Civinnovate

Discover, Learn, and Innovate in Civil Engineering

INTRODUCTION

A space, room or building in which goods are manufactured or repaired is know as workshop.

A workshop may also be defined as a room or building which provides both the area and tools (or machinery) that may be required for the manufacture or repair of manufactured goods.

Fig: Workshop

Safety Consideration On Workshop

- Personal Safety
- Fire Safety
- Machinery and Material Safety
- Environmental Safety

Workshop Tools and Equipments

❖Bench Tools

Tools used in bench and fitting shop are classified as:

- ➢Marking tools
- ➢Measuring devices
- ➢Holding tools
- ➢Cutting tools
- ➢Miscellaneous tools
- ➢Measuring Instruments
- ➢Supporting tools
- ➢Striking tools
- ➢Tightening tools

➢Marking tools

Marking tools used in bench work are:

Steel rule	Scriber	Divider
Centre punch	Try square	Protractor
Combination Set	Surface gauge	etc.

➢Measuring devices

Commonly used measuring devices used in bench and fitting shop are:

Radius gauge	Screw pitch gauge	Surface plate
Try square	Dial gauge	Feeler gauge

Wire gauge…. etc….

Fig: steel rule

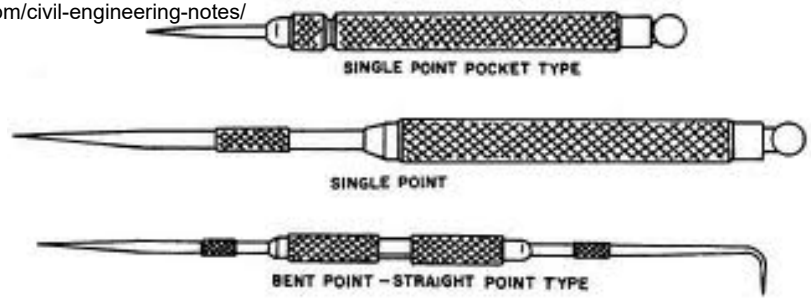


Fig: scriber

Fig: Divider

Fig: Center Punch

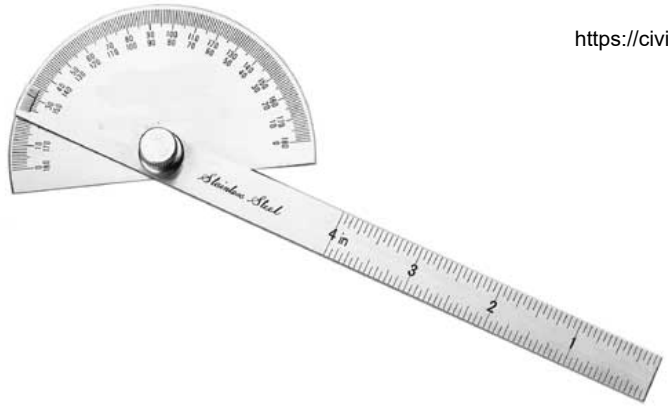


Fig: Bevel Protractor

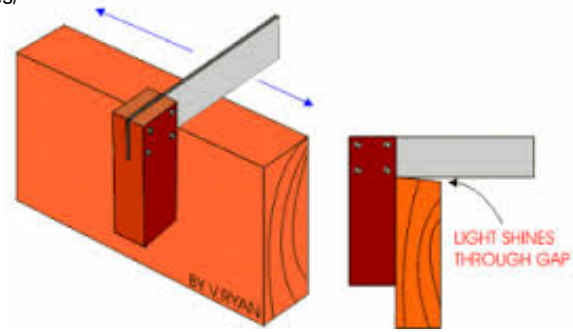


Fig: Try square

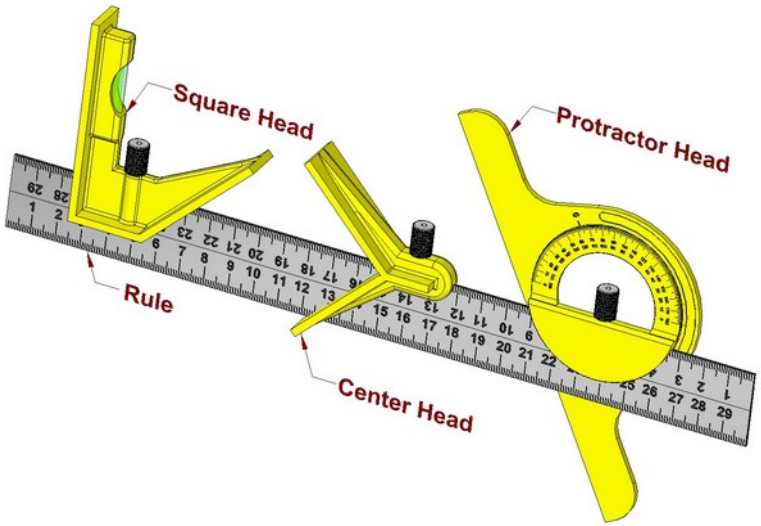


Fig: Combination Set

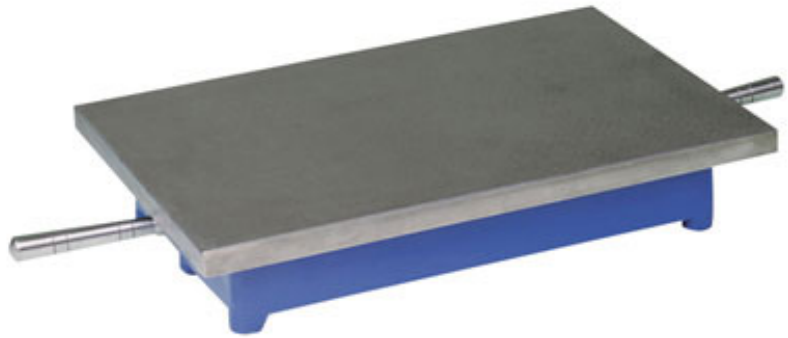


Fig: Surface Plate

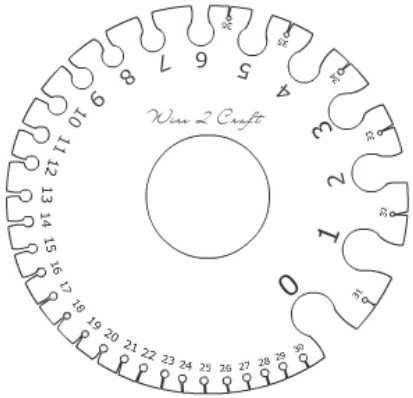


Fig: Wire gauge

Fig: Radius gauge

Fig: Dial gauge

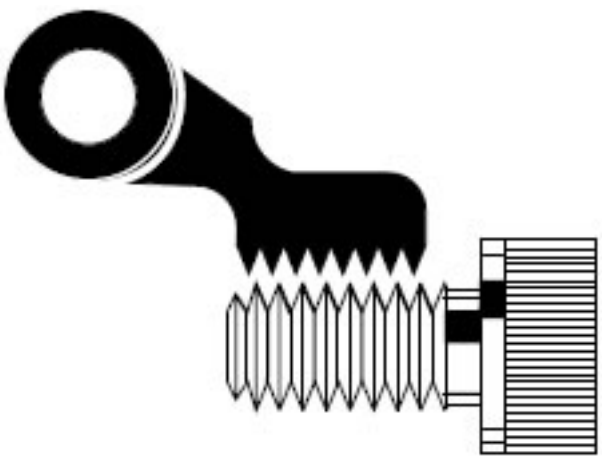


Fig: Screw Pitch gauge

Fig: Feeler gauge

➢Measuring Instrument

- Line measuring instruments

The ends of a dimension being measured are aligned with the graduations of the scale from which the length is read directly such as scales or steel rules.

- End measuring instruments

The measurement is taken between two ends as in a micrometer, vernier calipers and gauge block, etc.

According to the nature of measurement the measuring instruments are categorized as:-

- Linear measuring instruments
- Angular measuring instruments
- Surface measuring instruments
- Comparators

➢ Linear measuring instruments

Non-precision instruments

- Steel rule
- Dividers
- Depth gauge
- Calipers
- Telescopic gauge

Precision instruments

- Micrometers
- Vernier depth gauges
- Slip gauges
- Vernier calipers
- Vernier height gauges

➢ Angular measuring instruments

Non-precision instruments

- Protector
- Engineers square
- Adjustable bevel
- Combination set

Precision instruments

- Bevel protector
- Angle gauges
- Sine bar
- Clinometers
- Autocollimators
- Sprit level

➢ Surface measuring instruments

- Straight edge
- Surface table
- Profilo-meter
- Surface gauge
- Optical flat

➢ Comparators

- Mechanical Comparators
- Electrical Comparators
- Optical Comparators
- Pneumatic Comparators

➢ Supporting tools

Supporting tools are:

Vee- block Marking table Surface Plate

➢ Holding tools

Holding tool are vice and clamps.

Vice are of different types: hand vice, bench vice, leg vice, pipe vice, and pin vice.

Similarly different types of clamps are: c or g clamp, plane slot, goose neck, double end finger, u-clamp, parallel jaw, and clamping block.

- Striking tools

Various types of hammers such as ball peen hammer; straight peen hammer; cross-peen hammer; double face hammer; soft face hammer are used as stricking tool.

- Cutting tools

These involve various types of files, scrapers, chisels, drills, reamers, taps, snip or shear and hacksaws.

➢Tightening tools

Pliers and wrenches are tightening tool which are sub divides as:

Pliers. These are namely ordinary, needle nose, and special type

Wrench. These are open single ended, open double ended, closed ended adjustable, ring spanner, offset socket, t- socket, box wrench, pipe wrench and allen wrench.

➢Miscellaneous tools

These are die, drifts, counter sink tools, counter boring tools, spot facing bit and drill press.

Some of the important bench tools are described in details below :

❖ Scribers

Scribers, sometimes called the metal worker’s pencil. These are made up of high carbon steel and are hardened from the front edge. Scriber is used for scratching lines on the sheet metal during the process of laying out a job.

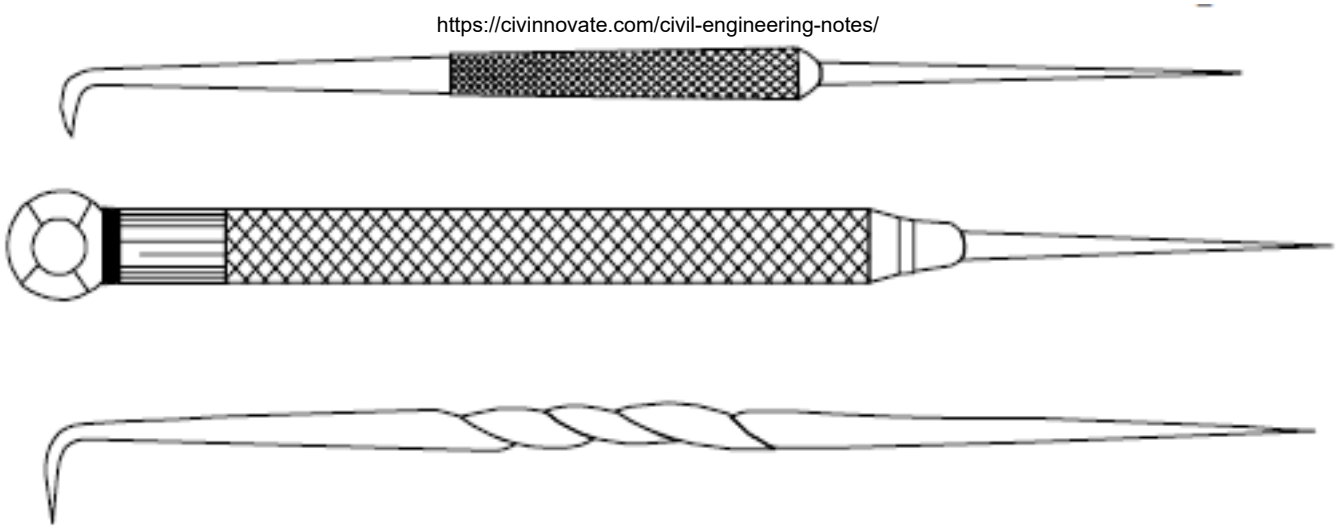
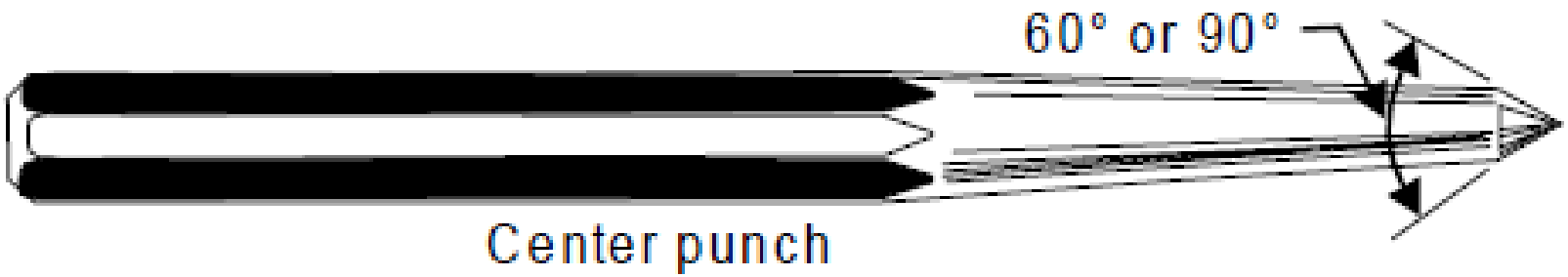


Fig: scriber

❖ Centre Punch

Centre punch is used for locating centre for indentation mark for drilling purposes.



❖ Surface Plate

Surface plate is a cast iron plate having generally a square top well planed and square with adjacent machined faces. The top surface of the plate is finished true by means of grinding and scrapping.

It possesses a cast iron base, which is also machined true to keep the top surface of the plate in a perfect horizontal plane. Its specific use is in testing the trueness of a finished surface, testing a try square, providing adequate bearing surface for V-block (Fig. (b)) and angle plates, etc. in scribing work.

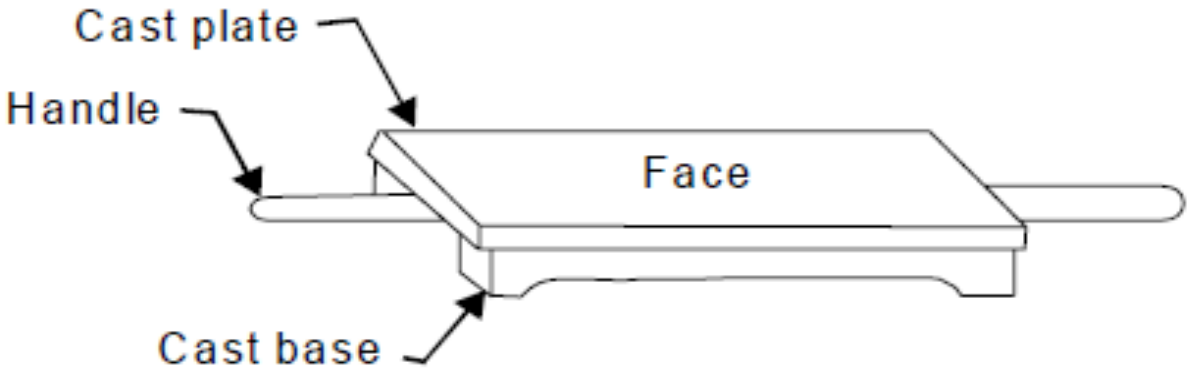


Fig. (a) A surface plate

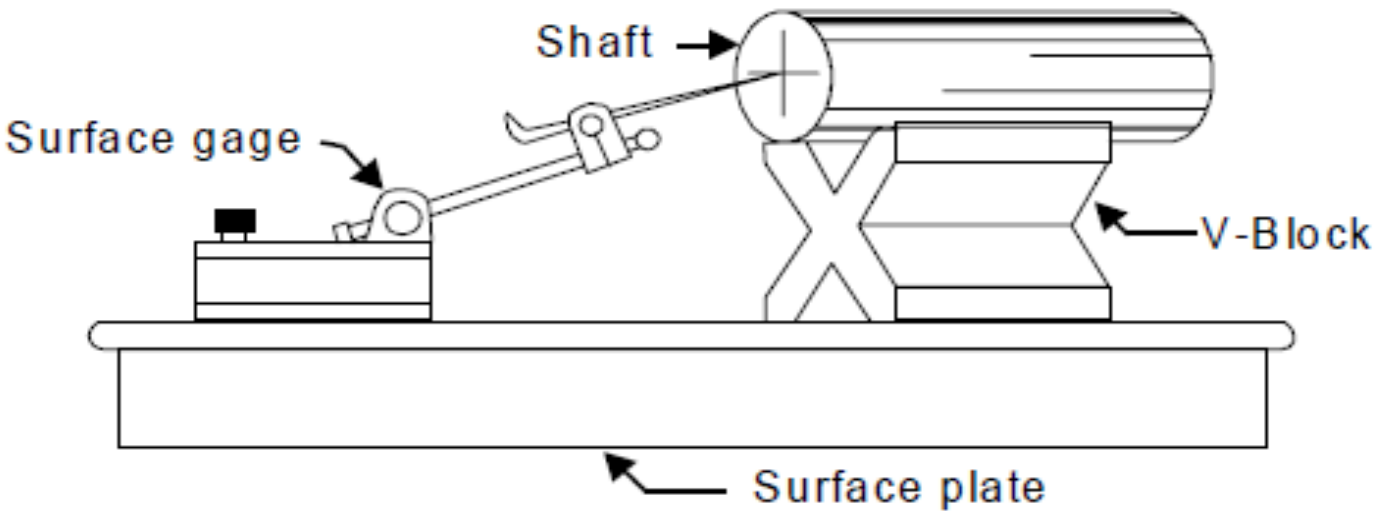


Fig. (b) A use of surface plate and v-block

❖ Micrometer

The micrometers are commonly employed for measuring small dimensions with extreme accuracy of 0.01 mm. They may be of the three kinds -

(a) External micrometer for measuring external dimensions,

(b) Internal micrometer for measuring internal dimensions,

(c) Depth micrometer for measuring depths.

Outside micrometer consists of the following main parts.

1. Metallic frame
2. Axial graduated sleeve
3. Circumferential screwed spindle
4. Hardened steel anvil
5. Thimble
6. Ratchet stop screw
7. Lock nut

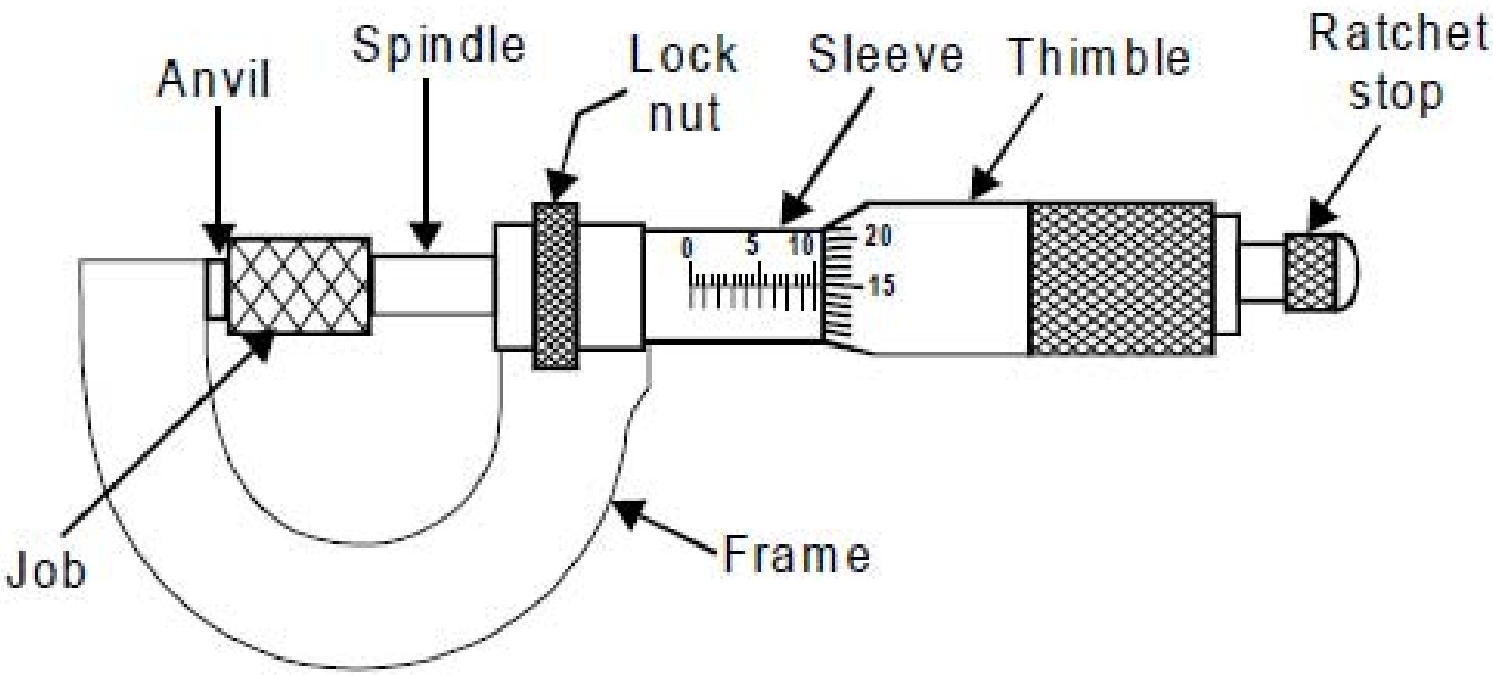


Fig: outside micrometer

❖ Caliper

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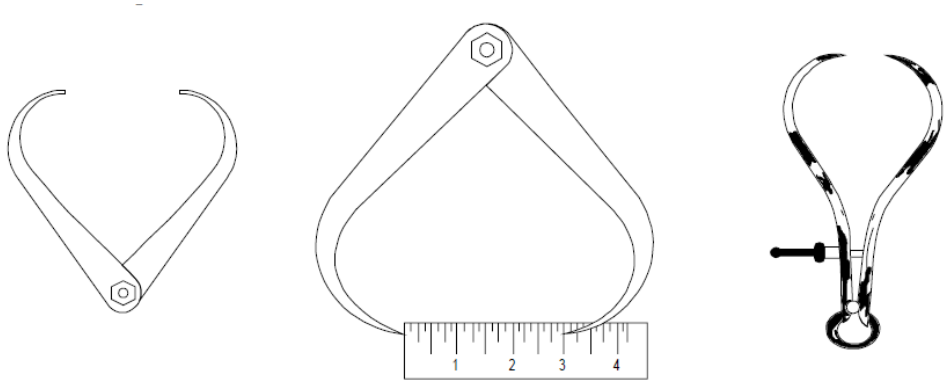
Calipers are generally of two types inside and outside to make internal or external measurements. They do not have direct scale reading. They transfer the measurement from jobs to scale or vice versa. Fig. below shows a simple outside caliper.



❖ Vernier Caliper

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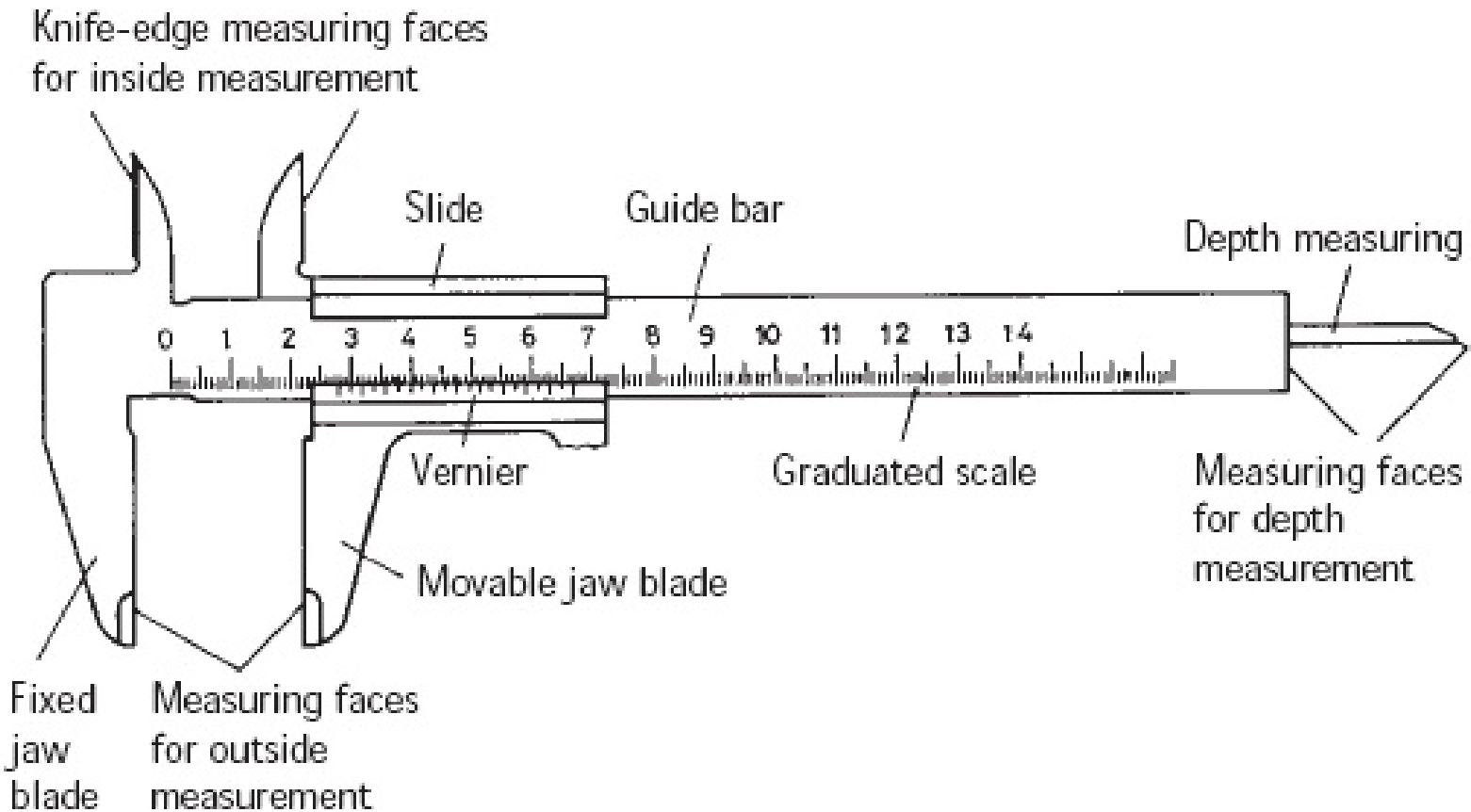


Fig: Vernier Caliper

❖ Combination Set

Combination set is an important instrument which has the combination of instruments namely square head, a centre head, and a bevel protractor and sprit level as depicted in Fig.

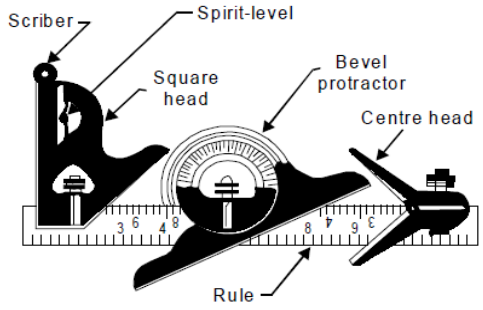


Fig. A combination set

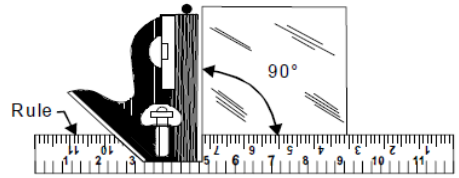


Fig. Checking 90° angle using combination set

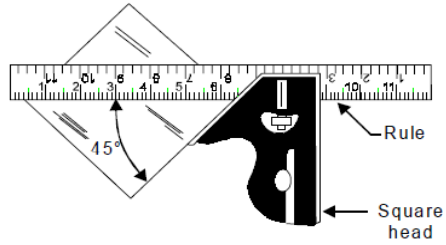


Fig. Checking 45° angle using combination set

❖ Inspection Gauges

Inspection gauges are commonly employed to avoid costly and lengthy process of testing the component dimensions. Fig. represented the principle of limit gauging.

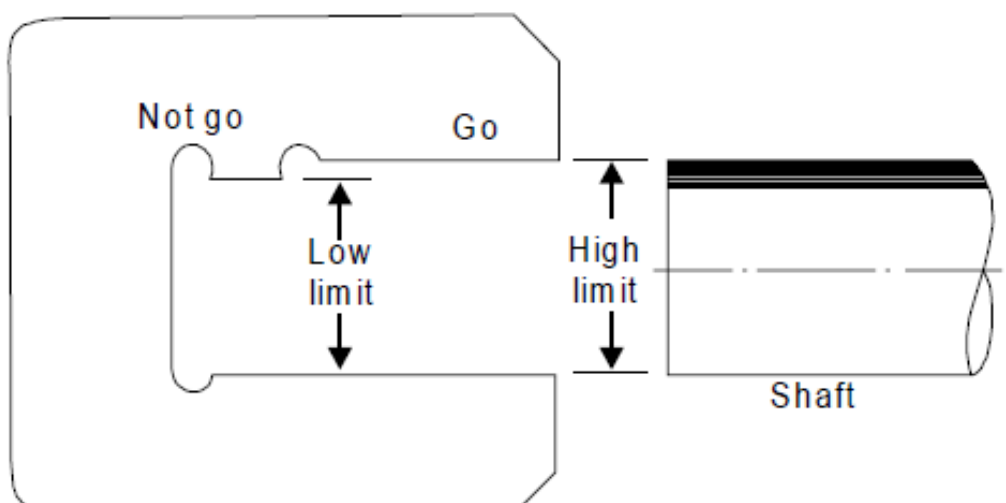
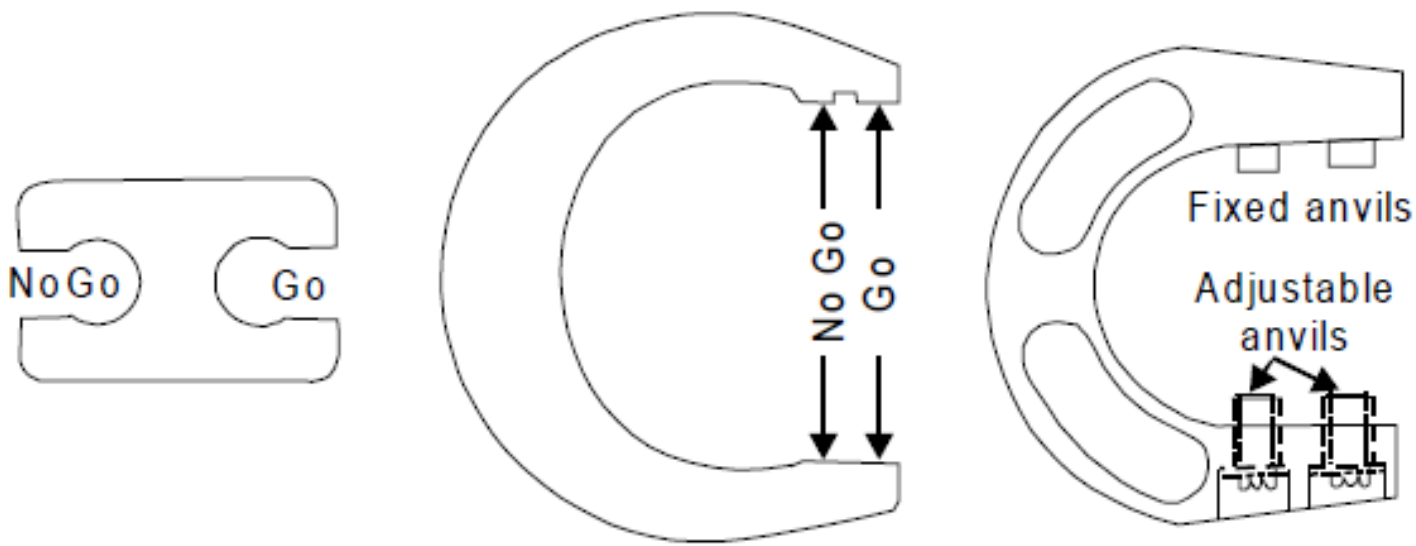


Fig. A principle of limit gauge

These gauges are basically used for checking the size, shape and relative positions of various parts. Standard gauges are made to the nominal size of the part to be tested and have the measuring member equal in size to the mean permissible dimension of the part to be checked.

Limit gauges or “go” and “no go” gauges are made to the limit sizes of the job to be measured. Sides or ends of the gauge are made corresponding to maximum and minimum permissible size of the job for its acceptance or rejection.

The objective of limit gauges is to identify whether the actual dimensions of the work are within or outside the specified limits of acceptance.



❖ Vices

The vices are hand vice, bench vice, machine vices, carpenter vice, shaper vice, leg vice, pipe vice, and pin vice.

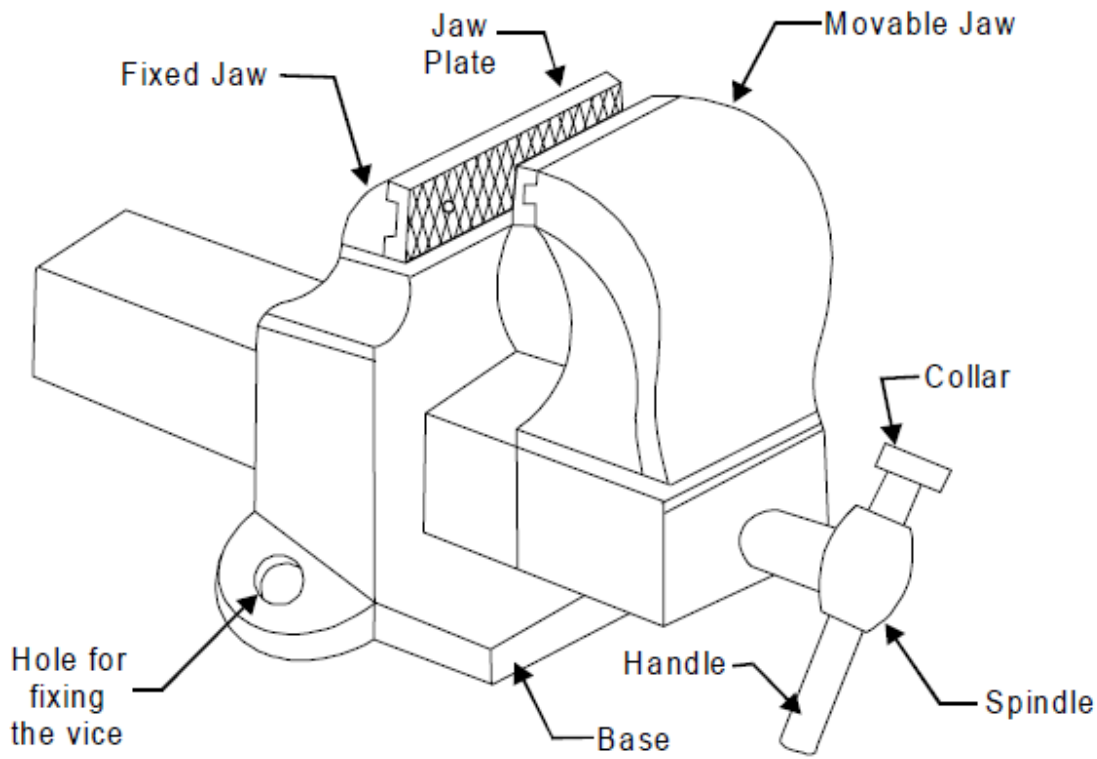
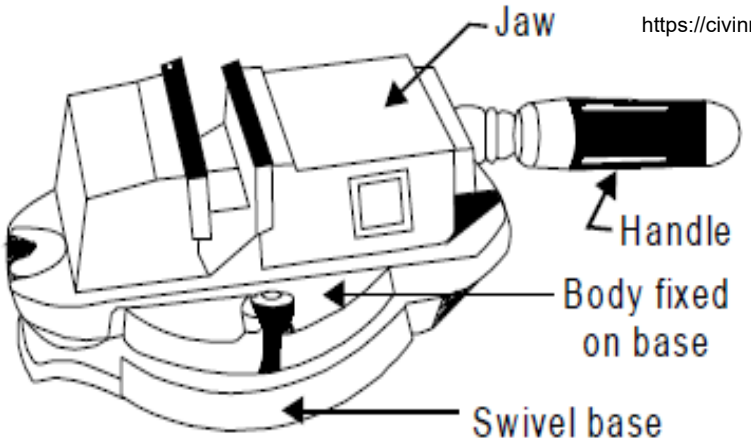
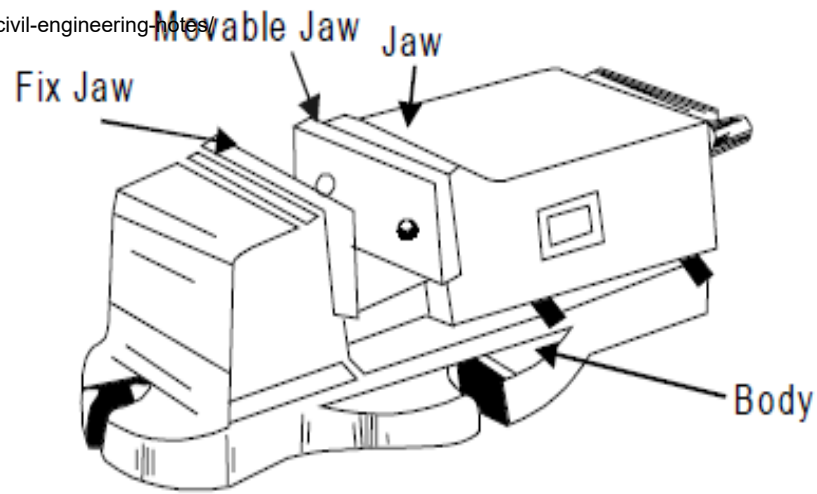


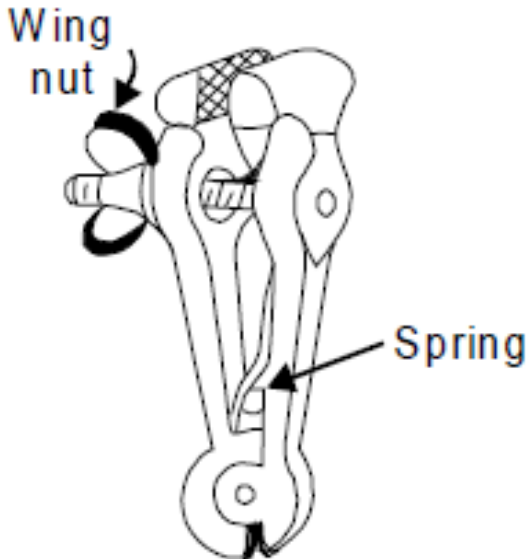
Fig. A bench vice



Machine vice with swivel base.



Parallel jaw machine vice.



❖ Files

The widely used hand cutting tool in workshops is the file. It is used to cut, smooth, or fit metal parts. Size of a file is specified by its length.

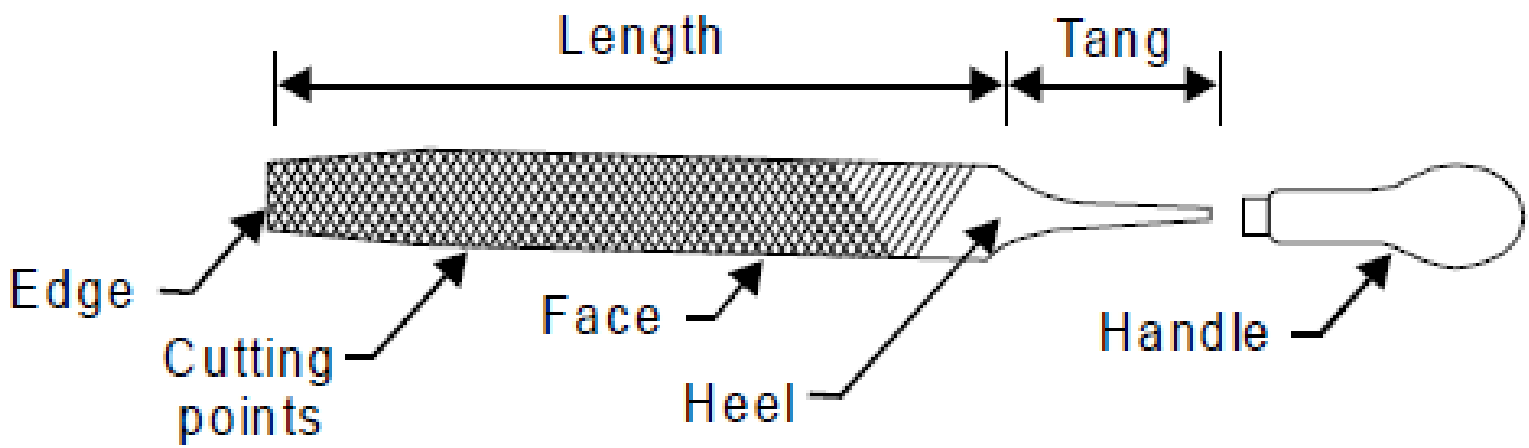
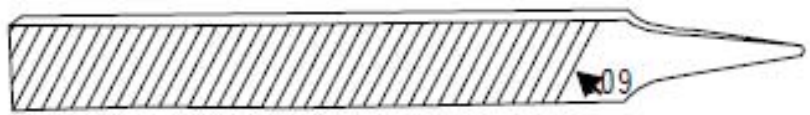
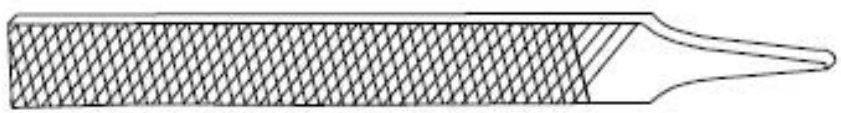


Fig. Parts of a file

➢ Classification of Files



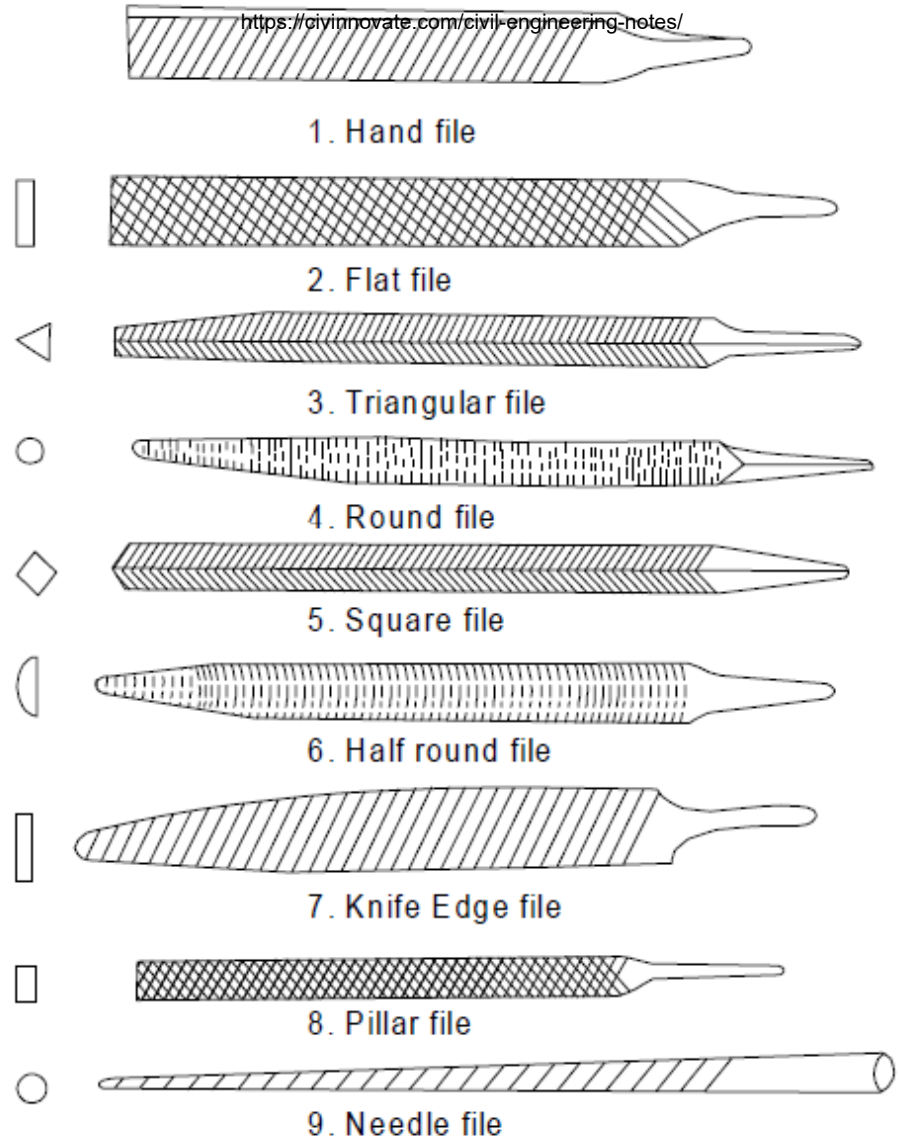
(a) Single cut file



(b) Double cut file

(c) Rasp cut file.

Fig. Types of files according to cuts of teeth



General classification of files based on shapes or cross sections

❖ Scrapers

Scrapers are made up of old files and the cutting edge of scraper is hardened and tempered. They are mainly used to scrap metal surfaces by rubbing the work surface. The scrapers are hand cutting tools used for removing metal from surfaces in form of thin slices or flakes to produce smooth and fine surfaces.

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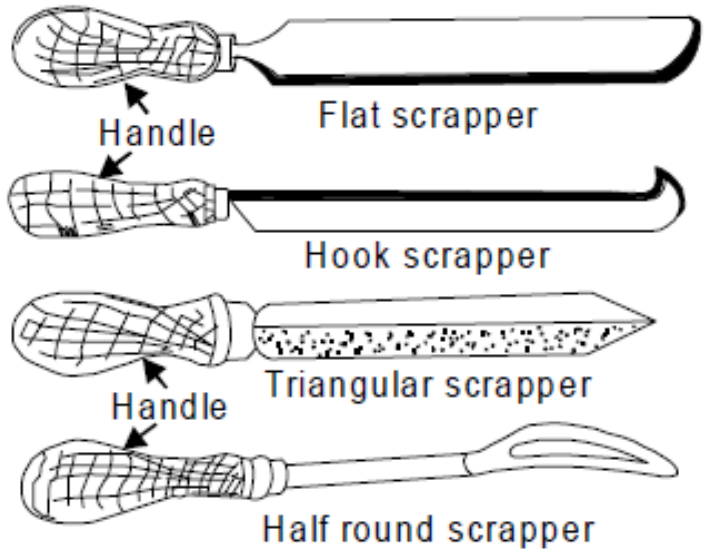


Fig. Common types of scraper

❖ Chisel

Chisel is one of the most important tools of the sheet metal, fitting and forging shop. It is widely used for cutting and chipping the work piece.

It is made of high carbon steel or tool steel. It is in the form of a rod having cutting edge at one end, hexagonal or octagonal body and striking head at the other end. The size of a chisel is described by its length and width of edge.

❖ Drill

Drill is a common tool widely for making holes in a metal piece in fitting shop. It is generally held in chuck of bench drilling machine.

Fig : Drill bit

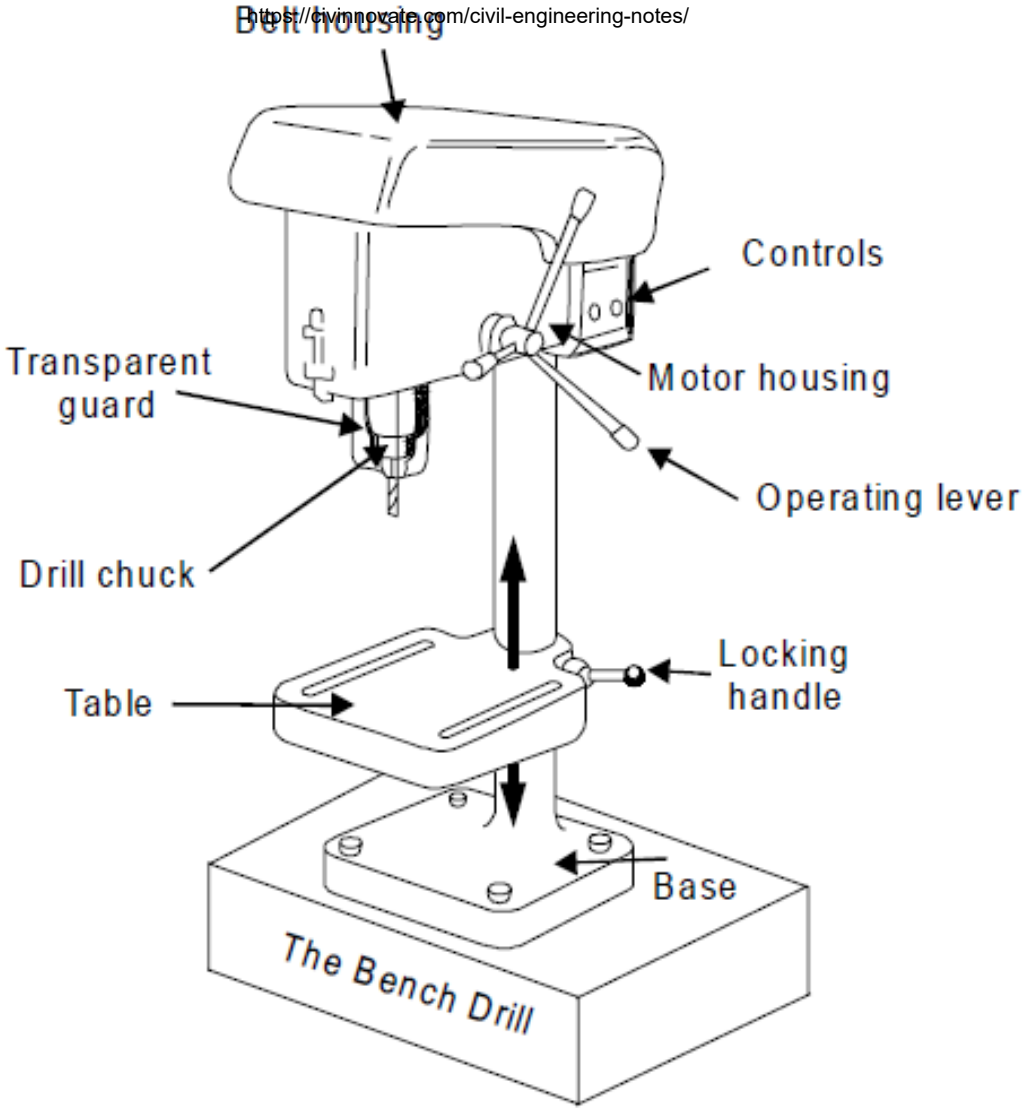
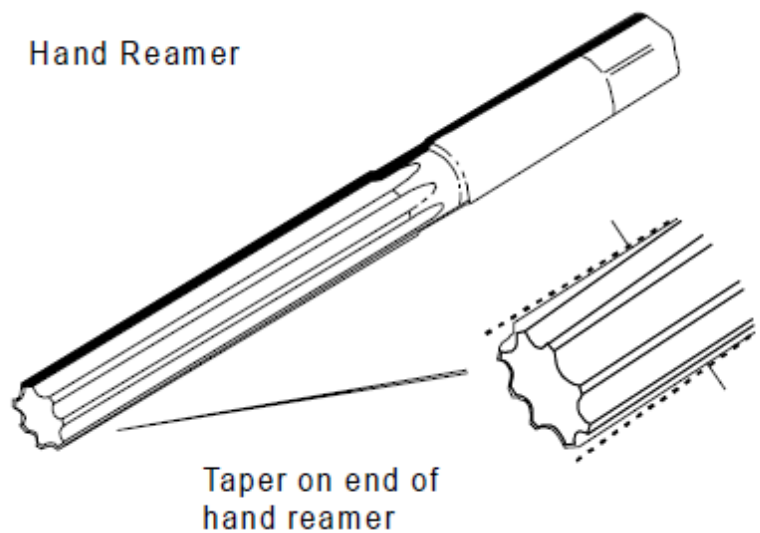


Fig : Bench drill machine

❖ Reamer

The drill does not always produce the correct hole some time with good finish. Thus a correct hole is produced with good finish of a pre drilled hole using a reamer. It is commonly employed to remove minimum amount of metal from the hole.



❖ TAPS

Taps are used for cutting or producing internal threads of either left or right hand kind in nuts or pre-drilled holes.

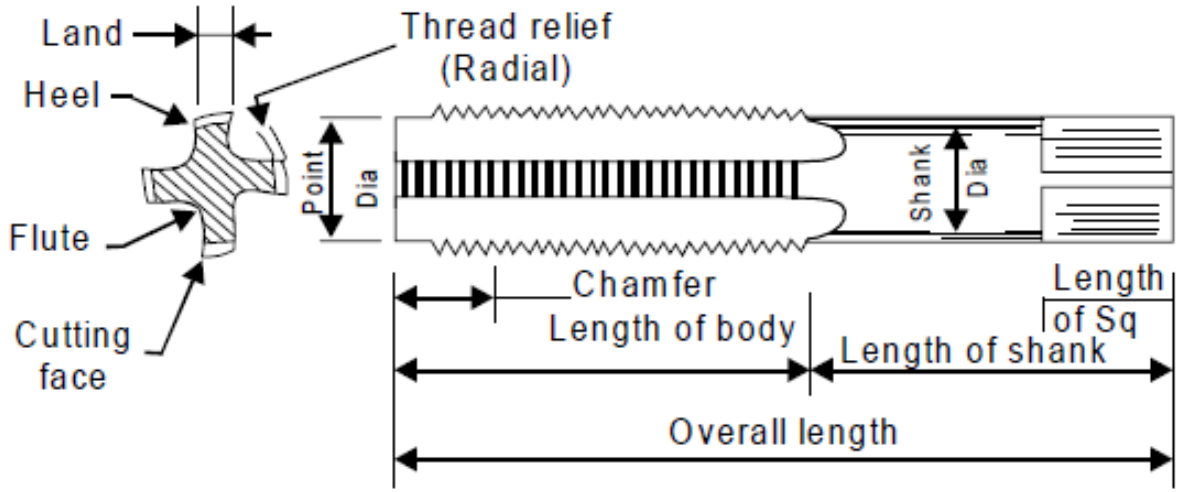


Fig. Nomenclature of tap

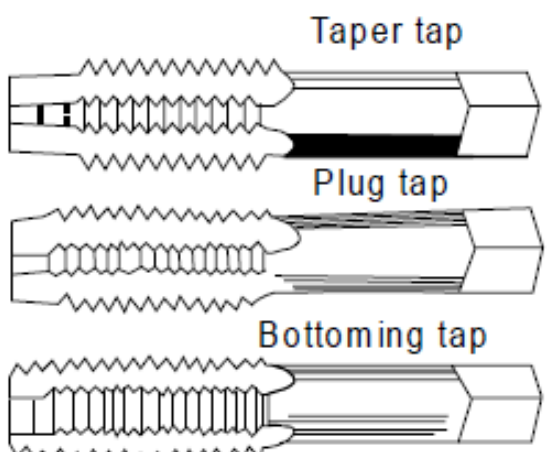


Fig. Types of hand taps

❖ Hand hacksaw

The hand hacksaws are commonly used for sawing all soft metal. They consist of a frame, handle, prongs, tightening screw and nut, and blade. Its frame is made to hold the blade tightly.

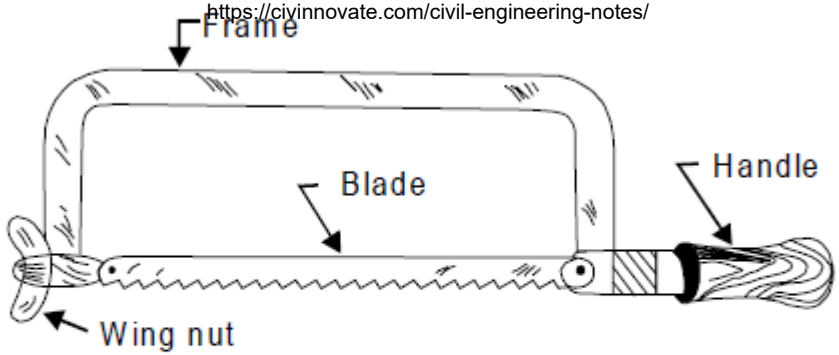


Fig. A fixed frame hacksaw

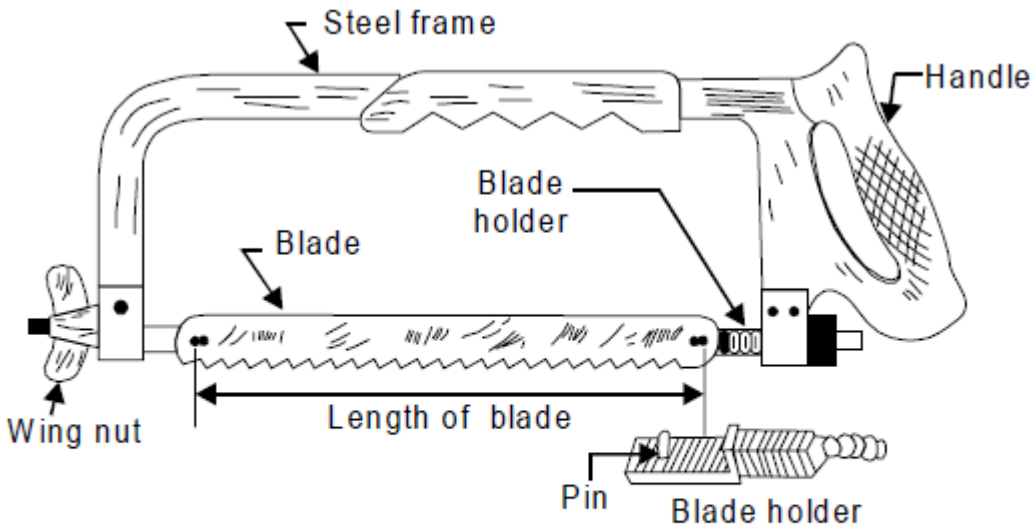


Fig. An adjustable frame hacksaw

❖ Striking Tools

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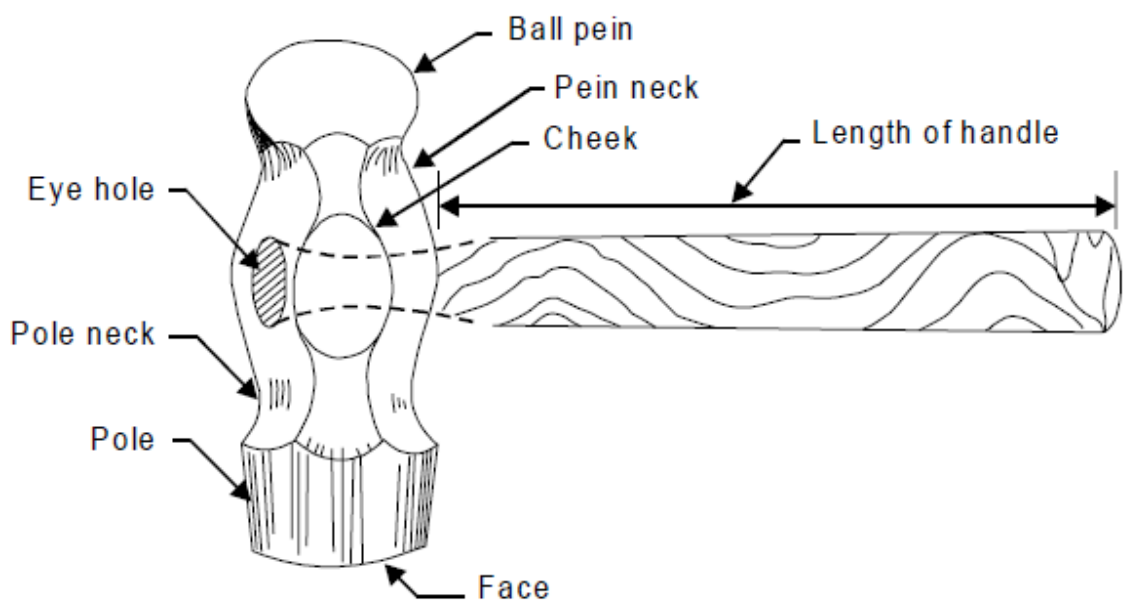
Various types of hammers (such as ball peen hammer, straight peen hammer, cross peen hammer, double face hammer and soft face hammer) are acting as striking tools.



❖ Screw driver

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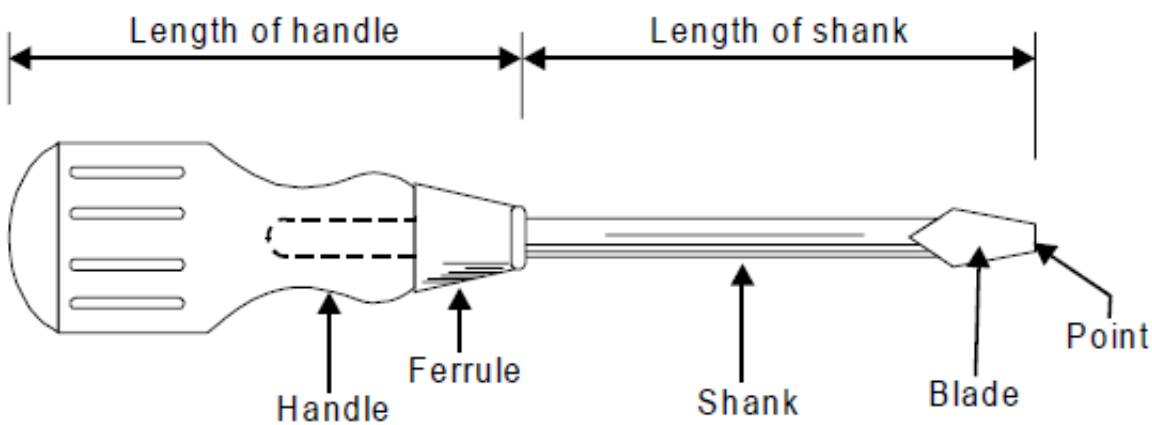
Screw driver is a screw tightening tool. The most commonly used standard screw driver with its parts is shown in Fig below:- It is generally used by hand for tightening the screws.



OPERATIONS PERFORMED IN FITTING WORK

The operations commonly performed in bench and fitting work may be classified as under.

- Marking
- Chipping
- Filing
- Scrapping

- Reaming
- Tapping
- Sawing
- Drilling

THANK YOU

MACHINE TOOLS

➢Lathe Machine

❑ Lathe is one of the most versatile and widely used machine tools and is also known as the mother of all other machine tool.

❑ The job is securely and rigidly held in the chuck or in between centers on the lathe machine and then turn it against a single point cutting tool which will remove metal from the job in the form of chips.

❑ The main function of a lathe is to remove metal from a job to give it the required shape and size.

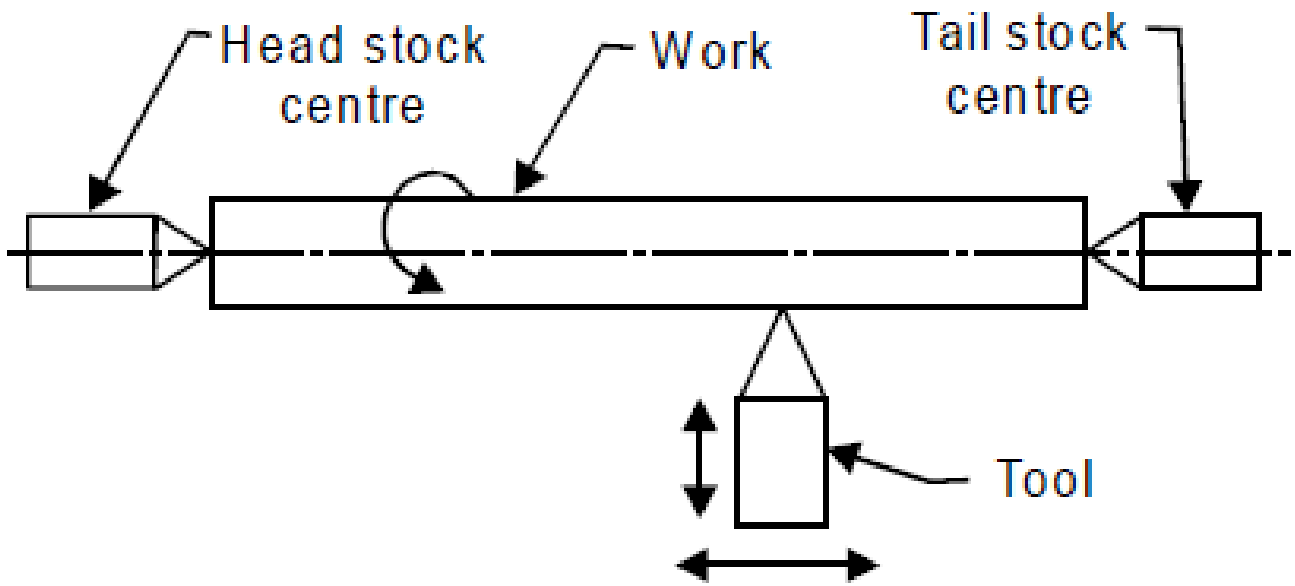


Fig. Working principal of lathe machine

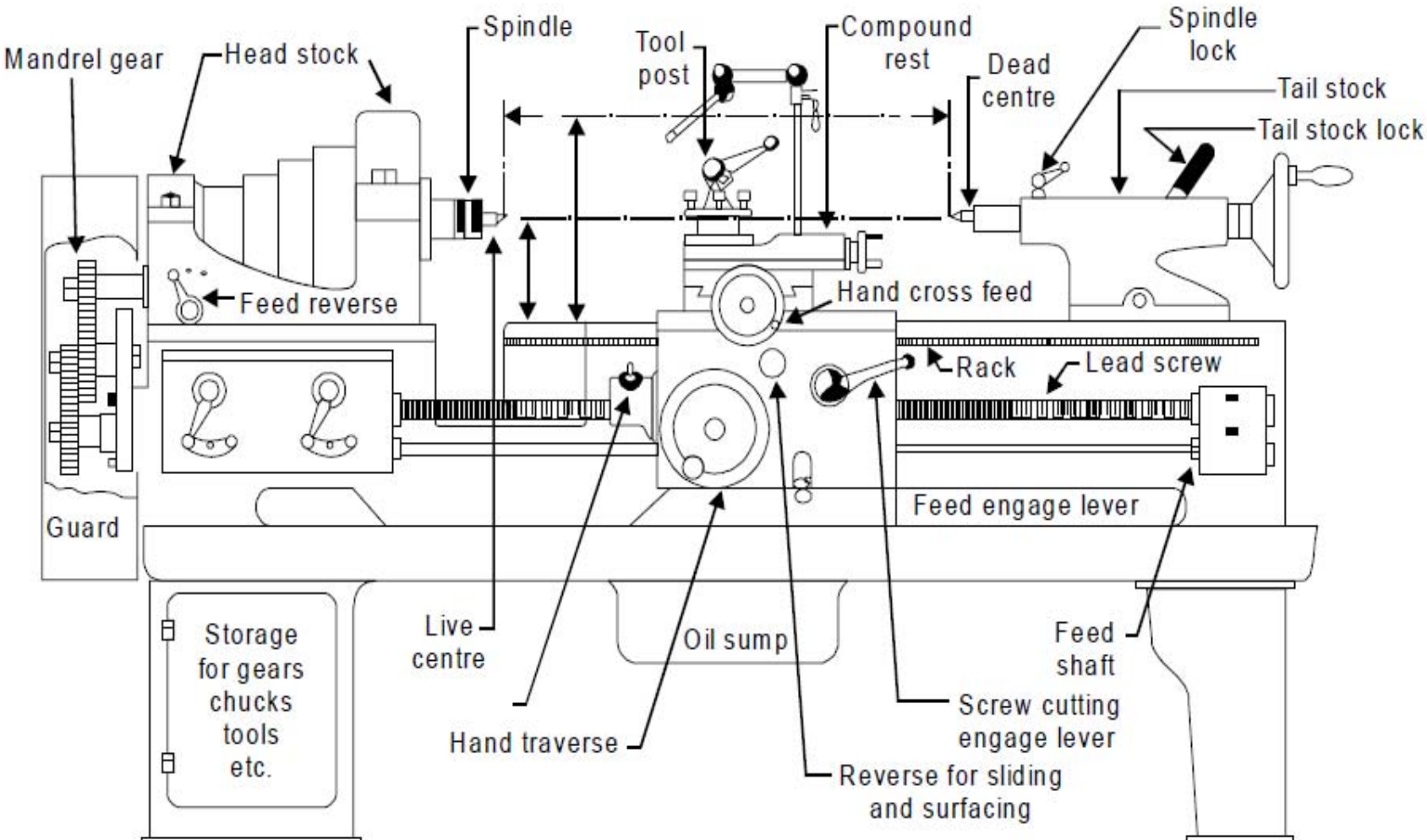


Fig. Different parts of engine lathe or central lathe

❑ A lathe is basically consist of a bed to provide support, a head stock, a cross slide to traverse the tool, a tool post mounted on the cross slide.

❑ The spindle is driven by a motor through a gear box to obtain a range of speeds.

❑ The carriage moves over the bed guide ways parallel to the work piece and the cross slide provides the transverse motion.

❑ A feed shaft and lead screw are also provided to power the carriage and for cutting the threads respectively.

❑ The most common operations which can be performed on the lathe are:-

- ❖ Turning
- ❖ Facing
- ❖ Threading
- ❖ Taper turning
- ❖ Eccentric turning
- ❖ Drilling
- ❖ Reaming
- ❖ Boring
- ❖ Knurling
- ❖ Scroll cutting etc

Specification of a lathe

- A lathe is generally designated by:

a. Swing i.e. the largest work diameter that can be swung over the lathe bed.

b. Distance between head stock and tail stock.

Types of lathe

The general classification of lathe are:-

- Speed lathe
- Turret lathe
- Tool room lathe
- Bench lathe
- Vertical turret lathes
- Engine lathe or Centre lathe
- Capstan lathe
- Gap bed lathe
- Hollow spindle lathe
- Special Purpose lathe

➢Milling Machine

❖A milling machine is a machine tool that removes metal as the work is fed against a rotating multipoint cutter. The milling cutter rotates at high speed and it removes metal at a very fast rate with the help of multiple cutting edges.

❖One or more number of cutters can be mounted simultaneously on the arbor of milling machine.

❖ There are two distinct methods of milling

1. Up-milling or conventional milling, and
2. Down milling or climb milling.

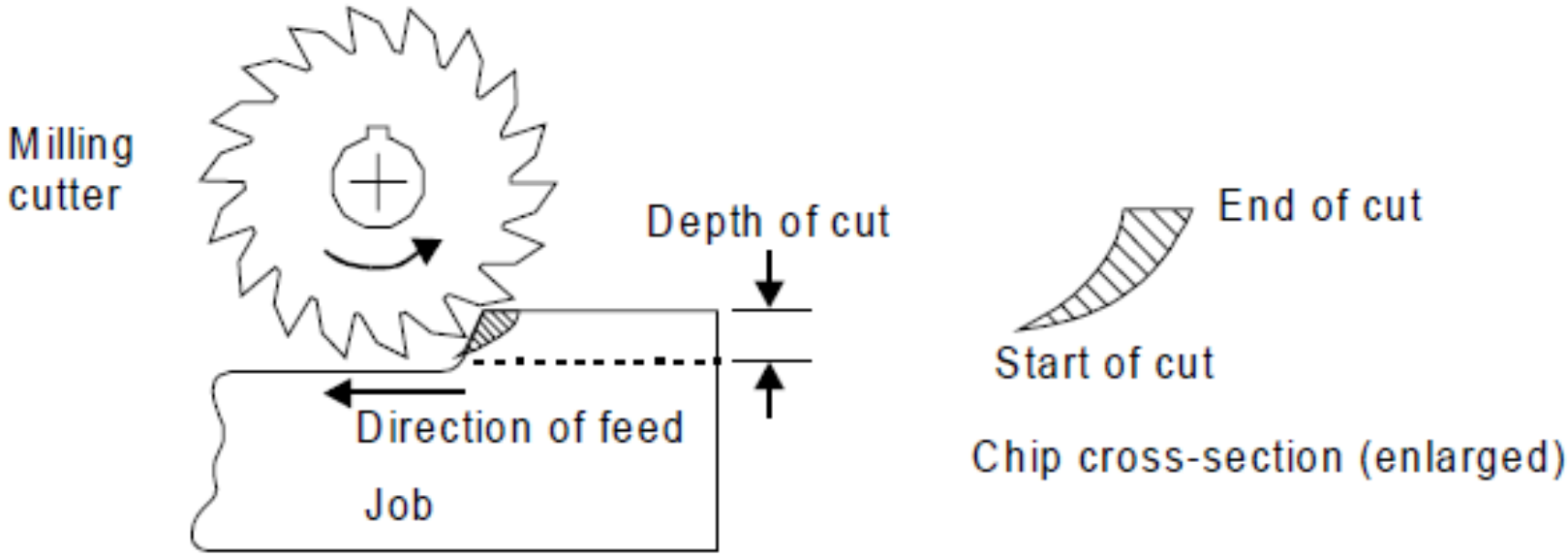


Fig. Principal of up-milling

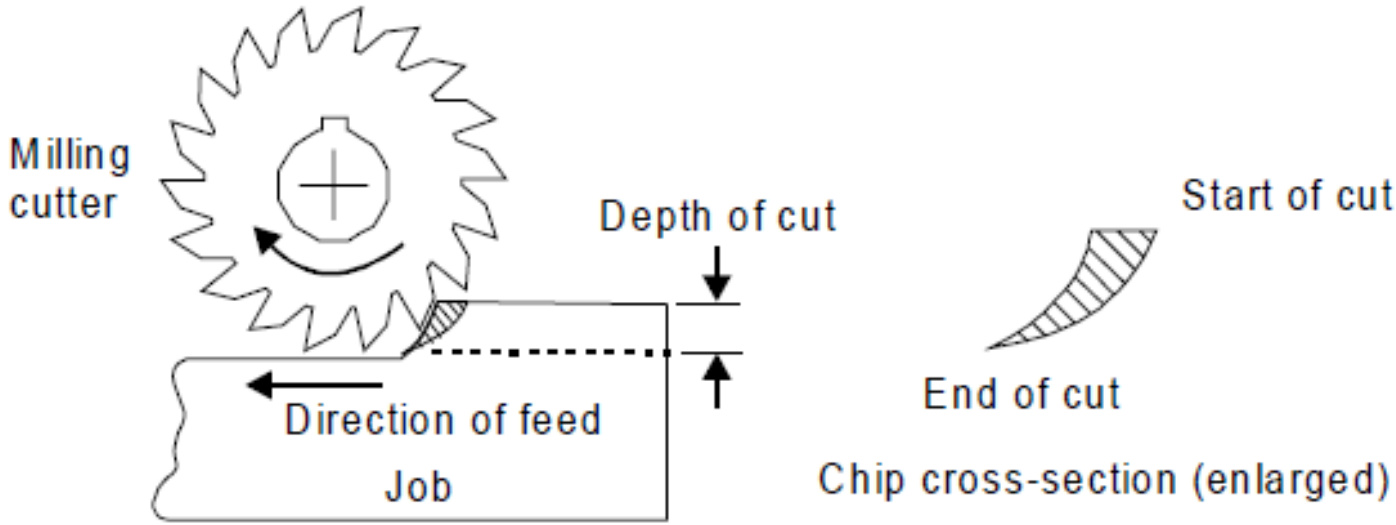
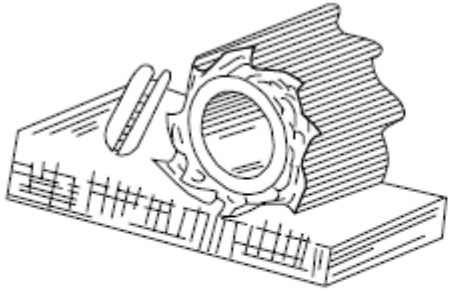
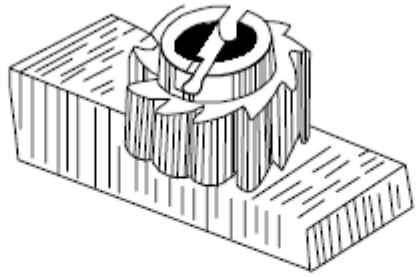


Fig. Principal of down-milling

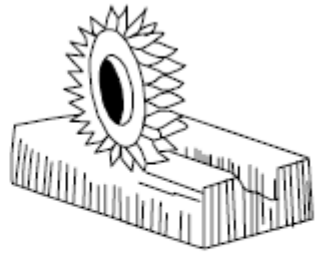
Types of milling cutter



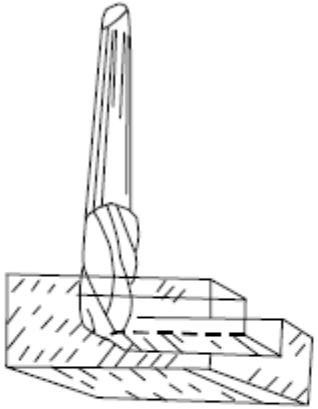
Plain milling cutter



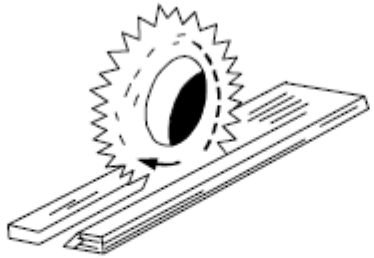
Shell end mill



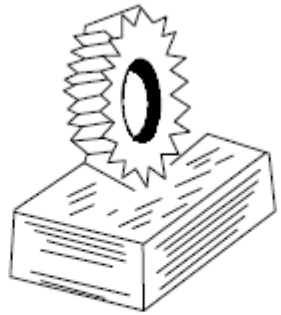
Side milling cutter



End mill



Metal-slitting saw



Angle milling cutter

Form milling

Fig. Types of milling cutters

➢Shaper Machine

❖ Shaper is a reciprocating type of machine tool in which the ram moves the cutting tool backwards and forwards in a straight line.

❖ It is intended primarily to produce flat surfaces but modern shapers can also generate contoured surfaces.

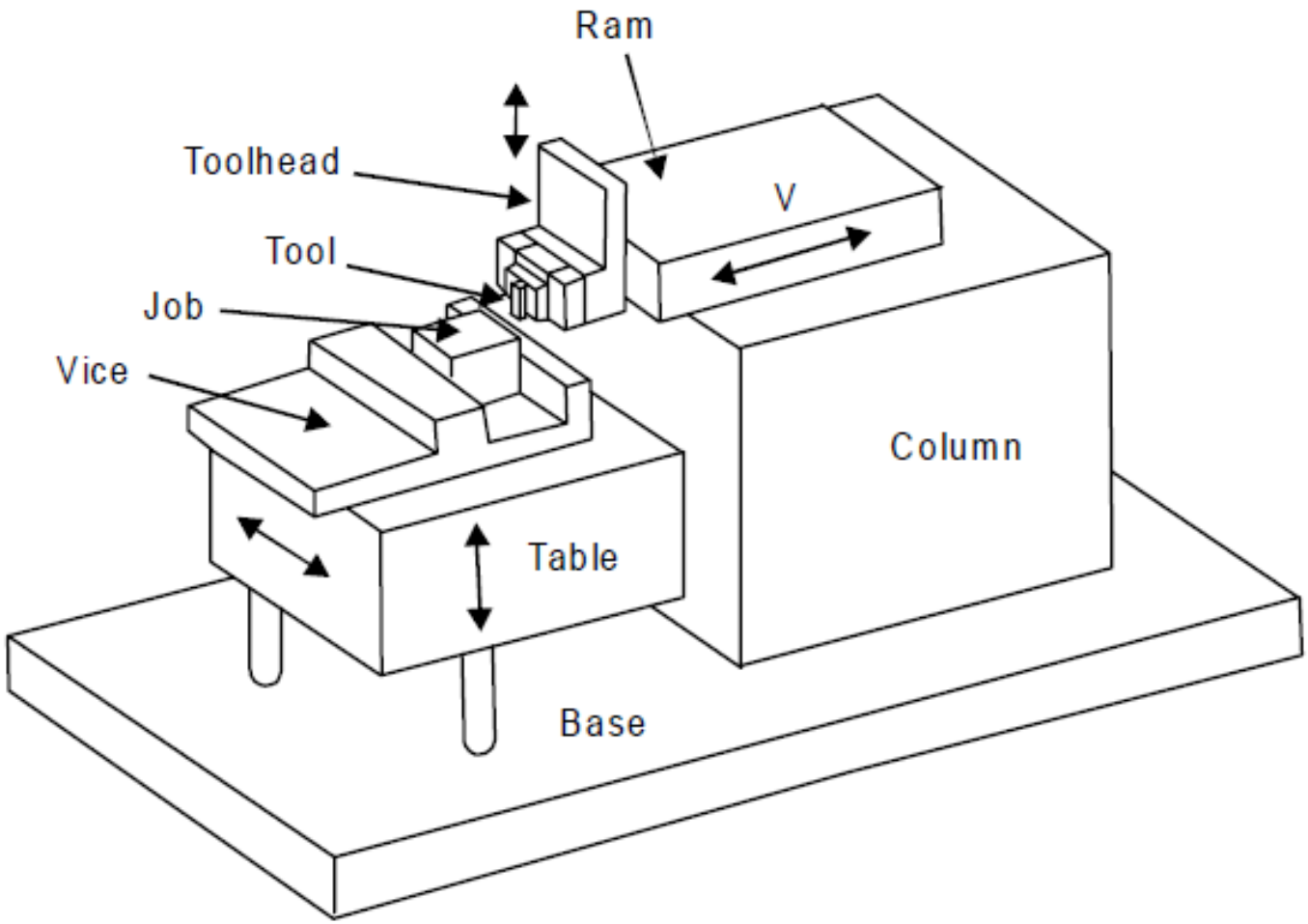


Fig. Principal components of a shaper

➢ WORKING PRINCIPLE OF SHAPER

❖ A single point cutting tool is held in the tool holder, which is mounted on the ram.

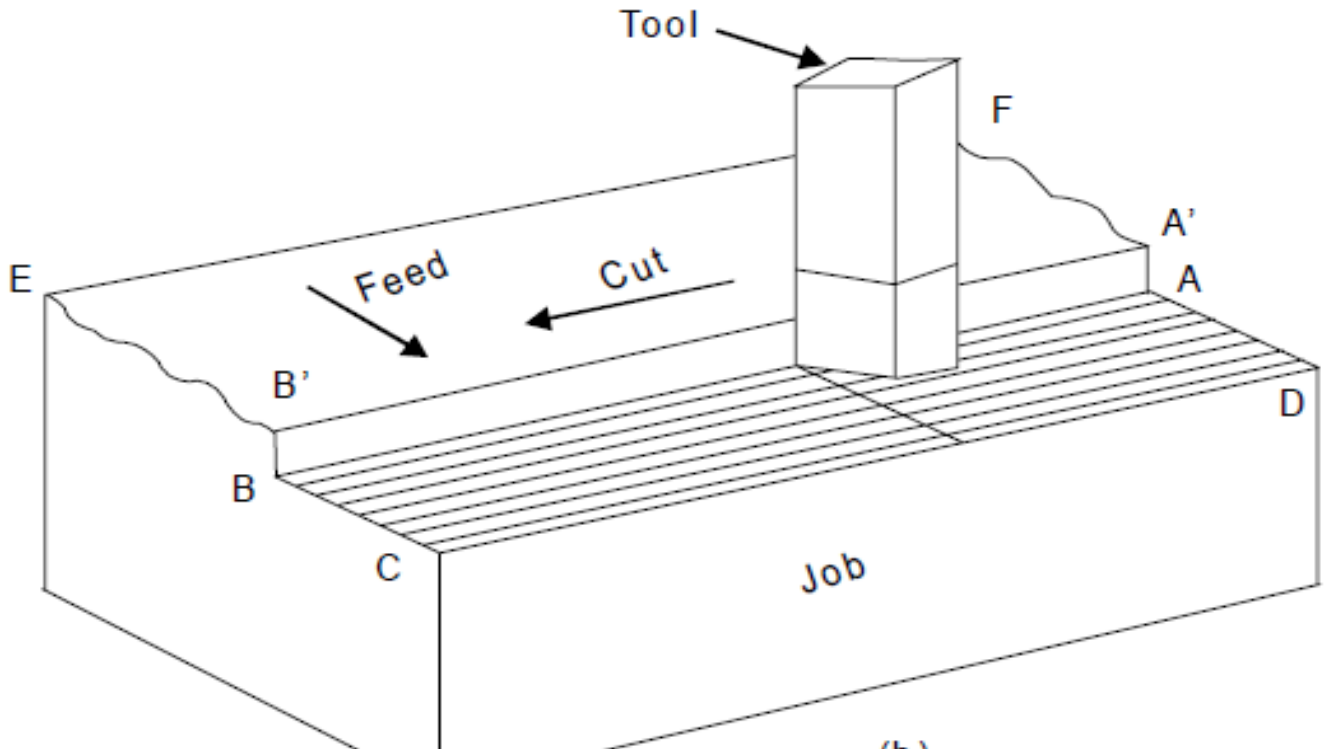
❖ The work piece is rigidly held in a vice or clamped directly on the table.

❖ The ram reciprocates and thus cutting tool held in tool holder moves forward and backward over the workpiece.

❖ In a standard shaper, cutting of material takes place during the forward stroke of the ram. The backward stroke remains idle and no cutting takes place during this stroke.

❖ The feed is given to the work piece and depth of cut is adjusted by moving the tool downward towards the work piece.

❖ The time taken during the idle stroke is less as compared to forward cutting stroke and this is obtained by quick return mechanism.



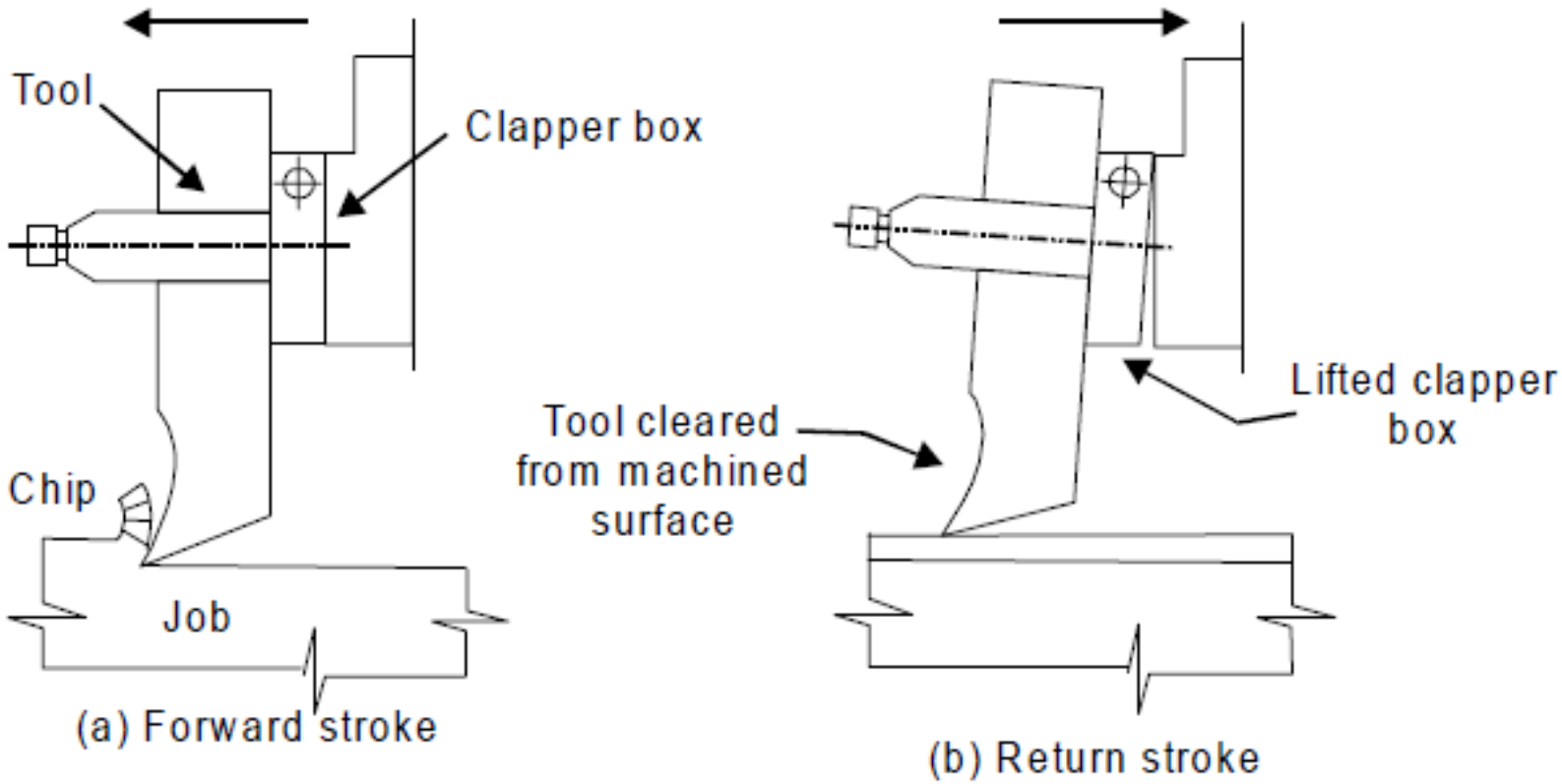
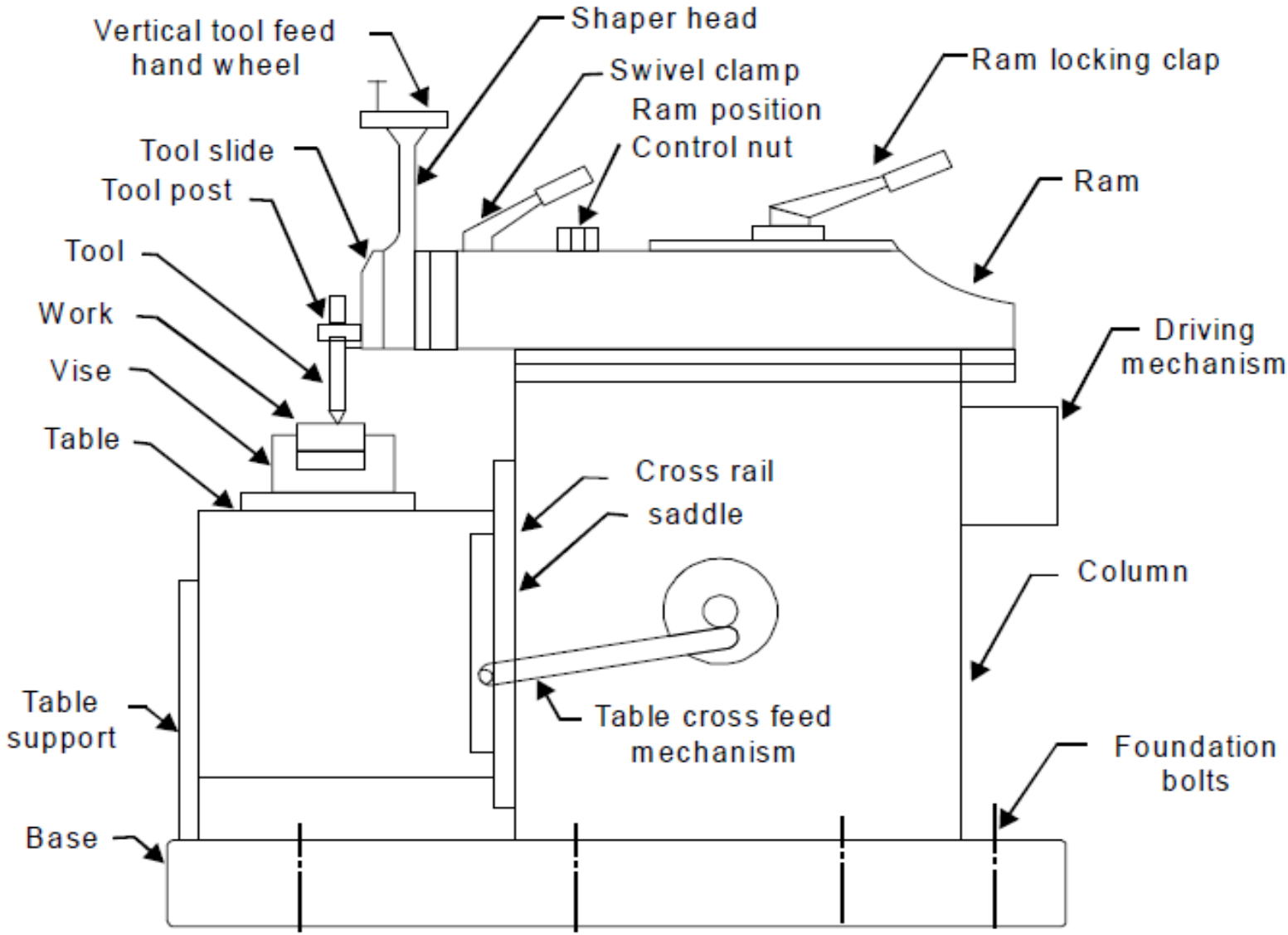


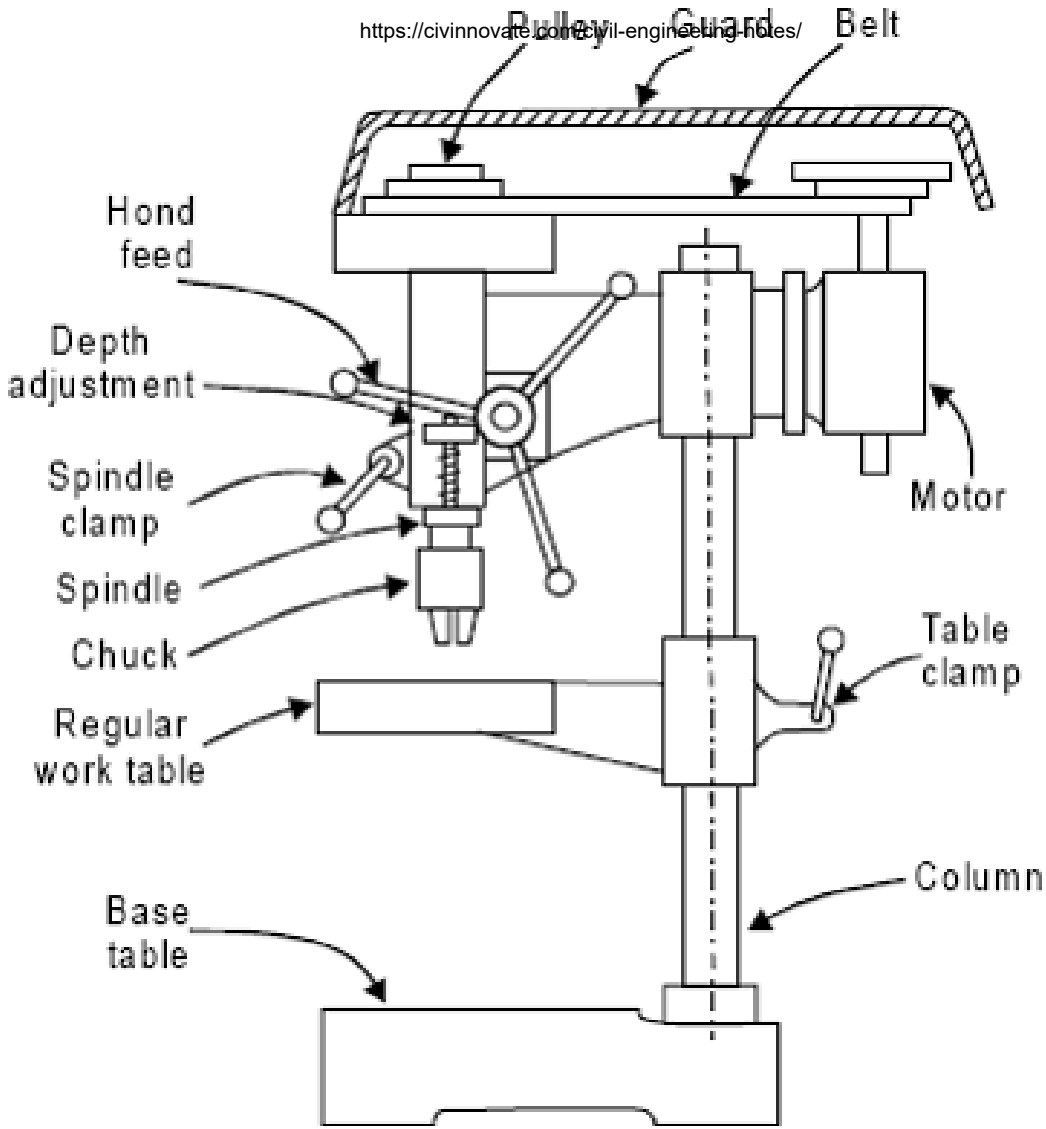
Fig. Cutting action and functioning of clapper box


Vertical tool feed
hand wheel
Shaper head
Swivel clamp
Ram position
Control nut
Ram locking clap
Tool slide
Tool post
Ram
Tool
Work
Vise
Table
Driving
mechanism
Cross rail
saddle
Column
Table
support
Table cross feed
mechanism
Foundation
bolts
Base

➢Drilling Machine

❖ Drilling is an operation of making a circular hole by removing a volume of metal from the job by cutting tool called drill.

❖ A drill is a rotary end-cutting tool with one or more cutting lips and usually one or more flutes for the passage of chips and the admission of cutting fluid.



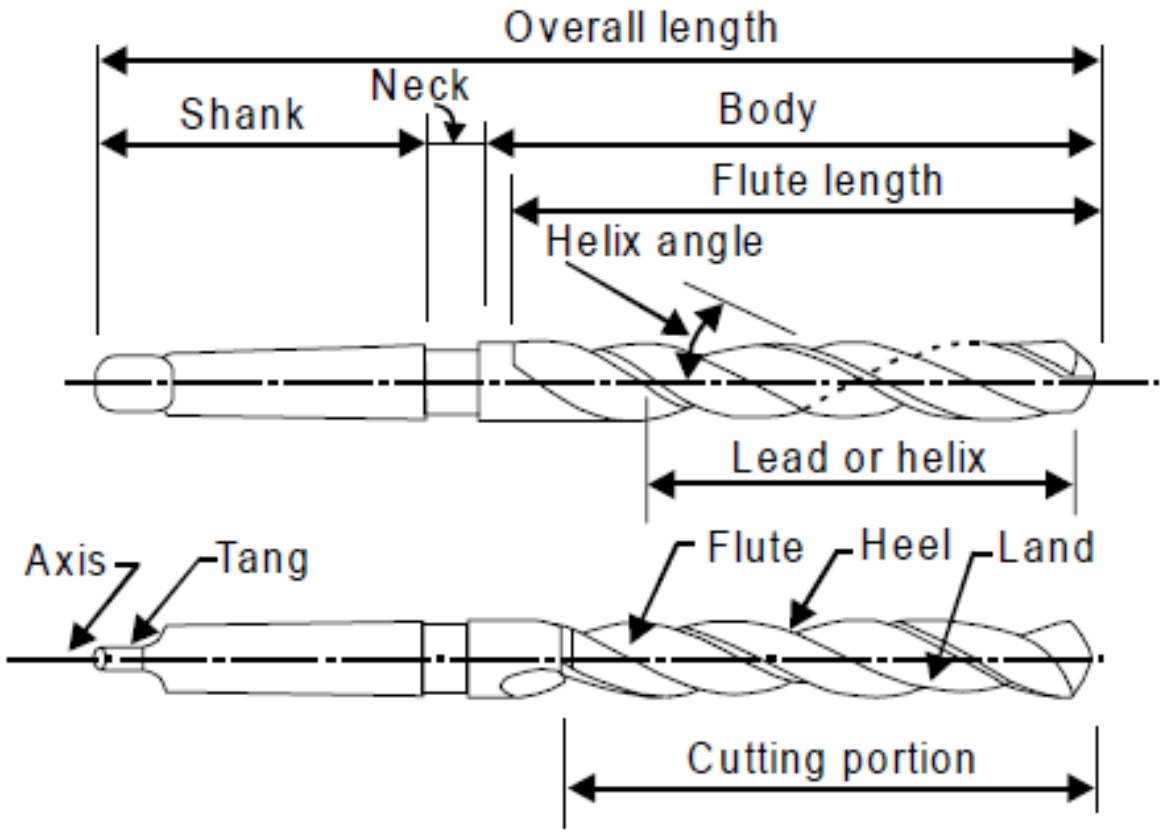
➢ TYPES OF DRILLS

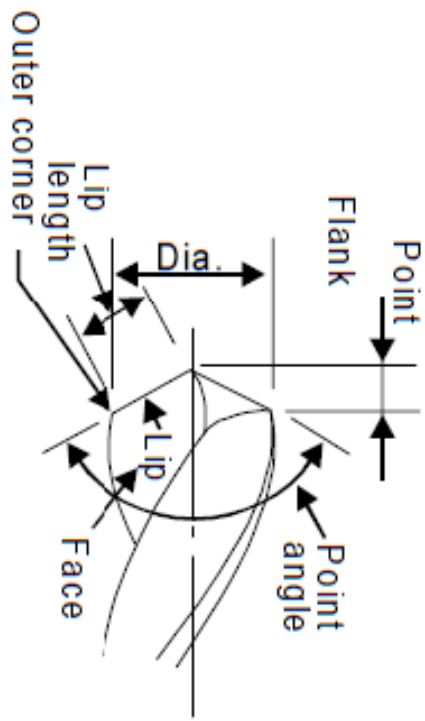
❖ A drill is a multi point cutting tool used to produce or enlarge a hole in the workpiece. It usually consists of two cutting edges set an angle with the axis.

Broadly there are three types of drills:

1. Flat drill,
2. Straight-fluted drill, and
3. Twist drill

❖ Twist drill is the most common type of drill in use today.





➢ OPERATIONS PERFORMED ON DRILLING MACHINE

❖ Reaming

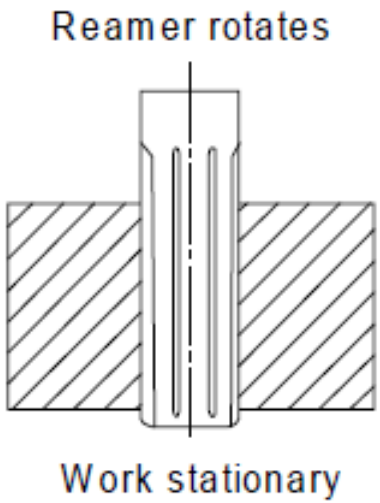


Fig. Reaming operation

❖ Boring

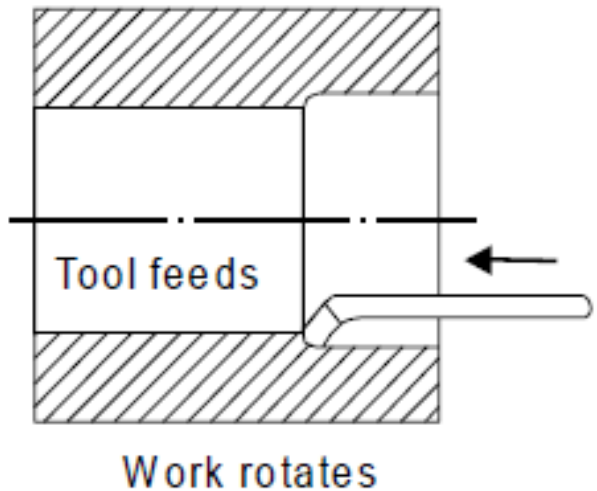


Fig Boring operation

❖ Counter boring

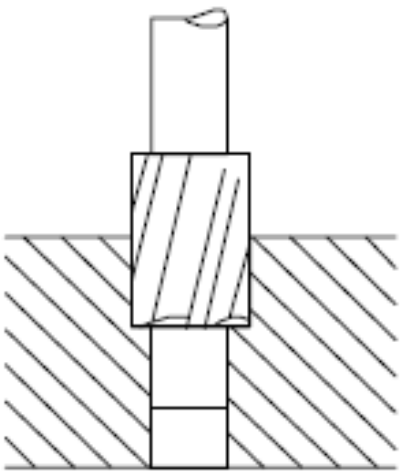


Fig. Counter boring operation

❖ Countersinking

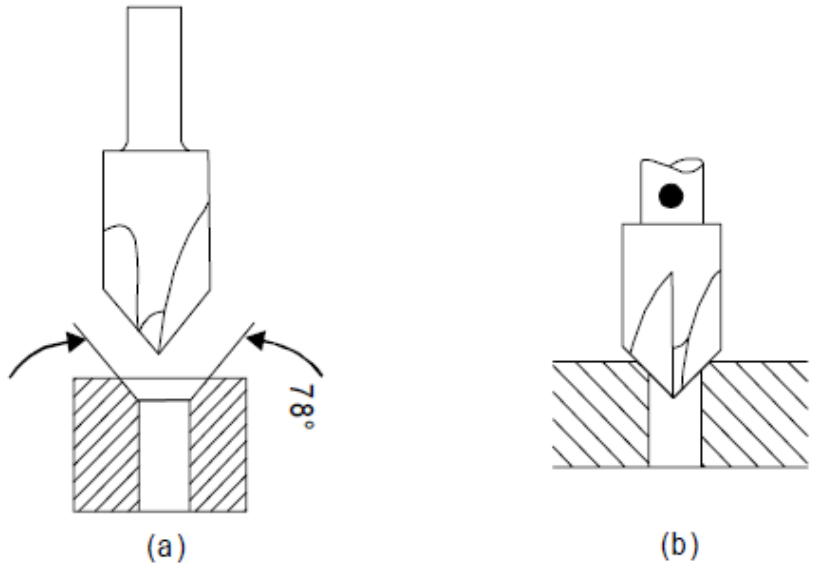


Fig. Counter sinking operation

➢Grinding Machine

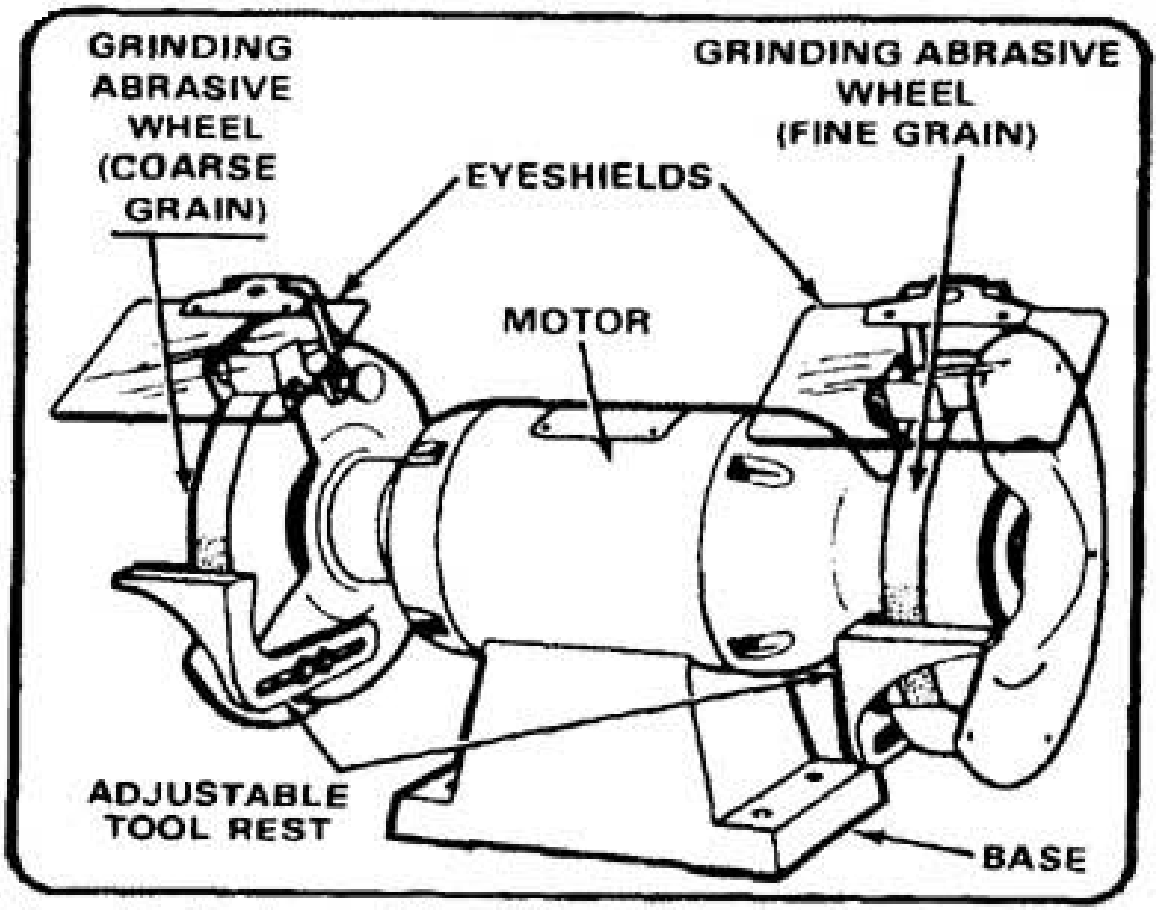


Figure 5-2. Bench-type utility grinding machine.

➢ WELDING

❖ Welding is a process for joining two similar or dissimilar metals by fusion.

❖ The fusion of metal takes place by means of heat.

❖The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction.

➢ TERMINOLOGICAL ELEMENTS OF WELDING PROCESS

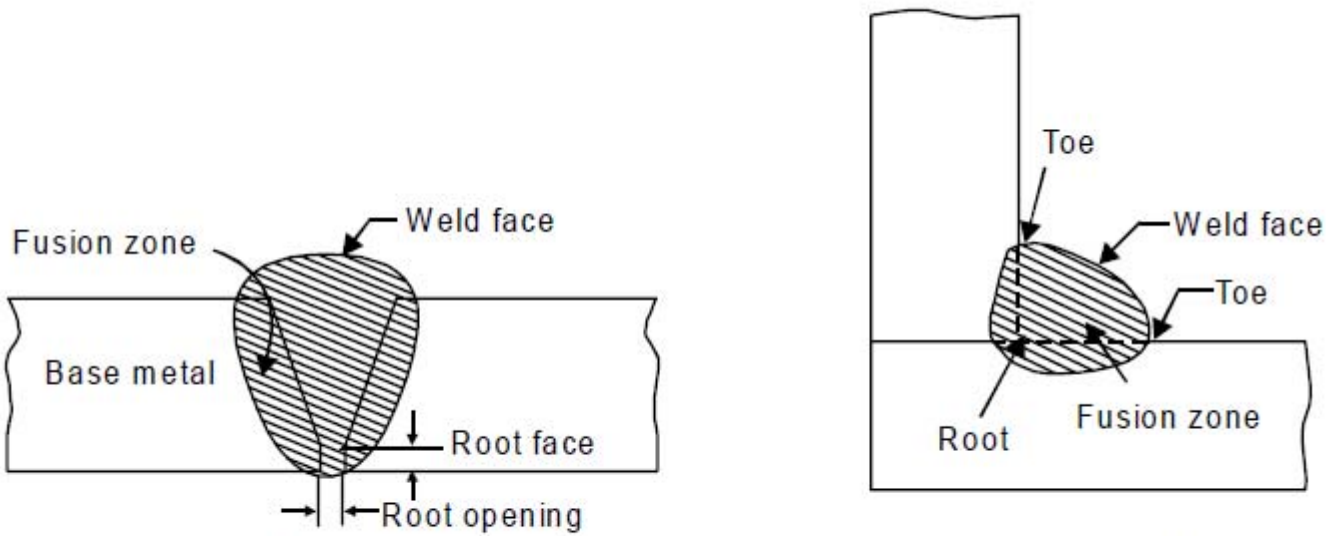


Fig. Terminological elements of welding process

❖ Edge preparations

https://civinnovate.com/civil-engineering-notes/

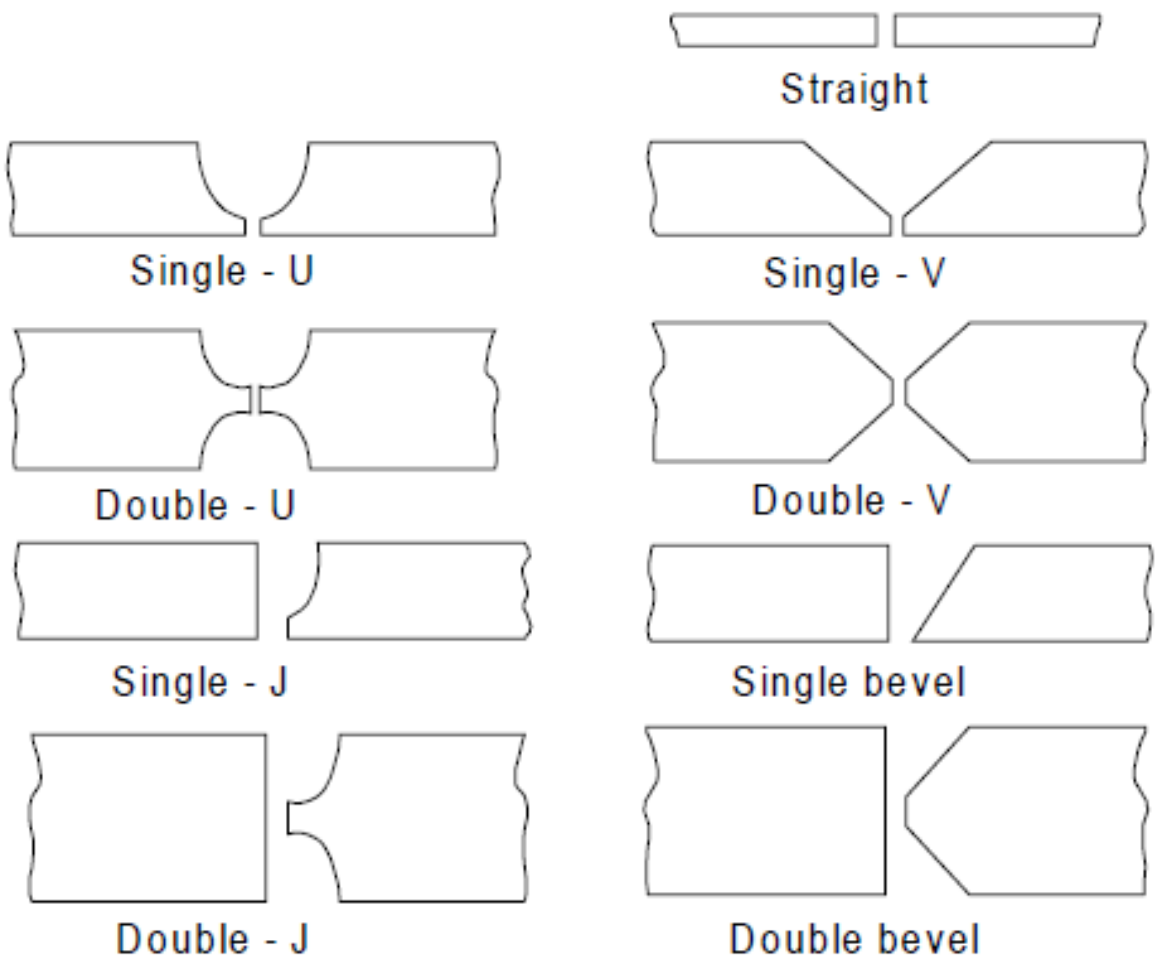
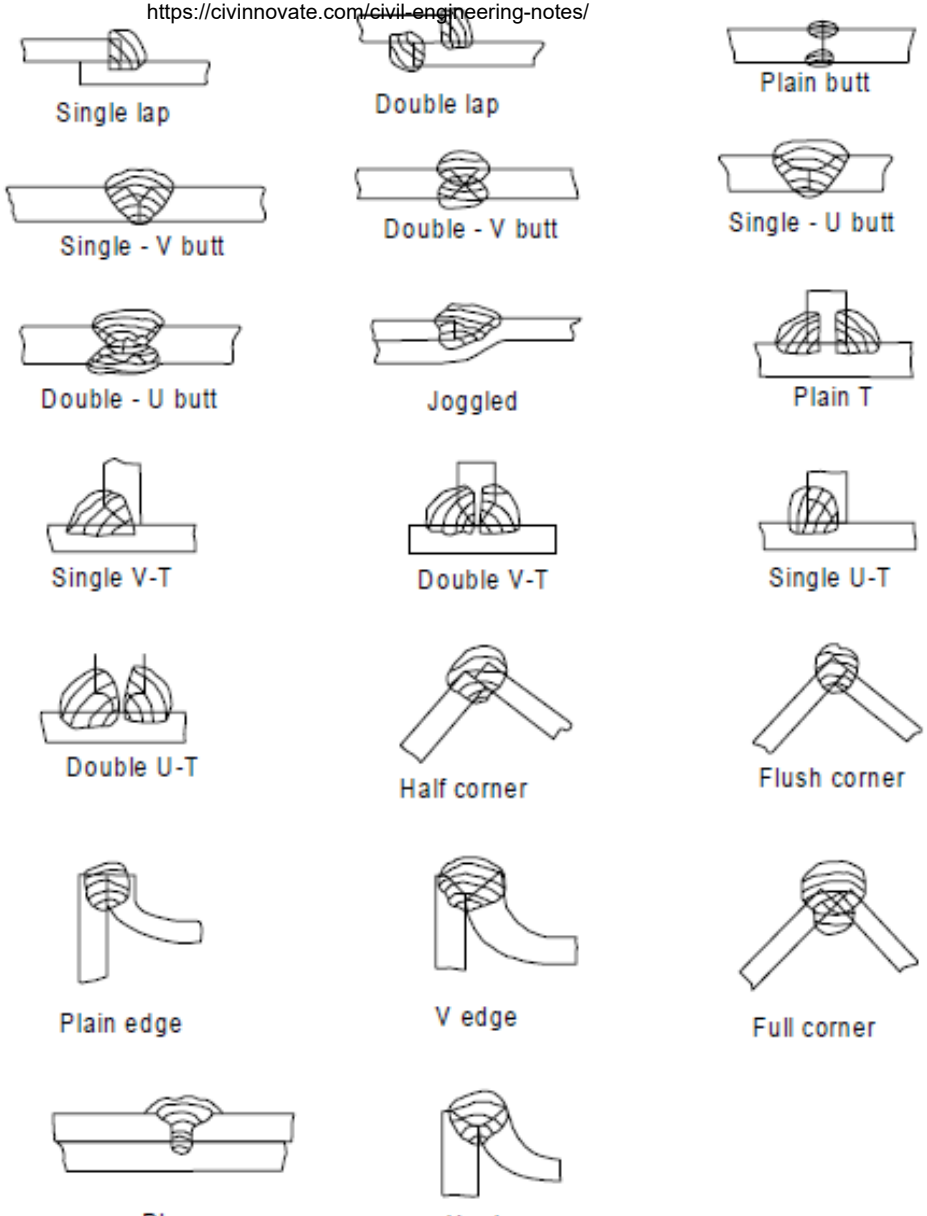


Fig. Butt welding joints edge preparations

❖ Welding joints

https://civinnovate.com/civil-engineering-notes/



❖ Welding Positions https://civinnovate.com/civil-engineering-notes/

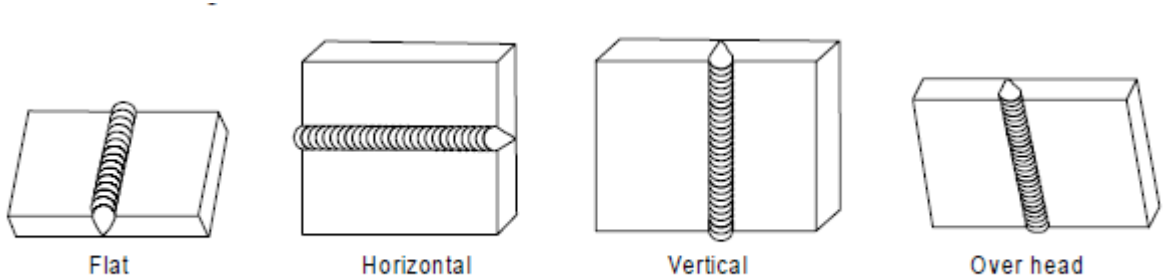


Fig. Kinds of welding positions

➢ Types of welding

- ❖ Gas Welding
- ❖ Arc Welding

➢ GAS WELDING PROCESSES

❖ A fusion welding process which joins metals, using the heat of combustion of an oxygen /air and fuel gas (i.e. acetylene, hydrogen propane or butane) mixture is usually referred as **‘gas welding’.**

❖ The intense heat (flame) thus produced melts and fuses together the edges of the parts to be welded, generally with the addition of a filler metal.

❖ The fuel gas generally employed is acetylene, Oxy-acetylene flame is the most versatile and hottest of all the flames produced by the combination of oxygen and other fuel gases.

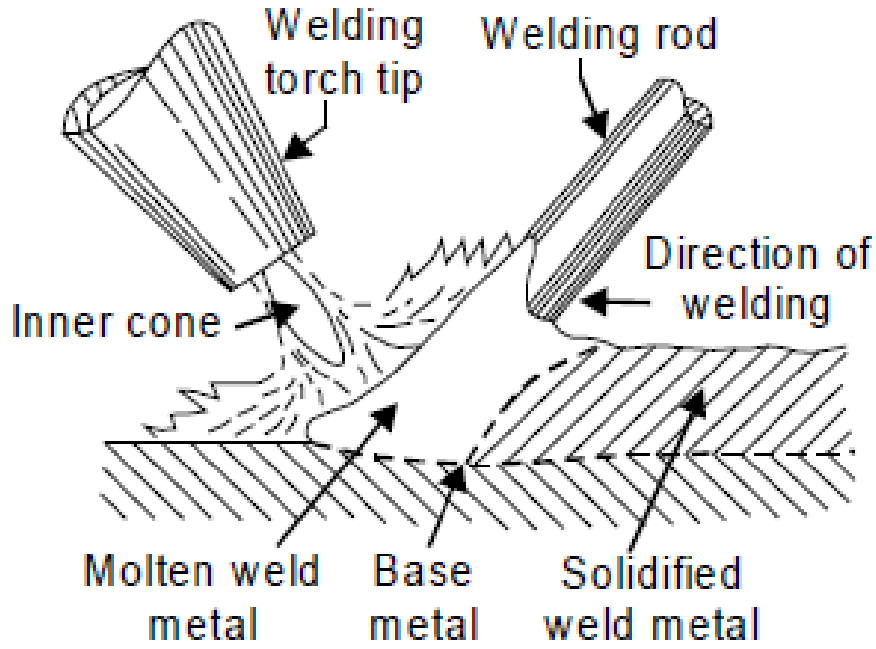


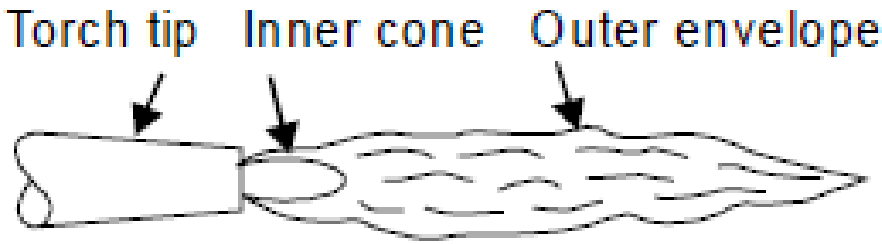
Fig. Gas welding operation

➢ Types of Welding Flames

❖ Carburizing welding flame or reducing (excess of acetylene).

❖ Neutral welding flame (Acetylene and oxygen in equal proportions).

❖ Oxidizing welding flame (excess of oxygen).



Neutral flame

3260°C

Oxidizing flame
(Excessive oxygen)

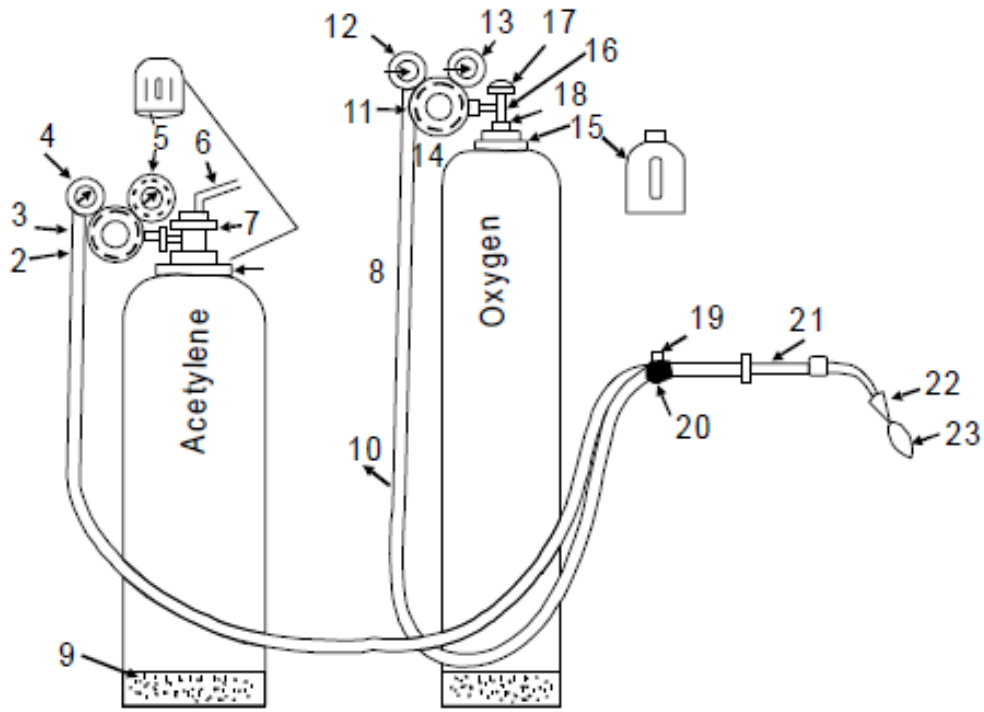
3480°C

Carburising flame
(Excessive acetylene)

3038°C

Fig. Gas welding flames

➢ Gas Welding Equipments



1. Acetylene hose
2. Adjusting screw
3. Acetylene regulator
4. Regulator outlet pressure gauge
5. Cylinder pressure gauge
6. Valve wrench
7. Acetylene cylinder valve
8. Cylinder cap
9. Fusible plugs
10. Oxygen hose
11. Oxygen regulator
12. Regulator outlet pressure gauge
13. Cylinder pressure gauge
14. Cylinder cap
15. Oxygen cylinder valve
16. Oxygen cylinder valve
17. Hand wheel
18. Bursting disc
19. Acetylene valve
20. Oxygen valve
21. Welding torch
22. Torch tip
23. Flame

➢ARC WELDING PROCESSES

❖ The process, in which an electric arc between an electrode and a workpiece or between two electrodes is utilized to weld base metals, is called an arc welding process.

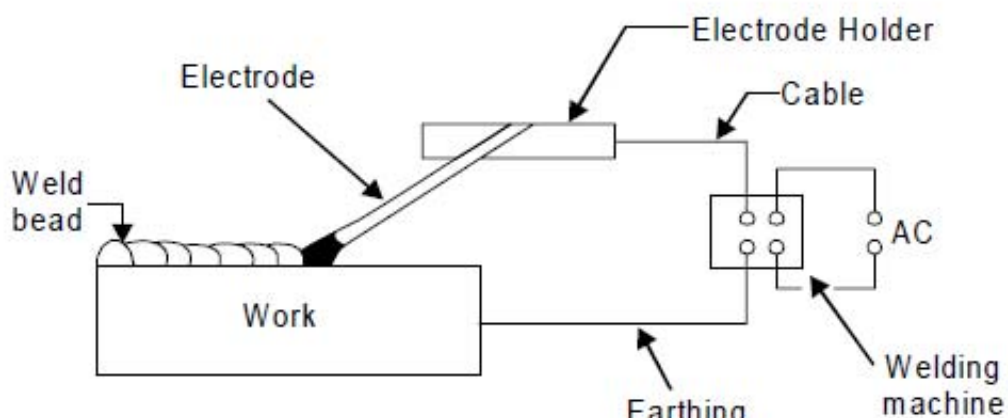
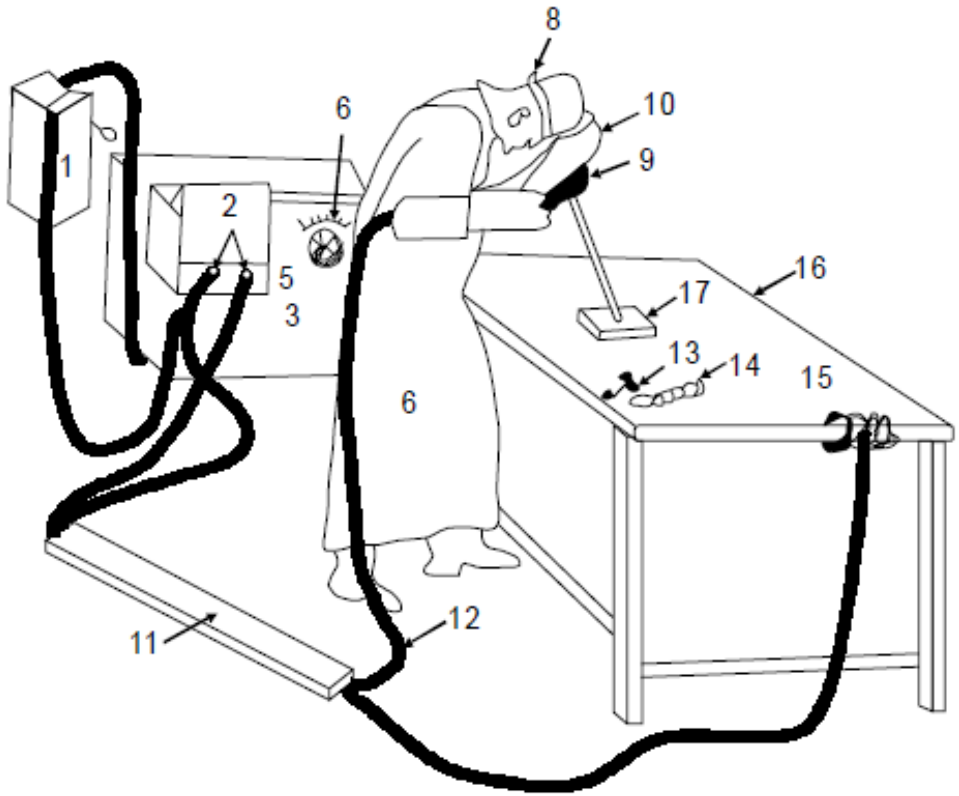


Fig. Principle of arc welding



(1) Switch box.
(2) Secondary terminals.
(3) Welding machine.
(4) Current reading scale.
(5) Current regulating hand wheel.
(6) Leather apron.
(7) Asbestos hand gloves.
(8) Protective glasses strap.
(9) Electrode holder.
(10) Hand shield.
(11) Channel for cable protection.
(12) Welding cable.
(13) Chipping hammer.
(14) Wire brush.
(15) Earth clamp.
(16) Welding table (metallic).
(17) Job.

Fig. Arc welding process setup

Arc Welding Equipment

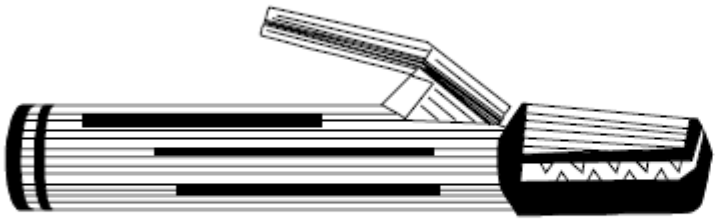


Fig. Electrode holder

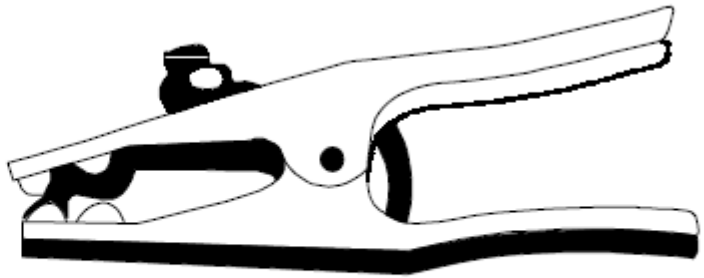
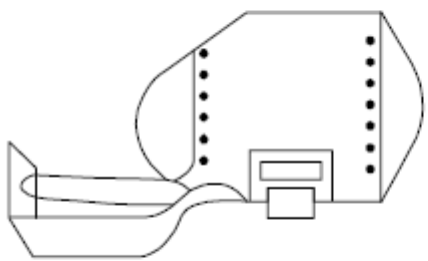
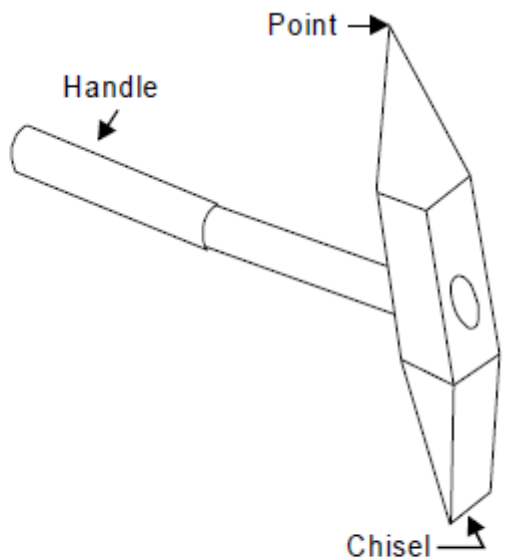


Fig. Earth clamp





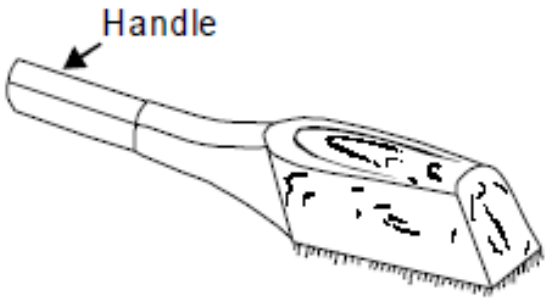


Fig. Wire brush

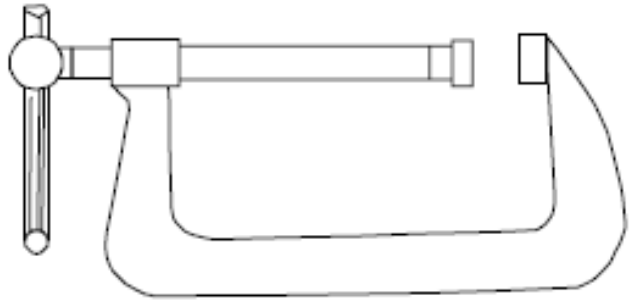
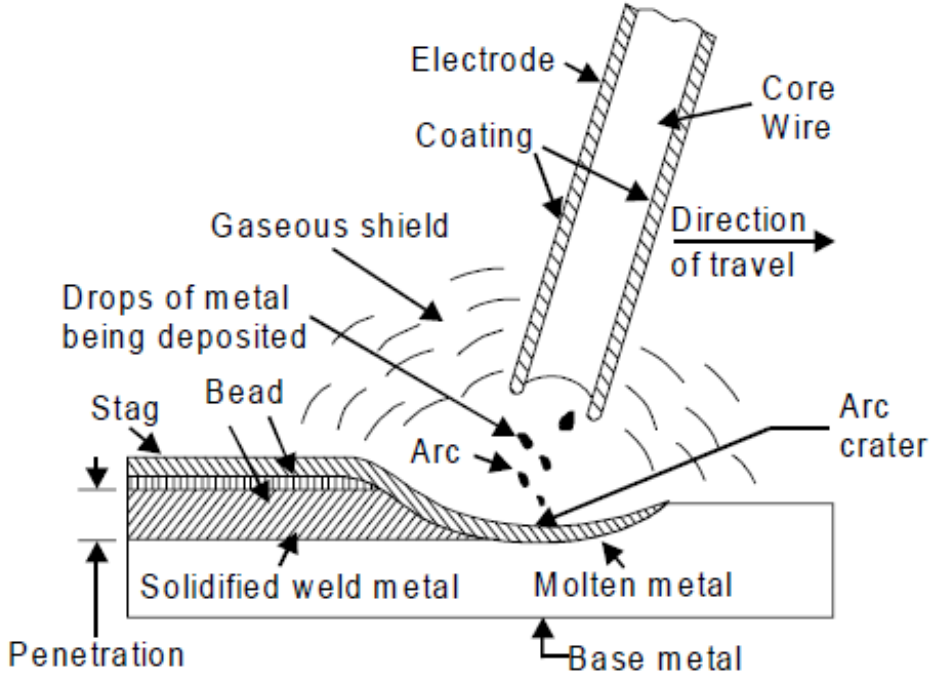


Fig. C-clamp



➢ Foundry / Forging

❖ Pattern

A pattern is a model or the replica of the object (to be casted). It may be defined as a model or form around which sand is packed to give rise to a cavity known as mold cavity in which when molten metal is poured, the result is the cast object. A pattern prepares a mold cavity for the purpose of making a casting.

➢ COMMON PATTERN MATERIALS

- ❖ Wood
- ❖ Plastic
- ❖ Metal
- ❖ Wax

➢ COMMON TYPES OF PATTERN

- ❖ One piece or solid pattern
- ❖ Two piece or split pattern
- ❖ Cope and drag pattern

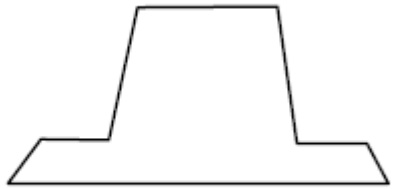


Fig. Single piee pattern

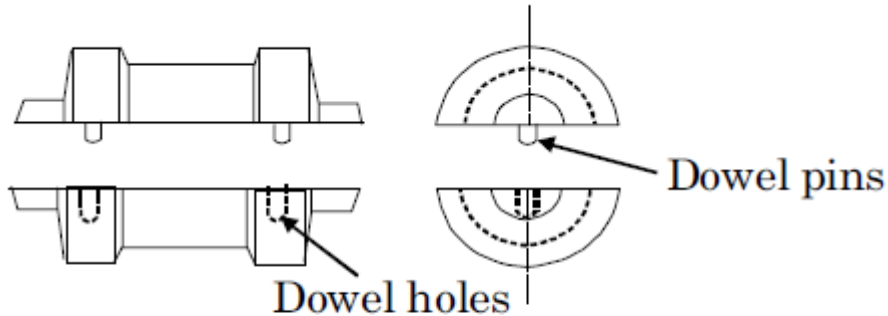


Fig. Two piece pattern

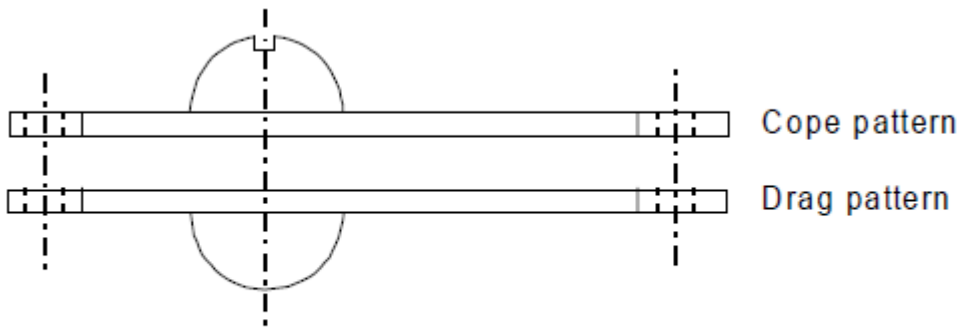


Fig. Cope and drag pattern

➢ PATTERN ALLOWANCES

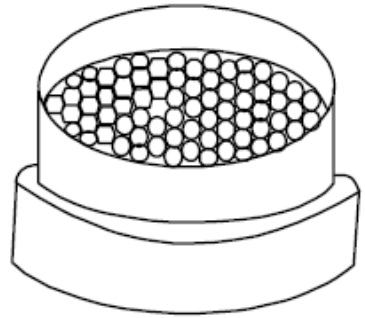
- ❖ Shrinkage Allowance
- ❖ Machining Allowance
- ❖ Draft or Taper Allowance

➢ CORE AND CORE BOX

- ❖ Cores are compact mass of core sand that when placed in mould cavity at required location with proper alignment does not allow the molten metal to occupy space for solidification in that portion and hence help to produce hollowness in the casting.

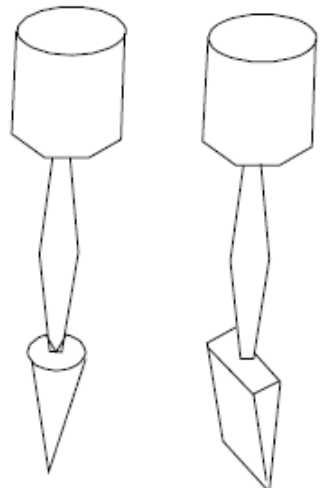
➢ HAND TOOLS USED IN FOUNDRY SHOP

❖ Hand riddle



❖ Shovel

❖ Rammers



❖ Sprue pin

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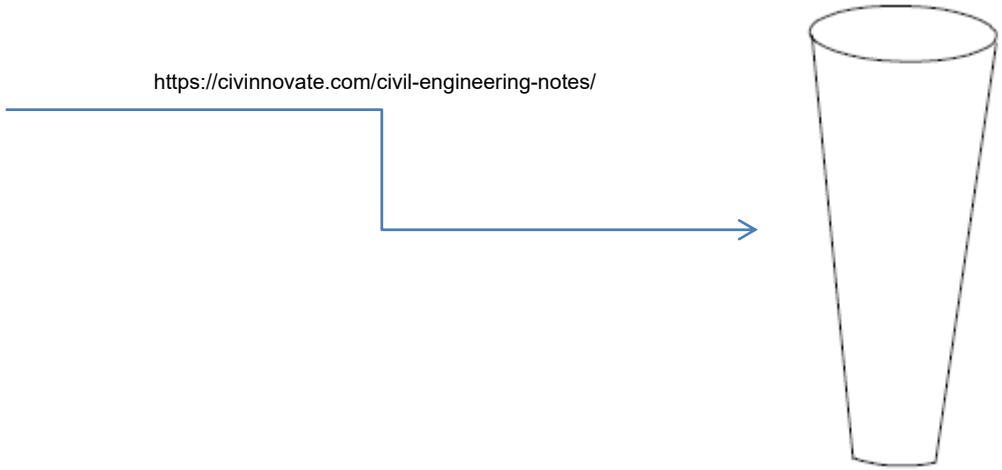
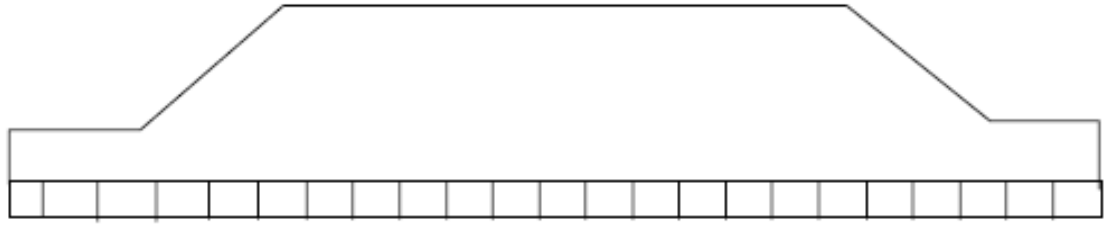
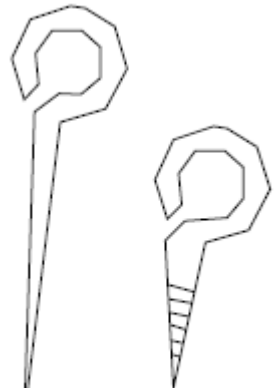


❖ Strike off bar



❖ Draw spike



- Vent rod

- Gate cutter

- Trowels