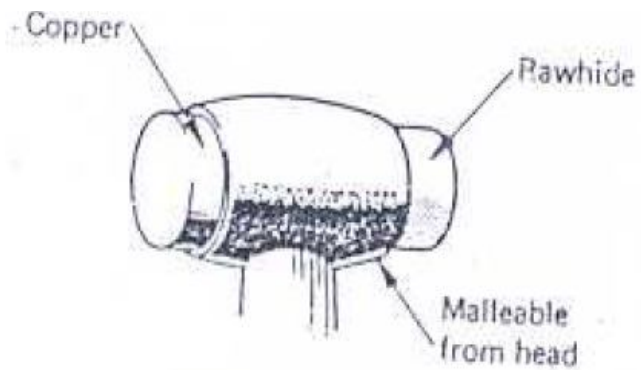


Hammers used for different application (as per weights)

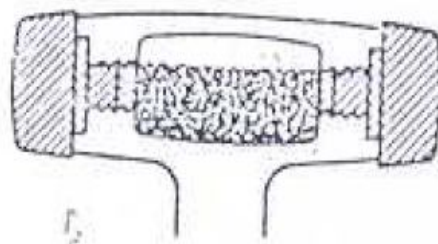
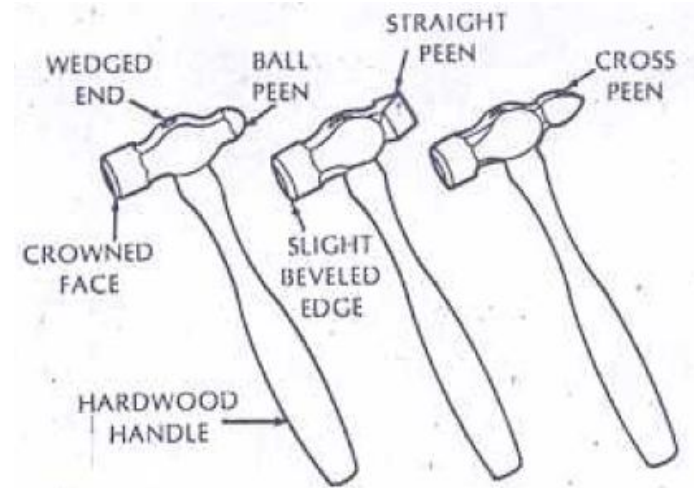
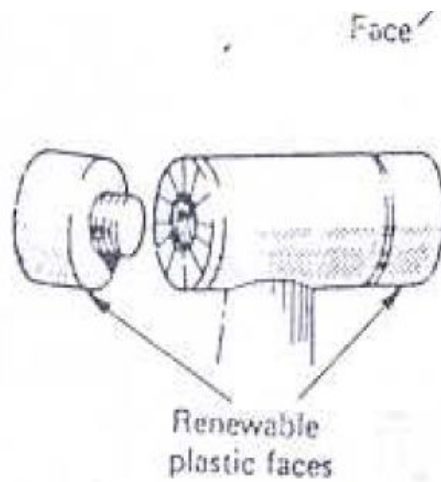
0.11 to 0.33 kg-light work- Rivet, punching

0.45 chiseling

0.33 to 0.45 popular for Bench work.

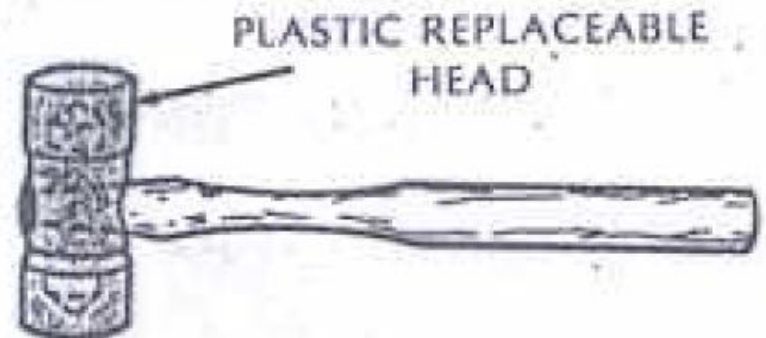
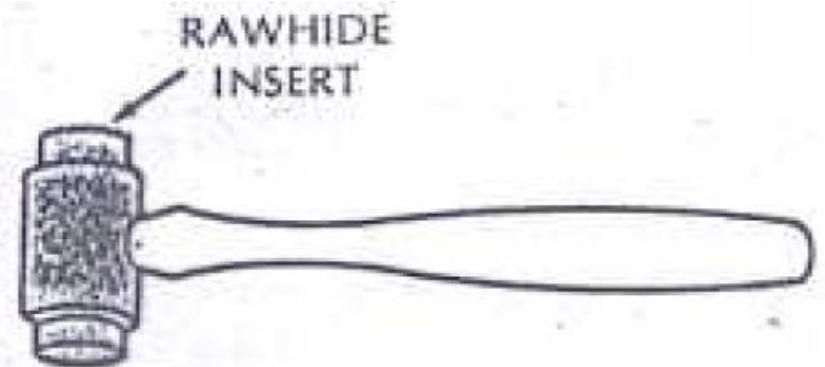


Soft faced hammer



Hollow head partially filled with steel shot to give added weight, prevent rebound and deliver "dead blows" on impact

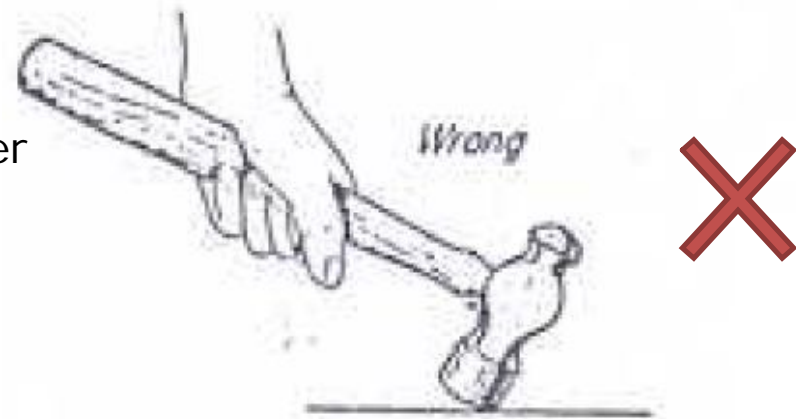
Dead blow nylon hammer



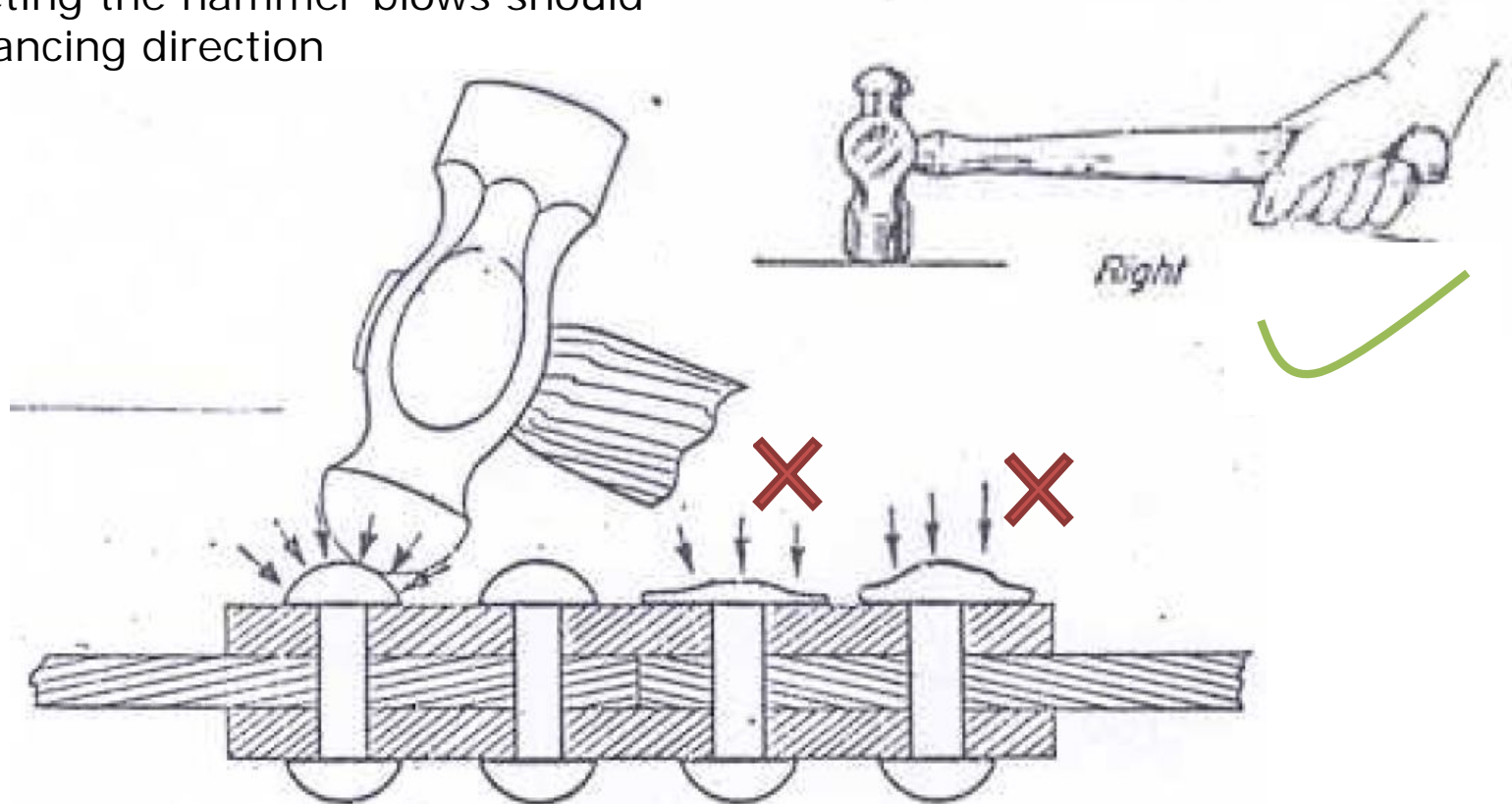
Hammer Care & Maintenance

- Use the right hammer for the job. Never use a hammer that isn't designed for a specific task. It could result into a injury
- Don't strike a hardened steel surface with a steel claw hammer. Metal chips can result in injury to the user or to a bystander.
- Never use a hammer with a loose or broken handle. If the handle is loose or cracked replace it.
- Never use a hammer with a chipped, cracked, or mushroomed face. It's an accident waiting to happen.

Right and wrong methods of using hammer

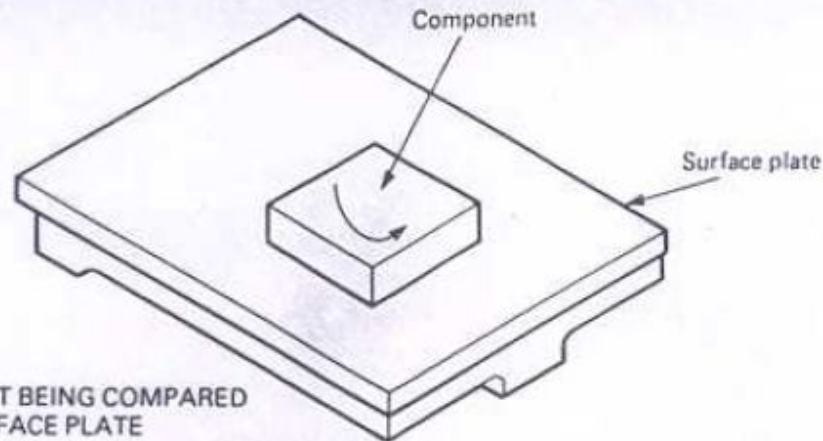


While riveting the hammer blows should be in a glancing direction



Scraping for Flatness

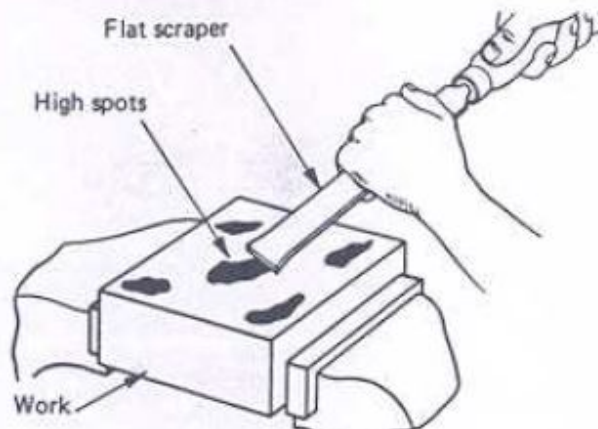
Scraping is finishing process done by a scraper. It is carried out by hands & requires skill



(a) COMPONENT BEING COMPARED WITH A SURFACE PLATE



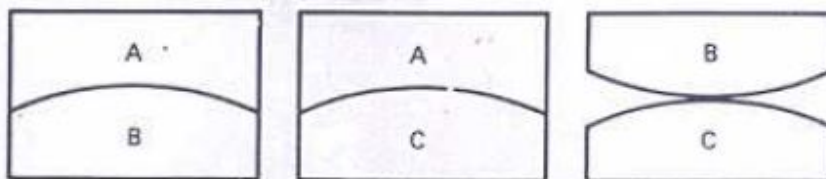
(b) IRREGULAR HIGH SPOTS (BEFORE SCRAPING)



(c) SCRAPING

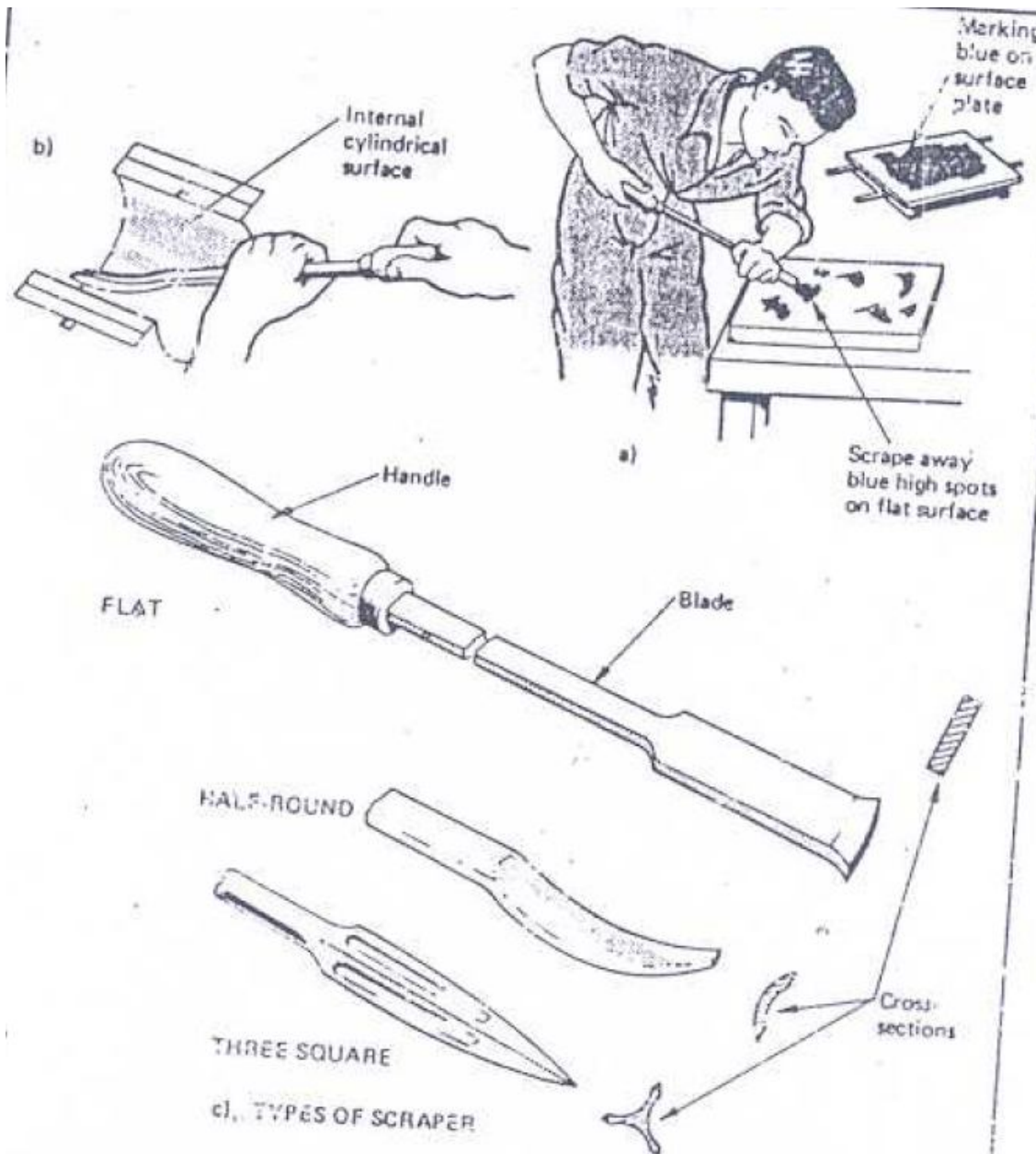


(d) FINISHED SURFACE (AFTER SCRAPING)



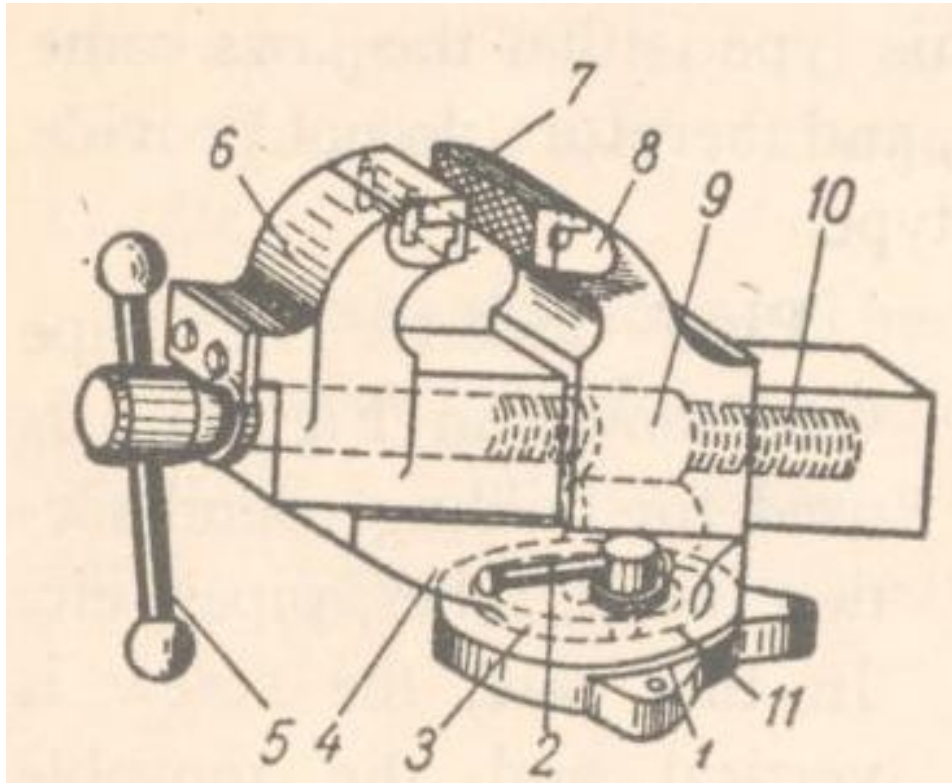
(e) COMPARISON OF THREE PLATES TO ACHIEVE FLATNESS

Scraping and Different Types of Scrapers



Work Holding Devices

- The **vice** is the most common tool for holding work.



Where,

- 1 stationary support disk
- 2 turning lever
- 3 swivel plate
- 4 base plate
- 5 handle
- 6 movable jaw
- 7 jaw plates
- 8 fixed jaw
- 9 fixed nut
- 10 clamping screw
- 11 circular slot

Bench Vice

Problems in work holding- Distortion, Damage, Support, Shape, Size

Work Holding Devices



G or C Clamps



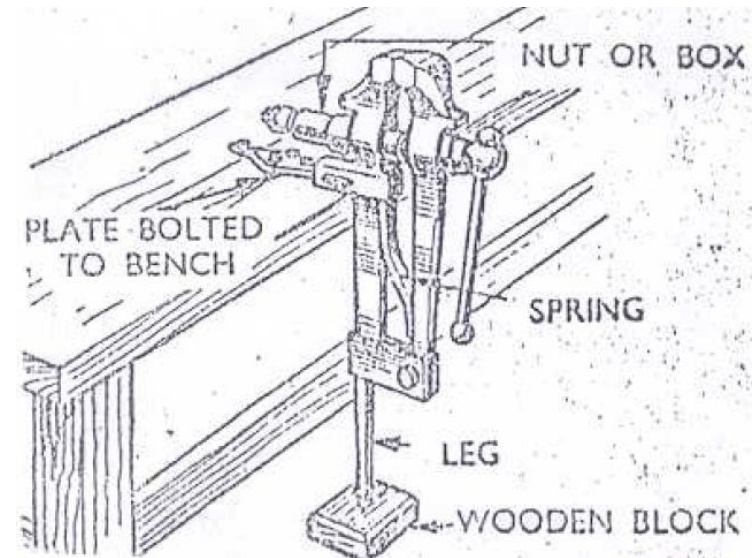
Cross slide vice



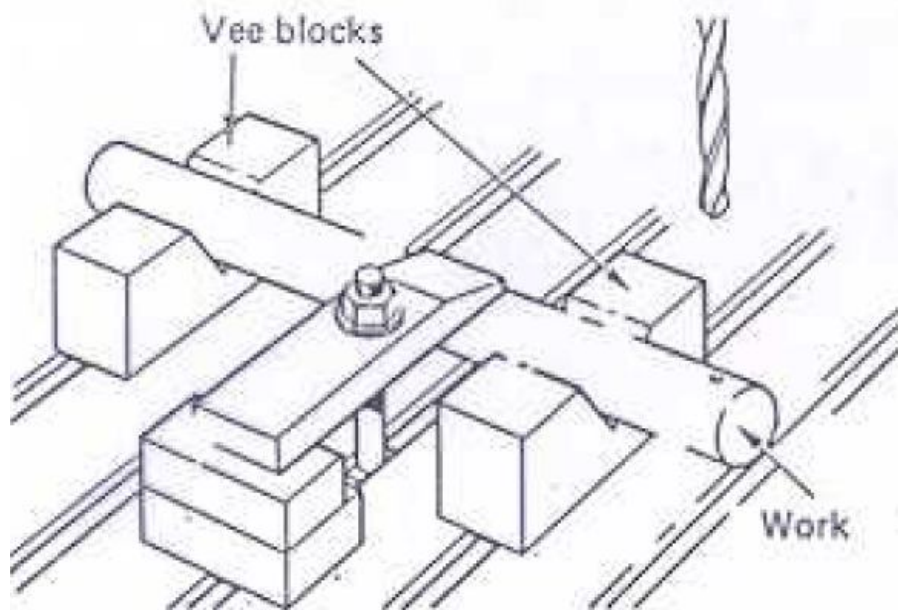
Universal machine vice



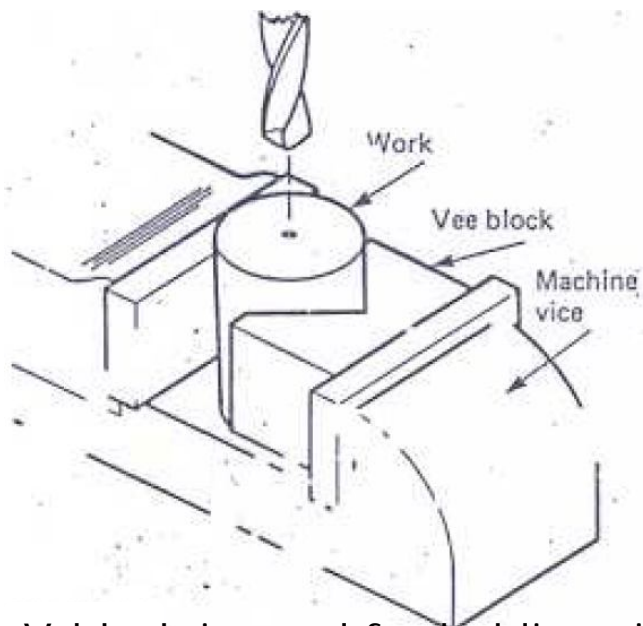
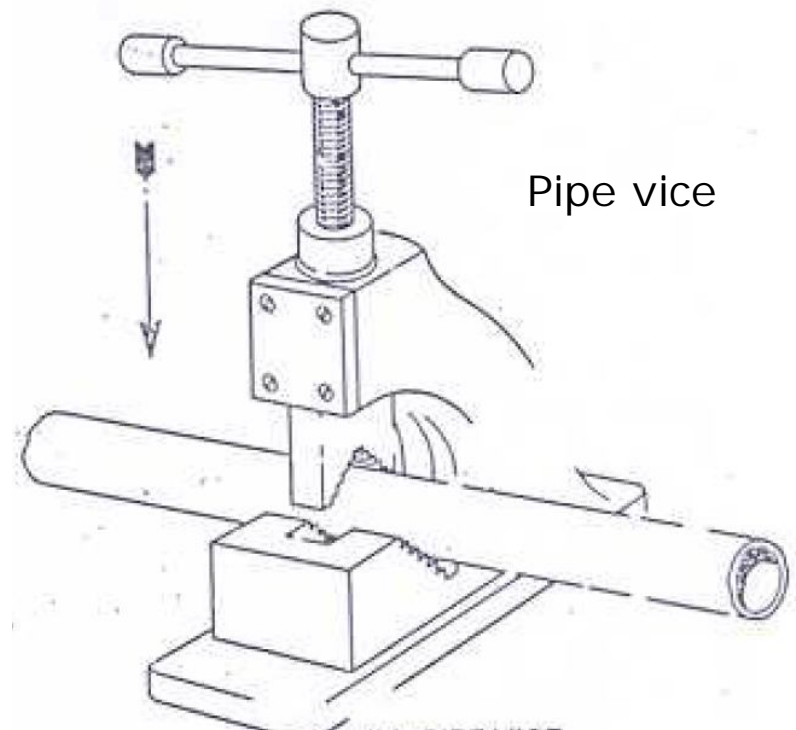
Toolmaker's vice



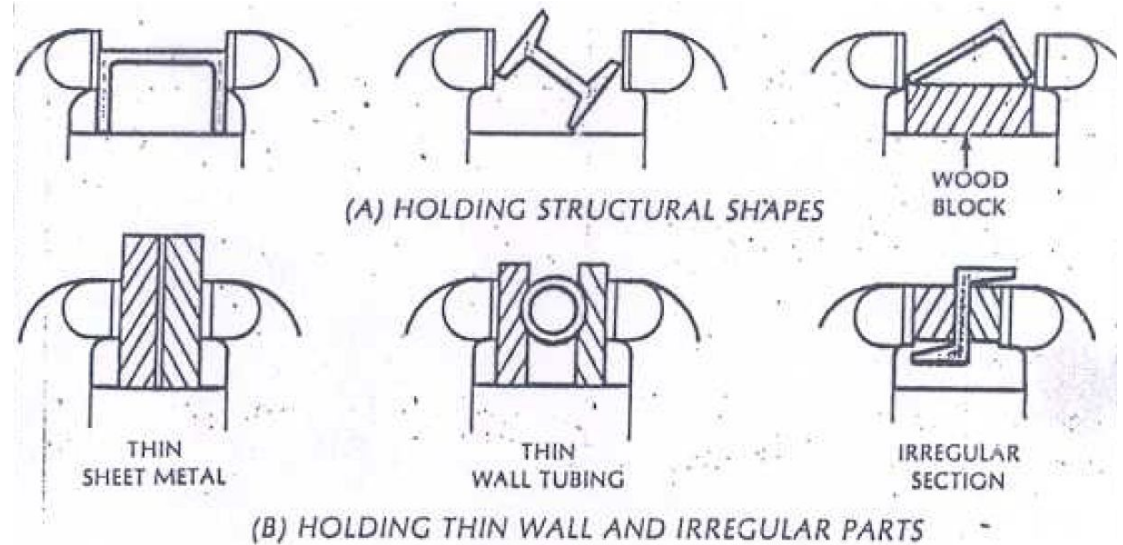
Leg vice



T-bolts,V-block is used for clamping

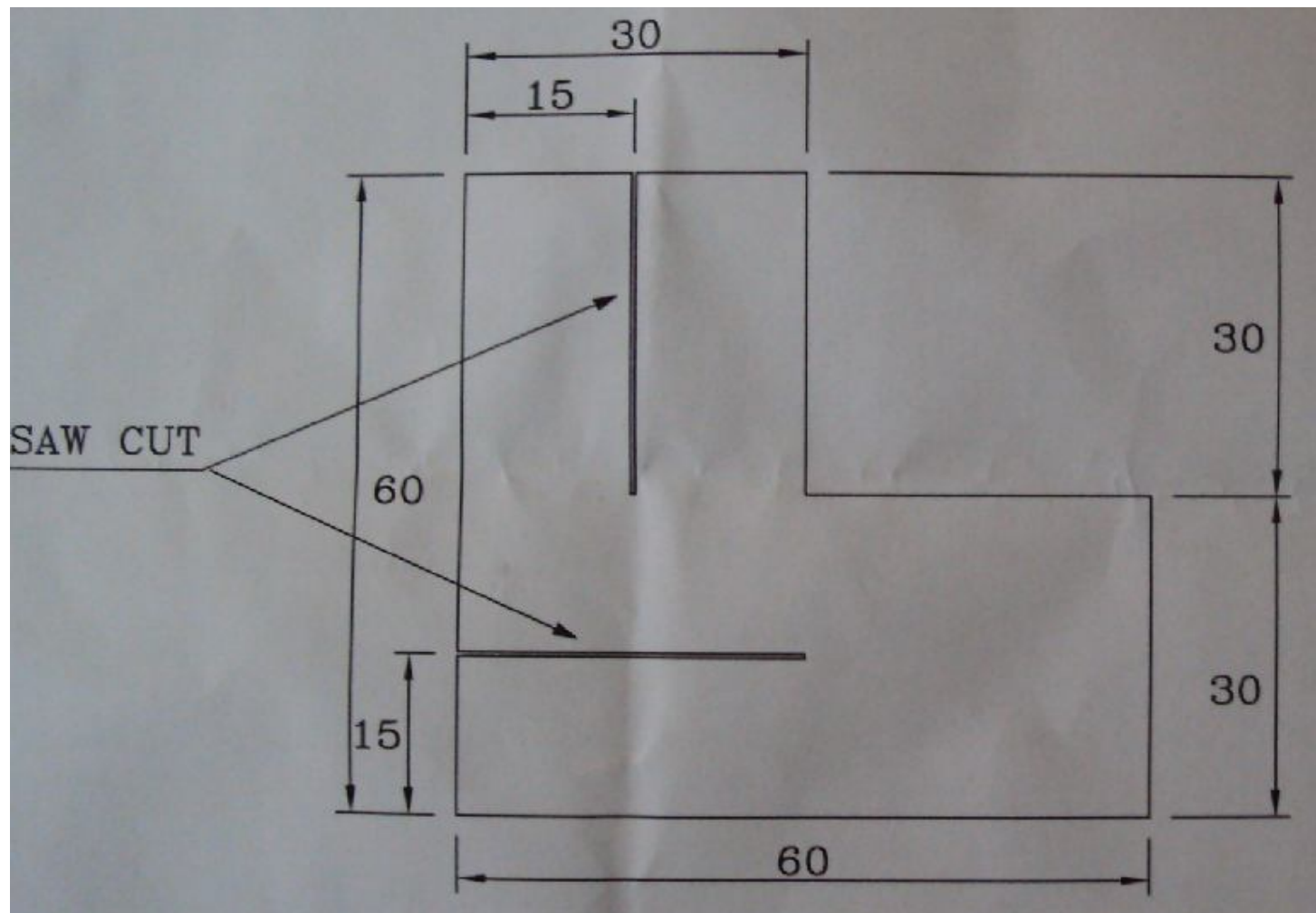


V-block is used for holding circular job

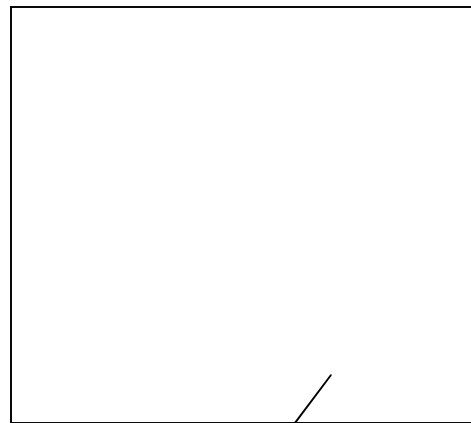


Holding different objects in a vice

Tutorial

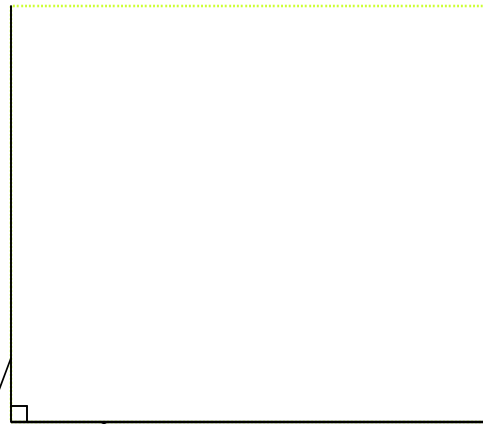


Tutorial



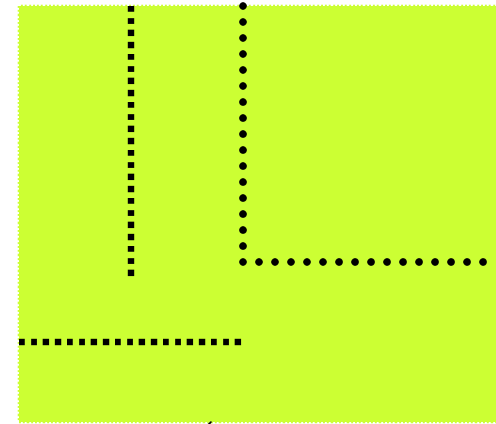
Step 1

Initial Block



Step 2

Right angle
surfaces



Step 3

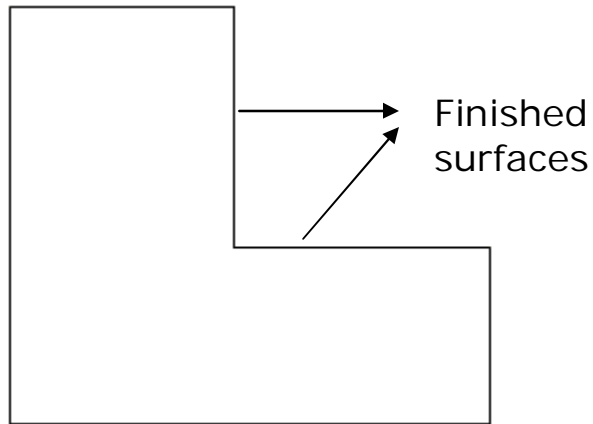
Marking out

Step 1 : Take optimum initial block size

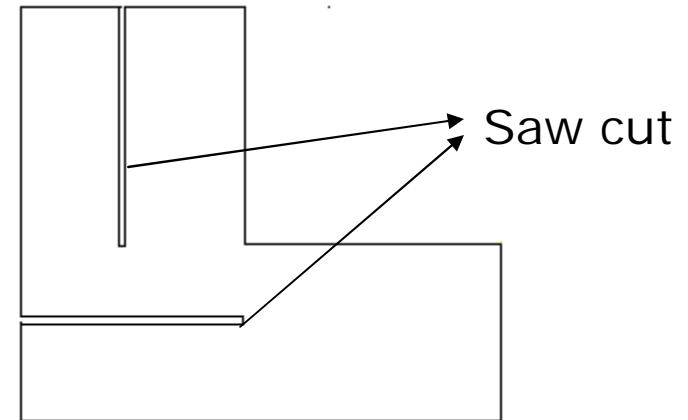
Step 2 : Make any 2 surfaces are perpendicular to each other. This are used as reference surfaces for further marking. This can be done by filing.

Step 3 : The surface of work to be marked out are usually treated with chalk. After the coat is dried the work is positioned for marking out using different marking tools like punch etc.

Tutorial



Step 4



Step 5

Step 4 : Rough cutting by hacksaw and final finishing by filing.

Step 5 : Slots are cut using hacksaw

Thank you



Acknowledgement

Contributions from M Tech TA Students, Mr. Viral Patel (09310059), Mr. Mahesh Teli (09310065) and Mr. Sachin Mali (09310064) are gratefully appreciated.