454/455

OPEN VOCATIONAL EDUCATION PROGRAMME

Diploma Course in

BASIC RURAL TECHNOLOGY

454 - Rural Engineering

(Material,Mechanics,Drawing & Costing)

455 - Home Environment & Basics of Electricity

NATIONAL INSTITUTE OF OPEN SCHOOLING

Open Vocational Education Programme

Course Code-454

Basic Rural Technology

3

RURAL ENGINEERING

(MATERIAL, MECHANICS, DRAWING & COSTING)

Course Coordinator

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Basic Rural Technology

RURAL ENGINEERING

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FROM THE DESK OF CHAIRMAN ....

Dear Learner,

Welcome to the National Institute of Open Schooling!

By enroling with this institution, you have become a part of the family of the world's largest Open Schooling System. As a learner of the National Institute of Open Schooling's (NIOS) Vocational Programme, I am confident that you will enjoy studying and will benefit from this very unique School and method of training.

Before you begin reading your lessons and start your training, there are few words of advice that I would like to share with you. We, at the NIOS, are well aware that you are different from other learners. We realize that there are many of you who may have rich life experiences; you may have prior knowledge about trades and crafts that are part of your family's legacy; you may have a sharp business sense that will make you fine entrepreneur one day. Most importantly, you have the drive and motivation that has made you enrol with this institution, which believes in the spirit of freedom. Yes, we are aware that you have many positive aspects to your personality, which we respect and relate to them.

During the course of your study, NIOS will treat you as the manager of your own learning. This is why your course material has been developed keeping in mind the fact that there is no teacher to teach you. You are your own teacher. Of course, if you have a problem, we have provided for a teacher at your Accredited Vocational Institution (AVI). I would advise you that you should always be in touch with your AVI for collection of study material, examination schedules etc. You should also always attend the Personal Contact Programmes and practical / Training sessions held at your study centres. These will give you the necessary hands on training that is very essential to master a vocational course.

Studying for a vocational course is different from any other academic course. Here, while the marks obtained in the examination will indicate your grasp on your subject knowledge, your real achievement will be, when you are able to apply your vocational skills in the market. I hope that this skill-based learning will help you perform your tasks better. This course of two year duration, Diploma in basic Rural Technology, has been developed in collobotation with Vigyan Ashram, Pune. It is a multi skilled programme, which will expose you to a variety of skills. We hope that you will find it useful. On behalf of NIOS, I wish you the very best for a bright and successful future.

Dr. S. S. Jena, Chairman,

National Institute of Open Schooling

FROM THE DESK OF DIRECTOR .....

Dear Learner,

In the fast expanding world of activities, learning new skills has become a necessity. Learning and re-learning has become essential for all. In such an environment, vocational education has assumed great importance. Vocational education, as a stream of education, promotes skill development, and training of youth and directs them towards meaningful employment.

In keeping with the needs of the Learners, NIOS conducts Vocational Education Programmes in many areas through distance mode. These programmes include Agriculture, Home Science, Engineering & Technology, Computer Science, Health & Paramedical. The Courses offered in these areas are aimed at providing self employment & wage employment opportunities for NIOS learners.

Vigyan Ashram under the leadership of late Dr.S.S.Kalbag, developed Rural Technology course for rural youth. Over the years, this course turned many youth into successful entrepreneurs. NIOS accrediated this course as Diploma in Basic Rural Technology and adopted it for further replication through AVI. This course will provide self-confidence to you and a new path to your future. You may be destined for starting a small enterprise and build your own future. This is multi-skilled programme, which will expose you to variety of skills. It includes Rural Engineering (Construction), Agriculture & Animal husbandry, Our Home Environment and Health sections. This will help in identifying learner's preference for future vocation. We are confident that this course will prove to be beneficial to you.

We wish you all the best in your future career.

Dr. K. P. Wasnik ,Director (VE),

National Institute of Open Schooling

A WORD WITH YOU...

Dear Learner,

Welcome to the Open Vocational Education Programme: "Basic Rural Technology"

This programme is developed specially for all those who are school dropouts and have started many small enterprises, do agriculture work as skilled workforce and they contribute substantially to the progress of India.

The multi-skill content with hands-on experience of this programme stimulates the intellect by going through concrete operations and then abstracting the concepts. At the same time by giving a variety of skills usable in everyday life, open the door of modern technology to the youth, allowing them to form their preferences and know their aptitudes thus enabling them to choose a career. It also improves their self-image and gives them confidence and hope for the future. The level of training, though basic, empowers them to start their own enterprise after a short stint with another enterprise in the field. Basic Rural Technology content and the system of Hands-on training not only make the education relevant but also understandable because it uses the 'learning while doing' system and is closely linked to services to the community. Students will get training by working in real life environment. Learner will also learn basic skill like Drawing, costing and project planning in DBRT programme.

The Self – Instructional Material of this programme consists of Four Modules: 1. Our Health, 2. Agriculture & Animal Husbandry, 3. Rural Engineering (Material, Mechanics, Drawing & Costing) and 4. Our Home Environment. Learner friendly approach has been adopted throughout this material. Each lesson is written in very simple and chronological order. The in- text questions are included in the text matter to analyze the learner's understanding of the lesson. The suggested activities are provided that go beyond classroom.

We hope that this programme will help you to carve an niche in your career and play an important role in the society.

With best compliments

Dr. Pawan Kr. Chauhan
Executive Officer (HPM)
National Institute of Open Schooling

DIPLOMA COURSE IN BASIC RURAL TECHNOLOGY

Introduction

About 90% of the children, who enroll in the primary school, do not cross the Senior Secondary (SSC) barrier. It is not that these children are unfit for education, in fact, they are the major work force for India. They start many small enterprises, do agriculture, works as skilled workforce and contribute substantially to the progress of India. They have probably dropped out because our book based education system did not suit them and the children lost interest in all education. Very often the very thought of schooling and examination frightens them.

The country is faced with a large proportion of school dropouts and a corresponding problem of unemployment and under-performance in the unorganized sector. In the present changing world scenario, this is a great handicap to progress of country. We, therefore, need a system by which the problem will be treated at the grass root level.

The main cause of this dropout problem is that our education system is almost entirely book based and a large section of the students, both during and after the schooling, find the education incomprehensible and irrelevant.

The multi-skill content of the Basic Rural Technology Course with hands-on experience stimulates the intellect by going through concrete operations and then abstracting the concepts. It uses the 'learning while doing' system and is closely linked to services in the community. At the same time by giving a variety of skills usable in every day life, they open the door of modern technology to the youth, allowing them to form their preferences and know their aptitudes, thus enabling them to choose a career. It also improves their self-image and gives them confidence and hope for the future. The level of training, though basic, empowers them to start their own enterprise after a short (less than a year) stint with another enterprise in the field.

The Diploma in Basic Rural Technology is the right course for such students. This course will give learners self-confidence and give a new path to their future. Learners may be destined for starting a small enterprise and build their own future.

This multi-skill program, will expose the learners to a variety of skills. Learners will work in Engineering-Construction, Energy-Environment, Agricultural and Animal husbandry and Health sectors. This will help in identifying Learners preferences for future vocation. This program is based on philosophy of "Learning while doing'. Students will get training by working in real life environment. They will also learn basic skills like drawing, costing and project planning in DBRT program during their training.

Objectives of the Course & Scope

Diploma in Basic Rural Technology, comprising of theory & practical component, is intended to *give learners self-confidence and a new path to their future. Learners may be destined for starting a small enterprise and build their own future. This is multi-skill programme, which will expose them to variety of skills. Learners will works in Engineering-Construction, Energy-Environment, Agricultural and Animal husbandry, home and health sections. This will help in identifying Learner's preference for future vocation.*

The programme is based on philosophy of "Learning while doing'. Students will get training by working in real life environment. Learner will also learn basic skills like Drawing, Costing and Project Planning in DBRT programme. The main objectives of this course are:

- To train the students using 'Learning while Doing' Philosophy.
- To train them for income generation through self-employment.
- To train students in multi-skills.
- To train students in different technologies and transfer these technologies to the society through them.
- To involve students in various rural development activities as a project work, thus integrating rural development and Education.
- To make available various services to the community at the modest cost and giving real life training to the students.

Eligibility Criteria

The admission for Diploma in Basic Rural Technology is open to those who fulfill the following Criteria:-

- Class 8th passed (Any one, who is willing to work with hands, handle machinery or play with animals or likes to grow plants, is well suited for this course. Learner should have passed the 8th standard school examination, so that learner can read and write fluently, do simple calculations.)

Job Opportunities

After passing through this course, the students can do apprenticeship in one of the areas of his interest and develop his career. Multiskilling helps in getting job in the following fields:-

1. Workshop in small scale industries / construction sites / Fabrication units.
2. Supervisor in agriculture and polyhouses / animal husbandry units such as poultry , dairy, goat farming etc.
3. In food processing industries.
4. Electric and Electronics workshops.

He can start his own enterprise after sufficient apprenticeship.

Duration of the Course

The duration of the course is two years. However, one can complete the course within five years of registration by appearing in any external examination as per rules of NIOS in force from time to time. The AVIs will be responsible for imparting training, skills and competencies of a qualitative standard by adopting suitable training methods, strategies & systems.

Attachment of Trainees : Minimum 06 months attachment of trainee for internship.

Scheme of Study : 30% in Theory & 70% in Practical Course Curriculum

The course curriculum comprises of four modules having both theory & practical components.

Out of four modules two are related to the living world and two to the non-living. Home- Environment (related to human society), and Agriculture (Plant and animal Kingdom) give the skills related to clothing, food and health of the society. Agriculture covers the skills needed for production and preservation of food of both plant and animal origin, including care of plants/crops, birds and cattle and their breeding. The Engineering

Programme	Duration	Essential Contact Hrs. for Theory & Practical Training
Diploma in Basic Rural Technology	Two Years	600

Course Curriculum

The course curriculum comprises of four modules having both theory & practical components.

Subjects/Papers for First Year	Subjects/Papers for final Year
• Module - 1: Our Health	• Module – 3: Rural Engineering *((Material, Mechanics, Drawing & Costing)*
• Module – 2: Agriculture & Animal Husbandry	• Module – 4: Our Home Environment (Home Environment Basics of Electricity)

Out of four modules two are related to the living world and two to the non-living. Home- Environment (related to human society), and Agriculture (Plant and animal Kingdom) give the skills related to clothing, food and health of the society. Agriculture covers the skills needed for production and preservation of food of both plant and animal origin, including care of plants/crops, birds and cattle and their breeding. The Engineering (material-joining, shaping and otherwise fabricating into usable things, including housing) and Energy-Environment (application of electricity and maintenance of Diesel, petrol and other IC Engines, non-conventional principles). The content though it looks formidable, is easily worked through because of the 'learning while doing' method. Of course the mastery depends on the student putting hard work for practice, for which ample opportunities are given. The students are encouraged to take on contract jobs involving these skills for practice and reinforcement.

The study material will be provided in the form of self-instructional print material and the practical component/training shall be provided to each student at the study centres(AVI's).

Medium of Instruction

The medium of instruction is English.

Instructional System

- Self instructional printed material
- Visual support system

- Assignments
- Face to face counseling at AVIs/Study centres
- Practical/Training facilities at AVIs/Study centers
- On the job training, wherever applicable/required.

Scheme for Evaluation/Certification

There will be evaluation of both components, the theory as well as the practical separately. Internal assessment will also be taken into account while computing final result. The scheme of Assessment, Evaluation and Certification will be administrated through the guidelines designed by NIOS. NIOS will award the final certificate according to its rules and regulations.

Basic Rural Technology Training Prog.	**Theory**		**Practical**			
Paper	Max. Marks	Duration	Max. Marks In Practicals	Duration	Max. Marks in Project Work	Total
Paper – I Our Health	30	1 hr	50	2 hrs	20	100
Paper – II Agriculture & Animal Husbandry	30	1 hr	50	2 hrs	20	100
Paper – III Rural Engineering (*(Material, Mechanics, Drawing & Costing)*	30	1 hr	50	2 hrs	20	100
Paper – IV Our Home Environment	30	1 hr	50	2 hrs	20	100
					Grand Total	400

MINIMUM PASSING CRITERIA

- In Theory, a trainee should secure 40% marks in each module/paper.
- In Practicals, a trainee, should secure 50% marks in each paper.
- In Internal Assignment, a trainee should secure 50% marks in each paper.

Procedure for Internal continuous Assessment

Practical / Training (Internal Assignments):

Assessment will be done by maintaining progress card of each candidate, indicating assessment of each Practical / experiments. (Total Marks = 80)

Course Fees:

A student will pay Rs.4000/- (Rs.500/- + Rs. 3,500/-) for the full course and will receive a set of printed material. In addition, the examination fee will be paid separately as per the NIOS rules.

Admission Procedure

Admission is done twice a year as per the dates notified by the NIOS. Application forms and Prospectus can be procured from either the NIOS or its Study Centrs (AVIs).

Criteria/Norms for Accreditation

The institutions having the following basic infrastructure may apply for accreditation:

(A) **Basic Infrastructure:**

1. Class Room: Classroom to accommodate 25 students (minimum area 225Sq. ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
2. One Lab: The Lab to accommodate 25 students (minimum area at least 20 ft. × 25 ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
3. One Workshop: The workshop to accommodate 25 students (minimum area at least 20 ft. × 25 ft.) should have black board/white board, proper ventilation, adequate lighting, furniture, exhaust and ceiling fans etc.
4. Agriculture land: Agriculture land for growing and cultivation the plants/crops.
5. Tools/ Environment: Details in this regard is available on our website.

Library: Library should have minimum 20 books/articles/magazines etc. related subject.

(B) Faculty & Supporting Staff

Batch Size – Maximum 25 students in one batch.

S.No.	Faculty & Supporting Staff	Educational/Professional Qualification	No.
1.	Coordinator	Graduate	01
2.	Instructor (part time)	Degree/Diploma in Nursing	01
3.	Instructor – Agriculture & Animal Husbandry	Degree/Diploma in Agriculture/Animal husbandry-DBRT with sufficient practical experience.	01
4.	Instructor – Engineering	Degree/Diploma in Engineering discipline – ITI-DBRT with sufficient practical experience.	01

5.	Instructor – Food lab.	Class 12th Pass – Home science or DBRT with practical experience in food processing	01
6.	Receptionist cum clerk	Relevant to job	01

Batch Size – Maximum 25 students in one batch.

FUNDAMENTAL DUTIES

Part IV A (Article 51 A)

It shall be the duty of every citizen of India -

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.

A brief Guide to NOS web site

The success of open learning and distance education very much depends upon the harnessing of the new and latest technology. The emerging Internet and Web technology help in effective dissemination of knowledge breaking all geographical boundaries. The web-site is a dynamic source of latest information and is also electronic information guide. The contents in the **NOS** web site are open to all.

The learners can have an access to NOS web-site at the following address:

http:/www.nos.org

Clicking this site address will bring the user to NOS Home Page that will further guide them to visit different information pages of **NOS**. NOS is also developing a school network through Internet known as **Indian Open Schooling Network (IOSN)**. The network will provide a common communication platform for learners and educators. NOS is offering **Certificate in Computer Applications (CCA)** through selected AVI. This course is also offered through Internet on NOS Web-Site.

Basic Rural Technology

3

RURAL ENGINEERING

(MATERIAL, MECHANICS, DRAWING & COSTING)

Course Content

Notes

1

MEASUREMENT

1.1 INTRODUCTION

We measure various things in our daily life. In the past, measurements were done using different parts of human body. For e.g. Feet, handbreadths, fathom etc. But there are many limitations on accuracy of such measurements. For e.g. length of handbreadth varies from a person. Therefore, need of standard measurement practices was emerged. The method of measurement depends upon the accuracy required. In this chapter, we are going to study measurement, commonly used units, basic units and derived units.

1.2 OBJECTIVES

After reading this lesson, you will be able to:

- Know Importance of measurement, SI units.
- Understand Quantitative and Qualitative measurements.
- Know Base Units and derived units.
- Understand Least Count of instruments.
- Estimate weight of goods.

1.3 IMPORTANCE OF MEASUREMENT

In today's world, we cannot do without measurement. Grocery shop owner needs to measure weight, doctors measures temperature, blood pressure, Two wheeler mechanics measures tyre pressure, milkman measures milk, mesons measures wall length etc. Measuring units become essential part of proper communication.

Module - 3

Notes

1.4 QUANTITATIVE AND QUALITATIVE MEASUREMENTS

We get new information everyday and from this information, we derived knowledge. "This year we got good yield of rice". This is a descriptive (qualitative) information. "This year we produce ten quintal rice"; this is quantitative information. Quantitative information is more useful than the descriptive information. Science depends upon such quantitative information. Therefore, it is necessary to measure all the characteristics. Few examples of qualitative and quantitative informations are given below:

Qualitative Information	Quantitative information
Give me little water.	Give me 200ml of water.
Give me some money	Give me twenty rupees.
I ate sufficient food.	I ate two chapattis.

Table: 1

Please refer table.1 for more examples. This 'little', 'sufficient', 'good', 'enough', 'lot' are the example of qualitative information. Whereas, quantitative information like 200ml, Rs.20, 2 chapattis, 5 quintals, 500mm, 5 bags gives specific information. Recording everything is basic requirement for improving productivity. Collecting proof, based on quantitative information is must to support your invention.

INTEXT QUESTIONS 1.1

Identify Quantitative and Qualitative information:

1) We got good yield of crop. _____.
2) We got 5 quintals of rice. _____.
3) This year there is enough rain. _____.
4) This year we got 500mm rain. _____.
5) This construction needs lot of cement. _____.
6) This construction needs 5 bags of cement. _____.

1.5 MEASUREMENT AND SI UNITS

Measurement is nothing but a measuring attribute of an object with other known attribute of similar object. The known things are called standards. In the past, there were different standard of measurement in different countries. Prominent among them are British standards and French Metric system. Now there are international standards (SI) for measurement.

In our country only use of SI standard is legal. Therefore, you will find only SI units in all Government contracts and agreements. We will discuss only SI units in our study. Different measuring parameters and their measuring units are shown in the table below:

Parameter	British Unit	SI Units
Weight	Pound	Kg.
Volume	Gallon	Liters
Distance	Yard, miles, inches	Meters
Time	Second	Second

Table: 2

The characteristic that we measure is called as Parameter. Some of the important Parameters and their Units are given in table 2.

1.6 INTERNATIONAL STANDARDS OF UNITS

The International System of Units (SI) is the modern, revised form of the metric system developed by French people. The SI unit allows easy multiplication when switching among units having the same base but different prefixes. To convert from meters to centimeters it is only necessary to multiply the number of meters by 100. Inversely, to switch from centimeters to meters, one multiplies the number of centimeters by 0.01.

Observe scale given in fig.1.1. It gives conversion of various units into meter. For e.g. 1 cm = 0.01m, 1 kilometer = 1000 meter.

Base unit:

There are two types of SI units, base and derived units. Base units are the simple measurements for time, length, mass, temperature, electric current and light intensity.

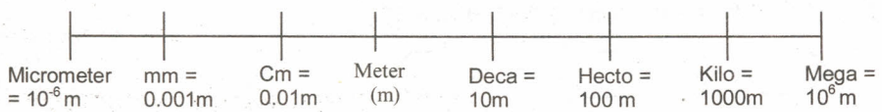


Fig. 1.1 - Meter and its multiple units

Commonly used base units are:

Derived units:

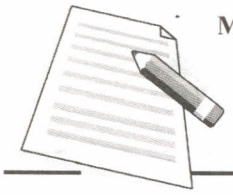
Derived units are made up of base units, for example, unit of speed is m/s, which is combination of unit of distance and time. Commonly used base units and their symbol names are given below:

	Name	Symbol
Length	Meter	M
Mass	Gram	Gm
Time	Second	S
Electric Current	Ampere	A
Temperature	Degree Centigrade	°C

Table: 3

Derived units are calculated as follows:

1) Speed = Distance / time, unit of distance is meter and time is second.



Example of Derived units and their symbol names are given in Table below:

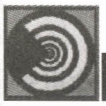
Therefore, unit of speed becomes m/s

2) Area of square = length * breadth, unit of length and breadth is meter.

Therefore, unit of area = m * m = m^2

Derived Quantity	Name	Symbol
Area	Square meter	m^2
Volume	Cubic meter	m^3
Speed, Velocity	Meter per second	m/s
Acceleration	Meter per second	m/s^2
Density	Mass per volume	Kg/m^3

Table: 4



INTEXT QUESTIONS 1.2

1) Convert the following:

50 cm = _____ m

5.5 km = _____ m

1600 m = _____ km

102 mm = _____ m

2) Observe different weight and answer:

500g + 500g = _____ kg

1.7 MEASURING OTHER PARAMETERS

How to measure other characteristic which are not following in base or derived units for e.g. testing good behavior, smell, magnetism, light, colour etc.

Measurement is nothing but comparison. For measuring something,we select unit and consider it as standard. Therefore we judge the characteristics by measuring how many times the characteristics is more than the selected standard unit. For e.g. by considering sweetness of sugar as a unit, we can decide how many times is the sweetness of sweet.

Factors affecting measurement:

No measurement is absolute in nature. It is very difficult to claim that any measurement is 100% accurate. But we can always reduce the errors in measurement.

Accuracy depends on lots of factors:

i) Reading taken by the individuals.

ii) The way of measurement.

iii) Alertness of individual and care taken by him in measurement.

iv) Error due to variation in the measuring instruments.

In mathematics we get exact answer for $2 \times 2 = 4$, but while measuring 4 meter it may be measured as 3.995 meter or 4.007 meter. This is not a wrong measurement but it is lack of accuracy. Practically, there are limitations to achieve 100% accuracy and it is not possible to have 100 % accuracy every time.

Least count of an Instrument

The smallest measurement, you can make using an instrument is the least count of that instrument. For example on a small scale in your compass box, smallest measurement you can make is 1mm. This means least count of scale is 1mm.

Do not use any instrument to measure below least count of that instrument. This means, if you want to measure 0.05 mm then regular scale is not a good device.

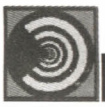
While measuring always take measurement one decimal higher than the least count on the measure. For example if on the Scale, millimeter is the smallest sign of measure, then do not measure less then 0.1 millimeter. Further, in decimal if last number is 5 or more than 5, then make number previous to it as 1. For example in measurement of 3.9935 make it 3.994.

Selection of instrument depends on the accuracy required. For example

i) We can use wrist watch to measure time but for athletics competition in Olympic, we need digital watch.

ii) To measure length of a wall, we can use a tape but for measuring length of compass -box we need to use scale.

iii) To measure weight of a truck, a weigh bridge is used. But grocery shop owner use simple balance.



INTEXT QUESTIONS 1.3

i) Name proper instruments to measure following jobs:

Job	Instrument
Diameter of rod	
Current	
Temperature	
Measure weight	

ii) Write down least count of following instruments:

Vernier caliper = _____

Meter tape = _____

Wrist watch = _____

1.8 ESTIMATING WEIGHT OF GOOD

Due to convention, many times we use different units than SI units. Many times things are sold using different measurement. For example Iron is sold on per Kg weight. This means though we measure dimension for manufacturing 'Table' in length, still we need to measure its weight. For making estimate of a job, we have to calculate the weight of the angle used. The formula for calculation is given below:

Weight of material = Density of material × volume of job.

Volume of a job = Area of cross section of an object × length of object

Density of iron is 7.87 gm/cm^3 or 7870 Kg/m^3

Example:

1) Calculate a weight of 4 cm diameter iron rod of 100 cm. in length.

Diameter = 10 cm Area = π / 4 × D^2

Area = 3.14 / 4 × (4 × 4) = 12.56 cm^2

Volume = Area × Length = 12.56 × 100 = 1256 cm^3

Weight = Density × Volume = 7.87 × 1256 = 9884.72 gm = 9.88 Kg

2) Calculate weight of a 25 × 25 × 3 mm angle of length 3 meter

Length = 25 mm = 2.5cm, thickness = 3 mm = 0.3 cm, Length = 3 mtr = 300cm.

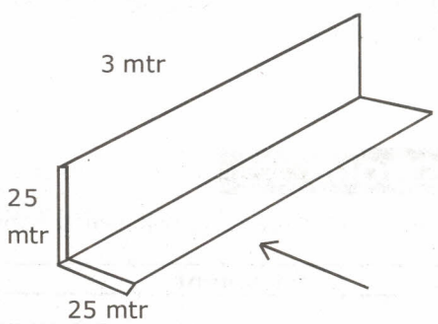


Fig: 1.1

Area of cross section = (Area of vertical cross section) + Area of horizontal cross section

= (Length × breadth) + (Length × breadth)

= (2.5 × 0.3) + (2.5 × 0.3) = 1.5 cm^2

Length = 3 mtr. = 300 cm

Volume= Area × Length = 1.5 × 300 = 450 cm^3

Weight = Density × Volume

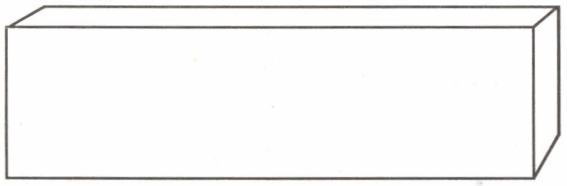
= 7.87 × 450 = 3541.5 gm = 3.54 Kg

1.9 WHAT YOU HAVE LEARNT

In this chapter, we have learned about measurement, types of measurement, base unit and derived units. We have studies quantitative and qualitative measurement. We also discussed SI units and International standards of units. We also discussed about factors affecting selection of instruments, least count of instrument. At the end, we learned to calculate weight of goods.

1.10 TERMINAL QUESTIONS

1) Write down factors affecting selection of measuring instruments.
2) Estimate weight of iron flat of following dimension.



L = 3 meter, Breadth = 0.5 meter, thickness = 5 cm

Density of iron is 7.87 gm/cm^3 or 7870 Kg/m^3

1.11 ANSWER TO INTEXT QUESTIONS

1.1

1)	We got good yield of crop.	Qualitative
2)	We got 5 quintals of rice.	Quantitative
3)	This year there is enough rain.	Qualitative
4)	This year we got 500mm rain.	Quantitative
5)	This construction needs lot of cement.	Qualitative
6)	This construction needs 5 bags of cement.	Quantitative

1.2 i) 0.5m, 5500m, 1.6km, 1.02m

Notes

ii) 1 Kg

1.3 i) vernier caliper, Ampere meter, Thermometer, Balance

ii) 0.01cm, 1mm, 1 second

SUGGESTED ACTIVITIES

1) Measure dimensions of your house.
2) Read and write down different parameters and units written on biscuit or any other packet.

2

BASIC ENGINEERING CONCEPTS

2.1 INTRODUCTION

In scientific language each word has clear and specific meaning. Therefore, commonly used words are avoided in scientific language. For example, Mass and weight are two different term. Your mass on earth and on moon is same. But you weight will be less on moon than earth. That is the reason, astronauts' floats in the space. In this chapter, we will discuss commonly used scientific terminology.

2.2 OBJECTIVES

After reading this lesson, you will be able to:

- Understand basic engineering concepts.
- Understand relationship between work, force and Power.
- Learn the Law of conservation.
- Know scalar and Vector.

2.3 MASS AND WEIGHT

- Generally, **mass** is defined as the measure of how much matter an object or body contains. It is measured in Gram (g).
- **Weight** is the amount of force that earth exerts on us. More the mass of object more is the gravitational force on the object. If we drop an object from a height, earth pulls it at the acceleration of $9.8 m/s^2$
- **Acceleration** is the rate of change of speed. This means speed of an object will increase by 9.8m every second. This means, if an object falls from a height to reach earth, after 10 second it would have achieve speed of $9.8 \times 10 = 98$ m/s.

- Force causes acceleration, Sir Isaac Newton's Second Law states that the acceleration (a) of an object is directly proportional to the force (F) applied, and inversely proportional to the object's mass (m).

Newton's Second Law is usually summarized in equation form:

$a = F/m$, or $F = ma$

Unit of force is derived as follows -

Unit of force F = m (Kg) × a (m/s^2) = Kg m/s^2 = N

To honor Newton's achievement, the standard unit of force i.e kg m/s^2 in the SI system is named as Newton (N). One Newton (N) of force is enough to accelerate 1 kilogram (kg) of mass at a rate of 1 meter per second square (m/s^2).

A kilogram is the amount of weight at which 1 N of force will accelerate at a rate of 1 m/s^2.

In practice, we measure weight, in terms of gms. or Kgs. But when weight is used as force, we must remember to measure it in terms of Newton.

INTEXT QUESTIONS 2.1

Fill in the blanks:

i) _____ is the rate of change of speed.

ii) Weight is measured in grams, but when weight is used as force, we measure it in terms of _____.

2.4 FORCE

As studied earlier, weight is the kind of force that the earth exerts on us. As shown in the Fig.2.1 there are multiple forces applied on a car from different direction. Gravitational force puts downward force on the car, engine puts forward force etc. some forces gets balanced by equal and opposite force e.g. downward gravitational force gets balanced by equal and apposite force exerted from ground.

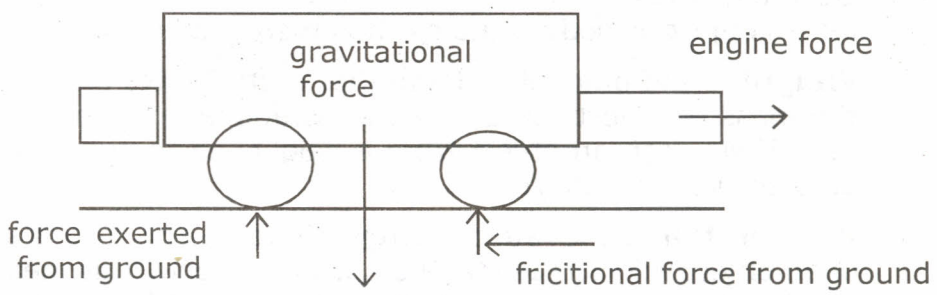


Fig.2.1 Multiple forces applied on car

Car moves forward when forward engine force overcomes frictional force from the road.

2.5 TORQUE

Torque is a force that tends to rotate or turn things. Refer Fig.2.2, you generate a torque whenever, you apply a force to turn handle of diesel engine.

Torque = Force × Distance from the center.

Unit of Torque = N × m = Nm.

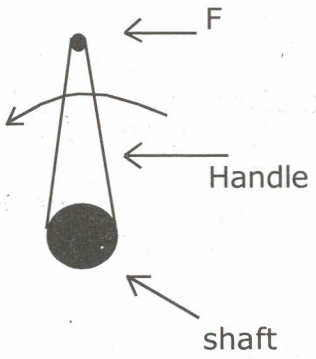


Fig: 2.2 : Torque

It is common experience, that a nut which is hard to move by hand can be easily rotated when a spanner of longer length is used. Increasing length of application of force from the center of shaft increases torque applied.

2.6 WORK

Work is the application of a force over a distance. When we lift an object from the ground and put it on the shelf, we do work. The

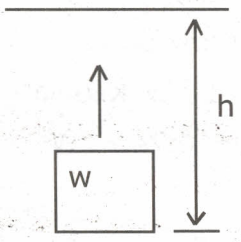


Fig 2.3 (a)

force is the weight of the object and distance is the height of the shelf. Similarly, when we push an object and moves it, we do work.

The distance taken for calculating work has to be in the direction of force applied.

Example: Ref fig.2.3(a), a weight of 50kg. is lifted to height of 5 meter. Calculate the work done.

Work = force × distance through force is applied

= (W kg × 9.8) × h (W = 50kg, h = 3m)

= 50 × 9.8 × 3 = 1470 Nm

When we push an object and it moves through a distance L ref. Fig.2.3(b) the work done is calculated as follows:

Work = force × distance through which force is applied

W = F × L (unit of force is N, distance is in meter)

W = F (N) × L (m) = F × L (Nm)

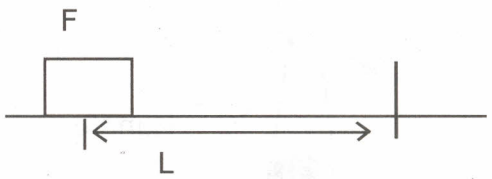


Fig: 2.3 (b)

When we do work, we use energy. Work and Energy are closely related. Work is measured in the same unit of energy.

2.7 POWER

Power is the rate of work done or rate of energy consumed. We can manually pedal a wheel of bicycle at 1 revolution per second. If we want to turn the same wheel with 10 revolutions per second, we need more power and will use engine.

The SI unit for power is watt. One **watt** is equal to 1 Newton-meter per second (Nm/s). If you were pushing on something with a force of 1 N, and it moved at a speed of 1 m/s, your power requirement would be 1 watt.

British unit of power is horsepower. The conversion is as follows:

SI: Watts (W) 1000 W=1 kW Kilowatt (kW) 1kW = 1.341 hp

Horsepower (hp) 1 hp = 0.746 kW

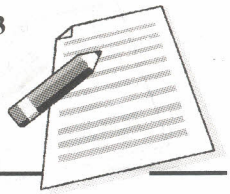
INTEXT QUESTIONS 2.2

i) Fill in the blanks:

1) Power is rate of _____ done.

2) Torque is force that tends to _____ things.

3) Work is application of _____ over a distance.



ii) Match of the following:

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

2.8 ENERGY

Energy means invisible strength of doing work. Energy is a measure of how much work we can do. Energy needed to do certain work will always remain the same. For example energy required to lift 500lits. of water to height of 10m. will always remain the same irrespective of doing it manually or by using engine. We can only do the work faster by using engine.

Common unit of energy is the kilowatt-hour (kWh). 1 KWh energy means, one kW of power will last one hour.

There are three Main types of Energy:-

1) Kinetic Energy 2) Potential Energy (Gravitational) 3) Chemical Energy

Electrical, Heat, sound, solar, wind etc. are other examples of different forms of energy. Many times energy is invisible. It is visible by their effects. Kerosene, diesel, food, wood contains energy in the form of chemical energy. When these things burn energy comes out in the form of heat energy.

Stone falling from height (or anything in motion) contains energy. The object placed at highest place also contains hidden energy. This is called potential energy. An object in motion contains kinetic energy.

Law of Energy Conservation

Energy can neither be created nor can be destroyed. Only one form of energy can be converted to other form of energy. Energy is immortal. It is not distortable.

Energy Conversion

i) We eat food. Food contains chemical energy, in it after digestion this chemical energy is kept in the chemical form in our

body and as and when required it gets burnt and gets converted into other forms of energy.

ii) When we fetch the water from the well, the energy in the form of chemicals in our body gets converted into potential energy of water. Water will contains energy equal to the amount of work done while lifting the water.

iii) If we pour the water on the land, where the energy in it will go? If this water gets percolated in land then as it will go deep into the earth, potential energy in it will get converted into heat through friction. We never felt the heat since land is big and quantity of heat generated is comparatively smaller.

iv) When we do cycling, chemical energy from food gets converted into kinetic energy. Once cycle catches the speed then we can move with same speed without peddling. At this time our body and cycle has kinetic energy in it. When we want to get down from the cycle, we reduce the speed by pressing the breaks. Kinetic energy gets converted into heat energy by friction and the ream of the cycle becomes hot.

Whenever we change the form of energy, some amount of energy gets wasted in the form of heat. Our objective is to convert maximum amount of energy in the desired form for use. This is called as efficiency.

In diesel engine, when we burn diesel approximately 40% of energy gets converted into kinetic energy of water. When water is lifted to desire height, kinetic energy gets converted into potential energy. Remaining 60% of energy is wasted in the form of heat. This means the efficiency of diesel engine is 40%.

In the past, relation between energy and work done was not clearly understood. Therefore, units of measurement of heat and work were different. Heat was measured in terms of calories and unit of work in terms of joule. These two units are still in use because it's easier to calculate heat in calories and work in joule. We can convert calories into joule by using formula 1calorie = 4.2 joule.

Power is the rate of work done or rate of energy consumed. It tells us amount of joules used or required in one second. If one-joule energy is used in one second, then it is said that one-watt power is used.

Power (unit W watt) = J/S joule/second

= Energy used (in joule) / time taken

INTEXT QUESTIONS 2.3

i) Write down energy conversion in the following:

Electric motor	
Pump	
Diesel Engine	
Wood stove	
Solar panel	

2.9 SCALARS AND VECTORS

If someone ask you a Questions, 'How far is Mumbai?' to locate Mumbai on a map. What answer will satisfy him? You will need to know the distance in Kilometers and the direction.

But if I ask what is the temperature of the object? Or how many people live there. you need only one number to get the full information. The distance to Bombay is not complete information without giving the direction of that measurement. But the temperature, say 35° C is complete and unambiguous information. Temperature is called Scalar (independent of direction). The quantities like distance needs the direction to become complete are called Vectors(dependent of direction).

The 3-D Space

All the objects in the universe have 3 dimensions; they have length, breadth and height. A line has only one dimension-length. An area has two dimensions i.e. breadth and length. A solid object has 3 dimensions. (ref. fig-5) So when we measure a distance, we need to know which direction we have measured.

There are four main directions. East, West, North and South. There is also up and down directions.

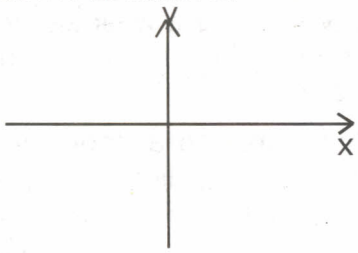


Fig: 2.4 Directions

There are also direction in between the two, north-east, south-west. This way there can be many directions, really infinite number.

There can be one in between any given two.

Two directions which are at right angles to each other are considered separate, because movement in one direction does not affect the position in the other. In a graph, change in the X directions does not change the Y-value.

Similarly, change in the Y-direction does not change the position in the X- direction. And we say X and Y are two 'orthogonal' directions (fig.4)

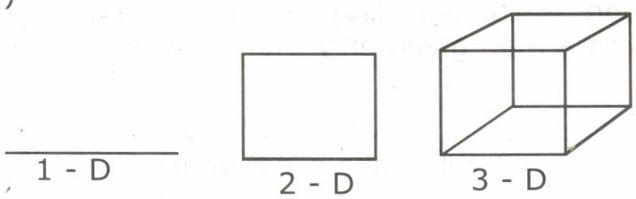


Fig: 2.5 Various dimensions

In this sense our space has three dimensions because we can draw only three orthogonal directions, not more (ref. fig.6)

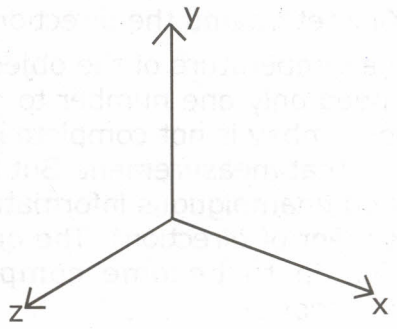


Fig: 2.6

DEFINING SCALE AND VECTOR

How do we know if a quantity is scalar (independent of direction) or vector (dependent on direction)? In simple language, if the direction is changed it must make a difference that we can experience.

i) *Distance:* If one goes 1 km for a walk every day, will he reach the same place, every time? Of course not, it depends on the direction. So distance is a vector.

ii) *Force:* If you apply a force to a door, will it open or close? It depends on the direction in which you apply the force. Pulling and pushing is not the same. So force is a vector.

iii) *Area:* You are going with an open umbrella in a storm. How do you hold the umbrella? For the same wind force, the direction of the umbrella makes a difference. It may even turn inside out. The sail of a boat has to be turned in a proper direction to use the wind to best advantage, So area is also a vector.

iv) *Temperature, weight and Colour* are not vectors.

v) *Volume:* If you measure 5 liters it makes no difference what the direction is. Volume is a quantity that involves all three dimensions so nothing more to tell. Volume is a scalar.

In conventional books, distance is called a scalar and Displacement is called a vector. There is no fundamental difference between distance and displacement. Displacement is a distance in a definite direction. But every distance has a direction. You cannot locate a town on a map given only a distance. Therefore distance is a vector.

All units based on a vector will also be vectors, because if the direction is changed, it will make a difference in the other vector also. Thus area, force, velocity etc are vectors.

INTEXT QUESTIONS 2.4

i) Write down if following parameters are scalar or vector.

Mass, distance, velocity, volume, temperature, area, force, colour

Addition of Vector

We cannot add things which are different. How much is 5 mangos + 2 apples? It will be 5 mangoes + 2 apples. If we ask the same Questions by calling them fruit, then we can add and we have 7 fruit.

Similarly, we can add 2 cms + 1 inch only if we bring them to a common unit form. 1 Inch is 2.5 cm so 2 cm + 1 inch(2.5 cm) is 4.5 cm.

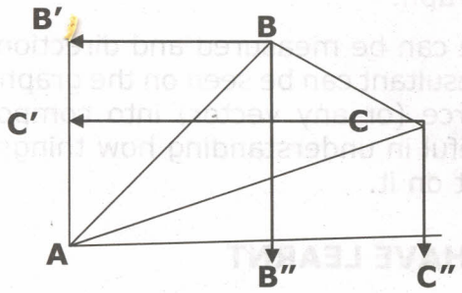


Fig: 2.7

Vectors in different directions are like quantities in different units. You can add them only when they are in the same direction. But how do we do this?

In fig 7 a force AB and AC are acting on a point A. They are vectors. They can be added only after they are made in the same form. To make them in the same form, we break up each into its components in the X and Y directions. To do this we take projections (shadows in simple parlance) on the X and Y axis. Projection of B on x axis is B" and on Y Axis it is B′. Similarly projection C on X axis is C" and on Y axis is C′.

When we apply force, it may have effects in different directions. In real life, we apply forces in different direction, projection of these vectors on X and Y direction is taken to predict result of forces.

Let us see an example:

Two people A and B are pulling on a rope, tied to a tree. A is applying 20N force and B is applying 30N force. Both of them are applying force in 90° of each other. How much force does have and which direction?

If forces A and B are applied in the directions shown, the resulting force, the sum of A and B will be as if a single force is applied in the direction marked 'Resultant'.

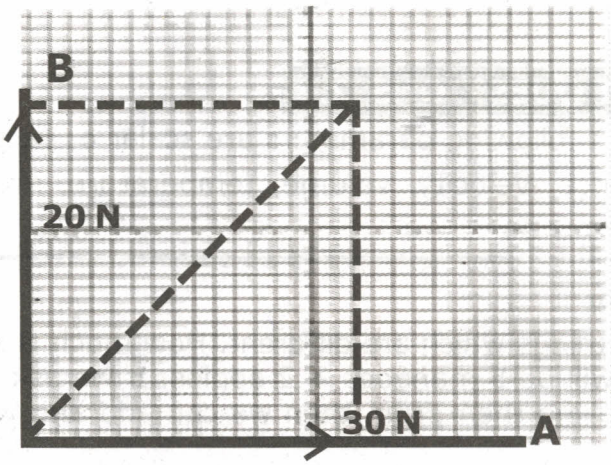


Fig :2.8

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

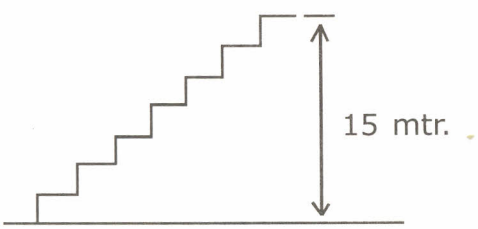
Scalars	Vectors
Mass	Distance
Volume	Velocity
Temperature	Force
Colour	Area
Time	Pressure

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.

Module - 3

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.

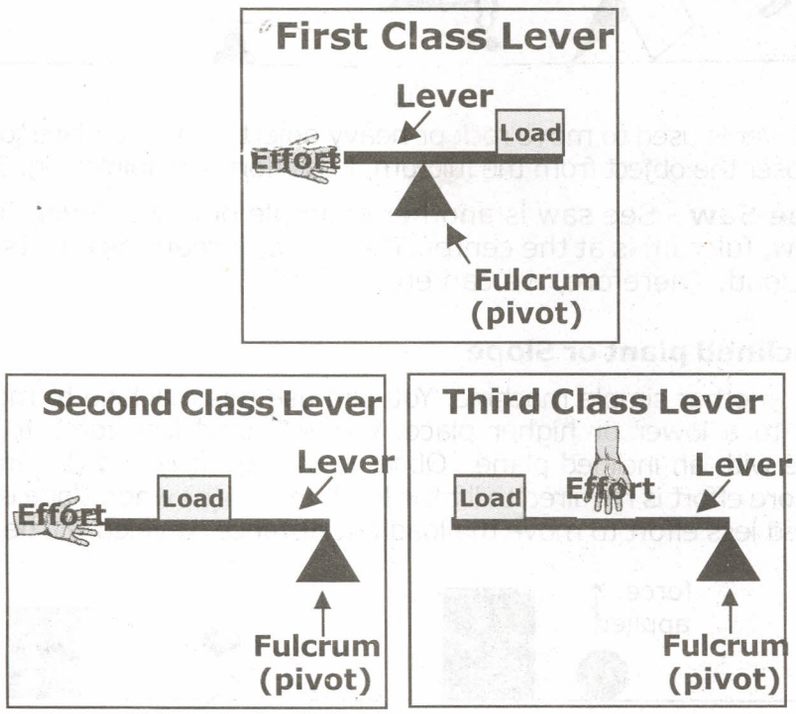


Fig: 3.1

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:

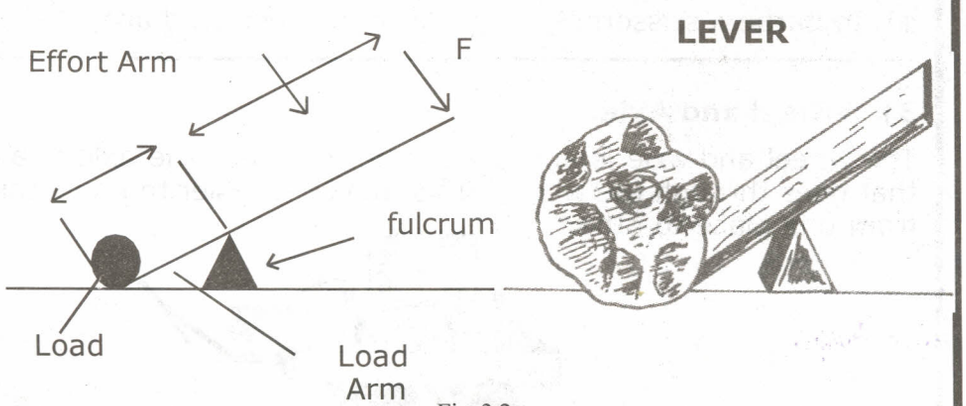


Fig: 3.2

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.

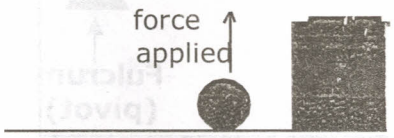


fig: 3.4(a)

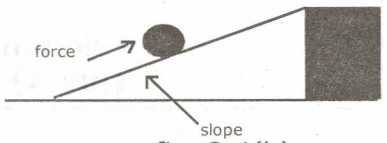


fig: 3.4(b)

INTEXT QUESTIONS 3.2

Fill in the blanks:

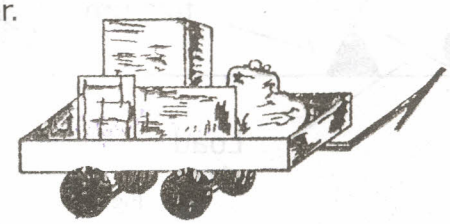
i) Ramp near big warehouses are made using _____ type simple machine to reduce force required to move object.

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.

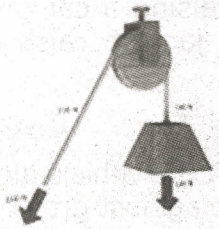


Fig: 3.5 Pulley

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.

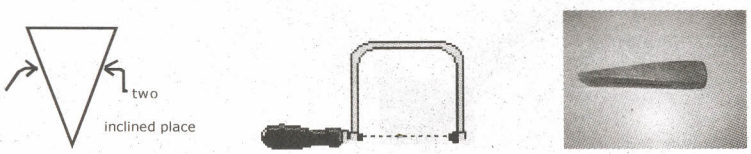


Fig: 3.6 Wedge

6) SCREW

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

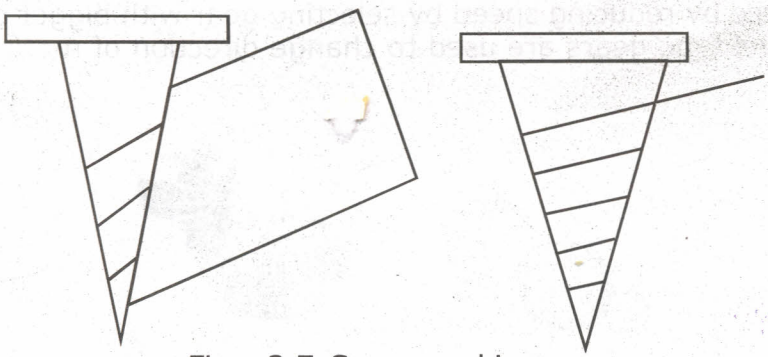


Fig : 3.7 Screw making

Module - 3

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.

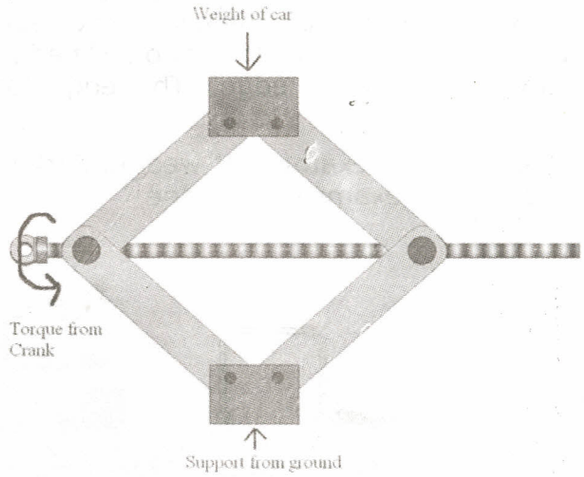


Fig: 3.8 Screw jack

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.

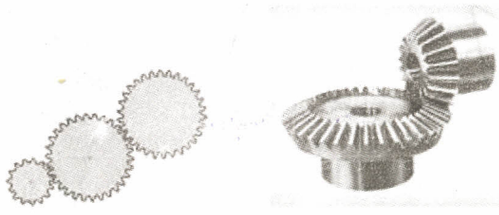


Fig: 3.9 Gears

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.

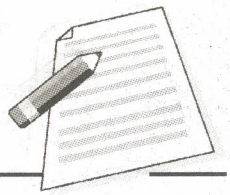
Lubrication

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

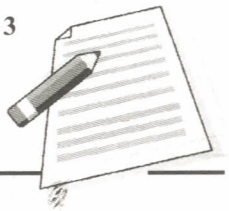
i) Barber scissor

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

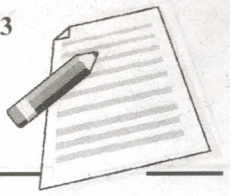
Seasoning

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.

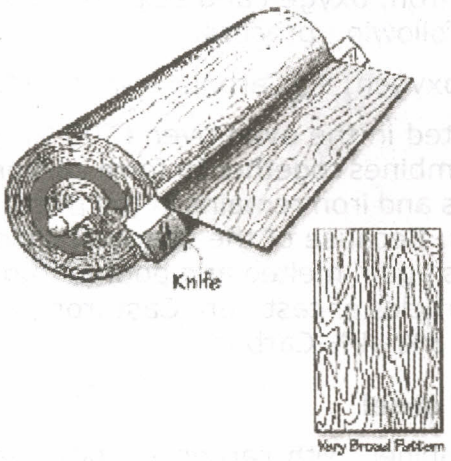


Fig: 4.1 Plywood

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.

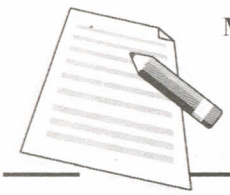
How cement gets it strength?

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.

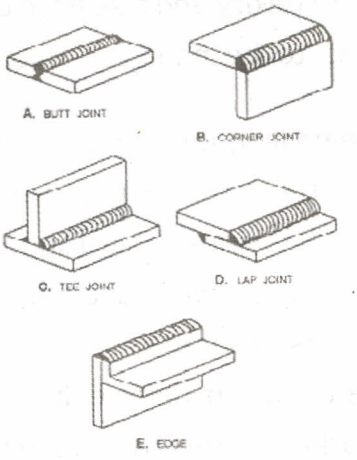


Fig: 5.1 Various weld joints

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

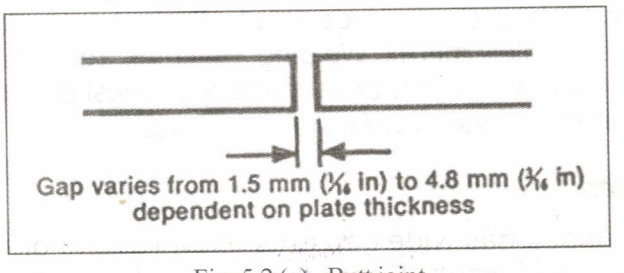


Fig: 5.2 (a) Butt joint

2) V butt joint

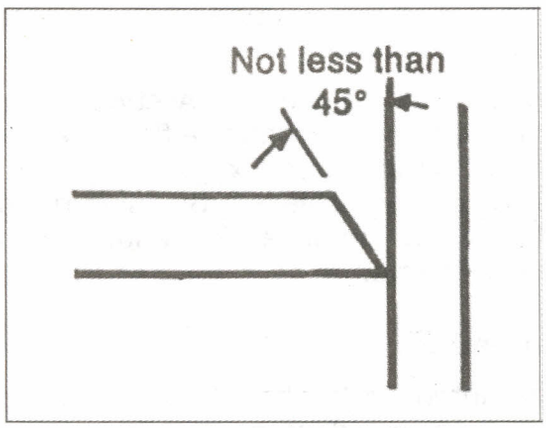


Fig: 5.2 (b) V butt joint

3) Double V butt joints. When metal is thicker

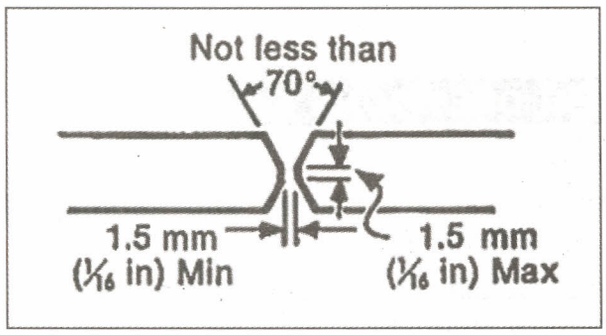


Fig: 5.2 (c) Double V butt joint

4) A Lap joint

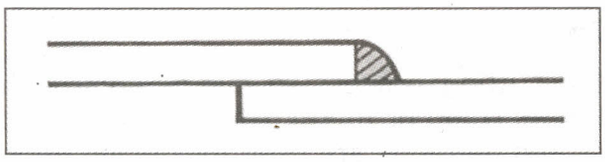


Fig: 5.2 (d) Lap joint

5) T joint

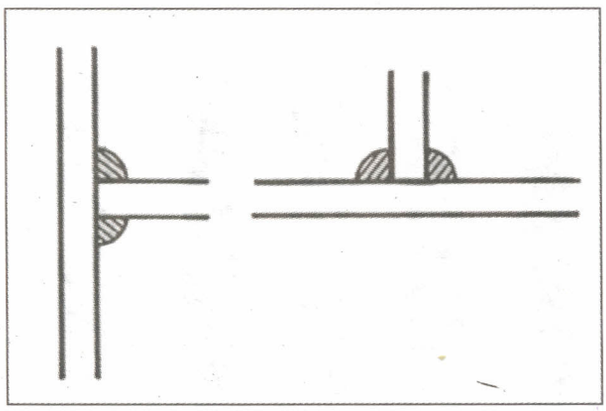


Fig: 5.2 (e) T. joint

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)

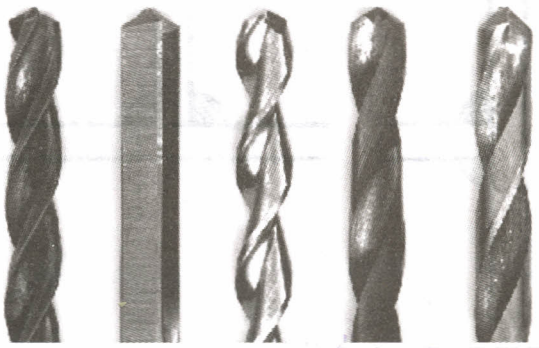


Fig: 5.3 (a) Drilling tools

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)

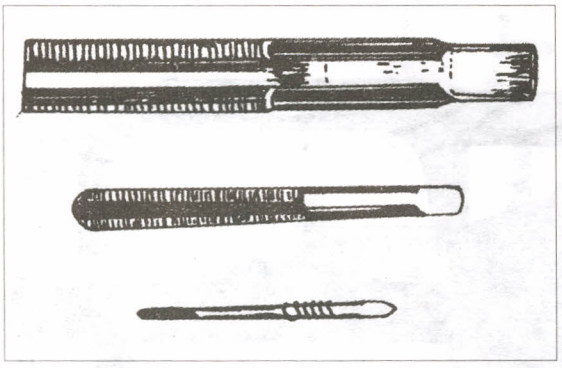


Fig 5.3 (b) Taps

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)

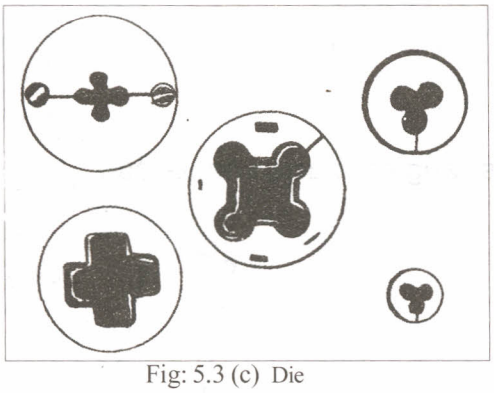


Fig: 5.3 (c) Die

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

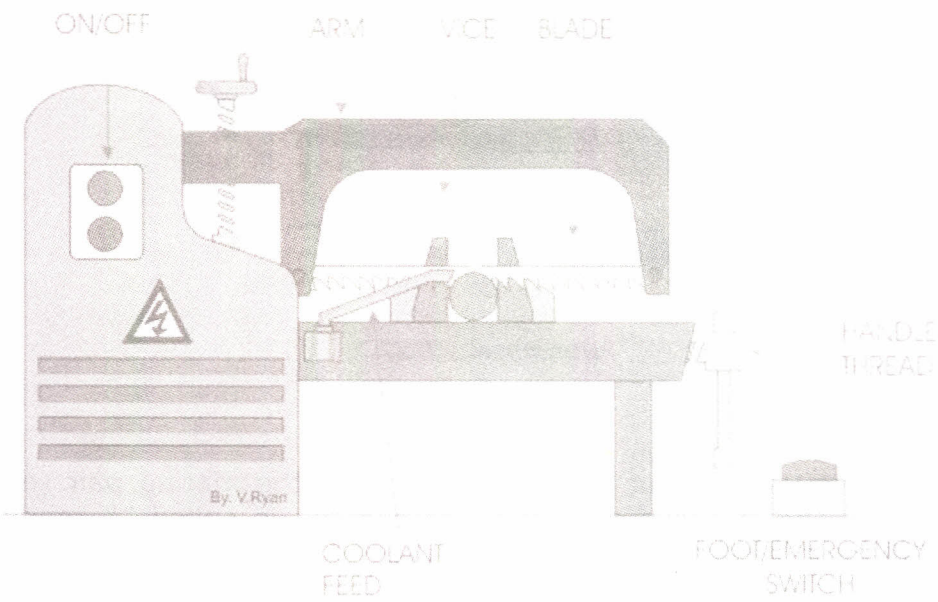


Fig: 5.4 Power hacksaw

Shearing machine

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

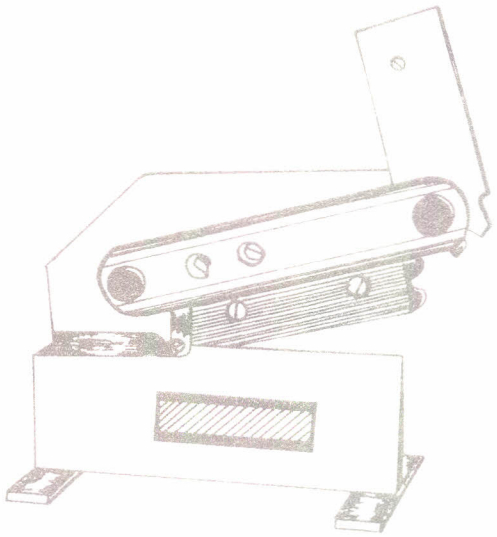


Fig: 5.5 Shearing Machine

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

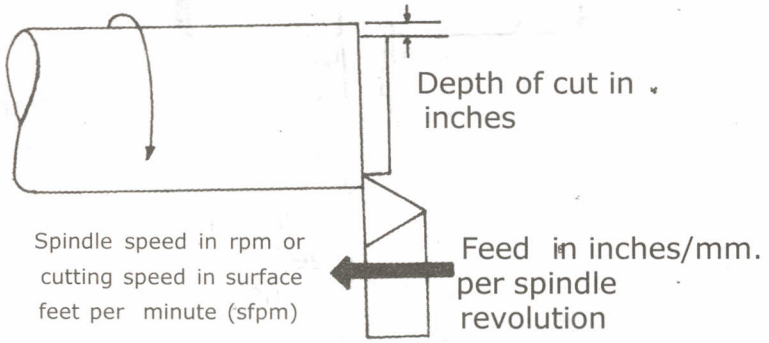


Fig: 5.6(a): Turning and the adjustable parameters

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.

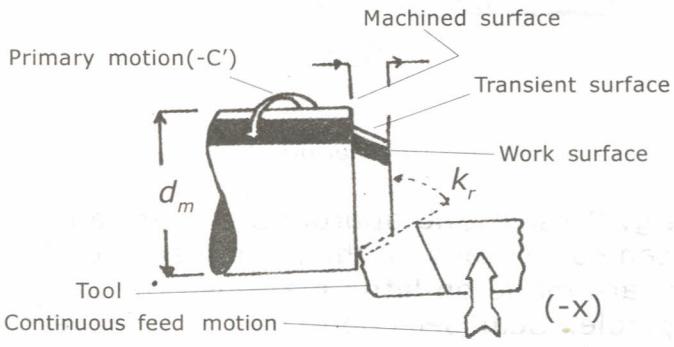


Fig:5.6 (b): Lathe Machine

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

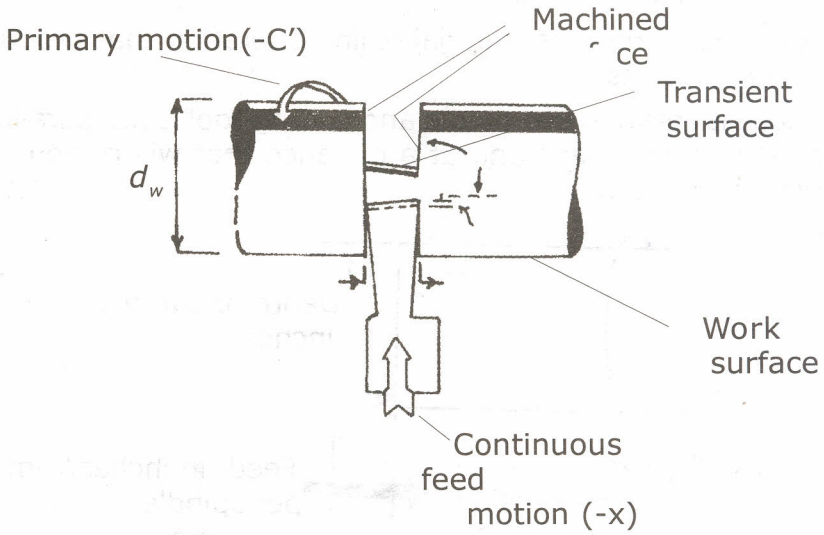


Fig: 5.6 (c) Parting

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.

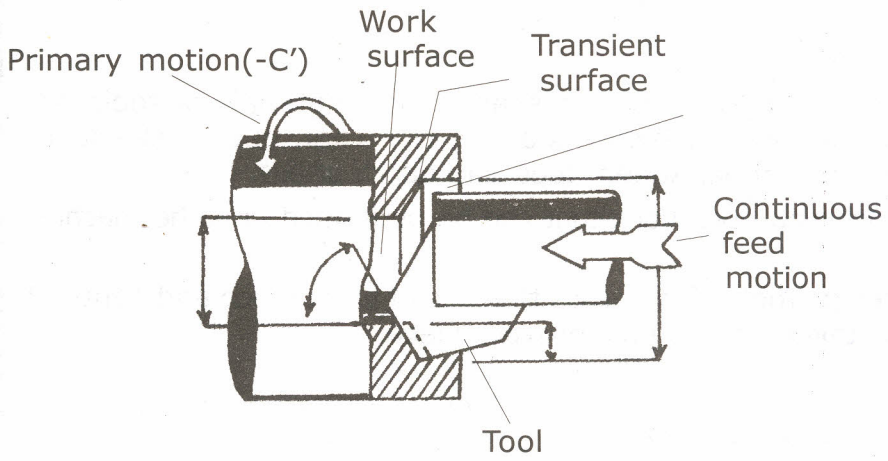


Fig. 5.6 (d) Boring

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.

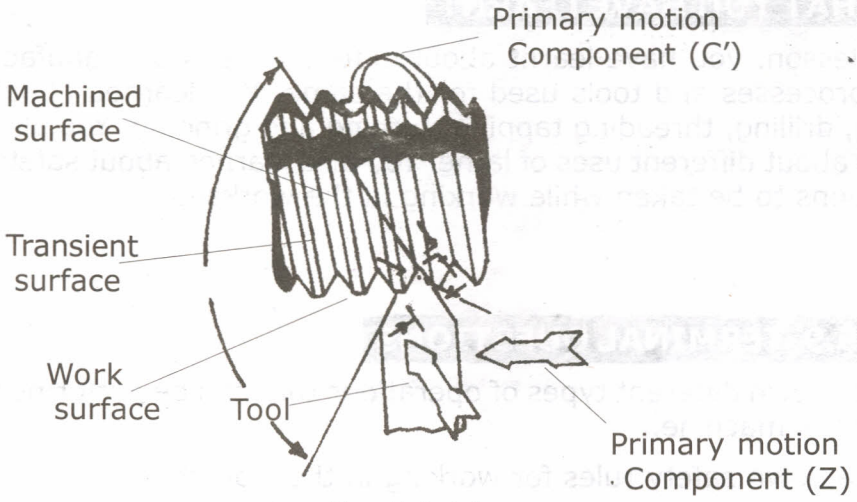


Fig: 5.6 (e)

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.

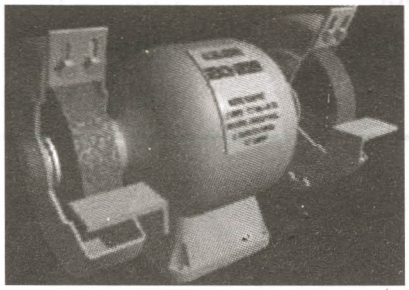
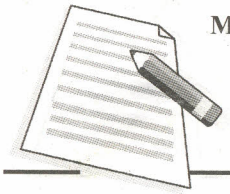


Fig: 5.7 Grinding Machine

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

6

CONSTRUCTION

6.1 INTRODUCTION

Construction carries important place in human civilization. It shows us the progress made by man from time to time. The first buildings made by human were simple huts, tents. Wood, stones and sands were the only material used.

The first bridges made by humans were probably wooden logs placed across a stream.

In the ancient time architects put all their skill in building the roof of the construction. They construct walls and roofs using stones. Still we can see the stony beam on the stony column in old temples.

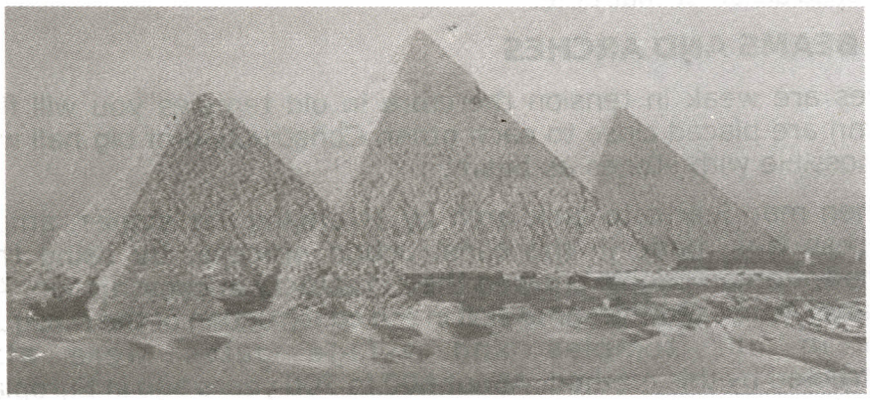


Fig 6.1 Pyramids

The knowledge gained over 5000 years ago is still used in the construction of every building in the world. Ancient architects were constructing large buildings with the help of limestone, stones, and earthen materials etc. Today Steel, cement etc. material is available for architects to construct big buildings and large bridges. We will study common types of construction method in following section.

6.2 OBJECTIVES

After reading this lesson, you will be able to:

- learn about history of construction, different types of structures.
- know about different tools used in construction.

6.3 HISTORY OF CONSTRUCTION

Construction has a long tradition of thousands of years. To become immortal in history, Kings asked their architect to construct huge buildings. Pyramids were build to bury Faroha king around 5000 years ago. Height of the pyramid is approximately 300 feet and was built with 5-6 feet rectangular stones. Those architects showed their skill of building such huge, accurate construction. Pyramids are one of the Seven Wonders of the World.

In India, Kailash temple at Ellora (Dist Aurangabad) is built from huge stones in 7^{th} – 13^{th} centuries.

It is the largest and most magnificent rock-cut temple in the world and is considered one of the wonders of India. 3 million cubic feet of rock was chiseled away to complete the temple buildings, life-size elephants, and sculptures. It is estimated that to carve the Kailash Temple, 200,000 tons of rock had to be removed by thousands of workers for over 150 years.

Archaeologists estimate it took thousands of skilled stone cutters seven to eight generations to construct this temple. Kailash temple is 81m long, 47m wide, and 33m high.

In recent history, Tajmahal was built by Shahjahan in the memory of his wife. Human being always expresses his creativity and skill through the construction of that time.

6.4 BEAMS AND ARCHES

Stones are weak in tension therefore in old temples you will find column are placed close to each other. Construction of big hall was not possible with stones as beam.

When man learnt to built arch by arranging the stones, ample progress was made in the construction process. By using this method, Roman people showed their creativity in construction. Afterwards Arab used the same skill in the construction of the mosque. Arch in our temples and village gates were also constructed by this method. About 600 to 700 years ago in Europian started building elliptical arches instead of rounded one.

In stony roof and beams, pressure comes on the beam due to the weight of the roof and it bends at the center. Therefore, limited distances were kept between the two beams. In case of circular arches, pressure is equally distributed and hence, we can keep more distance between the columns. In elliptical arches we can increase this distance further and can construct the stony concave roof.

TRUSSES

People realized that wood and steel can bear the tension & pressure easily. Therefore, use of Wood and steel started in construction.

Architects recognized importance of triangular frames in construction. Triangular frames are stronger than square or pentagon frames.Therefore, architects started making the truss for the roof by joining different sized triangles for small houses. People started using roof tiles on this truss with the support of vertical and horizontal planks. Afterwards method of putting steel or cement sheets on the roof got developed.

INTEXT QUESTIONS 6.1

State True or false:

i) Stone is strong therefore, always preferred material for beams. ( )

ii) Man started constructing big halls after he learnt to build arches. ( )

iii) Modern construction is far advanced and do not use any of the old construction techniques. ( )

iv) Triangular frames are stronger than square frames. ( )

6.5 TYPES OF CONSTRUCTION

Following two are the most commonly used construction methods :

1. Wall bearing structures
2. RCC structures

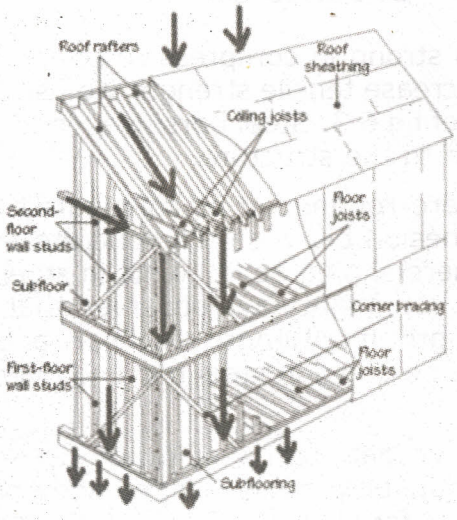


Fig: 6.2 Wall bearing construction

(1) Wall bearing construction

In wall or load bearing construction, all load of roof and structure is carried by walls down to its foundation ref. fig.6.2. This type of construction may not use supporting column or wood pillar. The size of walls needs to be bigger to carry all the loads. Further, there is limitation to construct long walls at a stretch. This is typically used in residential or 1–2 storied buildings. This is economical than RCC structure or steel frame structures.

(2) Reinforced cement concrete (RCC)

Most of the high rises building uses RCC techniques.

In an RCC framed structure, the load is transferred from a slab to the beams then to the columns and further to lower columns and finally to the foundation which in turn transfers it to the soil.

The walls in such structures are constructed after the frame is ready.

Fig: 6.3 Image showing laying process of cement concrete with steel bars in rcc coloum

Cement concrete is strong in compressive strength but weak in tensile strength. To increase tensile strength we use mild steel bars in cement concrete. Ref.fig 6.3. Steel bars used in cement concrete provide good strength to the structure.

Usually steel bars are roughened or corrugated to further improve the bond or cohesion between the concrete and steel. Care must be taken that there should be no joints in steel bars used for RCC work. Therefore, you might have observed that steel used for RCC work is long in length. If full length steel bars are not available, proper overlap should be given in steel bar and overlap should be staggered.

A care must be taken that steel should not disturb during concreting. Steel rods should be properly binded and proper planks or plates must be provided for walking. Curing of all concrete is done at least for 20 days.

Following are the different names of the structural elements in a building as shown in the figure

Slab: A The flat ceiling of a story is called a 'Slab'.

Beam: The peripheral horizontal members supporting the slab are called 'Beams'.

Plinth Beams: The beams at ground level or plinth level (the lowermost habitable level) are called 'Plinth Beams'.

Columns: The vertical members supporting the beams are called 'Columns'.

Foundation: The system below ground transferring the entire load of the structure to the soil is called 'Foundation'.

Cantilever: A slab or a beam supported only on one side and projecting horizontally on the other side is called a 'Cantilever' slab or beam e.g. balconies, lofts and canopies.

6.6 STEEL FRAME STRUCTURES

In big buildings, a steel frame is constructed as a skeleton of building. All loads of roof and floor are transmitted to beams and girders. Walls in these structures do not carry load of the structures.

6.7 FOUNDATION

Foundation is in direct contact with soil and transmits load of complete structure to soil. If foundation is weak then there is danger that walls will collapse or tilt due to load of the structure.

Generally, foundation is below the ground level. Depth of foundation depends on type of soil and its bearing capacity, depth of ground water table and the size of structure.

To allow removal of top loose soil and variation in ground level, the best recommended depth of foundation is from 1.00 meter to 1.5 meter from original ground level.

Following are the different steps in Foundation Work:

1. Excavation of soil for foundation.
2. Laying out cement concrete.
3. Laying Brick work up to plinth level.
4. Refilling of earth around the walls
5. Refilling of earth in the building portion to the required height.

INTEXT QUESTIONS 6.2

Fill in the blanks:

i) Long form of RCC is _____.

ii) Two common types of construction methods are _____ and _____.

iii) _____ transmits load of entire structure to soil.

iv) The beam at ground level is called _____.

v) A slab supported only on one side is called _____.

BRICK WORK

When laying bricks, the manner in which the bricks overlap is called the bond.

1) **Stretcher bond** (also known as running bond) is the most common bond. Ref Fig 6.4 (a) It is easy to lay. It is entirely composed of stretcher bricks, set in rows that are offset by half a brick as shown in the figure.

   Stretcher bond is generally used to build a single-brick wall.

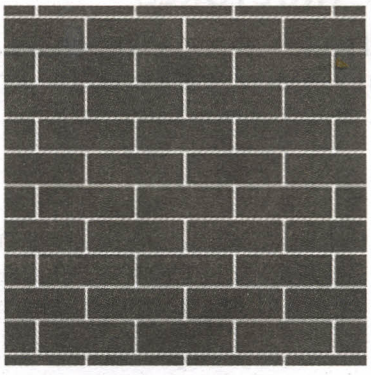


Fig: 6.4(a)

2) **English bond** is shown in the figure 6.4(b). This produces a solid wall that is a full brick in depth. English bond is fairly easy to lay and is the strongest bond for a one-brick-thick wall.

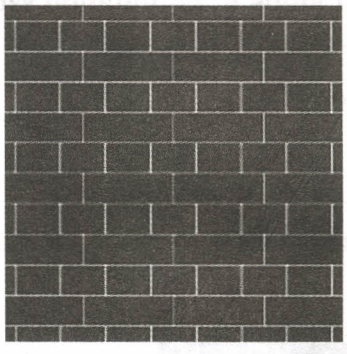


Fig: 6.4 (b)

3) **Header bond** (also known as Spanish bond) was a very common bond for bearing walls Ref fig 6.4(c).

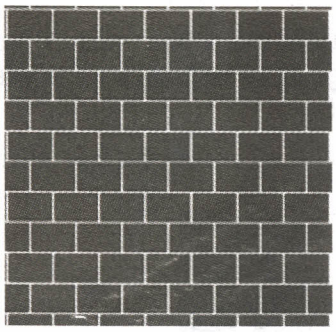


Fig: 6.4(c)

4) Flemish bond-Flemish bond, also known as Dutch bond, has historically always been considered the most decorative bond. Ref Fig 6.4(d)

Fig: 6.4(d)

5) **Rat-trap bond**, also known as Chinese bond.

The air cavity gets created between the bricks hence the name 'Rat – trap bond'. It shown in fig 6.4(e). It requires less number of bricks than a solid wall. Air cavity helps in keeping the building cool.

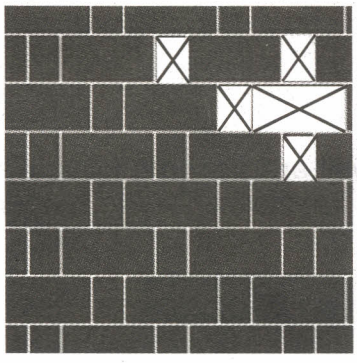


Fig: 6.4(e)

6.9 USE OF PLUMB, LEVEL TUBE AND SPIRIT LEVEL

In any type of construction, accurate measurement of construction is most importance. It is necessary to maintain the right angle direction. Tools used in construction are discussed here.

1) Plumb – bob

A **plumb** is a weight, usually with a pointed tip on the bottom that is suspended from a string. It is used as a reference line for leveling vertical length. Ref fig 6.5(a)

Mesons used this method to ensure that their constructions are perfectly upright

Fig. 6.5 (a) Plumb

2) String Line

You must have seen meson using string for laying bricks of foundation. A line is described by two points, the start point and the end point, and the shortest distance between two points is a straight line. A mason uses a string line between two points (nails or line blocks etc.) and he pulls the line tight to get it the shortest distance, to make it straight, with no sag. He takes this string as a reference to complete his work.

3) Spirit level

It is used to check the horizontal level of construction. The bubble in the tube should be at the center to make the level horizontal. Ref. fig 6.5(b)

Fig:6.5(b) Spirit Level

4) Water tube

To check all points of wall are at same level, a simple water tube is used. It uses the simple principle of 'water remains at the same level'.

INTEXT QUESTIONS 6.3

Match the following:

	A	B
i)	Spirit level	leveling horizontal level
ii)	Plumb	Cooler houses
iii)	Rat trap bonds	Single brick wall

iv) Spanish bond	Leveling vertical length
v) Stretcher bond	bearing wall

6.10 FERRO CEMENT CONSTRUCTION

In Ferro cement construction a frame of chicken wire mesh is made. A mixture of cement, sand, and water is spread over the frame. Then the Ferro cement structure is allowed to cure for 28days. Advantages of Ferro cement structures are as follows: i) Despite the small thickness, Ferro cement structures are strong ii) Economical iii) It requires less skill to manufacture iv) Safe in earthquakes. Now a days other materials viz fiber, bamboo etc are used in place of chicken mesh to reduce the cost.

Structures for strength

In this section, we will discuss commonly used arrangements to get the proper strength for construction. In nature, all animals have skeleton. They are able to take up their own weight and do movement due to skeleton. In tree trunks fibers are connected to each other using lignin. This makes wood strong. Man has learnt from nature and made use of this structure in imaginative way for their benefit.

There are two different kinds of structure:

1 Skeleton type

Flexible limbs and parts of animal body are supported by a bony skeleton (frame). Similarly man has learnt to construct frame-work to support weak substances. Viz. Man has constructed trusses,

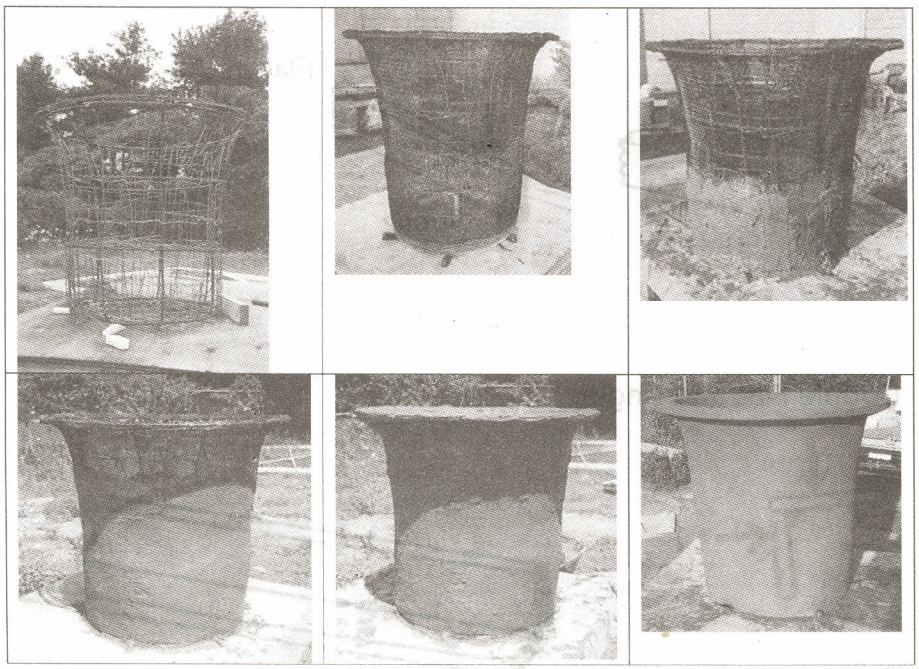


Fig:6.6

beams, and columns of steel or wood, to support roof made of grass or mud-tiles. Similarly steel frames filled with concrete become stronger than either.

2 Fiber method

Fiber's are often flexible but they are strong in tension. If the fibers are combined together by an adhesive substance then it can produce strong material.

If fiber is added to brittle substances then its brittleness decreases. For example :

i) Cement is brittle; to overcome that weakness asbestos is added to cement to make strong asbestos- cement sheets.

ii) Plastic is breakable. If glass fiber is added to it then it turns into strong FRP.

iii) Cement Mortar is easily breakable. But if thin chicken-mesh is put into mortar that makes it a strong Ferro cement.

iv) Similarly, fiber is added to tar to make it into durable roof-sheet.

It is not always necessary to use two or different materials to create strong objects. Strength can be obtained by arranging the same material in different ways. We can learn this from following comparisons:

1) Flat and Rod – Judge Strength of flat from all direction.

Rod is strong in all direction but flat is stronger in only one direction.

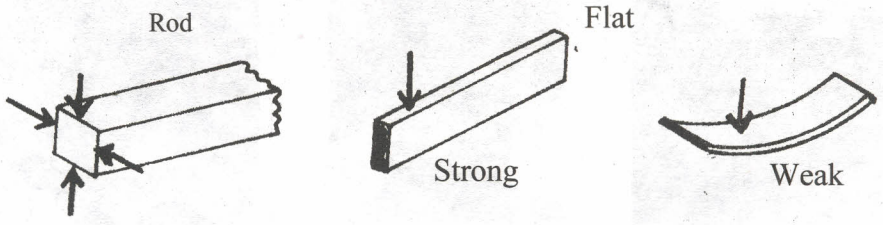


Fig: 6.7(a)

2) Double Flat and Angle.

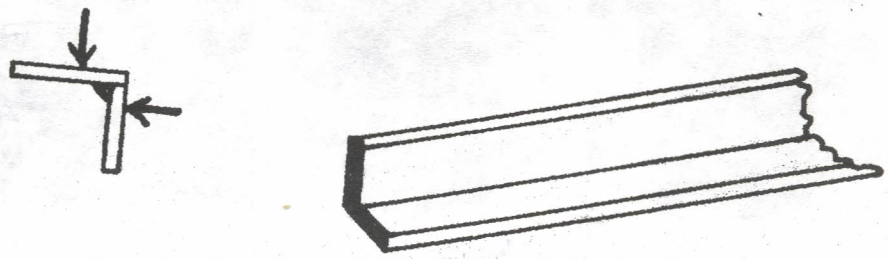


Fig: 6.7(b)

3) Twisted Flat

Fig: 6.7(c)

4) Rod and hollow Tube

If the diameter of cross section is same, Hollow tube is stronger than the rod.

Fig. 6.7 (d)

5) Triangle and Rectangle: Between the same size of triangle and rectangle, triangle is stronger. Under load triangle will not change its shape.

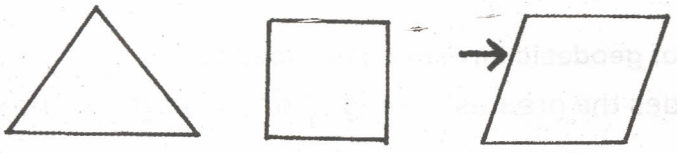
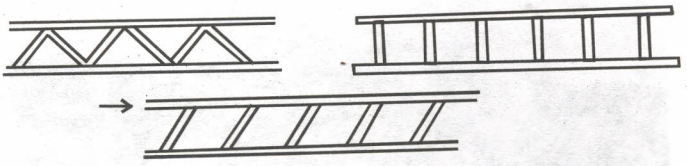


Fig: 6.7(e)

6) A joint in fig 8(f) be made stronger as shown in the fig 8(g).



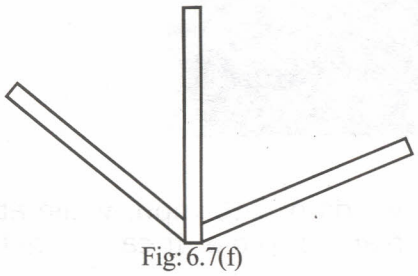


Fig: 6.7(f)

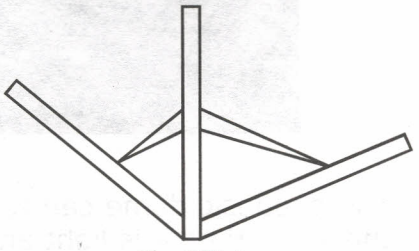


Fig: 6.7(g)

7) Truss

Different types of trusses are shown in the figure. Different triangles are joined together to get the required shape and strength.

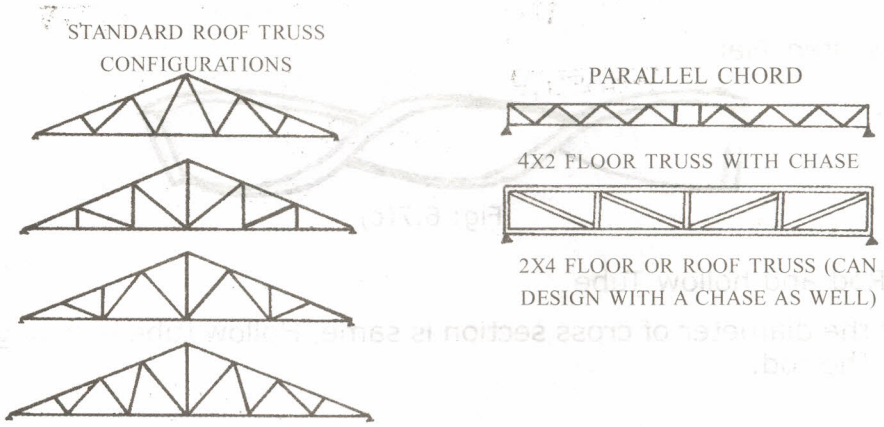


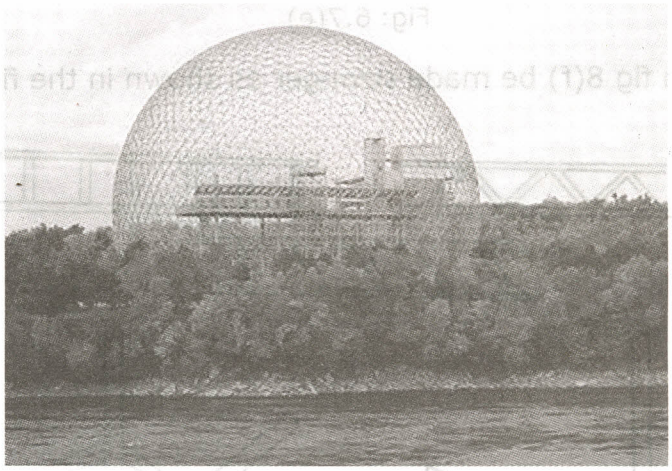
Fig: 6.8

8) Geodesic Dome structure

Architect "Buck Minster Fuller" had shown the method of constructing a geodesic dome structures. In which round building is constructed by connecting frames. In this type of construction, wall and roof are not separately constructed but both are combined in single round. In this way buildings can be constructed with large diameter without any column.

Advantage of geodesic structure is as follows :

- It provides the greatest strength for the least volume of weight.



- The geodesic dome can withstand winds of 210 mph, while at the same time it is light and easily transportable. It can be put up in hours.
- A geodesic dome can withstand cyclones and earthquakes far better than conventional buildings.

The geodesic dome is the only structure that actually gets stronger, lighter in density and cheaper per square foot with size.

Cost effective housing structures

Low cost housing does not mean inferior or low quality housing. Many organizations worked on cutting down construction cost by using alternatives to conventional methods and inputs. It is about the usage of local and indigenous building materials, local skills, energy saver and environment-friendly options. Famous architect Laurie Baker said "a cheaper house is not just for the poor. One can cut unnecessary expenditure even while building beautiful houses'.

INTEXT QUESTIONS 6.4

Write True or false:

i) Despite smaller thickness ferrocement structure are strong.

ii) Cement can withstand tensile load.

iii) If diameter of cross section is same, hollow tube is stronger than the rod.

iv) It is necessary to connect two different materials to create strong object.

v) Geodesic domes are preferred in earthquake and cyclone prone region.

6.11 WHAT YOU HAVE LEARNT

In this chapter, you studied history of construction. You learnt about different types of construction. You studied different elements of RCC construction. You learnt about different ways to lay bricks. You studied basic instruments used in construction. Now you know about different structures used to get strength for construction.

6.12 TERMINAL QUESTIONS

1) Write reason:

   i) In old temples, stone columns are placed close to each other.

   ii) Arches are used to build big halls or bridge.

   iii) Triangle is more stronger than square under load.

2) Write different simple instruments used by meson.

4) Write down advantages of ferrocement construction.

5) Write down advantages of geodesic structure.

6.13 ANSWER TO INTEXT QUESTIONS

6.1 i) False ii) true iii) false iv) true

6.2 i) Reinforced cement concrete ii) wall bearing structure, RCC structure iii) foundation iv) plinth beam v) cantilever

6.3

	A	B
i)	Spirit level	Leveling horizontal level
ii)	Plumb	Leveling vertical length
iii)	Red trap bonds	Cooler houses
iv)	Spanish bond	bearing wall
v)	Stretcher bond	Single brick wall

6.4 i) True ii) False iii) True iv) False v) True

SUGGESTED ACTIVITY

- Observed different types of trusses used in your surroundings. Draw sketches of trusses used in old houses, poultry shed, tin roof shed, polyhouses.

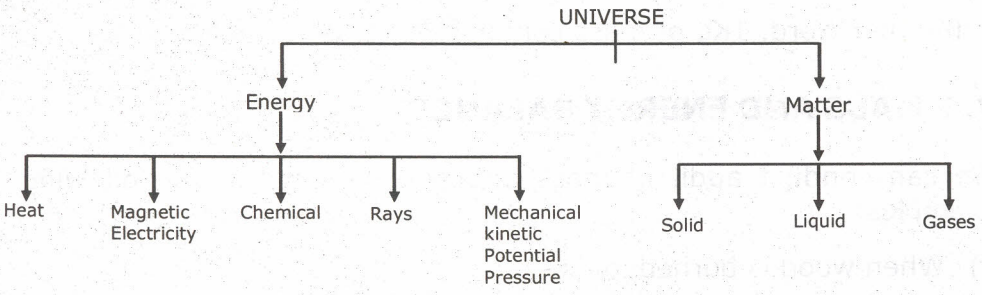
7

MASS AND ENERGY

7.1 INTRODUCTION

We are the part of universe. Our earth is in solar-system and our solar system is in a galaxy. There are many galaxies in the universe. All that exists is in the universe. The universe is endless. The universe cannot be created or destroyed. The universe is made up of matter and energy.

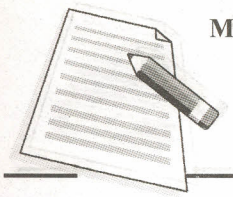
There are different types of energy, shown as above. Matter in the universe is available in solid, liquid and gases states. It is not possible to create or destroy total of matter and energy that exists in the universe. We can change matter and energy from one form to another.



7.2 OBJECTIVES

After reading this lesson you will be able to-

- Understand the law of conservation of mass and energy;
- Calculate efficiency of some of the daily applications.



7.3 LAW OF CONSERVATION OF MASS AND ENERGY

Energy can neither be created nor destroyed. Only one form of energy can be converted into another form is law of conservation of energy.

Einstein showed relation between mass and energy. It is expressed by the formulae : $E = m \times c^2$ (m = matter in Kg, C = speed of light 3×10^8 in m/s^2).

He showed that mass and energy can be converted into each other. But it is not possible to convert matter into energy in normal conditions. It can be done in nuclear reactors.

How much energy is stored in 1 Kg of mass?

$E = m \times c^2$ (m = matter in Kg, C = speed of light 3×10^8 in m/s^2)

$E = 1 \text{ kg} \times (3 \times 10^8)^2$

$= 1 \times 9 \times 10^{16}$ Joules

This means 1 kg of mass can release 9×10^{16} Joules of energy.

You must have confused with the above numbers. Let's calculate, what such amount of energy means?

First convert it into calories. 4.2 Joules = 1 calories

Therefore, 9×10^{16} Joules = $(9 / 4.2) \times 10^{16}$ calories

= approx. 2×10^{16} calories

Therefore, 1 Kg of mass contains approx. 2×10^{16} calories

Generally, 1 gm of oil contains 10000 calories.

1 kg of oil contains = $10000 \times 1000 = 10000000 = 10^7$ calories

Therefore, to get 2×10^{16} calories energy we will need 20 lacks tons of oil.

In other word, 1Kg of mass contains 20 lacks tons of oil.

7.4 MASS AND ENERGY BALANCE

We can conduct audit of mass and energy. Let's study following examples:

1) When wood is burned in air–

100gm of wood when burned in air, it produces 2g. of ash. Where did the balance of 98 g. go?

If you carry out detailed investigation, you may find some gas and vapour goes into air. In the above example, we found 143.79g. of Carbon dioxide (CO_2) and 58.9g of water vapour gets generated in the process.

The material balance is written as follows:

100 gm wood → 2 gm (ash) + 143.79 gm (CO_2) + 58.8 g (water) i.e total 204.5g.

100 gm wood → 204.5 g of above materials

It is quite clear that 104.5g other material gets added in the burning process from outside. The other material is nothing but oxygen (O_2) gas.

2) To measure water contain in the substance.

For measuring water content in any substance, first measure total mass of the substance, and then dry it, completely. After drying, take the weight again. The difference between the weight is the weight of water that has gone off.

INTEXT QUESTIONS 7.1

Fill in the blanks:

i) When a chapatti weighing 70g was put in the pan and roasted, the weight became 60g. The water vapour removed is _____ g.

ii) E = m × _____

7.5 EFFICIENCY

Efficiency is a measure of 'how effectively the resources are used?'. Ratio of output to input of any machine is called efficiency. It is usually calculated in percentage therefore

$$\text{Percentage efficiency} = \frac{\text{Output}}{\text{Input}} \times 100$$

Calculate efficiency of some of the daily applications

1) A pump set is consuming 5 hp energy while lifting water. It needs 1 lit of diesel in one hour. Calculate efficiency of the pump set. (1 lit diesel contains 42 MJ energy i.e. 42×10^6 J)

Step I: Power input = Input to pump set is 1 lit. diesel = 42×10^6 Joules

Step II:

Output of pump set = 5 hp

Lets convert hp to joule as follows:

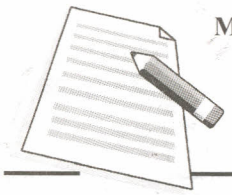
1 hp = 746 w

Therefore, 5 hp = 746 × 5 = 3730w

Watt is joule / second

This means energy output per second is = 3730 J/s

The pump was running for 1 hour.



1 hour = 60 min. = 3600 second

Energy output in one hour = 3730 × 3600

= 13428000 Joule = 13.42×10^6 J

Step III:

The efficiency of the pump = (Output / Input) × 100

$$= \frac{13.42 \times 10^6 J}{42 \times 10^6 J} \times 100$$

= 31.95 %

This shows efficiency of pump set is 31.95%

2) One Lit. milk was heated by 70° C. The weight of milk after heating was 1025g.

The 30g of kerosene was used to heat this milk. Find out the efficiency of the system and how much energy spent in heating the pot and surrounding air.

{Data: Milk lactometer –30, Energy needed to convert 1gm of water into vapour =540 Cal, kerosene has energy ~ 10000 cal/gm}

Step I: Power Input =

Total 30g kerosene was used.

It is given that Kerosene has energy = 10000 cal/gm.

Energy input from kerosene = 30g × 10,000 = 300,000 cal.

Step II: Calculation of Energy output

Write down the energy, mass balance

Milk has a lactometer reading of 30. This means density of milk is 1.030 or 1 lit of milk weighs 1.030kg. 1025g of hot milk is obtained. Therefore 5 g of water became vapour.

1lit (1.030 g) of milk → heated → 1025g of hot milk + 5 g of vapour

The energy supplied by kerosene is used to increase temperature of milk and to convert water into water vapour.

a) 1 cal of energy is needed for 1°C raise in temperature.

Energy needed to heat the milk = mass in g × rise in temperature

Here temperature of 1.030Kg or 1030g milk is raised by 70°C.

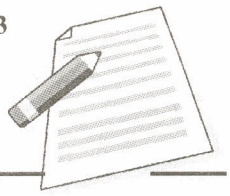
Therefore calories needed to raise the temperature of milk

= Mass × temperature of milk

= 1030 × 70 = 72100 calories

b) 540cal needed to convert 1gm of water into vapor.

Therefore, to convert 5 g of water into vapour. = 5 × 540 = 2700 calories



Total energy output = Energy needed for milk + energy needed to convert water into vapour

= 72100 + 2700 = 74800 calories

Total energy gone heating pots and surrounding air = Energy supplied – energy utilized for heating milk and water vapour.

= 300,000 – 74800

= 225200 cal

Therefore, 225200 cal. of energy must have been lost in heating the pot, air etc.

% Efficiency = (Output / Input) × 100 =

= (Useful energy / Total energy supplied) ×100

= 74800 / 225200 × 100 = 0.33 × 100

% Efficiency = 0.33 × 100 = 33 %

This means only 33% energy supplied got utilized while heating the milk.

7.6 WHAT YOU HAVE LEARNT

In this lesson, We know the Mass & Energy and understand their relationship. We learned that mass contains tremendous energy but it cannot be easily obtained. The conversion of mass to energy can be taken place in nuclear reactors. You also learnt to write mass and energy balance. You also learn to calculate efficiency of daily appliances like diesel engine and stove.

7.7 TERMINAL QUESTIONS

1) A diesel engine does 15MJ of work in 1 hour. It consumes diesel 1 lit diesel. (1 lit diesel has 42MJ energy). Calculate efficiency of the pump.

2) To prepare a rice, 9000 calories are required. It consumes 40gm of kerosene. Find out the efficiency of the system. (1 gm of kerosene contains 10000 calories)

7.8 ANSWER TO INTEXT QUESTIONS

7.1 (i) 10g

(ii) c^2

8

QUALITY AND AESTHETICS

8.1 INTRODUCTION

In today's world of competition, 'Quality' is the key word to remain in business. It is closely related to 'Customer Satisfaction'. It is necessary to learn and be cautious about quality for doing well and doing it better everyday.

It is very important to present a product in presentable form. A finished and good looking product gets more prices in the market.

8.2 OBJECTIVES

After reading this lesson, you will be able to:

- understand the meaning of the world 'quality'.
- ensure the quality.
- Do the painting and packing of the product.

8.3 QUALITY

Quality is always defined as meeting customer's expectation. Quality is always seen from the eyes of the customers. There is a quality in everything we do in our life. Commonly used terms with reference to Quality are Quality of manufacturing, Quality of performance, Quality of product, Quality of compliance with dimensions, quality of design, Quality of service, Quality of life.

Quality is not only limited to product manufacturing, it is applied everywhere. For example a good teacher will provide quality teaching to students, a government officer will provide quality service by becoming more sympathetic to the problems of citizens and try to solve their difficulties. A doctor will provide quality service by prescribing appropriate medicine and moral support to patient.

Mahatma Gandhi has famously said "A customer is the most important visitor in our premises. He is not dependent on us. We are dependent on him. He is not an interruption in our work. He is the purpose of it. He is not an outsider in our business. He is part of it. We are not doing him a favour by serving him. He is doing us a favour by giving us an opportunity to do so."

All our actions must be such to achieve customer satisfaction. Remember, no business will grow or survive if proper service is not given to its customers.

Quality Assurance

The manufacturing is done broadly in 2 ways to get the quality in our work follow the basic rules:

1) Define the customer need

Discuss with customer and find out his exact requirement. Suggest him alternatives available. Do not hide disadvantages or possible problems.

Prepare a Job card and take customers signature on it. Following things must be incorporated into the job card.

- Product title
- Sketch with dimension
- All material specification, dimension
- Coloring, packaging and forwarding instructions
- Possible delivery time
- Payment terms/Advance received etc. on the job card.

2) **Draw up an action plan:** This will include what needs to be done, who will do it, how it will be done, and when. Check your specifications from design point of view. If need revision, please do it at this stage. Inform customer about the changes and take his approval.

3) Select proper material, check for warrantee for the bought out parts, and ensure quality for subcontracted material.

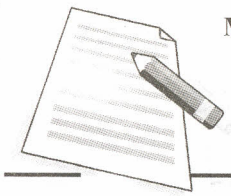
4) Implement-Do the work. If you need to make any deviation, inform customer about possible changes.

5) Housekeeping – keep the workplace clean to attract customers.

6) Review–always take review of the work in progress.

7) Quality check – please check the product for the final accuracy, performance etc.

8) Finishing: Aesthetic is very important. Look of the product will create impression about product.



9) Packaging: Make packaging as attractive as possible. Consider the transportation, handling issues, delicacy of instrument etc before shipping.

INTEXT QUESTIONS 8.1

State True or False:

i) Quality is defined as meeting customer expectation. ( )

ii) All our action must be to maximize profit and selling goods. ( )

iii) Customer depends on us. He must accept our terms. ( )

iv) If you make any deviation from the specification, keep it secret. ( )

v) Quality also includes quality in your appearance, language and behavior. ( )

8.4 PAINTING

Painting is the practice of applying colour to a surface such as paper, canvas, wood, glass, concrete etc. Painting gives the product its appearance. It is also useful to increase durability of product, prevent rusting etc. Some of the paint has water proofing, heat resistant capabilities. Painting is cheapest way to give fresh look to the old things.

Types of paints

1) **Distemper:** Distemper paint has been used primarily in the painting of interiors. It has a wonderful matte finish and a soft feel to it.

2) **Oil Paint:** Oil paint is useful for glazing and impasto techniques.

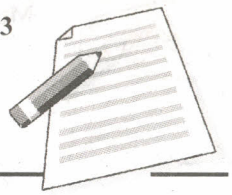
3) **Acrylic Paint:** Acrylic emulsion is the binder in acrylic paints. Acrylics are water soluble, but dry to a water insoluble and impenetrable flexible film. They are very fast drying and used for different combination of texture.

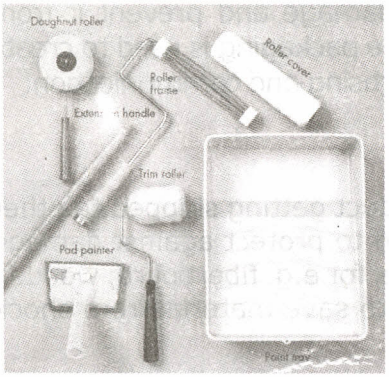
8.5 BRUSH

Selection of proper brush is very important for efficient and quality painting. Following are the tips for selection of proper brush:

1) The more flags, or split ends, the better the brush and its paint-spreading capabilities.

2) A good brush may lose a few bristles while working; a bad brush will lose many bristles.





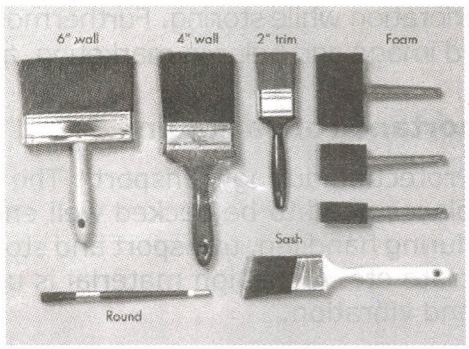


Fig: 8.1 Brushes

3) Find a brush with long, tapered bristles, particularly on narrow brushes.
4) Bristle length gives you flexibility to paint into corners and around trim.
5) Choose smooth, well-shaped handles of wood or plastic that fit in your hand comfortably.

Following are types of brushes as, shown in fig.8.1:

- Wall. This type spreads the most paint over the most surface.
- Trim. A 2-inch-wide trim brush is ideal for woodwork and for "cutting in" around windows, doors, and corners.
- Sash. A sash brush has an angled bristle end. It is useful for painting around windows.
- For flat surfaces, roller is used.

Painting practice

1) Clean up the surface. Fill up the gaps on the wall / article.
2) To save other items from falling of paint drops on them covered the area with old newspaper.
3) Never dip a brush more than about one-third the length of the bristles into the paint. Otherwise it will become impossible to clean.
4) One of the most important aspects of a successful paint job is keeping things clean as you're working. It's also important to clean equipments as soon as you're finished and to wipe up any drips as soon as they occur.
5) When the work is over, clean the brush. Shake out the excess solvent or water, and comb out the bristles.

8.6 PACKAGING

Packaging is enclosing of a physical object, typically a product that will be offered for sale. Packaging is the outer wrapping of a product. The purpose of the packaging is to make a product readily

sellable as well as to protect it against damage and prevent it from deterioration while storing. Furthermore the packaging is used to create brand image and helps in marketing, advertising and communication.

Importance of packaging

1. Protection during transport : The product getting shipped to other places need to be packed well enough to protect against damage during handling, transport and storage, for e.g. fiberboard, wooden crate etc. A cushion material is used to save material from shock and vibration.
2. To protect the product from weather.
3. To protect against dirt, insect etc.
4. Communication: A package must communicate what it sells. It must inform consumer about the product, how to use it and other utility information. It provides information including: quantity; price; lot number; manufacturing place, manufacturing date, colour; and merchandising and premium data.
5. Consumer Packing: It is mainly for marketing and attracting consumers.

INTEXT QUESTIONS 8.2

Fill in the blanks:

i) _____ is the cheapest way to give fresh look to old things.

ii) _____ Paint is used to paint interior.

iii) Roller is used to paint on _____ surface.

iv) _____ is to protect goods during transportation.

8.7 WHAT YOU HAVE LEARNT

Quality of product is judged from all the processes involved in the manufacturing of product for selling them to customer. A successful business has to remain concerned about customer satisfaction and therefore quality. Quality in design, manufacturing, painting and packaging are important to make customer happy. Most important thing is the quality of service you give to your customer. You also learnt about paints and packaging in this chapter.

8.8 TERMINAL QUESTIONS

1. Write down things that must be incorporated on the job card.
2. Write down steps in carrying out painting job.

3. Why packaging is important?

8.9 ANSWER TO INTEXT QUESTIONS

8.1 i) True ii) False iii) False iv) False v) True

8.2 i) Painting ii) Distemper iii) flat iv) Packaging

SUGGESTED ACTIVITY

Observe packaging of following goods available in the market

- Food products
- Furniture
- Glassware
- Clothes
- Grocery items
- A food served in good restaurant

9

ACCOUNTS

9.1 INTRODUCTION

Exchange of goods and services with money are happening in every business. An entrepreneur must be aware, if he is making profit or loss. Maintaining accounts of all transaction is very much important in daily business. It is also required for audit and Govt. taxation purpose. Banks need audited information while evaluating loan proposals. Therefore, it is very much important to learn about accounts to become successful.

9.2 OBJECTIVES

After reading this lesson, you will be able to :

- know good accounting practices;
- learn about estimate, quotation, budget, cash-flow statement, balance sheet and profit and loss account of business.

9.3 TIPS FOR MAINTAINING ACCOUNTS

Following tips are necessary for maintaining accounts:

1. Always keep records of all transactions.
2. Take a bill for all purchases and file them in separate file.
3. Please ensure you have tax paid bill for the purchases. If bill is not tax paid then you may not able to use it as proof of purchase. This means you will not get guarantee or warranty against the purchase.
4. Give receipt of all the money/cheque received.
5. As far as possible use cheque facility for all transactions. This will help in preparing your financial record with the bank. It is very important proof for banks to give you future loans.

6. Tally your accounts periodically and any discrepancy must be sorted out immediately.

9.4 BUDGET

Before starting any work, budgeting of the expenses is necessary. It is very useful to us. Its uses are givan below –

1. If activity-wise funds required are known, provision for funds can be made.
2. If there is two or more option, best option can be selected.
3. Area's of cost reduction can be found out and worked out.

Budget helps to understand, deficit or surplus in income. Every year finance minister presents budget for the country. If there is deficit then taxes are raised to meet the deficit. Similarly every organization makes budget. It is advisable that every household should have its budget.

Following are commonly used budget types:

i) **Estimation -** When customer has not yet made up his mind for purchase and studying option. Businessmen give him estimate. It is approximate calculation of raw material, labour and money required for a particular service or task or product manufacturing. The details are likely to change as per the material used, process performed or market situations. Estimate is to help customer to select appropriate option.

ii) **Quotation -** A time-bound, written surety about the price of certain service or Product, given to the customer based on the estimation of that particular Service or Production process. Sometimes, quotations assure a guaranteed sale for the seller and assure a guaranteed supply to the customer. Quotation helps customer to select best option for him.

For example: Ashish Shinde decided to construct a house. He got two quotations from contractor.

1. Mr Patil contractor :

   Material: Rs.50000/-

   Labour: Rs.20000/-

   Painting: Rs.4000/-

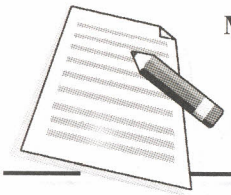
   Electrical fitting: Rs.6000/- (standard brand electric fitting)

   Plumbing: Rs.4000/-

   Total: Rs. 84000/-

2. Ms. Shraddha contractor :

   Material: Rs.48000/-



Labour: Rs.20500/-

Painting: Rs.4000/-

Electrical fitting: Rs.4500/- (normal make)

She does not take plumbing work.

Total cost without plumbing: Rs.77,000/-

Ashish Shinde wanted to have standard electric fitting with standard accessories. He asked Ms. Shraddha to provide electric fitting of standard make. This will increase the cost by Rs.1500/-. Similarly, Mr Ashish found there is local plumber, who does the plumbing job on labour rate basis. His labour charges was Rs.500/-. Material cost of plumbing is Rs.2700/-. Therefore, Mr. Ashish gave contractor to Ms. Shraddha with following modification:

Material: Rs.48000/-

Labour: Rs.20500/-

Painting: Rs.4000/-

Electrical fitting: Rs.6000/- (standard make)

Plumbing work from outsider: Rs.2700/- (material) + Rs.500/- (labour) = Rs.3200/-

Total cost: Rs. 81700/-

Thus quotation helps us in taking decisions.

iii) Cash Flow Statement

While executing a job, customer generally pays at the time of delivery. To meet payment of supplier or for labour payment, entre

Month	November	December	January	February
Expenses	Order for Birds- 540.00	Cage purchase- 2000.00 Food-1280.00	Medicine - 200.00 Bird of batch 2 - 540.00 Received batch 1	Food - 1280
Revenue	Initial investment -5000.00			Sold batch 1
Balance	5000.00 – 540.00 = 4460.00	4460.00 – 3280.00 =1180.00	1180.00 – 740.00 = 440.00	440.00 – 1280.00 = -840.00

Month	March	April	May	June	July
Expenses	Order for batch 3 - 540.00	Food - 1280.00	Received batch 3	Food - 1280.00	
Revenue	Batch 1 - 2128.00	Sold batch 2	Batch 2 - 2128.00	Sold batch 3	Batch 3 - 2128.00
Balance	-840.00 -540.00 + 2128.00 740.00	740.00 – 1280.00 – 532.00	-532.00 +2128.00 1596.00 – 540.00 1056.00	1056.00 – 1280.00 – 224.00	–224.00 + 2128.00 + 1904

Table: 1

ɜneur has to spend money. A statement showing timetable of ɻuirement of funds and receipt of funds is called as cash flow.

It is a schedule showing cash received and paid over a certain ıe period. We will study cash-flow statement using a example.

For example: A Poultry Farm owner needs to prepare a Cash ıw Statement, based on the following information -

If an order of a batch of Broiler birds is given 2 months in advance then only the fulfillment is assured and full payment needs to be done at the time of booking.

The sale amount is received within 15 days from the day of sale.

The order for the Poultry food is to be given 15 days in advance.

Medicines and cages are available immediately.

ɜnce, the owner prepared a Cash Flow Statement as follows ɔle 1.

ıe conclusions based over this Cash Flow Statement are:

Even though the transactions begin in January, he has to invest 2 months in advance, i.e. in November.

Even though at the end of a session the business seems to be in profit, there are times of deficiency (at the end of months February, April, June). So if some financial provision is not made for meeting these deficiencies, the progress is bound to halt.

If this deficiency is recovered from the initial investment, in small installments, then slowly this deficiency will be ceased.

If the advance payments of food and birds is done in small installments, say, 25 % or so, and the remainder is paid at the time of receiving the food or birds, then this periodic deficiency can be avoided.

Or if all transactions are done through Bank account, due to assurance of repayment, this deficiency can be demanded from the bank on interest basis.

Thus, the Cash Flow Statement help to support the business and exɔre various means to smoothen the ups-and-downs of the business.

ıdgeting

ıdget is a list of all planned expenses and revenues. This is necessarily lated to the monetary matters. This is liable to deviate + / - 5%. e.g. ıe budget of a Yuvak Mandal is shown in table. 2 as follows -

ıis Budget reveals some options viz. arrange another program thin the Savings amount, or reduce expenses over other two

items, increase the Savings and arrange a bigger program or keep the Savings in the Bank account and get some interest etc. This way the Budget helps to plan the financial matters.

Expected Revenue		Expected Expenses	
Contribution from members	5000.00	Sports	3500.00
Donations	10000.00	Entertainment Programs	6000.00
Bank interest	2000.00	Savings	7500.00
Total Revenue	**17000.00**	**Total Expenses**	**17000.00**

Table: 2

9.5 COSTING

Costing is calculation of actual production expenses and revenues of a certain task. A **Cost-Benefit Ratio** is calculated to study whether the benefit is sufficient with respect to the Cost of the product or service. The overall costing includes:

1. Pre-production expenses (Marketing Survey, advertisement etc.),
2. The production expenses (from raw material purchase to packing of finished product, depreciation of assets, running expenses etc.) ,
3. Expenditure for Sale of the product (including VAT or other taxes, advertisement, commissions, transportation etc.),
4. Profit (Manufacturer - 10%, Distributor - 1% -5%, Wholesaler - 10% -15%, Retailer - 10% -20%)

9.6 BALANCE SHEET

A balance sheet summarizes an organization or individual's assets, equity and liabilities at a specific point in time. It gives complete picture of health of business at given point of time. It is used to understand financial health of the organization or individual.

If liabilities and payment payable are less than the assets and payment receivable at given point of time then the business is in profit.

Similarly liabilities or payment payable are more than the assets and payment receivable then the business in making loss.

The sample balance sheet is shown in table 3.

Balance Sheet (As on .....)

If business is growing then Capital + reserve fund/deposit will grow. It should increase at 10-15% every year. If capital + reserve funds are not increasing, this means you are not progressing much. If it decreasing, this means you are spending from your capital and using it to meet recurring expenses.

Liabilities	Amount	Assets	Amount
Capital		Fixed assets	
Reserve fund/Deposit		Investment (Bank, Cash..)	
Loan payable		Loan receivable	
Amount payable		Amount receivable	
Total		**Total**	

Table: 3 Balance Sheet

Example:

Balance Sheet - A Production Company's Balance Sheet is shown in table 4.

All figures are in Lakh Rs.

The Balance sheets are prepared as on 31st December of each year.

Liabilities	2007	2006	Assets	2007	2006
Share Capital	5365.00	4666.00	Immovable property	10000.00	9434.00
Reserve Fund	11856.00	9815.00	Investments	830.00	217.00
Loan	21407.00	21203.00	Loan	27798.00	26033.00
Total	**38628.00**	**35684.00**	**Total**	**38628.00**	**35684.00**

Table: 4

The Balance Sheet reveals that, the Reserve Fund is 2.5 times than the Share Capital and the sum total of Share Capital and Reserve Fund is increasing by 15% every year. This proves that the company is prospering and is able to face difficult times.

Profit and loss statement

Balance sheet shows health of the organization. Income statement also called as profit and loss statement (P&L) gives company's financial statement for particular period. This shows if the organization has made profit or loss during particular period.

Amount spend on fixed assets is not shown in the P & L statement. But interest on the capital invested is shown in the P & L statement.

Example

Mr.Sunder Patil started poultry as a side business with 100 birds. He started business with his own saving of Rs.5000/-.

In the first batch of 100 birds, he incurred following expenses –

Birds (102 nos)	=	Rs.520/-
Transportation	=	Rs.20/-
Feed 380Kg.	=	Rs.1216/- (Rs.3.2 /Kg)
Medicine / electricity	=	Rs.90/-

Birds mortality	=	7
Transportation cost to sale birds	=	Rs.30/-
Labour charge	=	Rs.100/-
Interest on capital	=	Rs.100/-
Total expenses	=	Rs. 2076/-

Sales Amount of birds =

Number of Birds × (average weight Rate)

= 95 × (1.6 × Rs.14/Kg)

= Rs. 2128 /-

Profit = Rs.2128–Rs.2076=Rs.52/-

Profit & Loss statement is shown as

Sales
+ Interest on deposits in the bank
+ other income

Total income (A)

Expenditure
Variable expenditure -
Materials+
+Consumables
+Utility viz. Electricity
+Communication

Variable cost (B)

Fixed cost –
Rent
+Interest on loan
+Salary of fixed staff

Fixed cost (C)

Total profit/Loss = (A) – (B) – (C)

INTEXT QUESTIONS 9.1

Match the following:

A	B
Estimate	Health of the organization
Quotation	Approx. estimate of price of product
Cash-flow statement	exact estimate of price of product
Costing	financial statement for particular period
Balance sheet	Actual expenses incurred
Profit and loss statement	Schedule of cash received and paid

9.7 WHAT YOU HAVE LEARNT

In this lesson, you learnt about various types of budget, estimate, quotations, cash-flow statement etc. You also learnt about balance sheet, profit and loss statement. You studied uses of account. Quotation and Costing which helps us to assess health of the transaction. Balance sheet, profit and loss account and cash-flow statement helps to bring financial discipline to the business. This helps to make the payment of supplier, labour etc with time. It also helps in regular repayment of loan etc.

9.8 TERMINAL QUESTIONS

1. Prepare a budget for making a Coconut Peeler, as per the contemporary rates -

No.	Item	Qty.	Rate	Price
1	MS Angle - 30 × 30 × 30	5.5 '		
2	MS Flat 40 × 5	3'		
3	MS q. Pipe 1.5"	2'		
4	MS Round Bar 12mm	2.5'		
5	Welding Rod	15 no.		
6	Oil Paint	50 ml		
7	Nut Bolt set	2 no.s		
			Total Material Cost	
	Labour & Depreciation		25% of Total Material cost	

9.9 ANSWER TO INTEXT QUESTIONS

A	B
Estimate	Approx. estimate of price of product

Quotation	Exact estimate of price of product
Cash-flow statement	Schedule of cash received and paid
Costing	Actual expenses incurred
Balance sheet	Health of the organization
Profit and loss statement	financial statement for particular period

SUGGESTED ACTIVITIES

1) Estimate the Sales Value of an MS Grill having following details -

   Raw material - MS square bar 12 mm,

   Outer dimensions of the finished grill - 5' × 8'

   Grid inside - a square grid of 5 × 8 squares

2) Prepare a budget for the following

   A nursery of plants.

   a) Prepare a Moorghaas of 2000 kg - 3000 kg.

   b) Maintenance of a private or school garden.

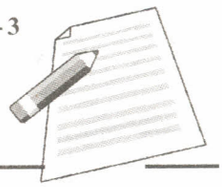
   c) To run a Poultry farm for 25 birds.

   d) Pest control of five different crops.

   e) Run a Vermi Culture plant.

   f) Management of a Dairy farm for one month.

   Study project for effects of various fertilizers on a particular crop.



10

ENGINEERING DRAWING

10.1 INTRODUCTION

Drawing is universal language. It has several a**dvantages** over textual information. It is easily understood, - even by illiterates. Engineering drawing is the language of the technicians. Like any other language, Engineering drawing has it rules and grammar. We must learn to use principles of engineering drawing to convey our ideas. Engineering drawing makes it possible to convey ideas from one person to others. It makes it possible to replicate the jobs in large numbers without any deviations. In this lesson, we are going to study basic rules of drawing.

10.2 OBJECTIVES

After reading this lesson, you will be able to:

- know different forms of drawing and their use;
- learn to select scale and draw basic shapes;
- calculate the area of regular and irregular shape.

10.3 BASIC FORMS OF GRAPHICAL REPRESENTATION OF KNOWLEDGE

Any information can be represented by any one of the following four basic forms: -

(1) Engineering drawing, (2) Geographical Maps & Contours, (3) Electrical Diagrams, (4) Flow charts & Graphs.

10.4 Basic symbols used in Engineering Drawing

Engineering drawings are usually created in accordance with standardized conventions for layout, nomenclature, interpretatition, appearance, line styles, size, etc. The purpose of drawing is to accurately and unambiguously capture all the geometric features of a product or a component. The end goal of an engineering drawing is to convey all the required information that will allow a manufacturer to produce that component. All engineering drawing uses standard symbols while drawing. The list of symbols is shown in the Table 1.

Different line styles are used to convey information such as hidden line, center line, dimension line etc. Standard symbols must be used, while drawing the maps and flow charts.

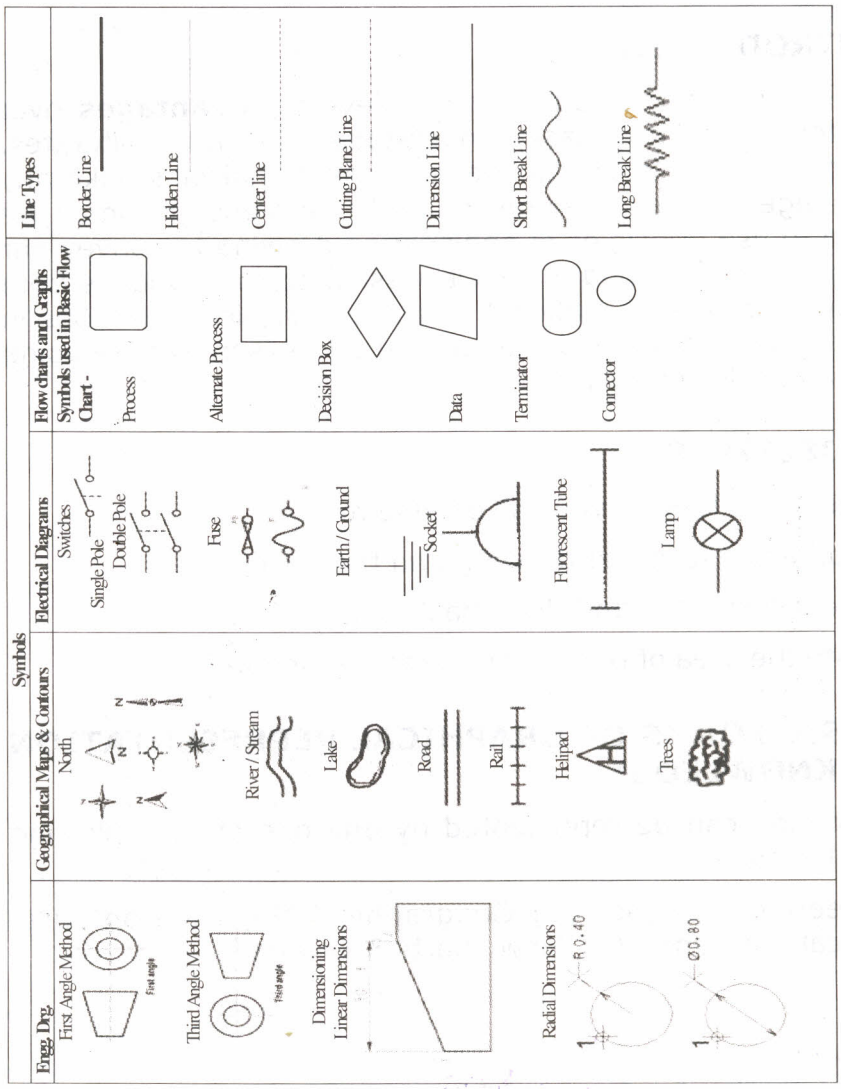
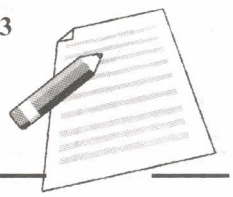


Table 1 – Symbols & Line Types



0.5 SELECTING SCALE FOR DRAWING

) Engineering drawing

draw engineering drawing or map on a small piece of paper, we eed scale. By selecting appropriate scale we can accommodate details of the object on a small piece of paper. It helps is study- g a large area.

Scale is selected by the maximum length available for drawing the paper divided by maximum actual length to be plotted.

For example if 25cm size drawing paper is available for drawing nd we want to draw engineering drawing of sketch given in the g.10-1 Maximum dimension to be plot is 300 meter on the draw- g paper. Therefore, you can select scale as —

Scale = length available on the paper / Maximum length of the bject to be draw:

= 25 cm / 300 m = 1 cm / 12 m

Therefore, scale will be 1 cm = 12 m

Please remember all dimensions on the plot has to be reduced to is scale. For make it simple, try to select the scale in integers. i.e. 2, 3 ... As far as possible do not select a scale in fractions 1.2, 4, 4.5 etc.

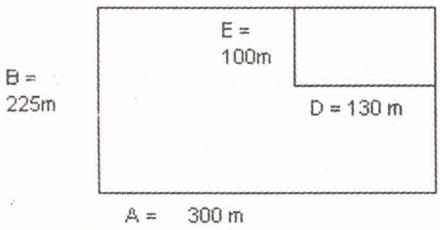


Fig: 10.1

Actual dimension in meter	Dimension reduced to scale for drawing on paper (12 m = 1 cm)
A = 300 m	300/12 = 25 cm
B = 225 m	225 / 12 = 18.75 cm
D = 130 m	130 / 12 = 10.8 cm
E = 100 m	100 / 12 = 8.3 cm

) **For Geographical maps & contours** – Distances plotted on he maps are very high. They can be hundreds of Kms. Consider aximum actual distance in the area to be mapped (A in KM) and aximum possible length available on the paper (B in cms), then,

Scale = B in cm / A in KM

For example if maximum distance in the area to be mapped is 70 KM (A) and maximum possible length available on a wide A3 size (11.693" × 16.535") is say, 35 cm (B); then,

Scale = 35 cm / 70 KM = 1 : 2 KM

This means every 1 cm on the paper represents 2 KM. Suppose, distance between two places on the map is 6 cm then the actual distance between those two places would be 12 KM.

c) For Electrical Diagrams – To communicate electric connections, position of switches and load, polarities etc electric circuit diagram is very necessary. We have seen various symbols used in electric circuits.

Scale for electric diagram is selected as in engineering drawing. For e.g. Maximum actual distance in the wiring diagram is A = 100 m and the maximum possible length available on the paper to be B = 35 cm. Then the scale would be:

B / A = 35 / 100 = 1 / 2.85

For simplicity of calculation, we can make it 1cm : 2 m That means, every 1 cm of the figure on the paper represents 2 meter of actual wiring.

d) Graphs generally have grid of 1cm × 1cm. Therefore considering number to be plotted on graphs , we can calculate the scale as shown above.

e) Flow charts - Flow Charts represent only flow of any procedure, so they don't need any scale.

INTEXT QUESTIONS 10.1

01. Select appropriate scale for plotting on the maximum drawing sheet of size 40 cm.

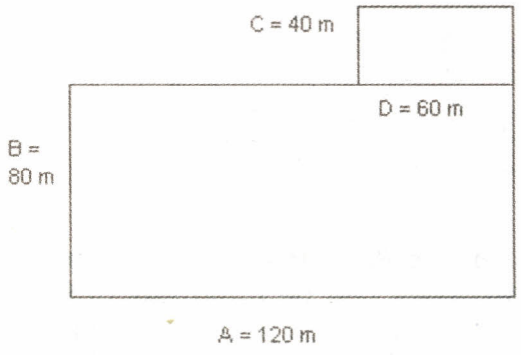


Fig. 10.2

02. Write down size of all dimensions for drawing on the paper.

Scale = _____

Actual scale	Drawing dimension
A = 120 m	
B = 80 m	
C = 40 m	
C = 60 m	

10.6 DRAWING BASIC SHAPES

Compass, scale, sets square (30 – 60, 45-45), protractor are used to draw basic geometrical shapes.

1) Triangle

We can use compass and scale to draw triangle. Various steps to draw triangles are shown in the figure. Sum of all three angles of triangle is 180^0.

Area of Triangle = base × height / 2

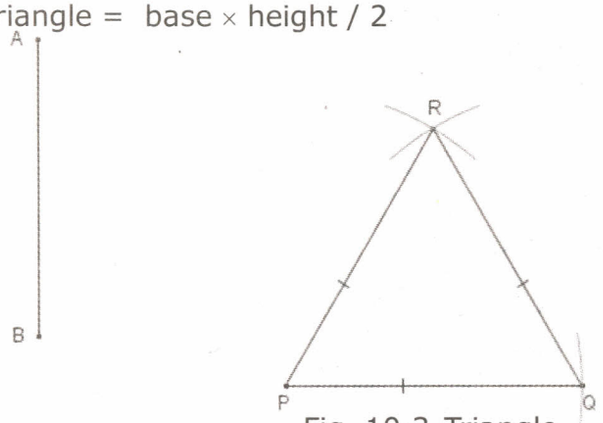


Fig. 10.3 Triangle

2) Quadrilateral

Quadrilateral has four sides. Sum of angles of quadrilateral is 360^0. Square has all four sides of same length. Rectangle has two opposite sides of same length. Square /rectangle is drawn as follows:

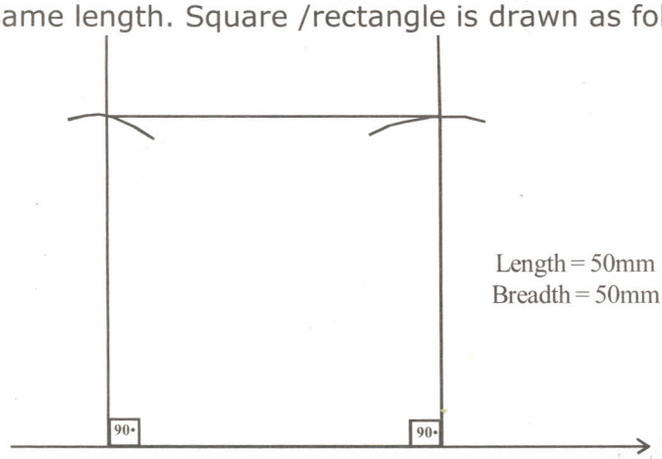


Fig 10.4 Quadrilateral

C) Regular Pentagon

Following are the steps in drawing pentagon of five sides of equal length. For e.g lets draw a pentagon of 5 cm in length:

1. Draw a line AB of 5 cm.
2. Draw a circle of 5cm radius by taking A as a center. Then draw another circle with B as a center. Both circle will cross each other at point X and Z. Join length XZ.
3. Now take distance ZA in compass and draw circle with Z as a center. The circle will cut other circles at point S and R.
4. Now draw line RC and line SE passing through point Y.
5. Using compass ,mark arc of length 5 cm from point E and C. The arc will cross each other at point D.
6. Now join all points A B C D E, to form a pentagon.

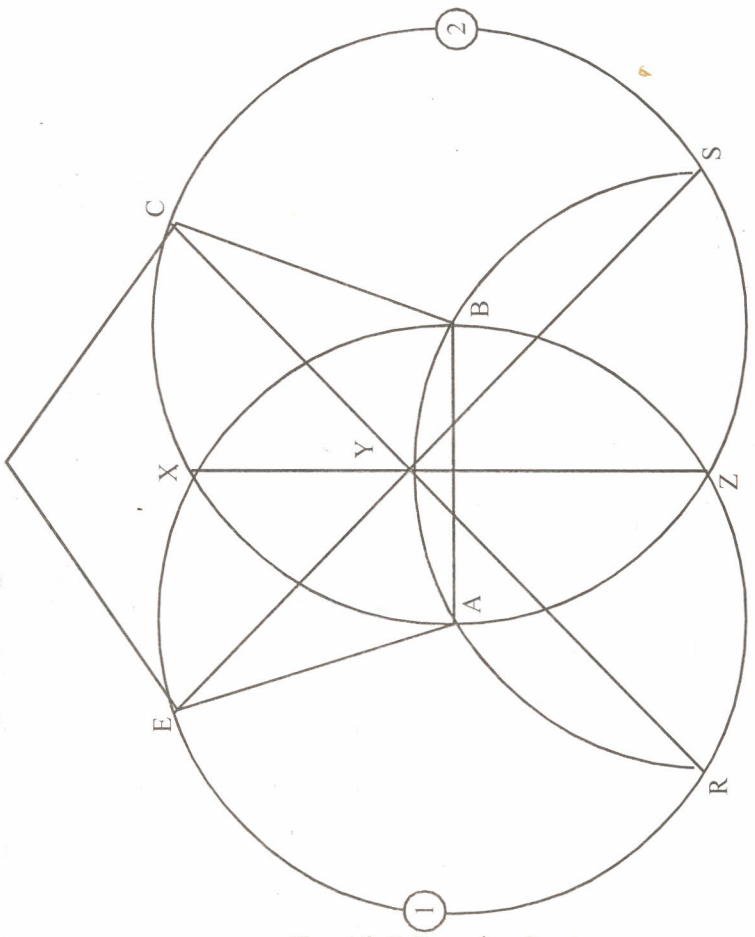


Fig. 10.5 Regular Pentagon

E) Hexagon.

Hexagon has six sides. Draw hexagon of equal side.

1. Draw a circle of radius equal to side of hexagon.
2. Put the compass anywhere at the edge of a circle, call that point as A.
3. Draw arc of circle cutting circle at point B and F. Now put compass at point B and mark point C using compass. Similarly point D and E are marked.
4. Join all points using scale to get a hexagon.

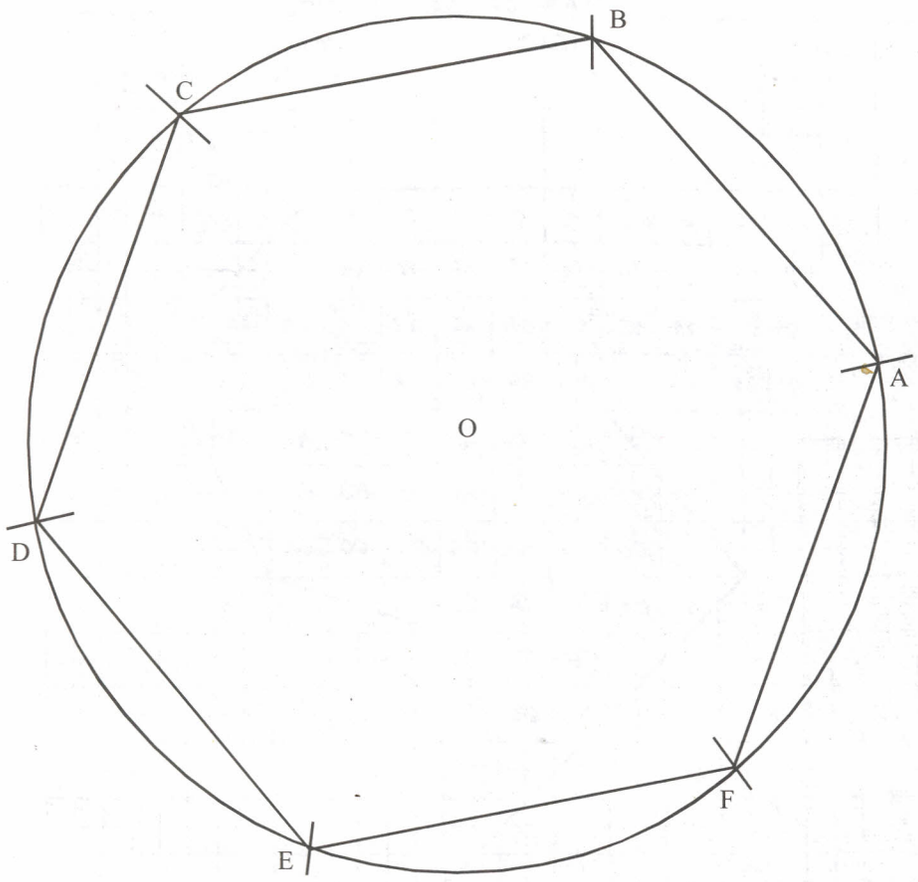


Fig 10.6 Hexagon

Area of geometric shapes

Area of regular shape is calculated using standard mathematical formula.

a) Triangle

Use following formula to calculate area of triangle.

Area = ½ × base × height

b) Quadrilateral

Area of quadrilateral = Length × breadth

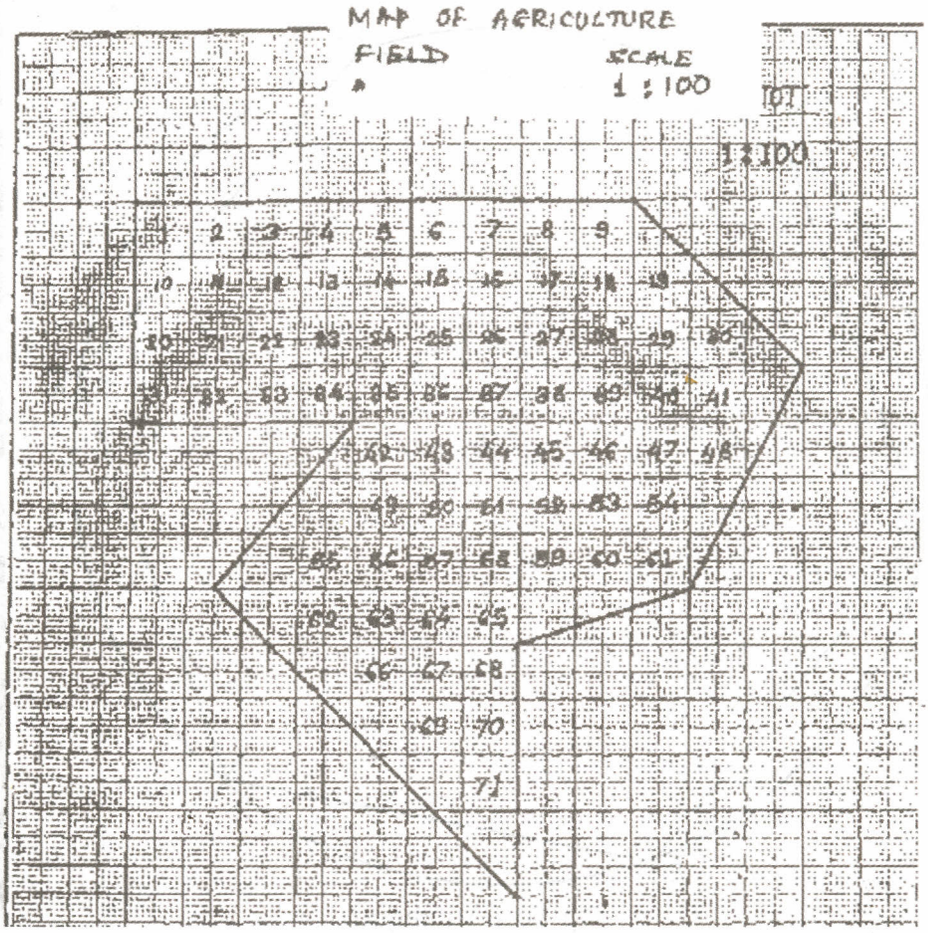
c) Circle

Area of circle = $\pi \times R^2$ (R = Radius)

Area of irregular shape

1) Graphical Method

In regular practice, we need to measure irregular shapes of land, construction area, material etc. Graphical method is used to calculate area of such irregular shapes.



Map of Agriculture Field

1) Select appropriate scale and draw the drawing on graph.
2) Then count number of complete square on the graph.
3) Count number 75% (three quarter) square on the graph.
4) Count the number of 50% square on the graph.
5) Count 25% square on the graph.

If you add all these squares then we get the area of the place. For example above Map is a graphical diagram of agricultural field. It has following squares:

Complete square	———	71 × 1	= 71
75% square	———	10 × 0.75	= 7.5
50% square	———	5 × 0.5	= 2.5
25% square	———	8 × 0.25	= 2.0
Total square is			= 83

This means total area of land on the graph is 83 Sq cm. If we multiply it with the scale we will get actual area of land.

2) We can also calculate the area of irregular shape by drawing many big size squares and triangles into the drawing. We can add area of all these squares and triangles to get area of the irregular shape.

INTEXT QUESTIONS 10.2

i) Match the following:

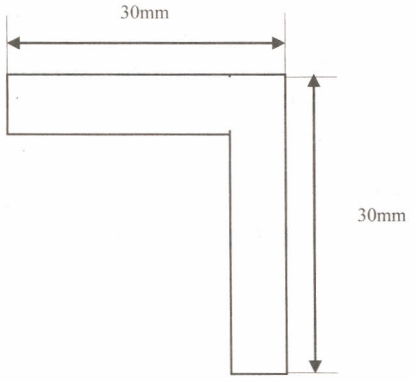
A	B
Area of triangle	Length × breadth
Area of rectangle	$\pi \times R^2$
Area of circle	½ × base × height

10.7 WHAT YOU HAVE LEARNT

In this lesson, We read about standard symbols and lines used in engineering drawing. Now we are able to select appropriate scale for drawing. We have also learned to draw different geometrical shapes and areas Calculation, of regular and irregular geometrical shape aslo.

10.8 TERMINAL QUESTIONS

1. If an MS bar of 2 mm thickness has 'L' shaped cross-section as shown in the figure. Calculate its cross-sectional area in cm^2.



2) Draw the following

   i) Equilateral triangle of 10 cm length

   ii) Square of 15 cm in length

   iii) Rectangle of length = 12 cm , breadth = 10 cm

   iv) Circle with radius = 7 cm

3) Draw symbols for the following

   i) River

   ii) Road

   iii) Rail

   iv) Hidden line

Actual scale	Drawing dimension
A = 120 m	40 cm
B = 80 m	26.67 cm
C = 40 m	13.33 cm
C = 60 m	20 cm

   v) Center line

   vi) Electric switch

10.9 ANSWER TO INTEXT QUESTIONS

1.1

Scale = 1 cm : 3 m

1.2

i) ½ × base × height

ii) Length × breadth

iii) $P \times R^2$

SUGGESTED ACTIVITIES

1) On A3 size (11.693 × 16.535 inches) drawing sheet - Draw the typical symbols used in all four forms of drawing – Engineering Drawing, Geographical Maps, Contours & Graphs and Line types.

2) Find area of a field/garden.

3) Find top surface area of a percolation tank.

11

ORTHOGRAPHIC AND ISOMETRIC PROJECTION

11.1 INTRODUCTION

Engineering drawing is a language of technicians. They can document and communicate all details of the job using engineering drawing. Drawing paper has two dimensions. To give information about 3-D object, only one view is not sufficient. Orthographic projection is a method to project 3-D drawing in two dimensions.

11.2 OBJECTIVES

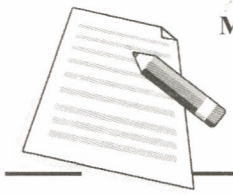
After reading this lesson, you will be able to:

- Understand the orthographic and isometric methods of projection;
- draw simple orthographic and isometric drawing:
- select isometric scale.

11.3 ORTHOGRAPHIC PROJECTIONS

A three dimensional sketch of an object to be manufactured doesn't always gives a clear idea about the exact construction. The artisan or craftsman needs constructional details which can be better explained in the Orthographic Projections.

Orthogonal means 'Perpendicular', The object is observed with the viewer's eye sight at 90 degrees to a face of the object shown in fig. 11.1



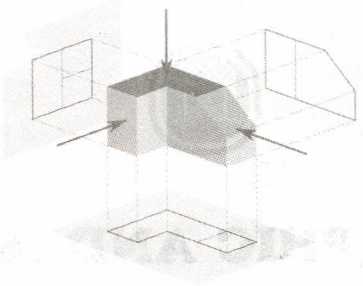


Fig: 11.1 Orthographie Projections

In First Angle Projection we place our object in the First Quadrant and in Third Angle Projection the Object is placed in the Third Quadrant. (See fig 11.2). It is consider as if the object is placed in a glass box with three planes of the object being parallel to the glass box. The image (or shadow or reflections) received on the three planes, collectively are called as 'orthographic projections'.

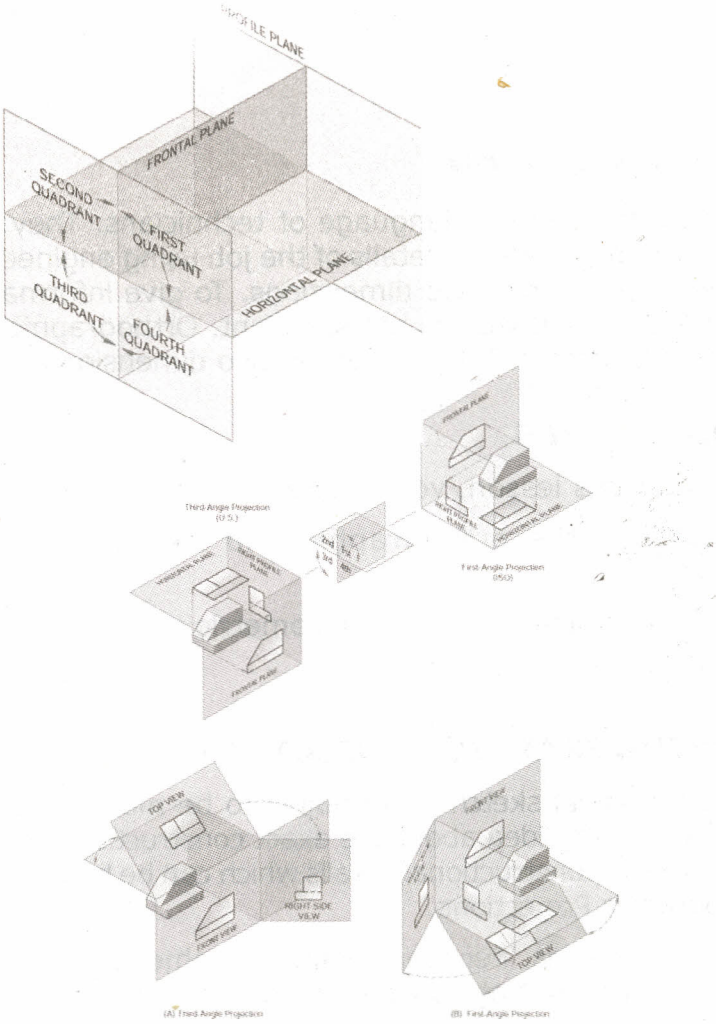


Fig: 11.2

When we draw an Orthographic view of the front of an object it is called an ELEVATION. When we draw an Orthographic view of the top of an object it is called a PLAN. When we draw an Orthographic view of one side of an object it is called an END ELEVATION.

If an object is very complicated then you can draw an End Elevation of the left and right hand side.

Observe following object and their orthographic projections:

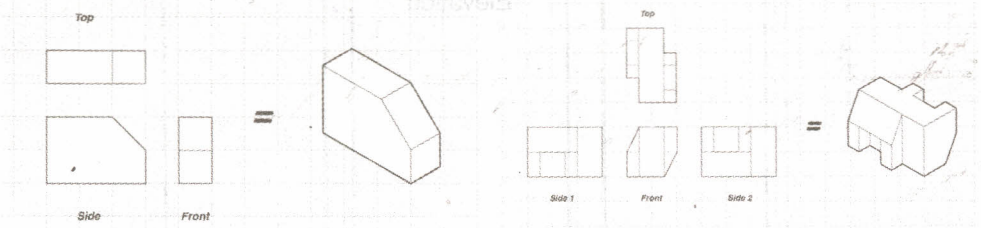
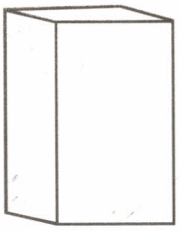


Fig: 11.3 Orthographic projections

11.4 STEPS TO DRAW THE ORTHOGRAPHIC VIEWS

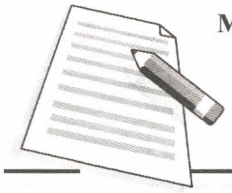
Lets draw orthographic view of block shown in fig. 11.4 using third angle projection method.

Draw a horizontal line XY in the middle of the paper.



1. Draw a rectangle measuring 'height CO length and AC width' below the line XY. This is the 'Front View' or the 'Elevation.' Leave some space; say 20 mm, between the line XY and top of the rectangle.
2. Draw two more rectangles on either side of the first rectangle. These are two 'Side Views.' These two rectangles must be admeasuring width of the object. Leave 20 mm space between each pair of rectangles.
3. Draw two vertical lines, AB and CD, from top of the Elevation and extend them above the XY line. These are 'Projections' from Elevation. These lines must be fainter than the rectangle.
5. Draw vertical projections, EF & GH, from the top of either Side View, but these projections should just touch the XY line.
6. Draw two more projections at 45°, HB & FJ, so as to intersect the extended vertical projections AB and CD, from the Elevation. Intersections of all these projections will give the 'Top View' or 'Plan', exactly above the Elevation. This set of 4 views-viz. Elevation, Top View and Side Views - is called the 'Orthographic Views' or 'Orthographic Projections'

Please study the examples of orthographic projection given in the following figures:



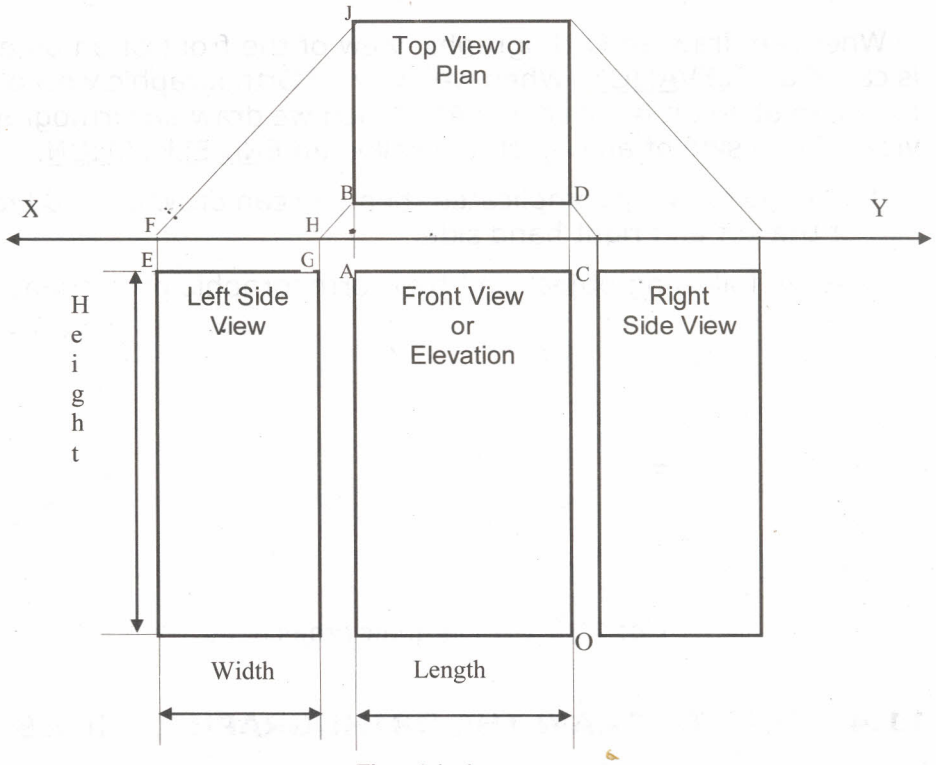


Fig: 11.4

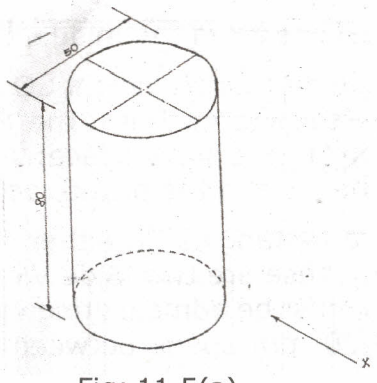


Fig: 11.5(a)

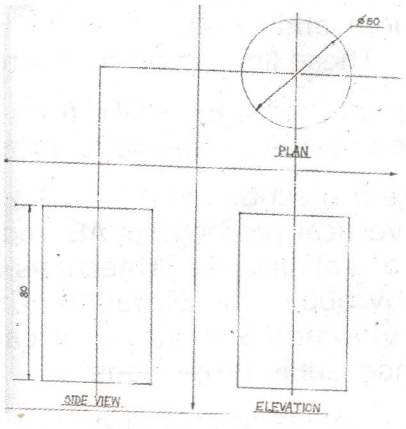
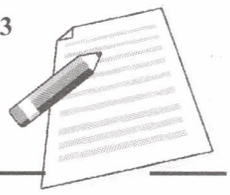


Fig: 11.5(b)



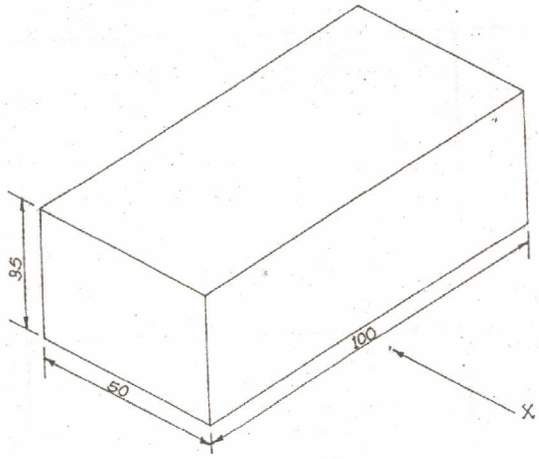


Fig: 11.6(a)

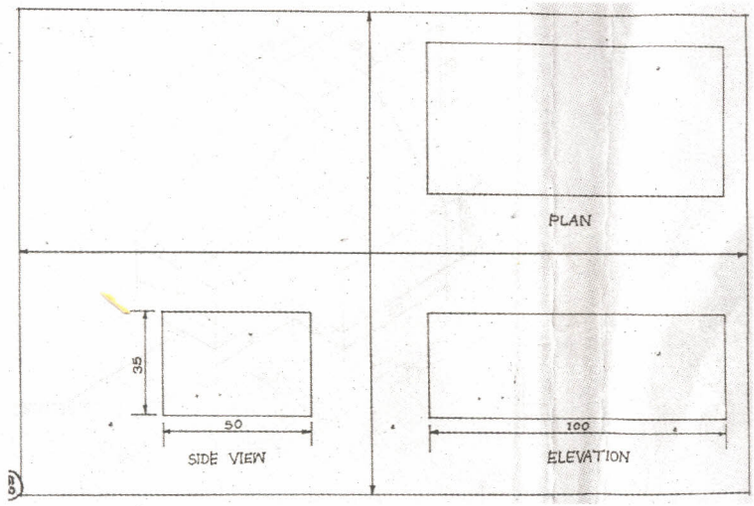


Fig: 11.6(b)

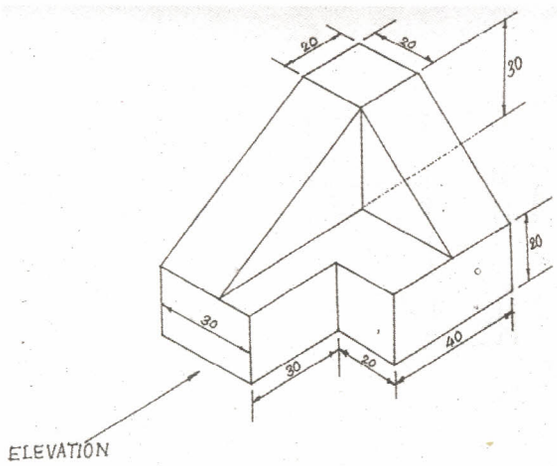


Fig: 11.7(a)

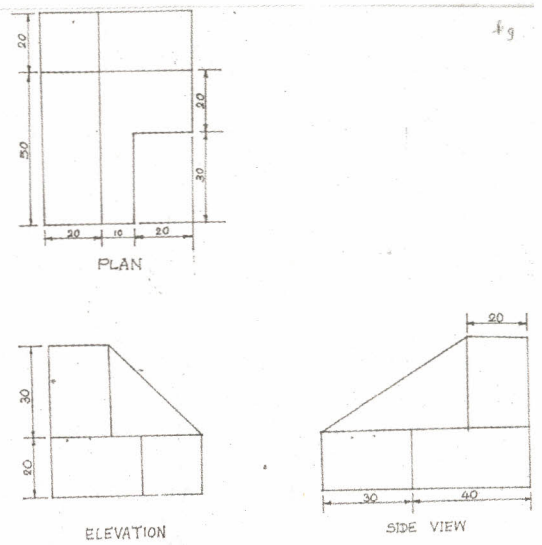


Fig: 11.7(b)

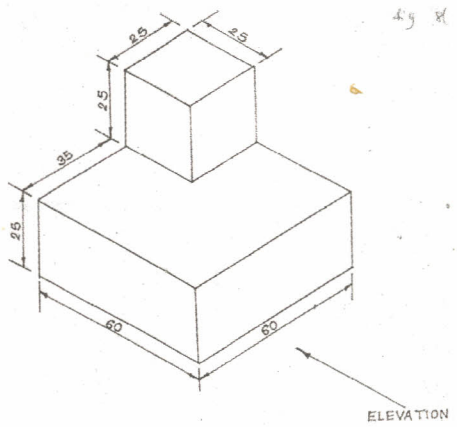


Fig: 11.8(a)

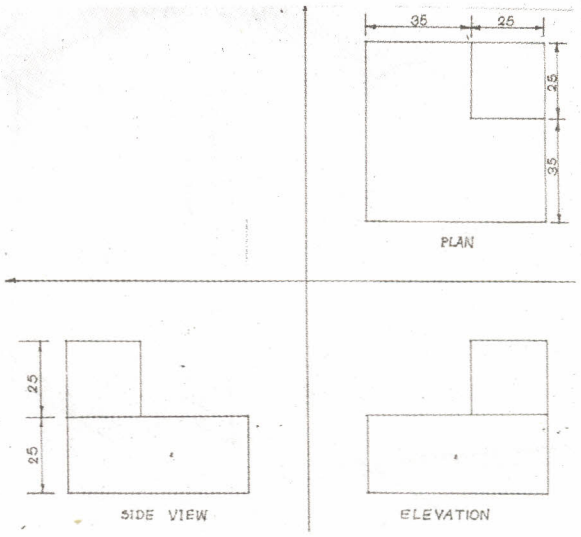
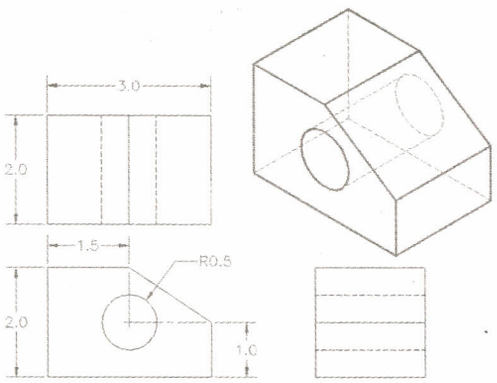
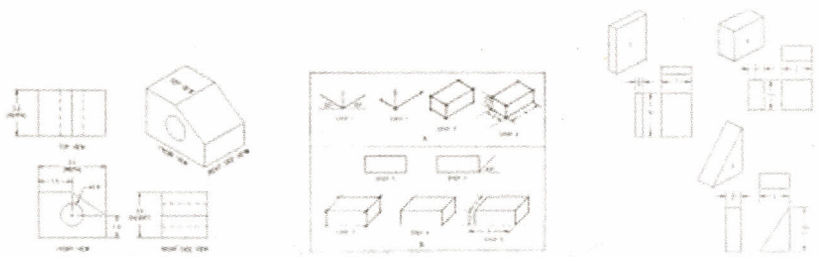


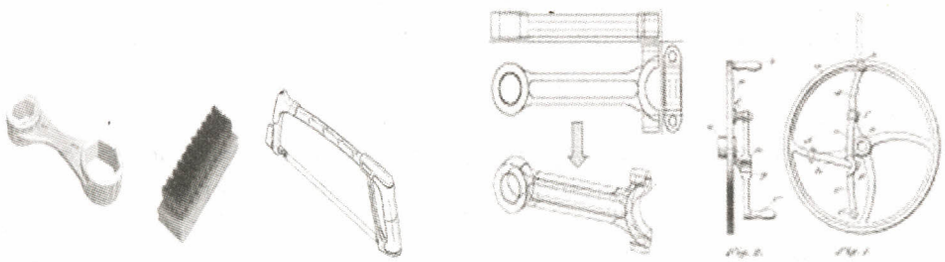
Fig: 11.8(b)

11.5 ISOMETRIC DRAWING

An Isometric Sketch is drawn with free hand; its dimensioning is just proportional, whereas the Isometric View is to be drawn with the Isometric Scale. **Isometric projection** is a method of visually representing three-dimensional objects in two dimensions, in which the three coordinate axes appear equally foreshortened and the angles between any two of them are 120 degrees. Isometric is a 3-D sketch whereas Orthographic is a set of 3 Plane Projections. Look at the fig.11.9 to see example of isometric drawing.







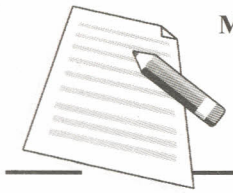
Spanner Brush Hack Saw Spanner Hand Wheel

Freehand Isometric sketches of common tools **Orthographic Views of hand Tools**

Fig: 11.9

11.6 NATURAL SCALE AND ISOMETRIC SCALE

True Scale or Natural Scale is used to draw Orthographic Views. In these views, the viewer's direction is exactly perpendicular to the plane of view,



hence true Dimensions are seen. But in Isometric view, object is seen from an angle to get view of all three plane. A corner of the 3D object is the nearest point to the viewer and all other dimensions of the object are moving away from the viewer. So the dimensions APPEAR to be smaller than the true ones. This difference can be computed by the figure 10. Unit 1 on the natural scale appears to be Unit 1 on the Isometric scale.

Step in drawing isometric scale –

Ref.fig.11.10 draw a line at 45° and at 30°. Mark points on true scale and draw line perpendicular to X – axis as shown in the fig. Distance of point O from point on isometric scale is the length of object on isometric scale.

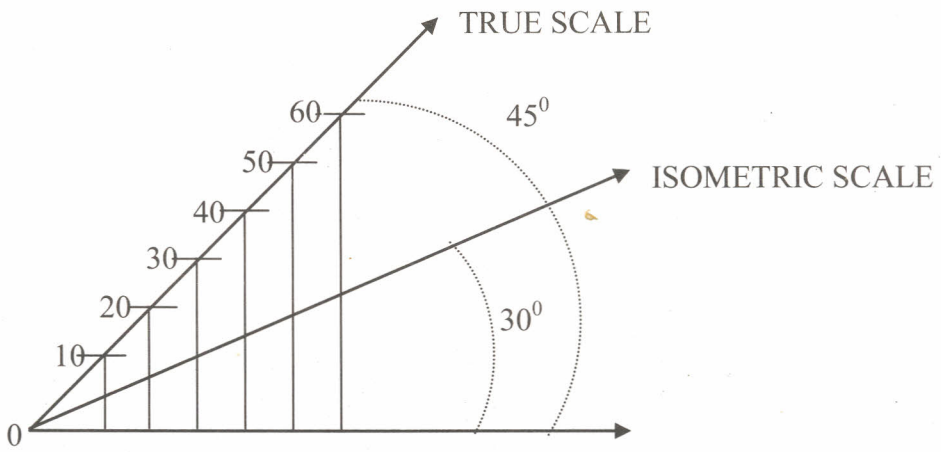


Fig. 11.10

11.7 STEPS TO DRAW AN ISOMETRIC VIEW

1. Orientation of the object and point of Origin, these two things are to be decided before drawing the Isometric View. For every Isometric View a separate Scale is required to be drawn.
2. Draw the Isometric and Natural scale, mark each dimension on the Natural scale, drop a perpendicular on the horizontal line, and transfer the corresponding Isometric dimension on the paper with the help of divider. (As Isometric dimension cannot be and need not be measured in cm or inches). Suppose we need a dimension of say, 35 mm to be converted into Isometric Scale. Take 35 mm dimension on the Natural scale, drop a perpendicular on the horizontal line. The perpendicular meets the 30° line at point A. The dimension OA is the Isometric dimension of Natural 35 mm. Transfer the dimension OA to the Isometric View to be drawn.
3. Take an Origin 'O' on the paper ref fig. 11.12, with sufficient space to draw the Isometric above the point 'O'. Draw a horizontal line XY through 'O' and another vertical line OZ.

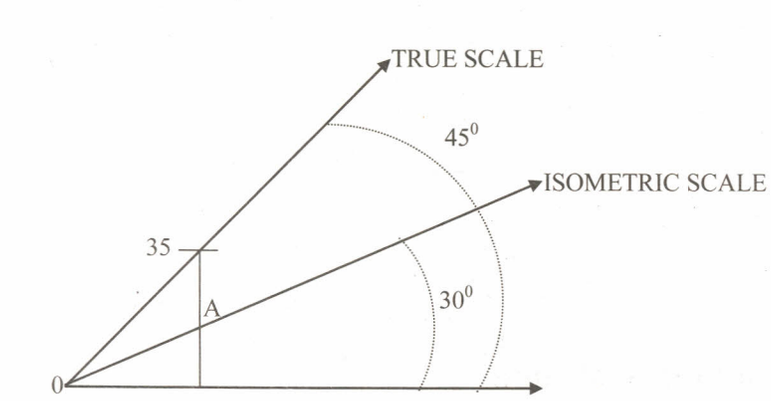


Fig. 11.11

4. Referring the orthographic Views, transfer the height, length and width of the object on the Natural Scale and convert them into Isometric Scale.
5. With the help of a Divider, transfer the height on the vertical line OZ, the length along OX and width along OY. Consider the Origin 'O'in the Elevation of the Orthographic Views (Lesson 2) to be the Origin in the Isometric View here.
6. Complete the entire Isometric block with the help of Tee Square and 30-60 Set Square.

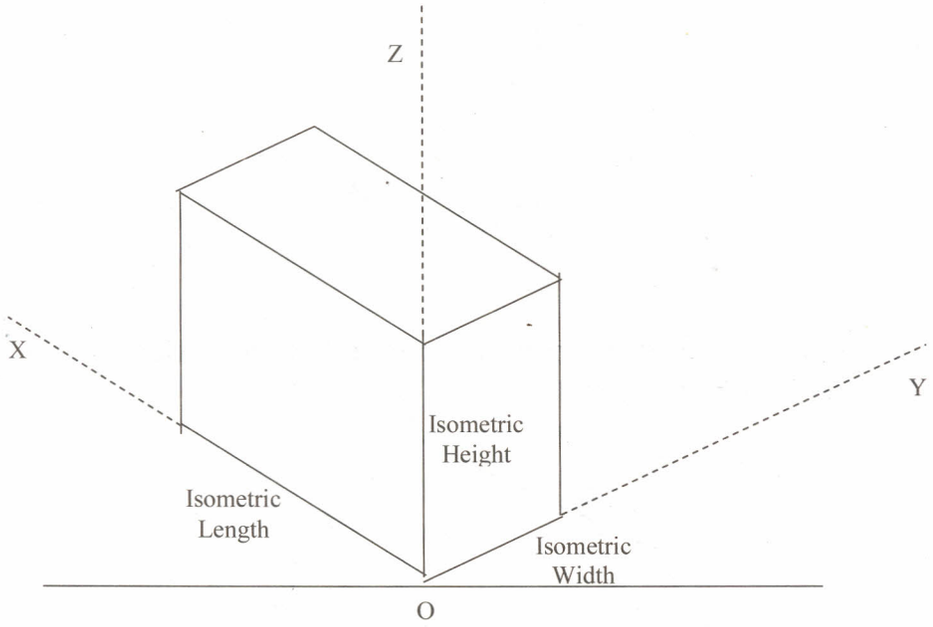


Fig. 11.12

Examples of drawing isometric drawing

1) Draw isometric drawing of a cube.

Orthographic projection of cube of 40cm length, 40cm height and 40cm width is shown below.

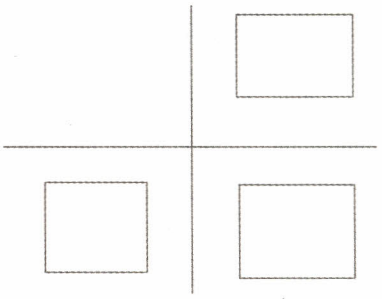


Fig. 11.13

To draw isometric of cube

1) Draw two basic 30 degree guidelines, one to the left and one to the right, plus a vertical guideline in the centre of the drawing. In this example three edges of the cube have been drawn over the guidelines (they are slightly darker)

2) Remember to draw the line of length equal to isometric scale. Therefore each side of 40cm cube should be converted to isometric scale.

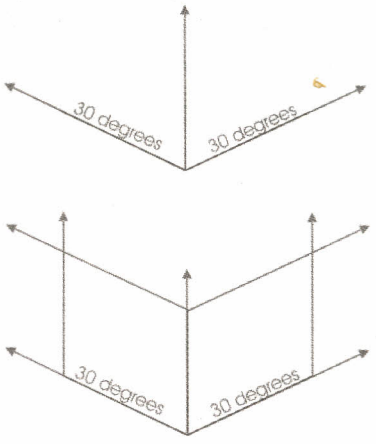


Fig. 11.14

Complete the top of the cube by projecting lines with the 30 degree set square as shown.

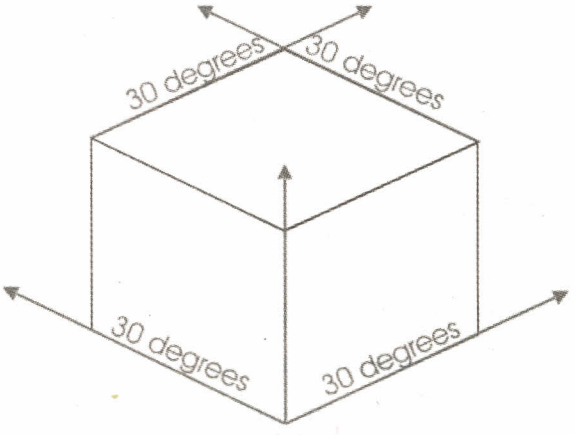


Fig. 11.15

2) Draw an square in isometric

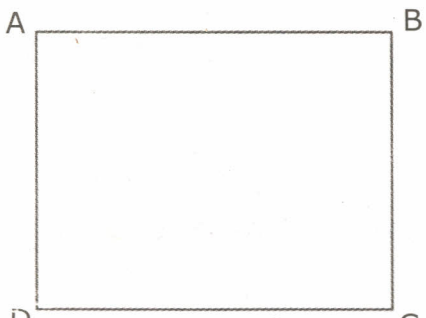


Fig. 11.16

Square ABCD is of 50mm size.

1) Draw a horizontal line.
2) Mark one corner of square at the center of line 'D' in fig.17
3) Draw two lines as shown in the fig at 30° to the horizontal line.
4) Select isometric scale as shown in the previous example. Measure distance on isometric scale.
5) Draw point A and B equal to isometric length.
6) Mark point 'C' using compass of length of isometric scale.

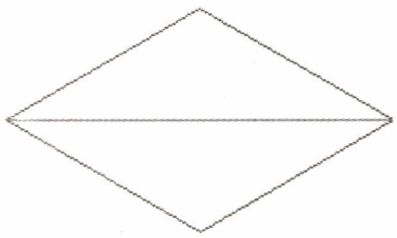


Fig. 11.17

3) Draw an isometric circle

Draw a square ABCD, centred on the position of the hole. The square should be the same size as the diameter of the hole.

Draw curves (GF and HE) using compass as shown in the fig.

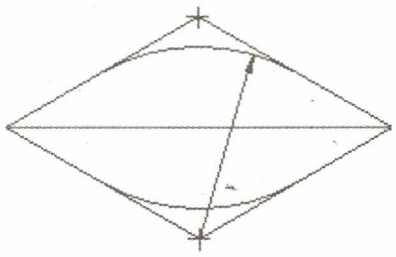


Fig. 11.18

Center of line CD and AB are marked as G and E. Join AG and CE as shown in the figure. Draw arc EF and GH using compass as shown in the figure. The isometric of circle is ellipse.

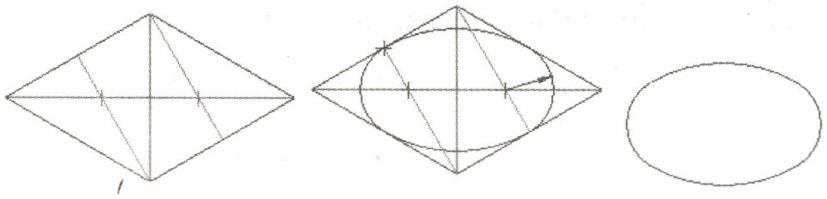


Fig: 11.19

Observe the following examples of drawing.

1. Stool

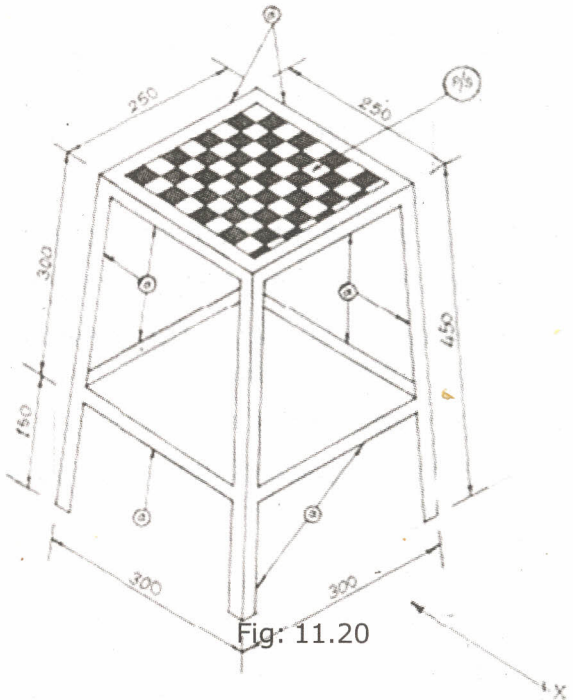


Fig: 11.20

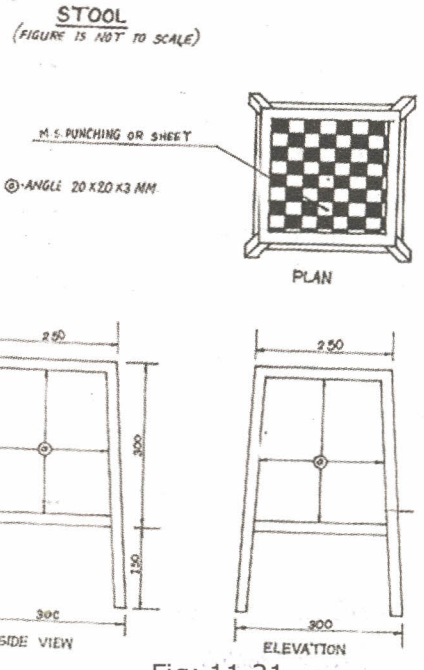
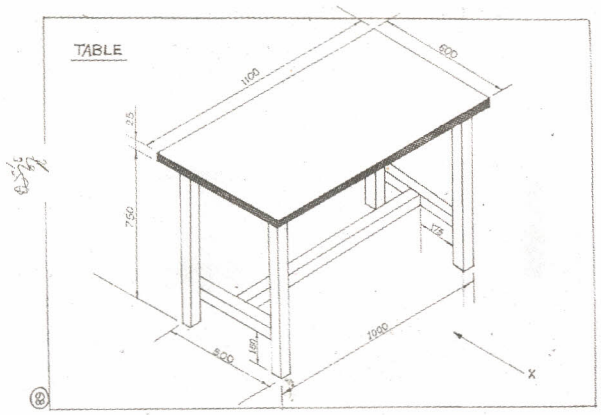
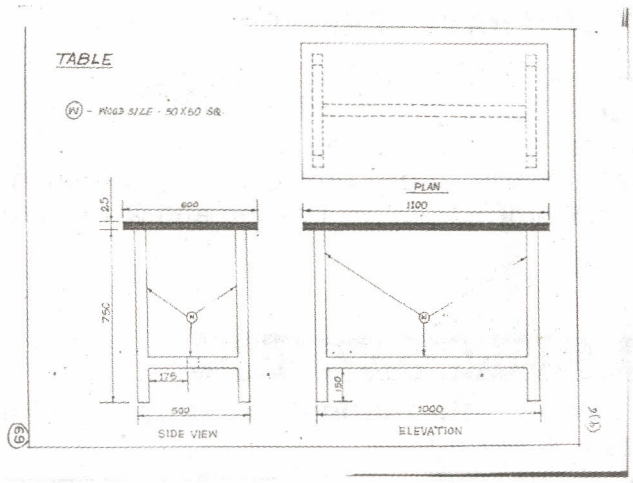


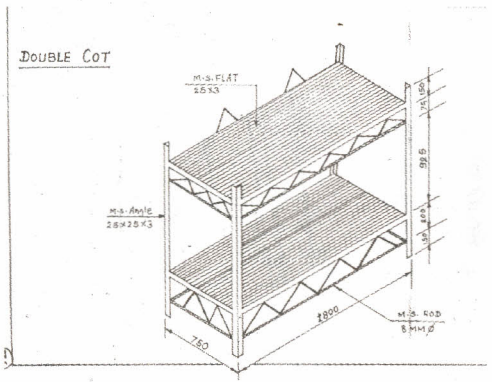
Fig: 11.21



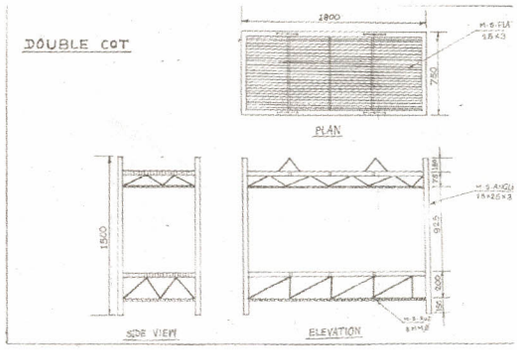
Example:11.12



Example: 11.13



Example: 11.14



Example: 11.15

11.8 WHAT YOU HAVE LEARNT

In this chapter, you read the orthographic and isometric projection. You learnt to draw orthographic and isometric projection. You learnt the procedure to draw them. You learnt to draw basic isometric shapes. You also learnt to present textual information to drawing form and to read information on drawing and write in textual form.

11.9 TERMINAL QUESTIONS

1. **Convert textual information into graphical form** - A box measures 30 mm (length) × 20 mm (breadth) × 45 mm (height). Draw its isometric sketch with length on your right side.
2. **Convert textual information into graphical form -** A cylinder measures 25 mm (base diameter) × 75 mm (height). Draw its three orthographic views.
3. **Convert graphical information into textual form**

   a. What is the total length and breadth of the object?

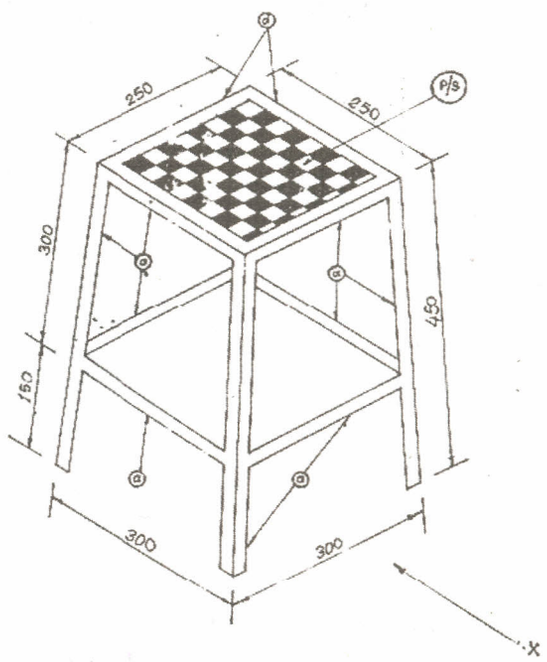
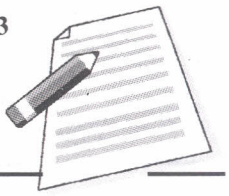


fig.11.16



b. State the dimensions of the top of the object.

c. What is the total length of each of the 4 legs?

d. What is the maximum distance between two legs?

e. What are the M.S. Angle dimensions?

f. Which two materials are suggested for the top?

SUGGESTED ACTIVITY

Make a orthographic projection of your house.

12

FLOW CHARTS & GRAPHS

12.1 INTRODUCTION

Information is required for decision making. It is very difficult to draw definite conclusions from the raw data. The raw data needs to be presented in appropriate form, which helps in decision making. Flow charts and graphs are important tools for taking management decision.

12.2 OBJECTIVES

After reading this lesson, you be will able to:

- know the flow charts and graphs;
- draw flow charts and straight line diagram;
- learn the rules for drawing flow chart.

12.3 FLOW CHART

What is Flow Chart?

Flow chart is graphical representation of a process, with the details of sequence, inputs, outputs, tools used, time taken etc. This helps us in better planning. Since you know the processes in step-by-step flow, you can concentrate more on smaller steps instead of feeling burdened by the whole process.

Types of Flow Charts

There are mainly two types:

i) Basic Flow Charts;

ii) Straight Line Diagrams (SLD).

Basic Flow Charts need Symbols, SLD do not necessarily need symbols.

Benefits of flow Charts

1) A sequential, precise and short description of a process can be obtained.
2) Chances to overlook or miss any step, input-output elements are reduced.
3) Misuse of elements or tools can be located precisely.

12.4 RULES TO DRAW FLOW CHARTS

1) We have studied the symbols used in drawing flow chart in lesson 10. Let's learn to draw a flow chart by taking an example.
2) Flow charts are mainly made up of three types of symbol.
   - Elongated circles, which signify the start or end of a process 
   -  Rectangles, which show instructions or actions
   - Diamonds, which show decisions that must be made 

Within each symbol, write down what the symbol represents. This could be the start or finish of the process, the action to be taken, or the decision to be made.

3) Symbols are connected one to the other by arrows, showing the flow of the process.

Lets draw a flow chart to make a tomato sauce.

Following steps are involved in making tomato sauce:

Input material – tomato, clean them, cook them in pressure cooker, make a pulp in mixer, remove seeds and wastage, cook on stove to remove water, add spices, Cook it in pressure cooker, taste, packaging.

The flow chart is shown in the fig. 12.1.

Straight Line Diagram(SLD)

Lets make a SLD for preparing a tea in which tea powder and water is boiled together and then milk and tea is added separately as required.

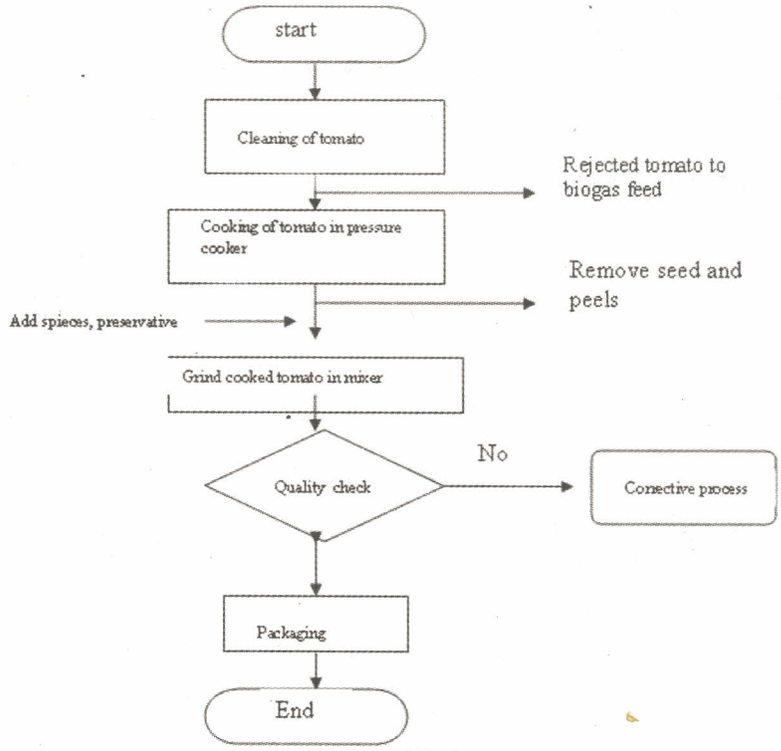


Fig: 12.1

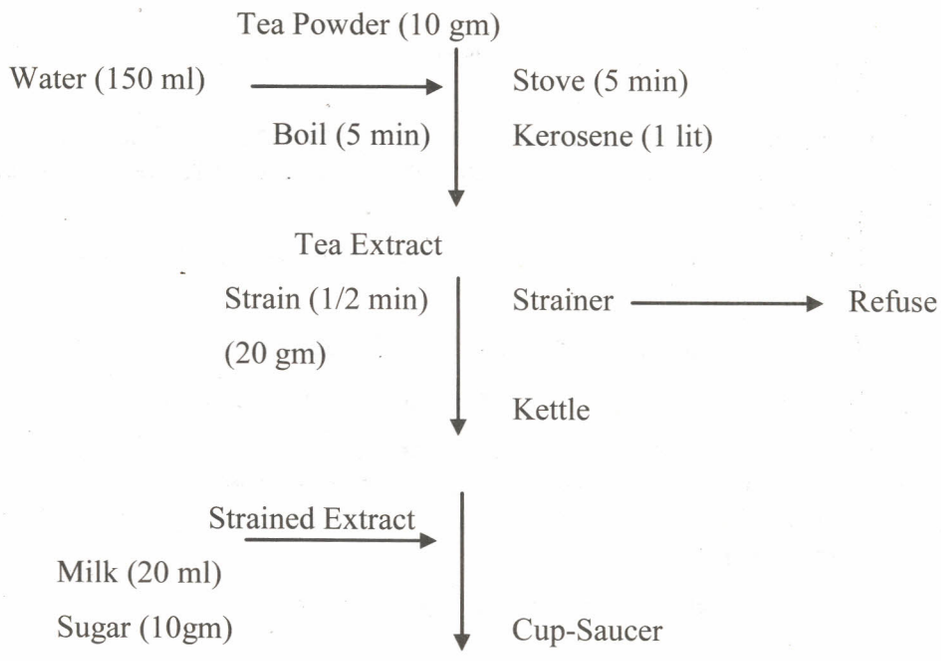


Fig. 12.2

12.5 GRAPH

A graph is a chart or drawing displaying the relationship between numbers or amounts. It is also defined as Visual representation of statistical information, with the help of two or more reference axes.

TYPES OF GRAPH

1. Line Graph

A line graph shows points plotted on a graph. The points are then connected to see form a line. Refer fig.12.3 It shows the runs made by team A and B in various overs. A Line graph is usually used to display each single Data value. The graph shows us the progress made by both team.

Overs	First	Fifth	Tenth	Fifteenth	Twentieth
Runs by Team A	60	120	185	240	300
Runs by Team B	80	140	170	241	323

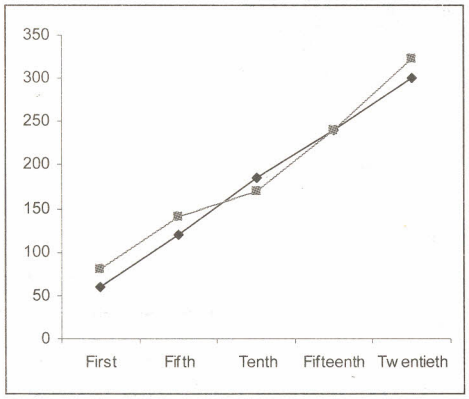


Fig: 12.3

2. Column Graph

It is also called as bar chart. A bar graph uses bars to show data. The bars can be vertical (up and down), or horizontal (across).

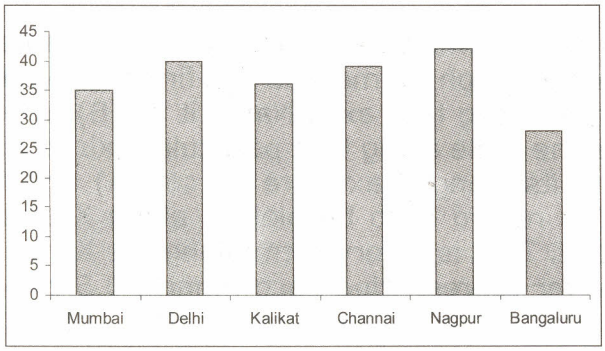


Fig:12.4

The data can be in words or numbers. A column or row bar graph compares values across a certain series. Fig. 12.4 shows comparative temperature of different cities.

3. Pie Graph

Refer fig. 12.5 it shows number of workers working in different departments. It shows comparative strength of each department. The graph is in circle form. A circle is divided into fractions that look like pieces of pie; Therefore, it is called a pie graph. A pie graph displays how mush each value contributes to the total.

Department	Welding	Fitting	Turning	Carpentry
No. of workers	40	37	46	20

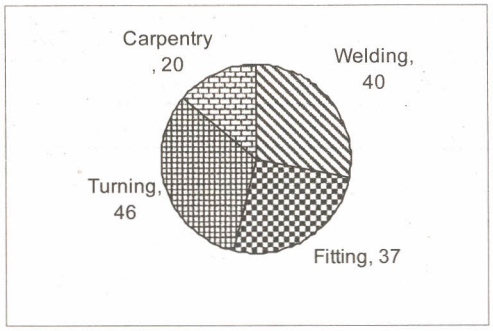


Fig: 12.5

Benefits of Graphs

Due to visual form of graph it easy to read and analyze the information. Graph is very useful management tool to analyze information. Using computers different style of graphs can be drawn, they can be enhanced by adding legends, labels etc.

Steps to plot a graph

1. **Draw two axes**, namely, X as horizontal axis and Y as vertical axis, both at right angled to each other. The point of intersection of axes is called the 'Origin' of the scale. It is treated as the 'Zero' of the scales.
2. **Decide a scale -** measure the maximum available units on any one axis of the graph. Name it as (A), find the maximum amount to be plotted along that axis. Name it as (B), the division of A by B gives the scale along that particular axis. e.g. if maximum available units along X axis are 12 cm (A) and maximum 24 months' (B) record is to be plotted along X axis then A/B = 12/24 = 1:2. That is, every 1 cm along the X axis represents 2 months or for representing each month, 0.5 cm of X axis can be used. Similar procedure is followed for other axes.
3. **To plot** each point of the graph, the X and Y values of that particular information are measured along the respective axes.

The point of intersection of perpendiculars drawn from these values, represents the point of information.

INTEXT QUESTIONS 12.2

i) Write down three main types of graphs?

12.6 WHAT YOU HAVE LEARNT

In this lesson, you read about flowchart and Straight line diagram. You also knew different types of graphs and their uses. You have also seen the examples of various types of graphs and flowchart. You have also studied how to draw them. Remember, graphs and flowcharts are very important tools in management. A flowchart is must before starting any practical in our course.

12.7 TERMINAL QUESTIONS

1. Draw a Straight Line Diagram (SLD) for the procedure of welding two MS circular rods of 20 mm diameter at right angles to each other.
2. Draw a Basic Flow Chart to express the procedure of making Tomato Sauce.
3. Prepare an SLD for packing a birthday gift.
4. Prepare an SLD for the steps to make 400 gm Guava Jelly from 2 Kg of Guava.
5. Plot a column graph of following information:

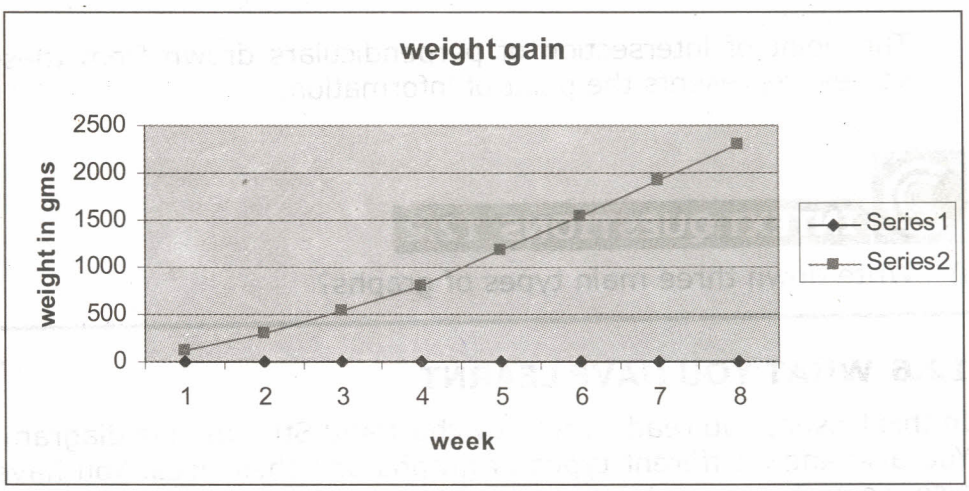
Students	Anuja	Rahul	Meghana	Hari
Marks	31	90	78	57

6. Plot a line graph of a 20-20 cricket match performance, given as follows -

Over	First	Fifth	Tenth	Fifteenth	Twentieth
Runs by Team A	12	34	120	190	230
Runs by Team B	3	60	85	100	236

7. Read the following graph and answer the questions:

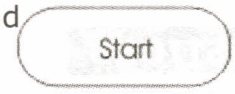
1) What is the weight of chicks after 6 weeks ?
2) What is the weight of chick after 3 weeks ?
3) What conclusion you can draw from the graph ?



12.8 ANSWER TO INTEXT QUESTIONS

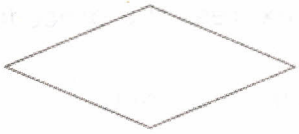
12.1

i) Start and End



ii) Process

iii) Decision



12.2

Bar chart, line chart, pie chart

SUGGESTED ACTIVITIES

1) Graphs of varied data viz. mark lists, contour readings, temperatures etc. are to be drawn, preferably using computer. Explore the Chart (means Graph) facility of computerized data sheets (e.g. Microsoft Excel), observe how the same information can be represented in different chart types.

2) Draw flow chart showing development of a broiler chicken from its first day to 8 weeks age.