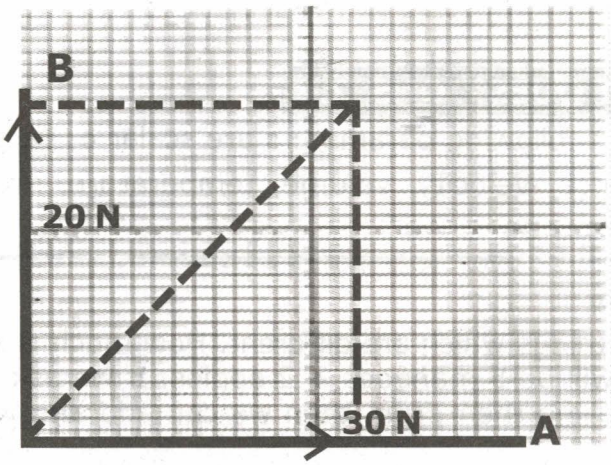


Fig :2.8

Plot the forces on a graph. Select proper scale. We will select 10N = 1cm on the graph.

The resultant force can be measured and direction of resultant. The direction of the resultant can be seen on the graph. This method of 'resolving' one force (or any vector) into components in any other direction is useful in understanding how things move or behave when forces act on it.

2.10 WHAT YOU HAVE LEARNT

In this chapter you have learnt about basic engineering concept such work, energy, force, power. You also learnt about law of conservation of energy. You learn to calculate work done, force and power required. You also learn about scalar and vectors. You learn, how two vectors can be resolved into components using graph and carry out its addition.

2.11 TERMINAL QUESTIONS

1) A weight of 100kg and 5 kg drops from the height of 10m. Tell which weight reaches the ground first and why?
2) Mass of object is 20Kg, how much is the force exerted on it by earth?
3) A mass of 20kg is lifted to a height of 5m in 5 second. Calculate thefollowing
   a. Force (F)
   b. Work done (W)
   c. Power required (P)
4) Write down difference between scalar and vector.

2.12 ANSWER TO INTEXT QUESTIONS

2.1 i) acceleration ii) N

2.2 i)

Parameter	Unit
Power	Watt
Work	N-m
Acceleration	m/s^2
Mass	Kg
Torque	Nm

2.3 1) work 2) rotate 3) force

Electric motor	Electric energy - Kinetic energy
Pump	Electric energy – Potential energy
Diesel Engine	Chemical energy – rotational energy
Wood stove	Chemical energy – Heat energy
Solar panel	Solar energy – Electric energy

2.4

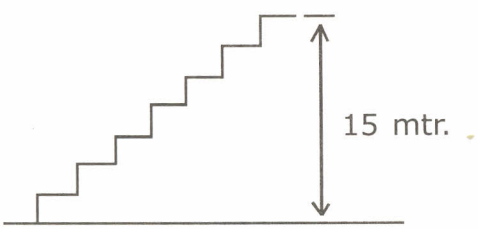
Scalars	Vectors
Mass	Distance
Volume	Velocity
Temperature	Force
Colour	Area
Time	Pressure

SUGGESTED ACTIVITIES

Calculate your own power.

Take this simple way to calculate your own power. It can be roughly calculated by measuring how quickly you can climb a stairs.

1) Select a two or three storied building.
2) Calculate the vertical height of stairs.
3) Ask your friend to measure time taken by you to climb the stairs



Notes

4) Run as much fast as you can to climb the stairs.

If you take 15 sec to climb stairs of height 15mtr, them your speed is = Distance covered / time = 15 m/ 15 sec = 1 m/s.

Force applied to climb the step is your weight itself. But you need to convert your weight from Kg to N. Lets consider your weight = 50 Kg.

Force applied = m × a = 50 Kg × 9.8 m/s^2 = 490 Kg m/s^2 = 490 N.

Power = Force × Distance covered / time

= 490 × 15 /15 = 490 N m/s = 490 W

3

MACHINES

3.1 INTRODUCTION

Machines became part of our daily lives. They help us to do work easily. Scissors, brakes, pulley, hears, screw jack etc. all are examples of machines. Machines help us to reduce efforts required to do the work. They have few or no moving parts. These machines uses energy to do work. A simple machine is a mechanical device that changes the direction or magnitude of a force. In this chapter, we are going to study six simple machines. All big complicated machines are based on the combination of these simple machines. To increase the efficiency of our work, we need to reduce friction. We will also learn about friction and lubrication in this lesson.

3.2 OBJECTIVES

After reading this lesson, you will be able to:

- Known about the prinicples of simple machine.
- known about different types of simple machines, like lever, slope, wheel, pulley,screw etc.
- Learn about friction and Lubrication.

3.3 PRINCIPLES OF SIMPLE MACHINES

To understand principles of simple machines, consider following examples -

1) We can put force or pressure with hands at a single spot at a time. But with the help of machine we can put pressure or force at different spots at the same time.

Example No. 1 – Bicycle.

When we apply pressure on brakes on handle, with the help of machine, the brake works on the both sides of rim of the wheels.

Example No. 2 – Churning Butter-milk.

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Notes

At the time of churning cream or butter-milk, we apply pressure on the rope with two hands but the pressure is spread on every part from bottom of the churn.

Thus, the power is transferred from one spot to another easily with the help of machine.

2) By changing, place of application of the force, we can increase or decrease the force required. Remember we cannot reduce energy required to do the job but we can reduce the force required. If more force is applied, we can do the work in smaller time. If force is less then we will need more time to do the same amount of work.

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{\text{force} \times \text{distance}}{\text{Time}} = \text{force} \times \text{speed}$$

We can increase and decrease force, distance, time and speed by changing other parameters using simple machines.

Power = force × speed

Work = force × distance.

Example:

1) Two tank of 50 lits. is to filled with water. One tank was filled by father and another by his younger son. Father used water bucket of 10lits. and son uses water bucket of 5 lits. capacity.

Father makes 5 trips to fill up the water and son makes 10 trips to fill the tank. Energy required by both is same. But since son could apply smaller force, he chooses 5 lits of bucket. Hence distance traveled by him increased.

2) While churning the milk, we increase the speed. The churn moves faster than the shaft, where we wind the rope. It is because churn is bigger in diameter. We need to churn milk with more speed, therefore we reduces the force and increases the speed of churn.

INTEXT QUESTION 3.1

Fill in the blanks:

i) _____ required to do the work remains the same.

ii) Work = force × _____.

iii) Unit of work = _____.

iv) There are _____ types of simple machines.

3.4 SIMPLE MACHINES

Main types of simple machines are 1) Lever 2) Slope 3) Wheel 4) Pulley 5) Wedge 6) Screw. We will study them in details.

1) Lever: A famous scientist Archimedes once said, 'Give me big rod and a point to rest it in the space, I will able to move earth alone'. A big rod and point to rest the rod is nothing but then lever. A bar is called lever and turning point is called the fulcrum. An object that a lever moves is called the load. The closer the object is to the fulcrum, the easier it is to move.

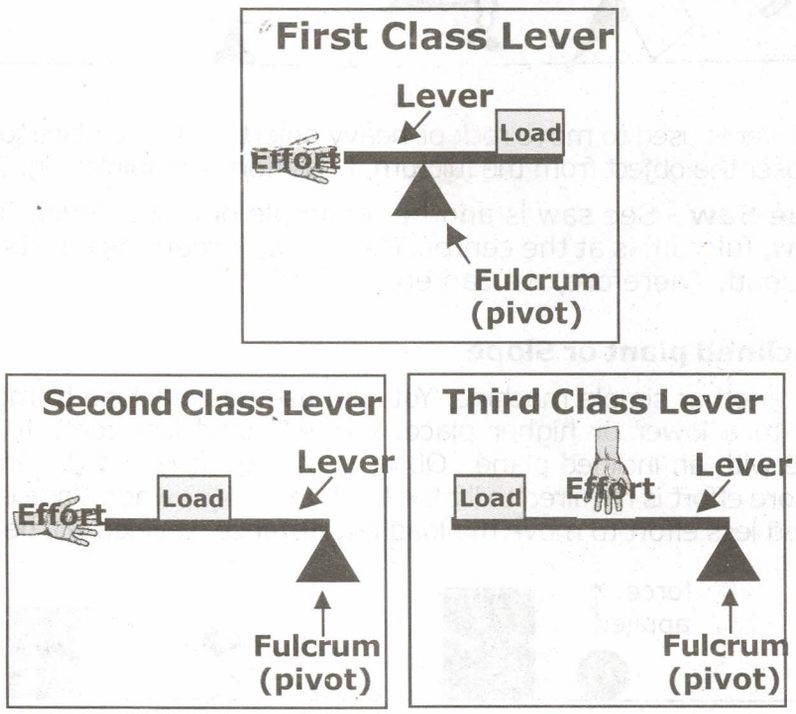


Fig: 3.1

There are three types of levers:

1) Class 1: the fulcrum is located between the applied force i.e. the effort and the load.
2) Class 2: the load is situated between the fulcrum and the effort.
3) Class 3: the effort is applied between the fulcrum and the load.

Following are examples of lever used in daily life:

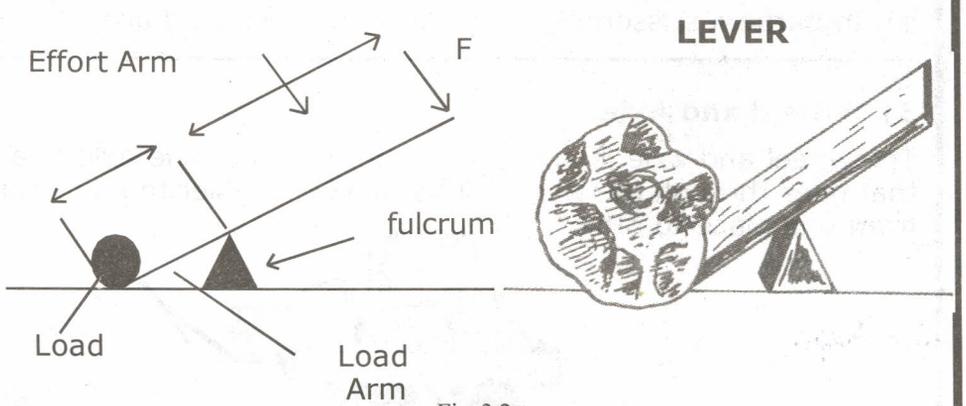


Fig: 3.2

Fig: 3.3

a) A lever is used to move rock or heavy object from one place to other. Closer the object from the fulcrum, less effort is required.(fig. 3.2)

b) See Saw - See saw is another example of use of lever. In see-saw, fulcrum is at the center. Therefore, it requires efforts equal to load. Therefore, we can enjoy playing it.

2) Inclined plant or Slope

This is another simple machine. You can use this machine to move an object to a lower or higher place. You will need less force to move objects with an inclined plane. Observe the fig. 4(a) and (b). In fig. 4 (a), more effort is required to lift the load. In fig 4(b) when slope is used, we need less effort to move the load but distance traveled will be more.

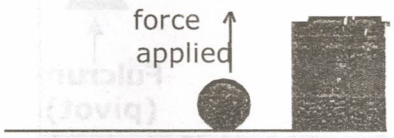


fig: 3.4(a)

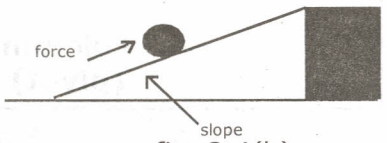


fig: 3.4(b)

INTEXT QUESTIONS 3.2

Fill in the blanks:

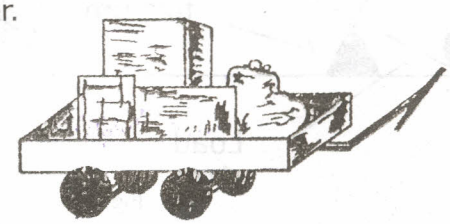
i) Ramp near big warehouses are made using _____ type simple machine to reduce force required to move object.

ii) In stapler, _____ is in between _____ and fulcrum.

iii) In Barbers scissors, _____ is in between load and _____.

3) Wheel and Axle

The wheel and axle is another simple machine. The axle is a rod that goes through the wheel. This makes it easier to move things from one place to other.



4) Pulley

A pulley is another simple machine. It is made of a wheel with a groove between two flanges around its circumference. A rope, cable or belt usually runs inside the groove.

Most common example of pulley is to fetch water from the well. Pulleys are also used in cranes to lift load. Pulleys are also used to change the direction of force to transmit rotational motion from one wheel to other.

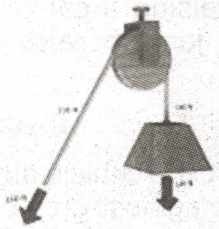


Fig: 3.5 Pulley

5) Wedge

Have you seen how wood cutter cuts big wood apart ? He uses tool called wedge. A Wedge is a simple machine used to push two objects apart. A wedge is made up of two inclined planes. These planes meet and form a sharp edge. This edge can split things apart.

Knife, axe, nail etc. are example of wedge. Fork spoon used to cut food item is also an example of wedge.

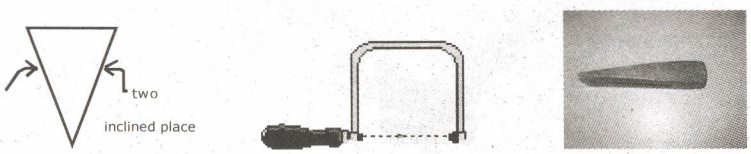


Fig: 3.6 Wedge

6) SCREW

A screw is nothing but an inclined plane wrapped around a rod.

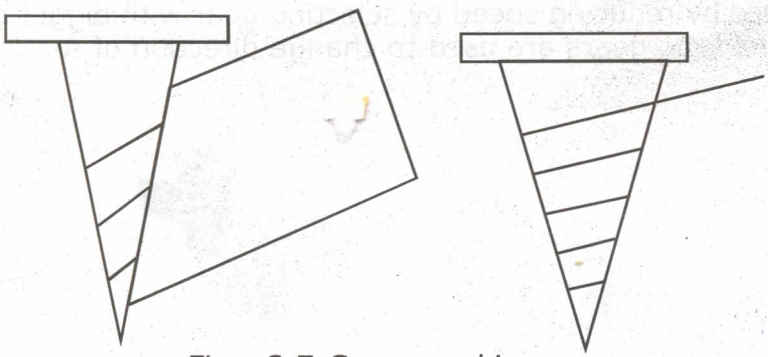


Fig : 3.7 Screw making

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Notes

Take a paper or thread as shown in the figure 3.7 and wrapped it around a bar, then it becomes screw. Screws are used to hold the job together. They are used to lower or raise the job. Following are some examples of use of screw:

i) Jar Lids ii) Clamps iii) Jacks iv) Wrenches .

Screw Jack

Have you seen one person raising a car or truck with the help of jack to repair tyre. He uses jack to raise the truck. Jack mainly uses principle of screw.

We have seen work done = Force × Distance

We will need lot of force to lift the vehicle directly. It is impossible for a man to lift truck vertically up against gravity. When we uses jack, it has a screw. The load has to travel through length of thread. This means we are increasing distance to be traveled. This reduces the force required and a normal person can lift the vehicle using jack.

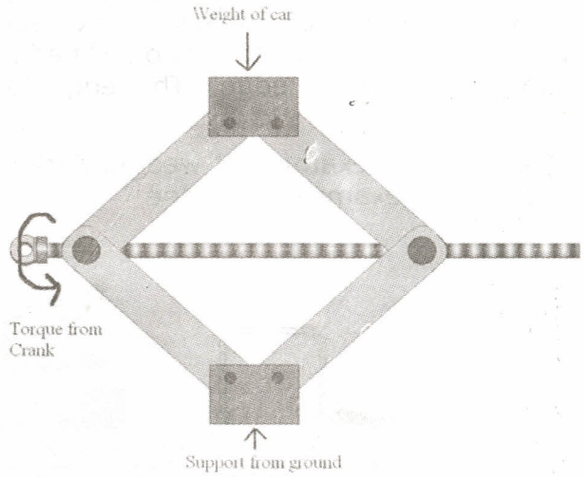


Fig: 3.8 Screw jack

GEARS

A gear has teeth cut on the circumference of a wheel. It is used to transmit the motion, increase or reduce the speed. We can apply more force by reducing speed by selecting gear with bigger diameter. Bevel type gears are used to change direction of motion.

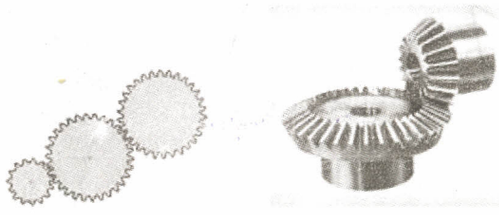


Fig: 3.9 Gears

MECHANICAL ADVANTAGE

Mechanical advantage is the ratio of output force to input force.

$$\frac{\text{Output force}}{\text{Input force}} = \text{Mechanical advantage}$$

EFFICIENCY

When moving parts move on each other, some energy gets lost in overcoming friction. Therefore, power output by the machine is always less than the power input. Lesser is the energy wasted, more is the efficiency.

$$\text{Efficiency} = \frac{\text{Power output of machine}}{\text{The power we put in}} = \frac{\text{useful power}}{\text{power put in}}$$

INTEXT QUESTIONS 3.3

i) Match the following:

A	B
Scissors	Inclined plane
Lifting pump from bore well	Screw
Wood cutting axe	Lever
Hilly road	Pulley
Jack	Wedge

ii) Fill in the blanks:

i) In hand drill, _____ types of gears are used.

ii) Efficiency = $\frac{\text{\_\_\_\_\_}}{\text{Power Input}}$

iii) In slope, force required is reduced because _____.

3.5 FRICTION AND LUBRICATION

Some times there is screeching sound while using a pulley or hand pump. Friction is a force. Whatever work we do, friction works opposite to our force. When we apply a force to move something, the friction opposes our force and there is no motion. When our force is greater than the friction force, the object starts moving. The parts where there is friction, they wear out fast.

A smooth surface shows lots of uneven and rough surface under a microscope. When these rough parts rub on each other, it results in friction.

Oiling and greasing reduces friction and wear & tear of parts. When there is dust or foreign particles in the area of contact, friction and

wear & tear are high and rapid. To prevent this, we must first clean the friction area and put oil or grease there.

Advantages of friction

Friction is not always bad. Sometimes we require friction. For example:

1) While walking friction helps us. If we put oil on the floor, we will fall down due to slippery floor. We need friction to be able to walk.
2) It is commonly seen that in muddy area the wheel of a truck slips round and round because there is no friction between the tyres and ground.
3) Flour mill works because of friction between belt and wheel.
4) Bicycle can be stopped by putting on a brake, which works because there is friction.
5) When we tie a knot in a rope, it is the friction which holds the knot.

Thus friction is useful to some extent but it will reduce the efficiency of work.

Factors affecting friction

The intensity of friction depends on following factors:

i) The area involved in friction.

ii) The pressure applied on the surfaces.

Force = Pressure × Area

Frictional force will increase, if the area of contact will increase or if pressure applied on the surface increased.

Methods to reduce friction

i) Polish the contact surface.

ii) Put oil or grease so that it fills in the small gaps of the flat parts.

iii) Use ball bearings to reduce area of contact between rotating parts.

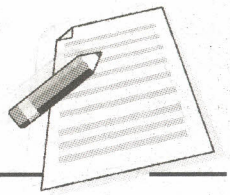
Lubrication

Following methods can be used to reduce friction:

Oil is either thin or viscous. It depends upon SAE No. of oil. (SAE means Society of Automotive Engineers). If we use very viscous oil, it does not reach all the parts. Very thin oil will flows away easily and gets wasted. Grease is used in such cases. It is generally used around ball-bearing.

Normal grease or oil is never used where there is high pressure, high temperature and high speed. Special lubricants are used in such cases.

In cold season the oil becomes thick and in hot season it becomes thin. Therefore selection of lubrication also depends on the season.



It is always advisable to refer operating manual of the equipment before selecting the lubricant.

3.6 WHAT YOU HAVE LEARNT

In this chapter, you have learnt different types of simple machines. You also studied its application. Any big machine is combination of six simple machines. You also know about efficiency and mechanical advantage. In the end, you learnt about friction and lubrication. You also learned about advantages of friction.

3.7 TERMINAL QUESTIONS

i) Draw a diagram of brake system of bicycle. Mark different fulcrum points, load arm and effort arm. Discuss how force is transferred to apply brakes.

ii) On the slope, driver changes gear. Can you give reason behind it?

iii) Draw different types of forks used in kitchen? Why they are of different shape? Which type of simple machine is used in it?

iv) Observe sugar cane juice machine. Write down important parts and simple machine principles used in it.

v) Why boric power is used on carom board?

vi) Give three examples when friction is desirable and undesirable.

vii) Why bush is used around a rotating shaft?

3.8 ANSWER TO INTEXT QUESTIONS

3.1 i) Energy ii) distance iii) N-m iv) Six

3.2 i) slope ii) efforts, load iii) fulcrum, efforts

3.3 i) Match the following

A	B
Scissors	lever
Lifting pump from bore well	pulley
Wood cutting axe	Wedge
Hilly road	Inclined plane
Jack	Screw

ii) bevel, Power output / power input , distance traveled by load increases

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Notes

SUGGESTED ACTIVITIES

Observe following scissors carefully

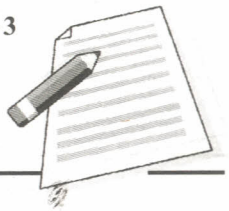
i) Barber scissor

ii) Gardner scissor

iii) Tailors scissor

iv) Doctors scissor.

What is difference between them? Find out reason by actually working with it.



4

MATERIALS

4.1 INTRODUCTION

Materials are the first thing you need to create new things. Material is a physical substance used as inputs for production. It is required for construction of buildings to rockets and from cloths to computers. In this lesson, we are going to study commonly used material in Engineering. Wood is an important material used in construction, for making furniture, articles etc. For all industries and constructions iron, steel, cement are basic materials.

4.2 OBJECTIVES

After reading this lesson, you will be able to:

- know the Material and its types.
- understand the advantages & disadvantages of different types of Material i.e. wood, iron, cement, bricks etc.
- learn the application of Material.

4.3 WOOD

Main function of trunk is to support the tree. Nature makes the trunk stronger by connecting cellulose fibers using lignin. In this way flexible but strong fibers are connected to each other to bring stiffness. Man has made, use of this structure in imaginative way for their benefit. Wood is primarily used as a fuel. But it is also used as a construction material for making houses, tools, weapons, furniture, packaging, artworks, and paper.

Advantages of Wood

In construction work wood is one of the most important materials-Advantages of wood is as follows:

1. Wood never catches rust or never rots.
2. As compared to its weight, wood is strong and stiff.
3. Wood is bad conductor of heat. Therefore, it never becomes more hot or cold.
4. Different attractive and beautiful articles can be made from the wood.

5. We can give desired shapes to wood easily.
6. By doing plantation we can get required quantity of wood.

Disadvantages:

Disadvantages of wood are:

1. Depending on size of the wood, it has to be used by joining joints.
2. The price increases as the size increases.
3. As it is natural product, there is wide variety of wood.
4. It is easily inflammable.
5. Insects and termite can infect the Wood.
6. With variation in humidity in atmosphere, wood gets wet, shrinks and develops cracks.

Type of wood

Following are the characteristics of commonly found wood shown in table no.1.

S.No	Name of Wood	Type of Wood
1.	Babhul	Hard
2.	Khair	Soft
3.	Jack fruit	Hard
4.	Eucalyptus	Soft
5.	Tembhurni	Soft
6.	Bijasag	Hard
7.	Mango	Hard
8.	Sagawan	Hard
9.	Jambhul	Soft
10.	Garlic	Soft
11.	Umbar	Soft
12.	Ashok	Soft

Table: 1

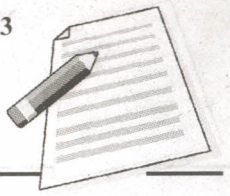
Seasoning

The fresh wood contains lot of water, when it is just cut out from the trees. Its strength is less and chances of forming fungus on it are more. Therefore, wood needs to be dried. Sometimes its corner portion dries faster than the inner core which causes it to shrinks from one side and may develop cracks. Therefore, it is necessary to dry it slowly. This drying process is called as 'Seasoning'. Commonly, wood is cut into small planks and they are kept for drying in covered place with sufficient space between the planks and proper air circulation. Drying under direct sun light is avoided.

Chemical process is done on the wood before drying to avoid fungal infection.

Prevention of termite

If wood is stored in close or humid place, the ant like insects eat it. These insects create their path like a tunnel using soil. Such wood is said to be infected by white ants or termites. Termite reduces



strength of wood. As a preventive measure chemical treatment using asphalt, chuna(limestone) is painted on the wood.

Plywood

Plywood is a board made from thin sheets of wood. Wood is cut across the grain as shown in fig 4.1. Plywood is made by laying up multiple layers of sliced or peeled veneer called plies. The layers are glued together, each with its grain at right angles to adjacent layers for greater strength. The plies are bonded under heat and pressure with strong adhesives, usually phenol formaldehyde resin. Some types of plywood are even resistant to hot water.

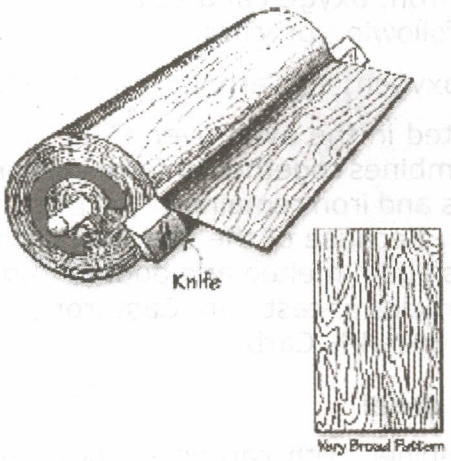


Fig: 4.1 Plywood

INTEXT QUESTIONS 4.1

Fill in the blanks:

1. Wood is_____ conductor of heat.
2. Drying process of wood is called _____.
3. To protect wood from termites'_____ is painted on the wood.

4.4 IRON AND STEEL

The Stone Age, Bronze age and Iron age are the three main era of human history. In the beginning man was making weapons like axe and sword, using stones. A sharpened stone was fitted in a wooden base and used. Then man invented bronze, from minerals having mixture of copper and zinc. Though, Copper was available, it was not useful for making weapons because of its soft & flexible nature. Bronze is hard. Therefore, it was used in most of the

instruments. Use of iron started 2500 to 3000 years ago. In the beginning iron was obtained only from meteorites falling from the sky. Since Iron was scare, it was considered to be the most valuable metal. The process of producing iron from minerals was difficult and the iron received was hard and brittle. The technique of melting iron was known in our country from 1500-2000 years ago. Iron pillar Kutubminar in Delhi was built at the time of Chandragupta is a proof of it. Use of iron became common only after industrial revolution in England. Today, Worldwide production of iron is in thousand of crores tonnes.

Production

Iron is available in nature in the form of minerals. These minerals are combination of iron, oxygen and sulpher. Iron is obtained from these minerals by following process.

Minerals (iron + oxygen) + (Carbon) = iron + (Carbon + oxygen)

Minerals are heated in the oven over 1500°C. In the oven, Carbon and oxygen combines together to form carbon-di-oxide (CO_2). This gas evaporates and iron remains in the oven. This liquid iron is solidified in moulds. Because of the shape of solid iron, it is called pig iron'. This iron is again melted and poured into different moulds to make different articles of cast iron. Cast Iron is hard but brittle in nature. It contains 3%–4% Carbon.

Types of iron and steel

Steel-Iron gets combined with carbon to form steel. Properties of Steel are different from that of iron. Following are types of iron steel:

1) High Carbon Steel: Steel containing 0.6%–2% carbon is called high carbon steel. It is used to make tools.
2) Cast Iron: Cast iron contains 3%–4% carbon. The cast Iron is hard in nature. You might be aware diamond is allotrope of carbon and it is very hard and used to cut glass.
3) Mild Steel: It contains 0%–0.3% carbon. It is used in the production of iron shades, angles, rods, pipes etc.
4) Stainless Steel: It is made of iron, chromium and nickel. Stainless steel does not stain, corrode, or rust as easily as ordinary steel. The price of stainless steel is more than the original metal. Stainless steel are commonly used in cutlery, utensil's etc.

Heat Treatment

As the percentage of carbon in steel increases, it becomes harder. Hardness of iron also changes with heat given to it. If steel is made red hot and then cooled rapidly then it becomes hard. If it cooled slowly then it become less hard. This is called heat treatment.

INTEXT QUESTIONS 4.2

Fill in the blanks:

i) Hardness of iron depends on _____ content in it.

ii) Tool used in lathe machine is made of _____.

iii) Kitchen appliances are made of _____ steel because it does not get corroded.

4.5 CEMENT

Cement is a fine, soft, powdery-type substance. It is prepared from a mixture of elements that are natural materials such as limestone, clay, sand and/or shale. When cement is mixed with water, it can bind sand and gravel into a hard, solid mass called concrete.

Manufacturing of cement

Cement is prepared from calcium oxide, aluminum oxide, silica, and iron oxide. Calcium (which is the main ingredient) can be obtained from limestone, whereas silicon can be obtained from sand and/or clay. Aluminum and iron are required in small amount and can be extracted from bauxite and iron ore. Following are the steps in cement manufacturing:

1) Mixture of limestone, sand, aluminum oxide and iron oxide is powered and is heated in the furnace.

2) Water present in these materials gets evaporated and the material comes to the melting stage. This partially molten material combines together.

3) The material that comes out of the furnace is large, glassy, red-hot cinders called "clinker".

4) After cooling the clinker, its powder is made. This powder is called Portland cement.

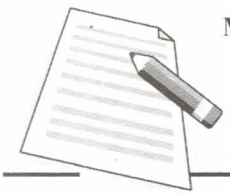
How cement gets it strength?

When cement is mixed with water, its molecules form bond with each other with the help of water. Because of this chemical bond, the cement gets hardened. Cement is always used to join two things. Concrete is made by mixing sand and gravels in the cement. Cement holds together gravels tightly and the block become a like a stone, though the quantity of cement is less, the concrete become like a stone.

Cement must be stored in dry place. If it gets wet due to water or humidity in storage then we cannot used it again by drying it.

Mortar and concrete

Cement is used to join the small stones together. In this process the gaps between this mixtures is filled using cement. To reduce



the cost of cement different small sized stones (sand, grovel) are used. The mixture of cement and sand is called mortar. The mixture of cement, sand and gravel is called concrete. Concrete becomes strong as the stones are joined to each other.

Characteristics of cement

1. Once chemical reaction is complete then cement is durable in water.
2. Cement never gets rusted or rotten in normal environment.
3. Cement concrete is strong in compression but weak in tension. Therefore, steel is used in the concrete in places with tension. This is called as R.C.C (Reinforced Cement Concrete). For e.g. columns and slabs of multistoried buildings.
4. There is no effect of normal heat on cement concrete or it never catches fire. But it gets cracked in big fire.
5. Cement is bad conductor of electricity or heat.
6. If water contains in cement mixture is more then after curing, hollows spaces are formed and cement becomes weak.
7. Strength of the cement is more if its density is more.

Curing and Drying

Cement powder solidifies due to the reaction of water on it. Therefore, if sufficient water is not available while using the cement, this process will not get completed and it will not get solidified. Therefore, for first 20 days cement should be kept wet. This is called curing.

If excess water is used immediately after applying the cement then small cement particles will washed away. Therefore, on the first day of the construction, care should be taken that the cement will remain wet. Further during the process of solidification, cement needs water but outside air will dry it quickly. Therefore, it is necessary to give sufficient water. Curing takes place quickly if temperature is more.

Strength increases with curing: Following table show how strength of concrete increases with time:-

Time required for curing	Strength of concrete
0 Days	50%
1 Days	61%
7 Days	85%
14 Days	92%
20 Days	100%

Table: 2

The ratio of Mortar/Concrete required for variable work

Following is the ratio of cement: sand: gravel for construction:

Type of Work	Proportion of Cement: Sand: Gravel
1. Water tank	1:3
2. Bricks work **(burnt)**	1:6
3. Steps construction(stony)	1:7
4. Finishing	1:2 (or cement + water)
5. Wall construction	1:3:6
6. Making foundation	1:3:6 or 1:3:5
7. R.C.C. column or beam	1:2:4
8. Handpump foundation	1:2:4

Table: 3

Concrete code and concrete ratio:

Concrete Grade	Proportion of Cement : Sand : Stone pieces	Expected Compressive Strength at 28 days
M100	1 : 3 : 6	10 N/mm^2 or 100 Kg/cm^2
M15 or M150	1 : 2 : 4	15 N/mm^2 or 150 Kg/cm^2
M20 or M200	1 : 1.5 : 3	20 N/mm^2 or 200 Kg/cm^2
M25 or M250	1 : 1 : 2	25 N/mm^2 or 250 Kg/cm^2

Table: 4

INTEXT QUESTIONS 4.3

Fill in the blanks:

i) Cement is strong in _____ but _____ in tension.

ii) Concrete is mixture of _____.

iii) The mixture of cement and sand is called _____.

iv) Cement power solidifies with its reaction with water. This process is called _____.

4.6 BRICKS

Initially, Man lived in natural caves. Then he started using wood, stone and mud to construct his house. He started making wall by placing cut stone on one another. Then he started filling mud to fill

Notes

the hollow places. During this he might have got idea of making bricks. Wood is mostly used for making roof, doors and windows.

Construction rocks

Rocks are formed from volcanoes. When molten lava gets solidified, some of the constituents form crystal. A stone having small crystals are hard and never breaks straight. Stone with medium size crystals can be cut in straight way in one hammer blow, this is compact basalt type stone.

Mud Bricks

By pressing the mud in a mould, raw mud bricks are made. It is necessary to make proper mixture of sticky clay (less than 0–0.02 mm) and sand (0.0–2mm).

If the amount of sticky clay is more, then bricks will develop cracks during drying. Similarly if sand is more, then bricks will become weak.

Mud raw bricks are dried slowly in a shade.

To make raw mud bricks stronger, grass is mixed in soil and clay is formed. This grass is rotted for 10-15 days in the clay. These bricks strength get reduced to $10kg/cm^2$ when it becomes wet.

In another process, hand machine is used. In this process small amount of water (12% –15%) is used.

Mixture of soil and water should not stick to hand but if pressed must become homogeneous. These bricks are dried under shadow for 28 days.

Mud-Cement Bricks

These bricks are made like raw clay bricks. Only difference is 3–7% (mostly 5%) cement is mixed in the soil before adding water to it. These bricks are stronger than the raw mud bricks.

Burned Bricks

Mud bricks are fired (burned) in kilns. they become light and porous and becomes strong. Unlike raw bricks their strength does not get reduced after putting it in the water. Its size is smaller than raw mud brick for the convenience in firing them in kilns. Country bricks are hand made and table molded bricks are made in steel mould. Burnt bricks are stronger and can be made in variety of shape.

Cement Block

Burnt bricks are becoming more costly due to increasing fuel cost. Therefore, hollow cement block are increasingly used in construction. In this process, cement mortar is pressed in machine mould. The mould is hollow in the center to reduce weight and cost of the

brick. These bricks are very strong. They keep the house cool since they are hollow in between and air is bad conductor of heat. They need less material for plaster & less expenses on outdoor colour.

4.7 WHAT YOU HAVE LEARNT

In this chapter you learnt about different materials used in construction work such as wood, iron, steel , cement and bricks. You also studied their advantages and applications. You learned about types of steels. Now, you also know about how cement got its strength and mortar and concrete is prepared. You also studied types of bricks used in construction.

4.8 TERMINAL QUESTIONS

1) Why steel is used in constructing pillars of multi-storied building?
2) What are advantages and disadvantages of wood?
3) Write down different types of steel and their uses?
4) Explain different types of bricks? Why cement blocks are preferred in construction?

4.9 ANSWER TO INTEXT QUESTIONS

4.1 i) bad ii) seasoning iii) asphalt and limestone

4.2 i) carbon ii) high carbon steel iii) stainless

4.3 i) compression, weak ii) cement, sand and grovel iii) mortar v) curing

SUGGESTED ACTIVITIES

1. Find out different sizes of bricks available in the market.
2. Study different types of brick work structures used in construction in your town.

5

MANUFACTURING PROCESS

5.1 INTRODUCTION

Manufacturing is the use of machines, tools and labor to make things for use or sale. Manufacturing is of different form e.g. electronics goods manufacturing, chemical manufacturing, food products manufacturing etc. In this lesson, we are going to discuss manufacturing process in mechanical engineering field. These processes are basic processes for converting raw material into products. We will also discuss the basic safety precautions while working in the workshop. In practical section, you are going to do these operations yourselves.

5.2 OBJECTIVES

After reading this lesson, you will be able to-

- know the safety precautions during the manufacturing process.
- understand the manufacturing process related to mechanical engineering i.e.
  - * Fabrication and welding;
  - * Drilling, threading and tapping;
  - * Metal cutting using hacksaw, shearing machine and power hacksaw;
  - * Turning;
  - * Grinding.

5.3 SAFETY PRECAUTIONS

Life is precious. While working with machines always follow following safety rules. Those who are not following safety rules are putting their own and others life at risk.

1. Workshop place has to be clean. There has to be free space around the machine. All rotating parts of machines must be covered or not accessible.
2. Please check electric connections and safety related to electric devices.
3. Workshop floor has to be dry and free from oil, water and grease.
4. Machine switch has to be near the machine table and free from any obstacle.
5. Check wiring and earthling for all machines
6. Never do welding without welding screen or goggles.
7. Use safety goggles while grinding, drilling.
8. While doing construction, always use hand gloves and helmet.
9. Keep all the tools in its position.
10. Keep the aisle free to run towards exit in case of emergency.
11. Be careful while working with sharp objects.
12. Whenever power goes off, please put all the switches in 'OFF' position.
13. Please put the tools and safety gadgets in the designated place.
14. Do not disturb person working in the workshop.
15. Keep first aid box in the workshop.

5.4 WELDING

Welding is the most economical and efficient way to join metals permanently. Following are the types of welding:

1. **Forge welding :** In this two pieces are heated up to plastic stage and then hammered together till they joined each other.
2. **Arc welding :** It is commonly found method in fabrication workshop. An electrical current is used to form a arc. A welding rod is used as electrode. A arc is formed between the tip of the welding rod and the base material. Tip of the welding rod melts and works like a filler material between the pieces to be joined. A flux is applied to welded material to protect it from oxidation. The process is very versatile, requiring little operator training and inexpensive equipment. This process is generally limited to welding ferrous materials and filler metal. Welding machine required for this is generally inexpensive. This type of welding is best suited for welding mild steel in the range of 2-8mm in thickness.

Welding Joints

If joint to be welded has wide gap or is dirty, rusting or greasy then we will not get good result. Depending upon shape of the object to

be welded, we need to prepare joints. Here are commonly used welding joints.

The five weld joints are named Butt joint, Corner joint, Edge joint, Lap joint and Tee joint as shown in fig 5.1.

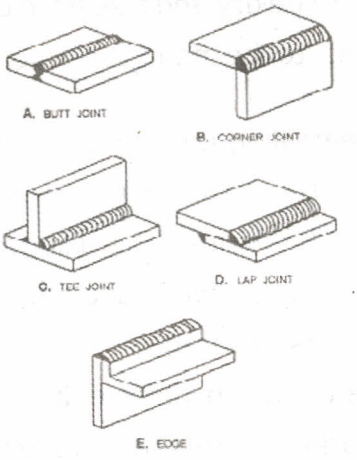


Fig: 5.1 Various weld joints

The first one named Butt joint is a joint that is between two members lying approximately in the same plane.

The second one named Corner joint has two members located at right angles to each other in from of an angle, mostly 90 degrees.

In Tee joint, it looks just like it is called because it forms a "T".

Fourth one is a Lap joint, that has two overlapping members to form the joint.

The Edge joint is a joint between the edges of two or more parallel members.

Depending upon the thickness of joint, butt joint is also made of following types:

1) A butt joint

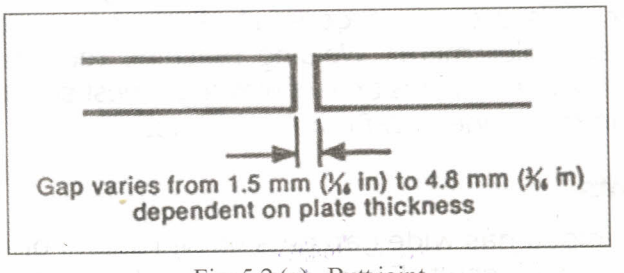


Fig: 5.2 (a) Butt joint

2) V butt joint

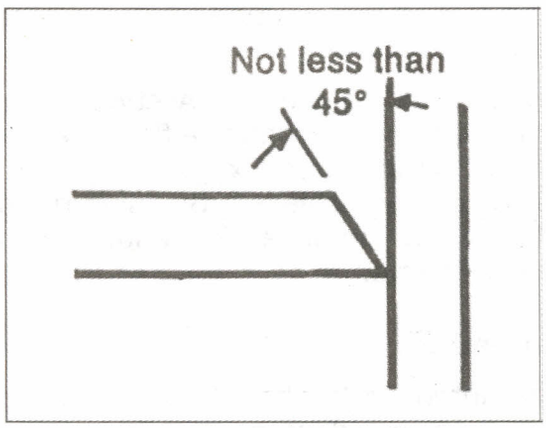


Fig: 5.2 (b) V butt joint

3) Double V butt joints. When metal is thicker

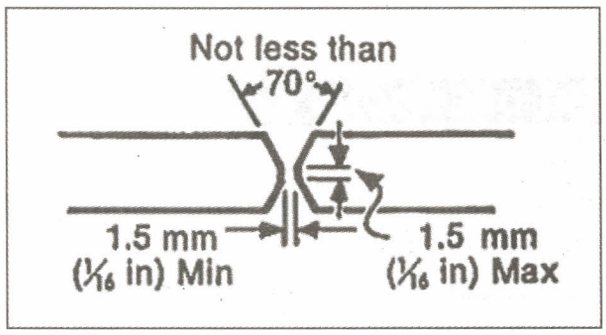


Fig: 5.2 (c) Double V butt joint

4) A Lap joint

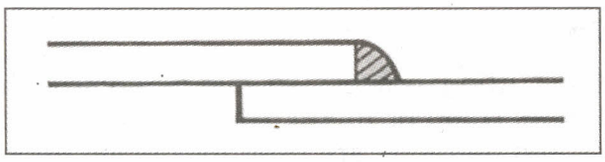


Fig: 5.2 (d) Lap joint

5) T joint

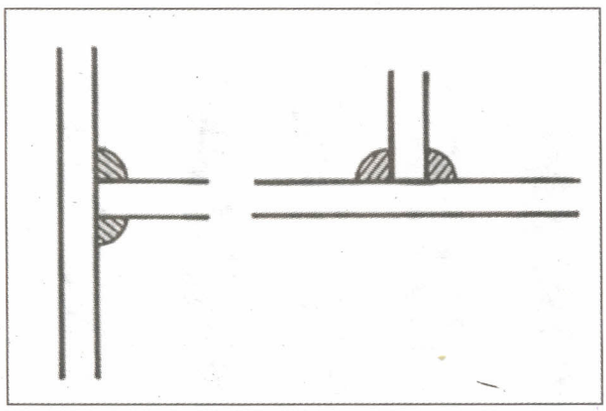


Fig: 5.2 (e) T. joint

Gas welding: Gas Welding is widely used for repair work, especially in welding thin sheets, cutting ferrous material, welding non ferrous metals.

Commonly used welding are Oxy-Acetylene welding. Acetylene gas when burned alone can produce a flame temperature of about 4000°F. With the addition of Oxygen a flame temperature in excess of 6000°F. can be achieved. By using the proper tips, rods and fluxes, almost any metal can be welded, heated or cut using the Oxy-Acetylene flame.

Things to remember:

Welding arcs are intensely bright lights. They contain an ultraviolet light which may cause eye damage. For this reason, the arc should never be viewed with the naked eye. Always use welding goggles while welding.

INTEXT QUESTIONS 5.1

Fill in the blanks:

i) Two metal pieces are heated and hammered together in _____ welding.

ii) To carry out welding of material in same plane _____ type of joint is most suitable.

iii) Commonly used gas in gas welding is _____.

5.5 DRILLING

Drilling is the cutting process to cut or enlarge holes in solid materials, such as wood or metal using drill bit and drill machine. Different tools and methods are used for drilling depending on the type of material, the size of the hole, the number of holes, and the time to complete the operation. Ref fig. 5.3(a)

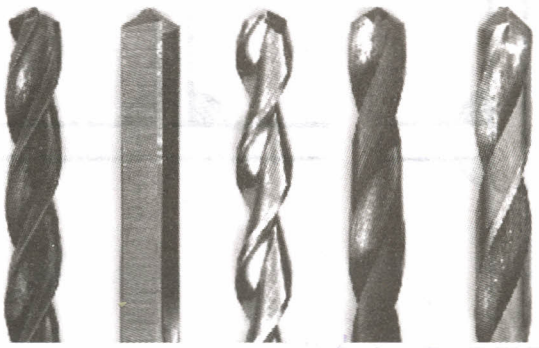


Fig: 5.3 (a) Drilling tools

Some hard material requires cooling while drilling. Speed and feed of drill also depends on the material to be drilled. Ensure right direction of rotation of drill.

Taps and dies are cutting tools used to create screw threads in material. A tap is used to cut the female portion of the mating pair (e.g. a nut). The process of cutting the threads in a hole is called "tapping" the hole. A photo of tap is shown in the figure, 5.3 (b)

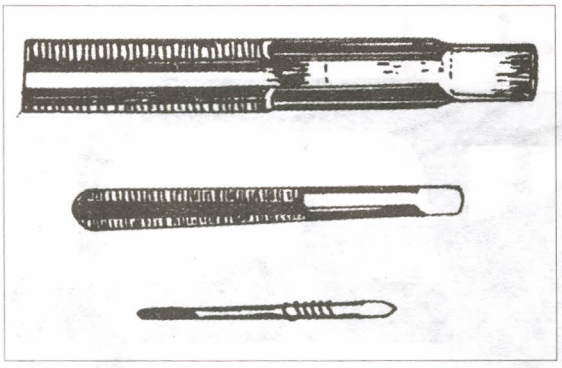


Fig 5.3 (b) Taps

A die is used to cut the male portion of the mating pair (e.g. a bolt). The process of cutting with a die is called "threading". Different die are shown in fig 5.3 (c)

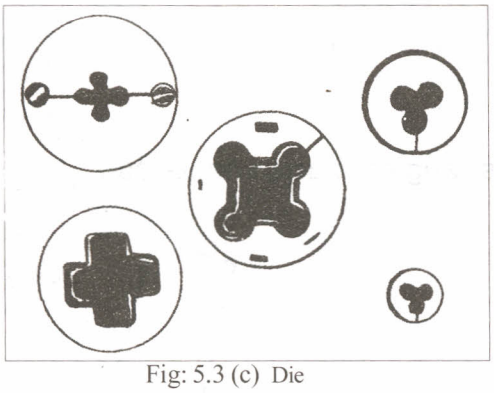


Fig: 5.3 (c) Die

5.6 METAL CUTTING

Normally, we use following tools for cutting materials in workshop.

Hacksaw: It is most used tool in the workshop. Following care must be taken while using hacksaw:

i) Do not use worn out blades.

ii) Fix the blade tightly.

iii) If blades are too flexible then they will twist while cutting and generate friction.

iv) The cutting action takes place when you pull the saw towards. Check the direction of the teeth.

v) Keep the constant pace of the strokes.

Power hacksaw

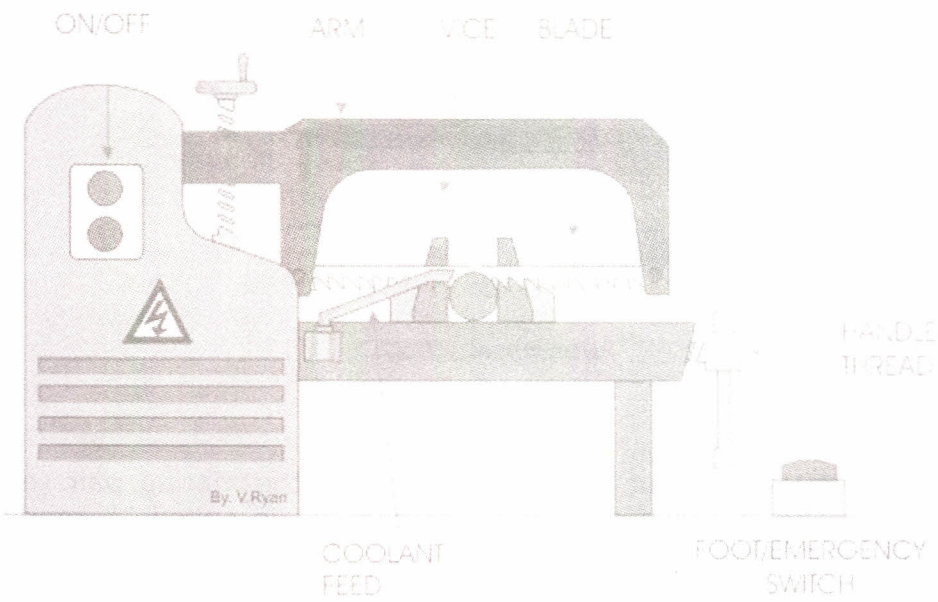


Fig: 5.4 Power hacksaw

Shearing machine

It is used to cut pipes, angles, bars, sheets etc.

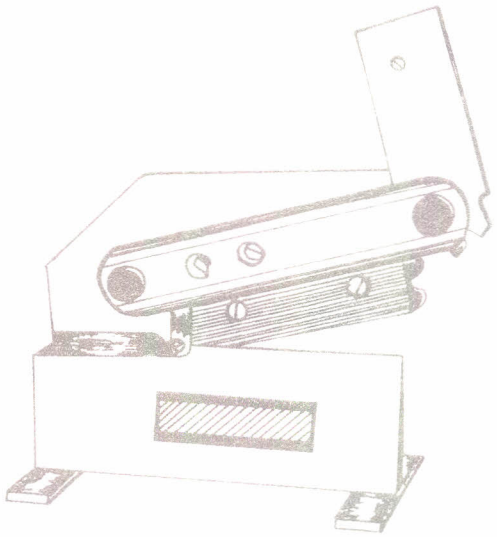


Fig: 5.5 Shearing Machine

LATHE MACHINE

Lathe is one of the oldest machines. Following operation are carried out with lathe machine:

1) **Turning:** Turning is the machining operation that produces cylindrical parts.

Work piece is rotating on spindle and cutting tool is fed parallel to the axis of the work piece and at a distance that will remove the outer surface of the work

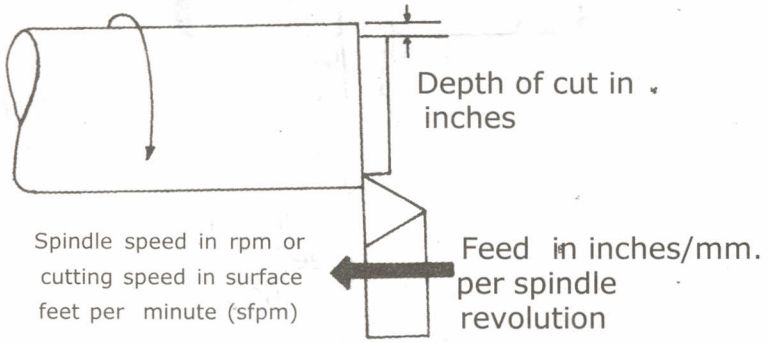


Fig: 5.6(a): Turning and the adjustable parameters

The quality of finish depends on the following parameters:

1) Speed, always refers to the spindle and the work piece. The speed (RPM) of lathe depends on the diameter of the work piece and the material to be cut.
2) Feed: it is the rate at which the tool advances along its cutting path.
3) Depth of Cut

There are different sizes and shapes and materials of tools are available for turning. Before starting the work, one must ensure right tool and proper speed, feed and depth of cut.

Other machining operations that can be performed on lathe machine are:

2) **Facing:** Tool is fed across the axis of work piece and depth of cut is taken on the face of work piece.

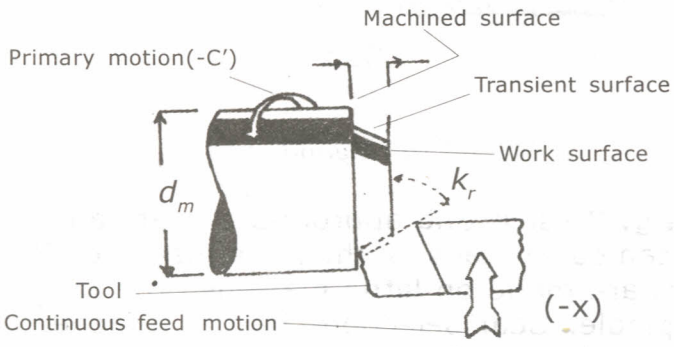


Fig:5.6 (b): Lathe Machine

3) Parting: is used to create deep grooves which will remove a completed or part-complete component from its parent stock.

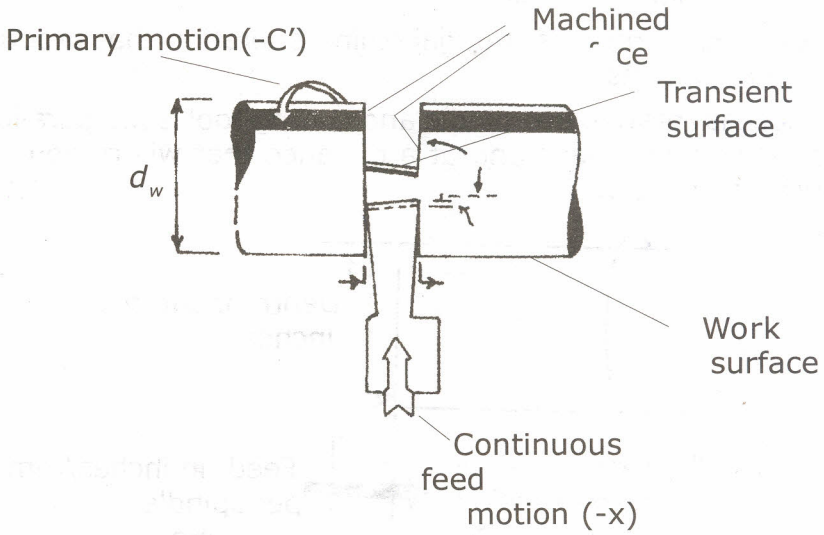


Fig: 5.6 (c) Parting

4) Grooving: is like parting, except that grooves are cut to a specific depth by a form tool.

5) Boring: Tool is mounted on the tail stock and fed into the job along the axis of the workpiece to drill a hole in the workpiece.

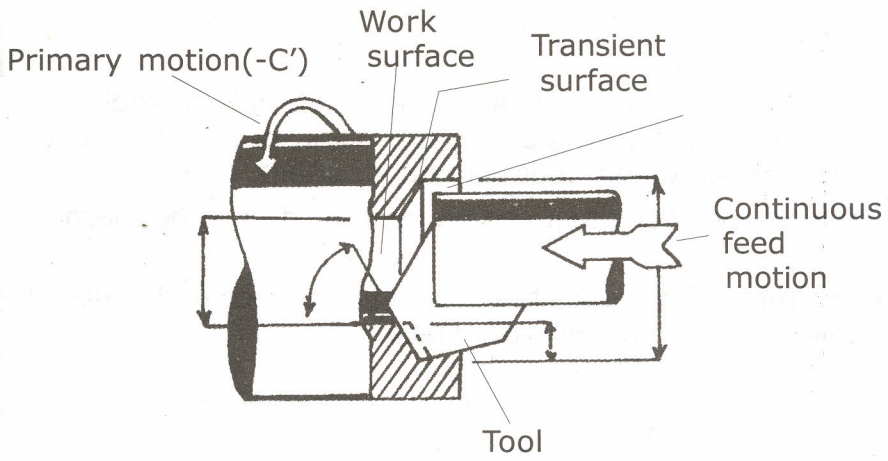


Fig. 5.6 (d) Boring

6) Threading: By selecting appropriate gears and threading tool, we can cut threads on the lathe machine. Threads on big shafts are made on lathe machine. The job is rotated on the spindle. Gear selection chart is attached on lathe machine and its operational manual.

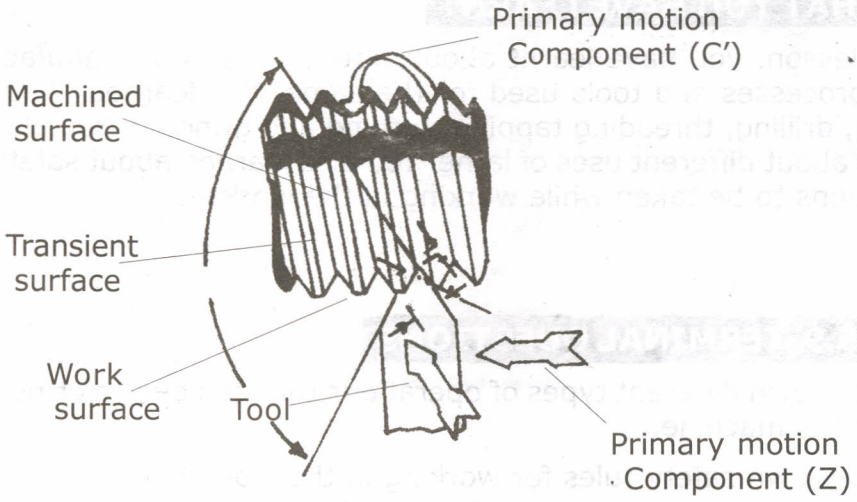


Fig: 5.6 (e)

5.7 GRINDING

A **grinding machine** is a machine with abrasive wheel as the cutting tool. A job is hold against rotating wheel. It is mainly used for surface finish and to make tools sharp.

Bench grinder is commonly found in workshop. Other types of grinder are belt grinder, surface grinder, cylindrical grinder etc.

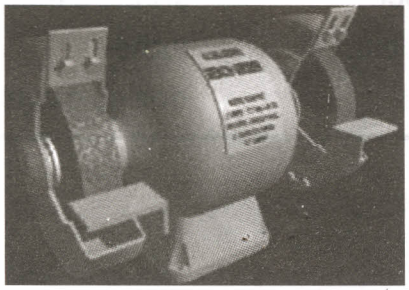
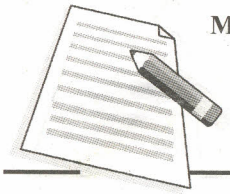


Fig: 5.7 Grinding Machine

INTEXT QUESTIONS 5.2

Match the following:

	Application	Tool
i)	To cut threads on bolt	Lathe
ii)	Cutting MS bar of 100mm dia.	drilling machine
iii)	Sharpening of turning tool	die
iv)	To reduce diameter of a bar	hacksaw
v)	To cut a drill on plate	grinding machine



5.8 WHAT YOU HAVE LEARNT

In this lesson, you have learnt about different types of manufacturing processes and tools used for the same. You learned about welding, drilling, threading tapping, turning and grinding. You also learned about different uses of lathe. You also learned about safety precautions to be taken while working in the workshop.

5.9 TERMINAL QUESTIONS

1) Write down different types of operations that can be performed on lathe machine.

2) Write down safety rules for working in the workshop.

5.10 ANSWER TO INTEXT QUESTIONS

5.1 i) forged ii) butt iii) Oxy-acetylene

5.2 Match the folowing

Application	Tool
To cut threads on bolt	die
Cutting MS bar of 100mm dia.	hacksaw
Sharpening of turning tool	grinding machine
To reduce diameter of a bar	lathe
To cut a drill on plate	drilling machine