SURVEYOR

NSQF LEVEL - 5

1st Year (Volume I of II)

TRADE PRACTICAL

SECTOR: Construction

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

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Trade : Surveyor 1st Year (Volume I of II) - Trade Practical NSQF level 5

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media development committe members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Surveyor, 1st Year (Volume I of II) Trade Theory NSQF Level - 5 in Construction Sector under Semester Pattern.** The NSQF Level - 5 Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 5 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 5 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

RAJESH AGGARWAL
Director General/ Addl.Secretary
Ministry of Skill Development & Entrepreneur-ship,
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New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

R. P. DHINGRA
EXECUTIVE DIRECTOR

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ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Surveyor** under the IT & ITES Sector

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NIMI records its appreciation for the Data Entry, CAD, DTP operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks the invaluable efforts rendered by all other NIMI staff who have contributed towards the development of this Instructional Material.

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop / Hall. It consists of a series of practical exercises to be completed by the trainees during the first semester course of Surveyor trade under NSQF Level 5 syllabus, which is supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in prescribed syllabus are coverd.

Module 1	Safety
Module 2	Basic Engineering Drawing
Module 3	Chain Surveying
Module 4	Compass Surveying
Module 5	Computer aided surveying

The skill training in the shop floor is planned through a series of practical exercises centred around some practical object. However, there are few instances where the individual exercise does not form a part of project.

TRADE THEORY

The manual of trade theory consists of theoretical information for the first semester course of the Surveyor Trade NSQF - Level 5. The contents are sequenced according to the practical exercise contained in the manual on trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual of trade practical. The indicating about the corresponding practical exercise are given sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise at least one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self - learning and should be considered as supplementary to class room instruction.

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Recognize & comply safe working practi ces, environment regulation and housekeeping.**
- **Concept of drawing & sheet layout.**
- **Draw lettering & numbering applying drawing instruments.**
- **Draw plain geometrical figures, curves & conics.**
- **Construct plain scale, diagonal scale, comparative scale, vernier scale.**
- **Draw orthographic projections of different objects with proper dimensioning & lettering.**
- **Draw conventional signs & symbols used in surveying.**
- **Perform site survey using chain/ tape 7 prepare a site plan.**
- **Perform the site survey using prismatic compass.**
- **Perform Auto cad drawing.**

SYLLABUS - SURVEYOR

1st Year (Volume I of II) **Duration : 06 Months**

Week No.	Reference Learning Outcome	Professional Skills with Indicative Hours	Professional Knowledge
1-2	Recognize & comply safe working practices, environment regulation. Concept of drawing & sheet layout.	1. Importance of trade training, Demonstrate of tools & equipment used in the trade. (6 hrs) 2. Occupational safety & Health. (6 hrs) 3. Introduction of safety equipments and their uses. (10 hrs) 4. Introduction of first aid, health, safety & environmental guidelines, legislations & regulations as applicable. (8 hrs) 5. Personal Protective Equipment (PPE). (8 hrs) 6. Hazard identification and avoidance, Safety signs for Danger. (4 hrs) 7. Use of drawing instruments and equipments with care. (4 hrs) 8. Method of fixing of drawing sheet on drawing board. (2 hrs) 9. Layout of different size of drawing sheet and folding of sheets. (8 hrs)	Importance of safety and general precautions related to the trade. All necessary guidance to be provided to the new comers to become familiar with the working of ITI system. Importance of survey or trade Job after completion of training. Introduction of First aid. Job responsibility of the trade. • Overview the subject to be taught. • List of the instrument equipments to be used during training • Layout of drawing sheet • Dimensions of drawing sheet.
3-6	Draw lettering & numbering & dimensioning applying drawing instruments.	10. Lettering & numbering (Single &double stroke) (70 hrs) 11. types of lines and dimensioning. (42 hrs)	Details layout of lettering, lines & dimensioning system .
7-8	Draw plain geometrical figures, curves & conics	12. Construction of plain geometrical figures, curves &conics. (56 hrs)	Introduction of surveying, typesof surveying, use, applicationprincipal.

9-10	Construct plain scale, diagonal scale, comparative scale, vernier scale.	13. Drawing of : - 14. Construction of scales – plain, diagonal, vernier. (56 hrs)	Knowledge of different types ofscales, determine of R.F & uses of scales.
11-14	Draw orthographic projections of different objects with proper dimensioning & lettering.	15. Drawing of three views in orthographic projection of point,line, plane, solid objects. (40 hrs) 16. Section of solids. (32 hrs) 17. Isometric projection of geometrical solids. (40 hrs)	Different types of projection views orthographic, sectional , isometric view.
15	Draw conventional signs & symbols used in surveying	18. Drawing of conventional signs & symbols (10 hrs) 19. Free hand sketch of linermeasurement instruments(18hrs)	Use & application of conventional signs & symbols.
16-18	Perform site survey using chain/ tape & prepare a site plan.	20. Practice of folding & unfolding ofchain. (5 hrs) 21. Equipment and instrment usedto perform surveying & testing of chain. (5 hrs) 22. Ranging (direct/ indrect) &distance measure with chain/ tape. (10 hrs) 23. Offset taking & entering field book. (6 hrs) 24. Overcoming obstacles inchaining. (6 hrs) 25. Chaining on sloping ground. (10hrs) 26. Conduct a chain survey of a small area with all details and plotting the map. (20 hrs) 27. Calculating the area of site. (6hrs) 28. Prepare a site plan by the help of chain / tape. (16 hrs)	Uses of Chain/ tape, testing of a chain & correction. Ranging (direct & indirect), Principle of chain survey, application. Terms used in chain survey, Offset, types of offsets, limit of offset, field book, types of field book, entry of field book method of chaining in slopping ground. Field procedure of chain survey errors in chain survey, plotting procedure. Calculation of area (regular & irregular figure) Knowledge of site plan.

19-22	Perform the site survey using prismatic compass	29. Temporary adjustment of prismatic compass. (10hrs) 30. Measure fore & back bearing of a line. (10 hrs) 31. Measure true bearing of a line. (20 hrs) 32. Prepare a closed & open traverse using prismatic compass measure the bearings, entry intofield book, calculation of correct bearing and adjust. (Local attraction), determine the closing error and adjust. Plotting the same. (72hrs)	Basic terms used in compass survey. Instrument & its setting up. Conversion of bearing web to R.B. Calculation of included angle from bearing local attrac-tion, magnetic declination and true bearing, closing error. Adjustment of closing error, precaution in using prismatic compass.
23	Perform Auto CAD drawing	33. Practice with AutoCAD using commands (28 hrs)	Introduction to Auto CAD. Use AutoCAD command.
24	**Project work** a) Prepare a map by using chain /tape & compass. (Close traverse), plotting & calculate the area.		
25	**Revision**		
26	**Examination**		

Importance of surveyor

Objectives : At the end of this exercise you shall be able to

- **know about the role of a surveyor**
- **state the importance of survey.**

Now a days for the purpose of designing any engineering project such as road, railway, canal water - supply a sanitary schemes etc. Surveyor would require to study the very first item the features of the earth's surface in which the project is to be located.

- Then he should prepare a map of the area.
- The success of any engineering project is based upon the accurate and complete survey work.
- Therefore surveyor must thoroughly familiar with the principles and practice of surveying.
- The role of a surveyor can be divided into three parts.

1 Field work

2 Office work

3 Care and adjustments of instruments.

1 Field work

- Taking measurements for details
- Recording the field notes
- Setting out of works.

2 Office work

- Preparing maps, plans and sections from the data collected in the field.
- Calculating the areas and volumes.
- Designing of various structures.

3 Care and adjustments of instruments

- The surveyor must be thoroughly familiar with the instruments which he will be used (handing)
- He must know the methods of testing and adjusting the instruments.
- Very costly instruments such as theodolite, Auto levels etc. must be handled with great care and accuracy.
- Before taking of instruments such as level/theodolite from the box, the correct position of various parts should noted and a rough sketch to be made for replacing of instruments after finishing survey works.
- The lenses of the instruments should be protected from the sun, dust and rain.
- Movable parts should be cleaned and lubricated with refined oil at frequent interval.
- Therefore a through knowledge of the theory of surveying and still in practice, good judgement and organisation are the essential requisites of a good surveyor which can be acquired by taking more interest in the field work.

Importance of survey

- The planning and designing of all civil engineering projects such as construction of bridges, tunnels route location and exploration for highways,air fields, railways, power lines and pipe lines are based upon the surveying measurements.
- Moreover during execution project of any magnitude is constructed along the lines and points established by surveying. Thus surveying is a basic requirement for all civil engineering projects. The other principal works in which surveying is primarily utilised are:
- To fix the national and state boundaries.
- To chart coast lines, navigable streams and lakes.
- To establish control points.
- To execute hydrographic and oceanographic charting and mapping.
- To prepare topographic map of land surface of the earth.
- To determine the latitudes longitude and azimuth from astronomical observation.
- To carryout surveying specific for open cost and underground mixing purposes
- Maping as various scales and essential for the economic development of natural resources, industrialized areas and for administration, national development and defence. Therefore, Aerial photographs are used for surveying work to attain the required degree of accuracy and at a minimum cost and in a minimum time.

Occupational safety and health

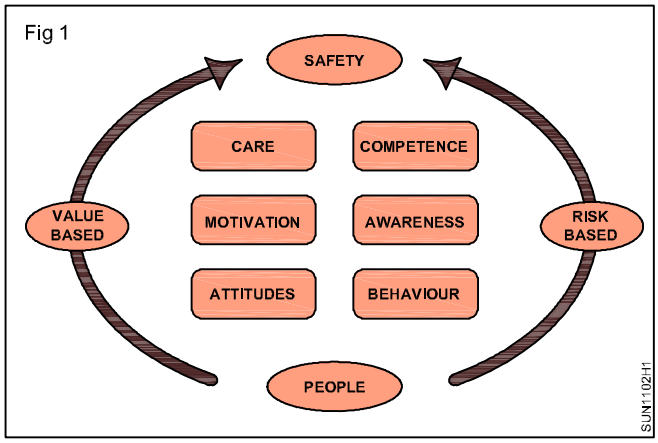
Objectives : At the end of this exercise you shall be able to

- **define occupational safety and health**
- **state the importance of safety and healty at workplace**
- **state the role of employer, trade union & employee for health & safety program.**

Occupational Safety and Health (OSH) is an area concerned with protecting the safety, health and welfare of people engaged in co- workers, family members, employees, customers,and many others who might be affected by the workspace environment.

Workspace safety : Owner/occupier of industries have to comply with legal direction to take care for the safety, health and welfare of therir employees. Equally the workers have moral responsibilities to follow all safety norms and healthy on the shop - floor. (Fig 1)

Fig 1



Occupational health : Health at work is also called occupational health.It is concerned with enabling an individual to undertake their day to day work fully knowing the health hazards they are exposed to and preventing them at the workspace.

Good safety and helath practices can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs. (Fig 2)

Fig 2

The joint ILO/WHO comittee on occupational health (1995) main focus in occupational health is on three different objectives.

The maintenance and promotion of workers health and working capacity.

The improvement of working environment and work to become conductive to safety and health.

Development of work organization and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and may enhance productivity of the undertakings.

Employment and working conditions in the formal or informal economy embrace other important determinants, including working hours, salary,workspace policies concerning maternity leave, health promotion and protection provisions etc.

The health of the workers has several determinants, including risk factors at the worksapce leading to accidents, musculoskeletal diseases,respiratory diseases, hearing loss, circulatory diseases, stress related disorders and communicable diseases and others.

Creating safe and healthy working conditions is challenge to all industries, as the new technologies and new pattems of work are fast growing. The challenges, changes resulting new risks and disorders are many. When safety and health measures are not followed or fail, accidents, injuries, diseases and even deaths may occur.

Victims of workspace injuries and occupational diseases have to be compensated properly. Prevention actions at worspace are needed so that similar cases will be prevented. The industries and the working population and their families including the dependent population will benefit from the good practice of occupational safety and health.

Safety problems in work settings range from immediate threats like toxic substances and grievous bodily injuries to subtle progressive dangers such as repetitive motion injuries, high noise levels, and air quality. In general,workplace hazards can be categorized into three groups:

1 **Chemical hazards,** in which the body absorbs toxins.

2 **Ergonomic hazards,**in which the body is strained or injured, often over an extended period, because of the nature (design) of the task, its frequency, or intensity.

3 **Physical hazards,** in whcih the worker is exposed to harmful elements or physical dangers, such as heat or moving parts.

In the modern context, corporate management increasingly has viewed industrial safety measures as an investment - one that may save money in the long run by way of reducing disability pay, improving productivity and avoiding lawsuits.

Prevention is better than cure

No place of work can always be completely safe all the time and whilst some work places present greater risks than others. Industry nowhere is immune to the possibility of an accident. Hence all industries should develop the ability to carry out risk assessment processes and to take all precautionary steps to ensure the safety of the workforce. It is a group collective effort that includes each and every member of the workforce. Employers should alaways ensure they do the following.

- Provide adequate control of the health and safety risks.
- Consult with employees on matters affecting their health and safety.
- Provide and malntaln safe plant and equipment.
- Ensure safe handing and use of substances.
- Provide information, instruction, supervision and training so that employees are competent to carry out their role.
- Review adn revise all these policies regulary.

Health and safety programmes

For all of the reasons (FIg 3), it is crucial that employers, workers and unions are committed to health and safety, addressing the following areas.

Fig 3

- Workplace hazards are controlled - at the source whenever possible;
- Records of any exposure are maintained for many years.
- Both workers and employers are informed about health and safety risks in the workplace.
- Establish an active and effective health and safety committee that includes both workers and management.
- To observe that the workers'health and safety efforts are ongoing.

Effective workplace health and safety programmes can help to save the lives of workers by reducing hazards and their consequences. Health and safety programmes also have positive effects on both worker morale and productivity, which are important benefits. At the same time, effective programmes can save employers a great deal of money.

Healthy workplace. hazard free work environment, zero accident work - life can help to save the lives of workers by reducing hazards and diseases. Effective programmes can also have positive effects on both worker morale and productivity. All put together enhance the human values at work and prosperity of the nation.

1 Occupational health and safety encompasses the social, mental and physical well- being of workers in all occupations.

2 Poor working conditions have the potenial to affect a worker's health and safety.

3 Unhealth or unsafe working conditions can be found anywhere, whether the workplace is indoor or outdoor.

4 Poor working conditions can affect the environment workers live in. This means that workers, their families, other pepole in the community, and the physical environment around the workplace, can all be at risk from exposure to workplace hazards.

5 Employers have a moral and often legal responsibility to protect workers.

6 Work - related accidents and diseases are common in all parts of the world and often have many direct and indirect negative consequences for workers and their families. A single accident or illness mean enormous financial loss to both worker and employers.

7 Effective workplace health and safety programmes can help to save the lives of workers by reducing hazards adn their consequences.

8 Effective programmes can also have positive effects on both worker morale and productivity, adn can save employers a great deal of money.

Electrical safety preventive measure for electrical accidents and practice steps to be taken in such accidents

Objectives : At the end of this exercise you shall be able to

- **practice and follow the preventive safety rules to avoid electrical accident**
- **perform the immediate steps to save the electric shocked victim.**

Requirements

Materials

• Heavy insulated screw driver 200mm	-1No.	• Wooden stool	-1No.
• Electrical safety chart (or) display	-1No.	• Ladder	-1No.
• Gloves	-1No.	• Safety belt	-1No.
• Rubber mat	-1No.		

PROCEDURE

TASK 1 : **Practice and follow the preventive safety rules to avoid electrical accident**

1 Do not work on live circuits if unavailable use rubber gloves or rubber mats,etc.

2 Do not touch bare conductors.

3 Stand on a wooden stool or an insulated ladder while repairing live electrical circuits/appliances or replacing fused bulbs.

4 Stand on rubber mats while working, operating switch panels,control gears, etc.

5 Use safety belts always, while working on poles or high rise points.

6 Use wooden or PVC insulated handle screw drivers when working on electrical circuits.

7 Replace (or) remove fuses only after switching off the circuit switches.

8 Open the main switch and make the circuit dead.

9 Do not stretch your hands on any moving part of rotating machine and around moving shafts.

10 Use always earth connection for all electrical appliances along with 3 - pin sockets and plugs.

11 Do not connect earthing to the water pipe lines.

12 Do not use water on electrical equipment.

13 Discharge static voltage in HV lines/ equipment and capacitors before working on them.

14 Keep the workshop floor clean and tools in good condition.

— — — — — — — — —

TASK 2 : **Perform the immediate steps to be taken to solve the shocked victim**

1 Proceed with treatment at once without panic emotion.

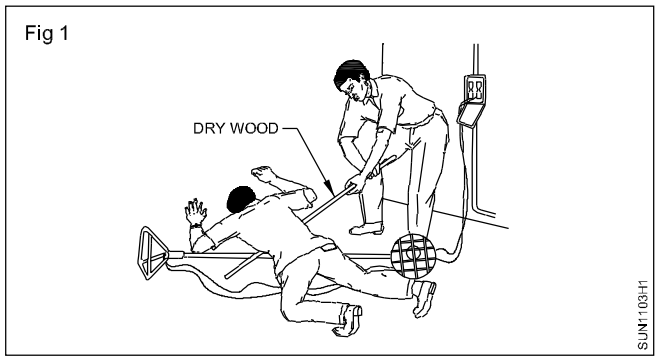
2 Break the contact either by switching off the power or removing the plug or wrenching the cable free.

3 Remove the victim from contact with the live conductor by using dry non- conducting materials such as wooden bar.(Fig 1 & 2)

Avoid direct contact with the victim. Wrap your hands in dry material if rubber gloves are not available. If you remain un - insulated, do not touch the victim with your bare hands.

4 Keep the patient warm and at mental rest.

Fig 1



Ensure of good air circulation and comfort. Call for help to shift the patient to safer place. If the victim is aloft action to be taken to prevent him from falling.

5 Loosen the clothing about the neck chest and waist and place in recovery position. If the victim is unconscious.

6 Keep the victim warm and comfortable. (Fig 3)

7 Send the person to call doctor, in case of electric burns.

Fig 2

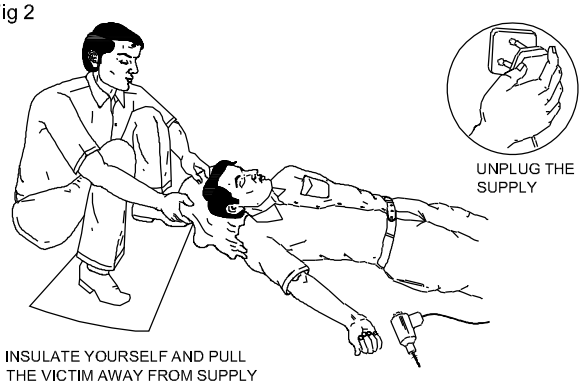


Fig 3

If the victim gets electrical burns due to shock, burns are very painful and dangerous. If a large area of the body is burnt give no treatment. But do the first aid as given below.

8 cover the burnt area with running pure water.

9 clean the burnt area by using clean cloth/ cotton.

10 send a person to call the doctor immediately.

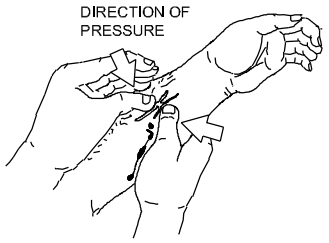
In case of severe bleeding

11 Lay the patient lie down and rest.

12 Raise the injured part above the level of the body. (If possible)

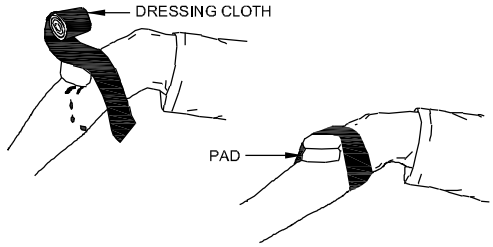
13 Apply pressure on the wound as long as necessary to stop the bleeding. (Fig 4)

Fig 4



14 Apply a clean pad and bandage firmly,if it is large wound. (Fig 5)

Fig 5



If bleeeding is severe apply more than one dressing.

14 Proceed to perform the right methods of artificial respiration.

Practice safe methods of fire fighting in case of electrical fire

Objectives : At the end of this exercise you shall be able to

- **demonstrate the ability of fire - fighting for electrical fire**
  -as a member of the fire - fighting team
  -as a leader of the group.

Requirements

Equipment/Machines

- Fire extinguishersCO_2 - 1No.

PROCEDURE

General procedure to be adopted in the event of electrical fire

1 Ralse an alarm. Follow the method written below for giving an alarm signals when fire breakes out.

– by raising your voice shouting Fire! Fire! to call the attention of others

– Running towards fire alarm/bell to actuate it

– Other means

– switch off the control main switch (if possible)

2 On receipt of the alarm signal:

– stop working

– turn off all machinery and power

– switch off fans/air circulators/exhaust fans. (Better switch off the sub - main)

3 If you are not involved in fighting the fire:

– leave calmly using the emergency exit.

– evacute the premises

– assemble at a safe place along with the others

– Check, if anyone has gone to inform about the fire break to the concerned authority

– close the doors and windows, but do not lock or bolt

As a member of the fire - fighting team

4 If you are involved in fire fighting:

– take instructions for an organised way of fighting the fire.

– If taking instructions, then follow the instructions, and obey, if you can do so safely; do not risk getting trapped.

– do not initiate your own idea.

As a leader of the group

If giving instructions:

– select CO_2 fire extinguisher

– send for sufficient assistance and inform the fire has brigade

– locate locally available suitable means to put out the fire

– judge the magnitude of the fire, ensure emergency paths are clear of obstructions and then attempet evacuate (Remove explosive material substances that can serve as a ready fuel for fire with the vicinty of the fire break.)

– fight out the fire with assistance to put it out, by naming the person resposible for each activity.

5 Report the fire accident and the measures taken to put out the fire, to the authorities concerned.

Reporting all fires however samll helps in the

Investigation of the cause of the fire. It helps to prevent the same kind of accident occuring again.

Use of fire extinguishers

Objectives: At the end of this exercise you shall be able to
- **select the fire extinguisher according to the type of fire**
- **operate the fire extinguisher**
- **extinguish the fire.**

Requirements

Equipment/Machines

- Fire extinguishers CO_2 - 1 No.
- Scissor 100mm - 1 No.
- Cell phone - 1 No.

PROCEDURE

1 Alert people surrounding by shouting fire, fire, fire when observe fire (Fig 1a & b).

2 Inform fire service or arrange to inform immediately (Fig 1c).

3 Open emergency exist and ask them to go away (Fig 1d).

4 Put "Off" electrical power supply.

Do not allow people to go nearer to the fire.

5 Analyze and identify the type of fire. Refer Table1.

6 Assume the fire is D type (Electrical fire).

Fig 1

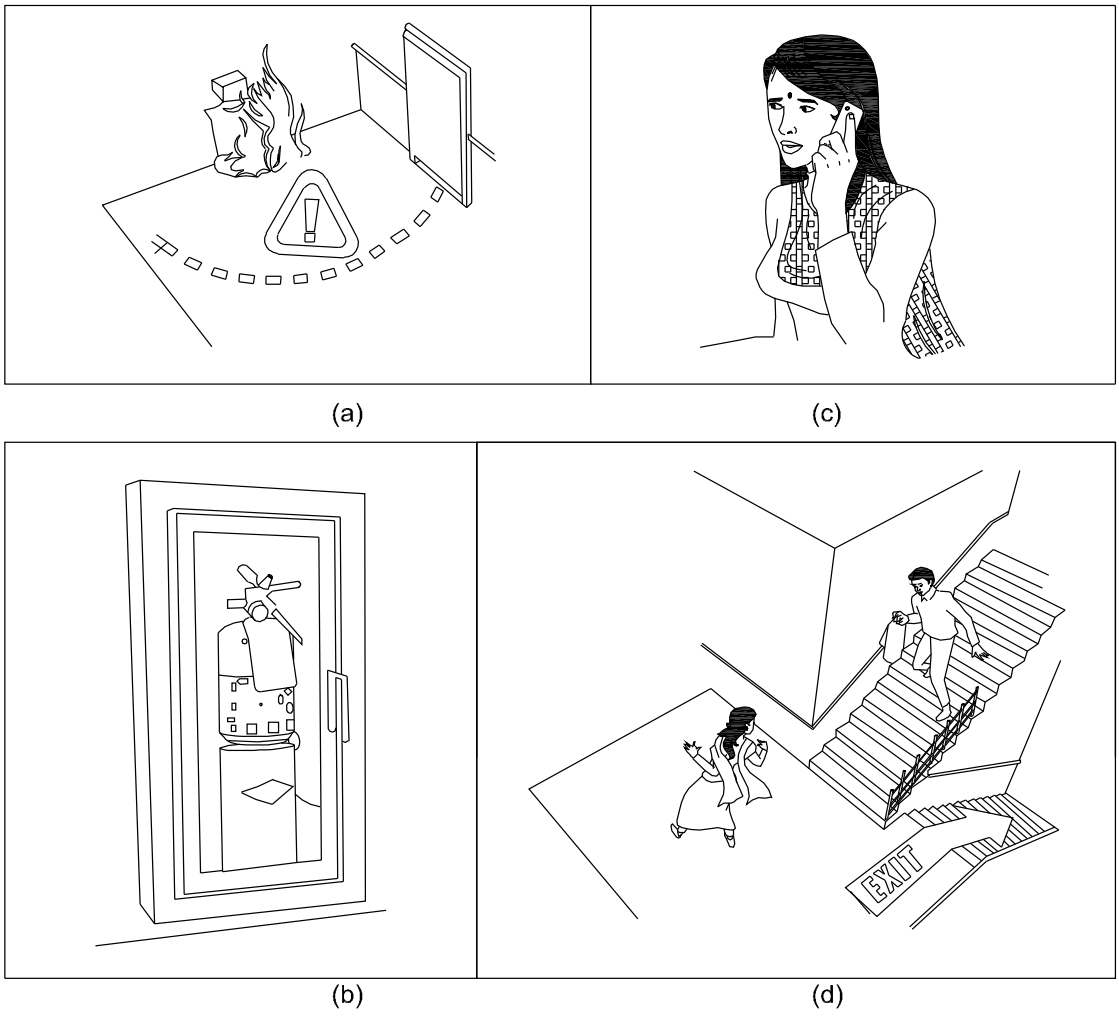
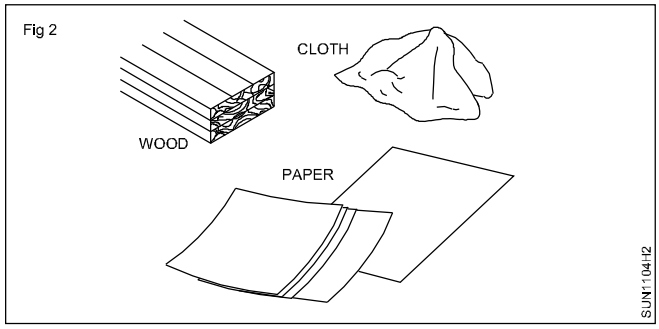
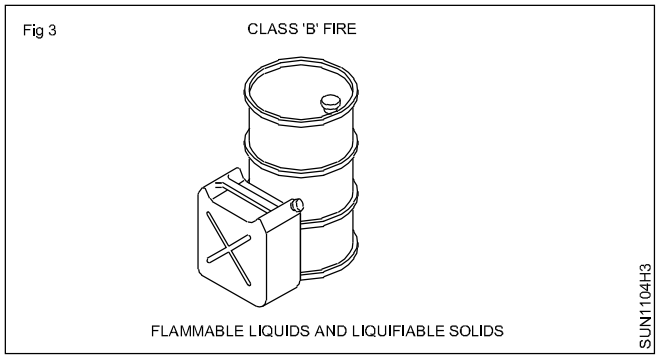
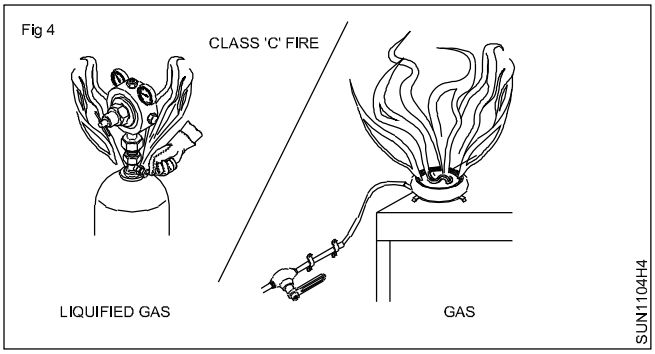
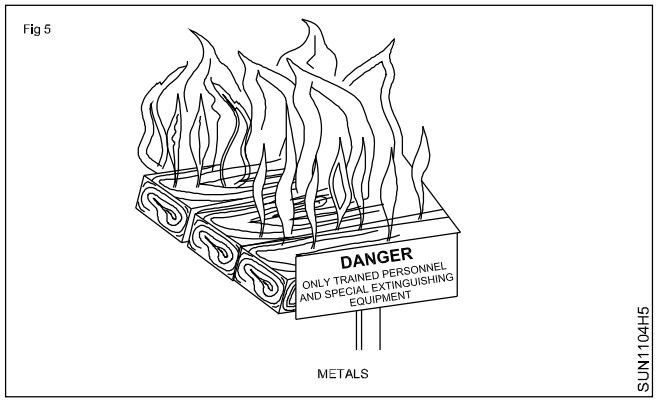


Table 1

Class 'A': Wood, paper, cloth, solid material	
Class 'B': Oil based fire (grease, gasoline,oil) & liquefiable solids	
Class 'C' Gas and liquefied gases	
Class 'D' Metals and electrical equipment	

7 Select CO_2 (carbon dioxide) fire extinguisher.

8 Locate and pick up CO_2 fire extinguisher. Check for its expiry date.

9 Break the seal. (Fig 6)

10 Pull the safety pin from the handle (Fig 7) (Pin located at the top of the fire extinguisher) (Fig 7)

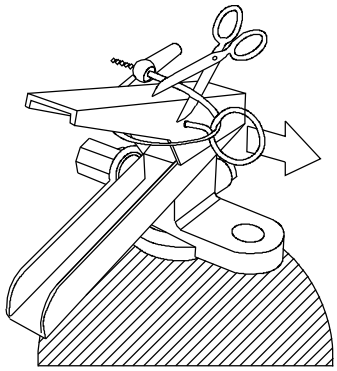
11 Aim the extinguisher nozzle or hose at the base of the fire (this will remove the source of fuel fire) (Fig 8)

Keep your self low.

12 Squeeze the handle lever slowly to discharge the agent (Fig 8)

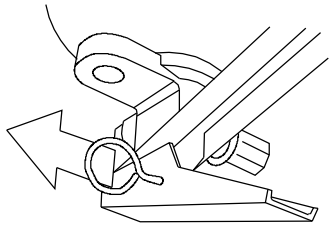
13 Sweep side to side approximately 15 cm over the fuel fire until the fire is put off. (Fig 9)

Fig 6



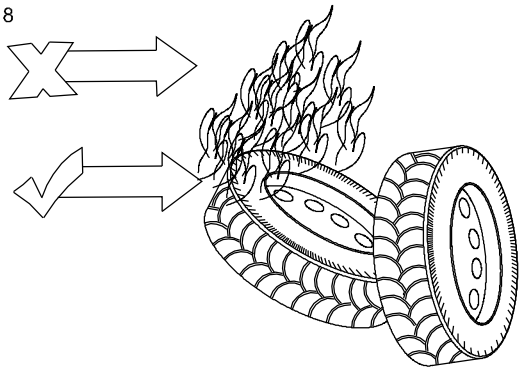
SUN1104-I6

Fig 7



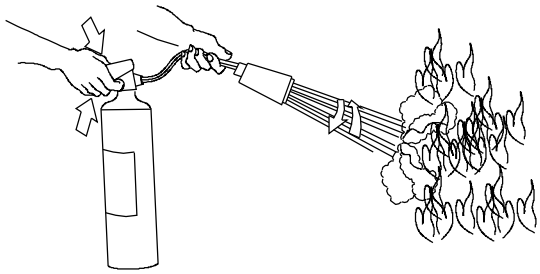
SUN1104-I7

Fig 8



SUN1104-I8

Fig 9



SUN1104-I9

Fire extinguishers are manufactured for use from the distance.

Caution

- While putting off fire, the fire may flare up.
- Do not be panic so long as it put off promptly
- If the fire doesn't respond well after you have used up the fire extinguisher move away your self away from the fire point.
- Do not attempt to put out a fire where it is emitting toxic smoke, leave it to the professionals.
- Remember that your life is more important than property. So don't place yourself or others at risk.

In order to remember the simple operation of fire extinguisher

Remember

P.A.S.S. This will help to use fire extinguisher

P for pull

A for aim

S for squeeze

S for sweep

Elementary first aid - And Health safety.

Objective : At the end of this exercise you shall be able to
- **prepare the victim for elementary first aid.**

Requirements

Equipment/Materials

No . of Person (Instructor can divide the trainees in suitable No. of groups) - 20Nos.

PROCEDURE

Assumption - For easy manageability, Instructor arrange the trainees in group and ask each group to perform one method of resuscition.

TASK 1: **Prepare the victim before giving first aid treatment**

1 Loosen the tight clothing which may interfere with the victim's breathing. (Fig 1)

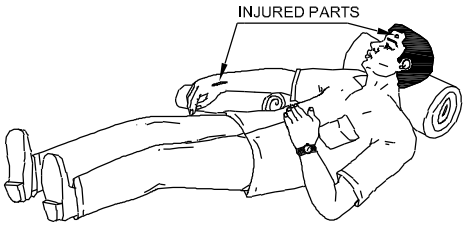
Fig 1

2 Remove any foreign materials or false teeth from his mouth and keep the victim's mouth open. (Fig 2)

Fig 2

3 Bring the victim safely to the level ground, taking necessary safety measures. (Fig 3)

Fig 3



Do not waste too much time in loosening the clothes or trying to open the tightly closed mouth.

4 Avoid violent operations to prevent injury to the internal parts of the victim.

TASK 2 : **Prepare the victim to receive artificial respiration**

1 If breathing has stopped, apply immediate artificial respiration.

2 Send word for professional assistance. (If no other person is available, you stay with the victim and render help as best as you can.)

3 Look for visible injury in the body and decide on the suitable method of artificial respiration.

4 Have you observed ? (In this case you are told by the instructor.)

5 In the case of injury/burns to chest and/or belly follow the mouth to mouth method.

6 In case the mouth is closed tightly, use Schafer's or Holgen–Nelson method.

7 In the case of burn and injury in the back, follow Nelson's method.

8 Arrange the victim in the correct position for giving artificial respiration.

All action should be taken immediately.

Delay even by a few seconds may be dangerous.

Exercise extreme care to prevent injury to internal organs.

9 Place the mock victim in the recovery position.

10 Cover the victim with coat, sacks or improvise your own method. It helps to keep the victim's body warm.

11 Proceed to perform the suitables artifical respiration method.

Environmental Guide lines

Objectives : At the end of this exercise you shall be able to
- **disconnect the victim from electric shock**
- **resuscitate the victim by**
  - **nelson's arm - Lift back method**
  - **schafer's method**
  - **mouth to mouth method**
  - **mouth to nose method**
  - **mouth to mouth.**

Requirements

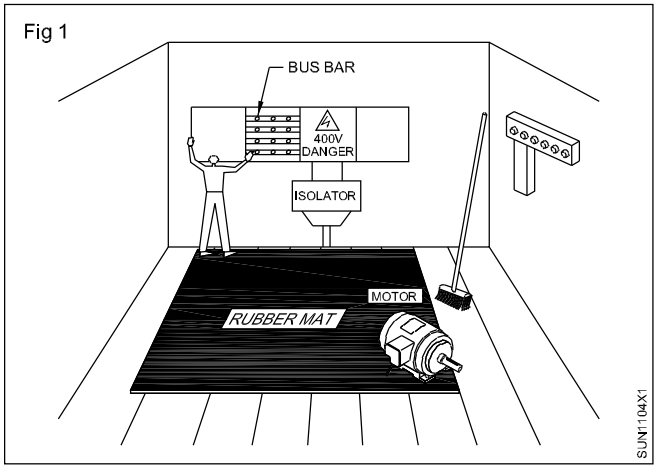
Equipments/Materials

- Control panel arrangement -1 No
- Motor - 1 No
- Rubber mat - 1 No
- Wooden stick - 1 No
- 2 persons for demonstration purpose

PROCEDURE

TASK 1 **: Disconnecting a person (mock victim) from a live supply (simulated).**

Fig 1



1 Observe the person (mock victim) receiving an electric shock. Interpret the situation quickly.

2 Remove the victim safety from the `live` equipment by disconnecting the supply or using one of the items of insulating material.

Do not run to switch off the supply that is far away.

Do not touch the victim with bare hands until the circuit is made dead or the victim is moved away from the equipment.

Push or pull the victim from the point of contact of the live equipment, without causing serious injury to the victim.

3 Move the victim physically to a nearby place.

4 Check for the victim's natural breathing and consciousness.

5 Take steps to apply respiratory resuscitation if the victim is unconscious and not breathing.

— — — — — — — — —

TASK 2 : **Resuscitate the victim by Nelson's arm - Lift back pressure method**

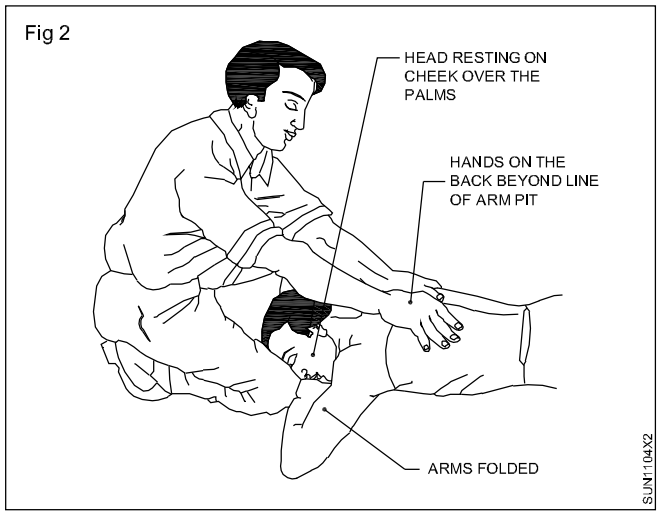
Nelson's arm-lift back pressure method must not be used in case there are injuries to the chest and belly.

1 Place the victim prone (that is face down) with his arms folded with the palms one over the other and the head resting on his cheek over the palms.

2 Kneel on one or both knees near the victim's hand.

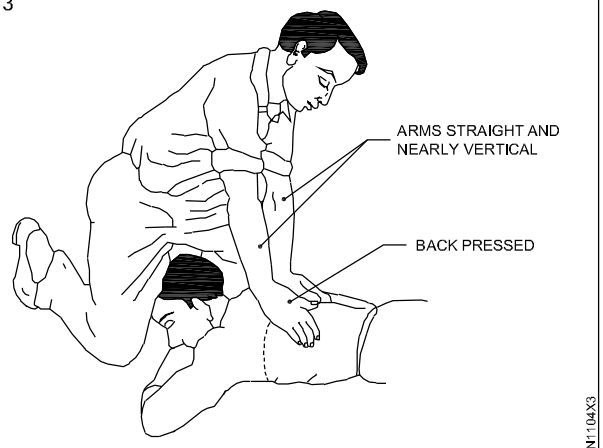
3 Place your hands on the victim's back beyond the line of the armpits,with your fingers spread outwards and downwards, thumbs just touching each other as in Fig 2.

Fig 2



4 Gently rock forward keeping your arms straight until they are nearly vertical, and steadily pressing the victim's back as shown in Fig 3 to force the air out of the victim's lungs.

Fig 3



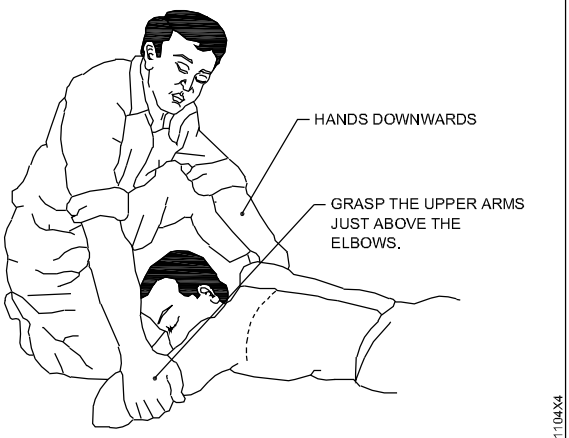
5 Synchronise the above movement of rocking backwards with your hands sliding downwards along the victim's arms, and grasp his upper arm just above the elbows as shown in Fig 4. Continue to rock backwards.

6 As you rock back, gently raise and pull the victim's arms towards you as shown in Fig 5 until you feel tension in his shoulders. To complete the cycle, lower the victim's arms and move your hands up to the initial position.

7 Continue artificial respiration till the victim begins to breathe naturally. Please note, in some cases, it may take hours.

8 When the victim revives, keep the victim warm with a blanket, wrapped up with hot water bottles or warm bricks; stimulate circulation by stroking the insides of the arms and legs towards the heart.

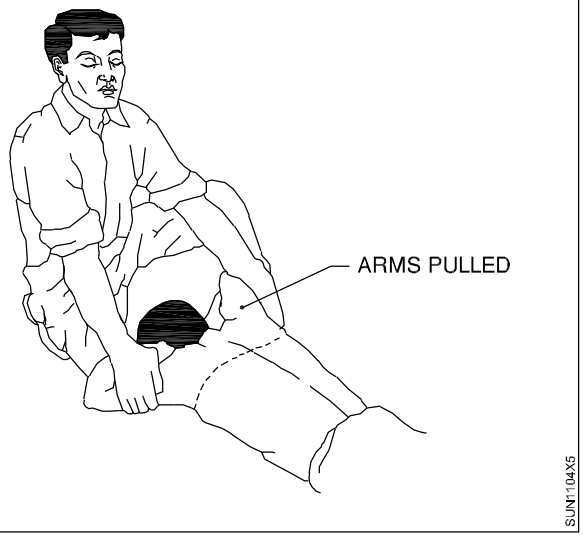
Fig 4



9 Keep him in the lying down position and do not let him exert himself.

Do not give him any stimulant until he is fully conscious.

Fig 5



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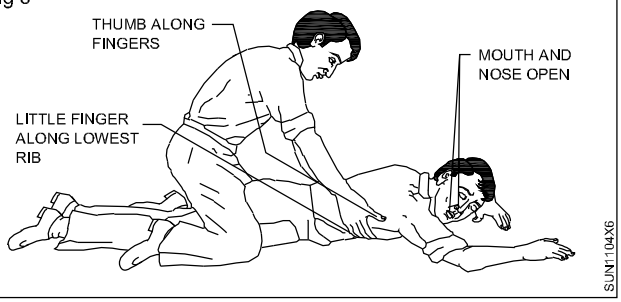
TASK 3 : **Resuscitate the victim by Schafer's method**

Do not use this method in case of injuries to victim on the chest and belly.

1 Lay the victim on his belly, one arm extended direct forward, the other arm bent at the elbow and with the face turned sideward and resting on the hand or forearm as shown in Fig 6.

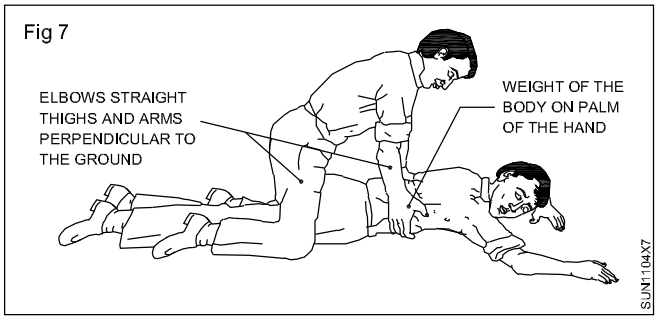
Fig 6



2 Kneel astride the victim, so that his thighs are between your knees and with your fingers and thumbs positioned as in Fig 6.

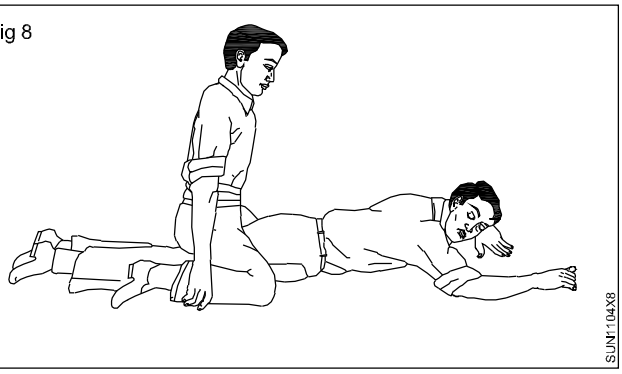
3 With the arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the lower ribs of the victim to force the air out of the victim's lungs as shown in Fig 7.

Fig 7



4 Now swing backward immediately removing all the pressure from the victim's body as shown in Fig 8, thereby, allowing the lungs to fill with air.

Fig 8



5 After two seconds, swing forward again and repeat the cycle twelve to fifteen times a minute.

6 Continue artificial respiration till the victim begins to breathe naturally.

TASK 4 : **Resuscitate the victim by mouth-to-mouth method**

1 Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. (Fig 9)

2 Tilt the victim's head back so that the chin points straight upward. (Fig 10)

3 Grasp the victim's jaw as shown in Fig 11, and raise it upward until the lower teeth are higher than the upper teeth; or place fingers on both sides of the jaw near the ear lobes and pull upward. Maintain the jaw position throughout the artificial respiration to prevent the tongue from blocking the air passage.

Fig 9

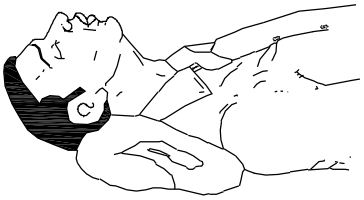


Fig 10

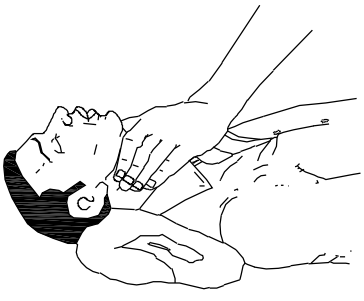
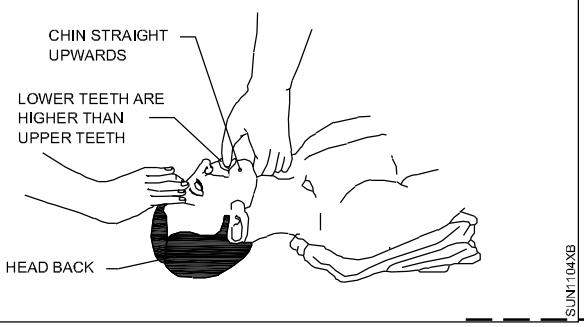
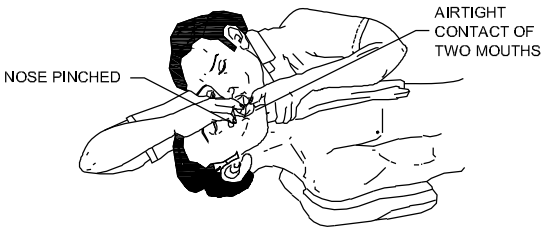


Fig 11



4 Take a deep breath and place your mouth over the victim's mouth as shown in Fig 12 making airtight contact. Pinch the victim's nose shut with the thumb and forefinger. If you dislike direct contact, place a porous cloth between your mouth and the victim's. For an infant, place your mouth over his mouth and nose. (Fig 12)

Fig 12



5 Blow into the victim's mouth (gently in the case of an infant) until his chest rises. Remove your mouth and release the hold on the nose, to let him exhale, turning your head to hear the rushing out of air. The first 8 to 10 breathings should be as rapid as the victim responds, thereafter the rate should be slowed to about 12 times a minute (20 times for an infant).

If air cannot be blown in, check the position of the victim's head and jaw and recheck the mouth for obstructions, then try again more forcefully. If the chest still does not rise, turn the victim's face down and strike his back sharply to dislodge obstructions.

Sometimes air enters the victim's stomach as evidenced by a swelling stomach. Expel the air by gently pressing the stomach during the exhalation period.

TASK 5 : **Resuscitate the victim by Mouth-to-Nose method**

Use this method when the victim's mouth will not open, or has a blockage you cannot clear.

1 Use the fingers of one hand to keep the victim's lips firmly shut, seal your lips around the victim's nostrils and breathe into him. Check to see if the victim's chest is rising and falling. (Fig 13)

2 Repeat this exercise at the rate of 10 - 15 times per minute till the victim responds.

3 Continue this exercise till the arrival of the doctor.

Fig 13

SUN1104XD

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TASK 6 : **Resuscitate a victim who is under cardiac arrest**

In cases where the heart has stopped beating, you must act immediately.

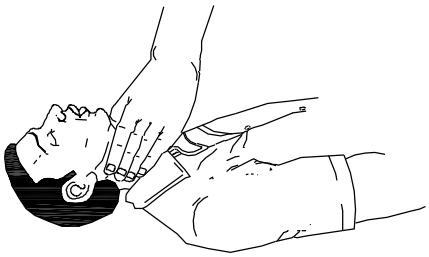
1 Check quickly whether the victim is under cardiac arrest.

Cardiac arrest could be ascertained by the absence of the cardiac pulse in the neck (Fig 14), blue colour around lips and widely dilated pupil of the eyes.

2 Lay the victim on his back on a firm surface.

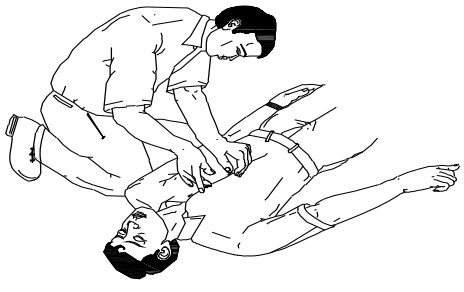
3 Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 15)

Fig 14



SUN1104XE

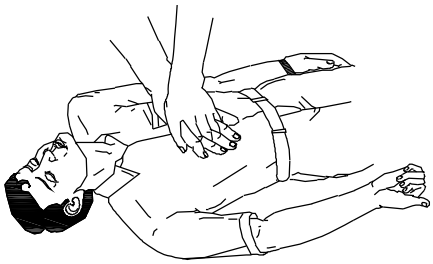
Fig 15



SUN1104XF

4 Place the palm of one hand on the centre of the lower part of the breastbone, keeping your fingers off the ribs. Cover the palm with your other hand and lock your fingers together as shown in Fig 16.

Fig 16



SUN1104XG

5 Keeping your arms straight, press sharply down on the lower part of the breastbone; then release the pressure. (Fig 17)

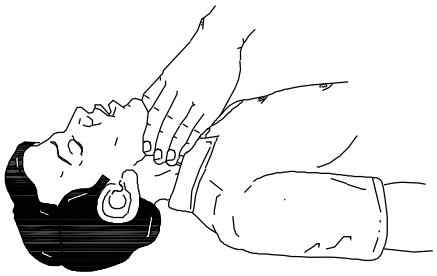
Fig 17

SUN1104XH

6 Repeat step 5, fifteen times at the rate of atleast once per second.

7 Check the cardiac pulse. (Fig 18)

Fig 18



SUN1104XI

8 Move back to the victim's mouth to give two breaths (mouth-to-mouth resuscitation). (Fig 19)

Fig 19

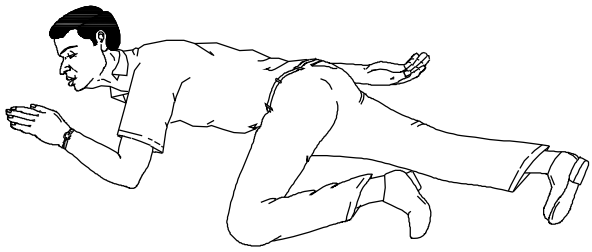
SUN1104XJ

9 Continue with another 15 compressions of the heart followed by a further two breaths of mouth-to-mouth resuscitation, and so on, check the pulse at frequent intervals.

10 As soon as the heartbeat returns, stop the compressions immediately but continue with mouth-to-mouth resuscitation until natural breathing is fully restored.

11 Place the victim in the recovery position as shown in Fig 20. Keep him warm and get medical help quickly.

Fig 20



SUN1104XK

Other steps

1 Send for a doctor immediately.

2 Keep the victim warm with a blanket, wrapped up with hot water bottles or warm bricks; stimulate circulation by stroking the insides of the arms and legs towards the heart.

Personal protective equipment (Occupational Safety)

Objectives: At the end of this exercise you shall be able to
- **read and interpret the different types of Personal Protective Equipment (PPE) from the chart (or) real PPE**
- **identify and name the PPEs for the corresponding type of protection and write their uses.**

Requirements

Tools / Equipments

- Chart **showing different types of PPES - 1 No.**
- Real PPEs (available in section) - as reqd.

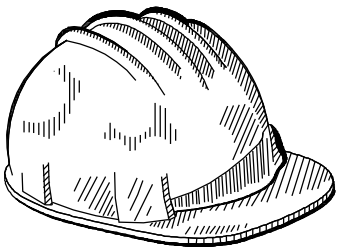
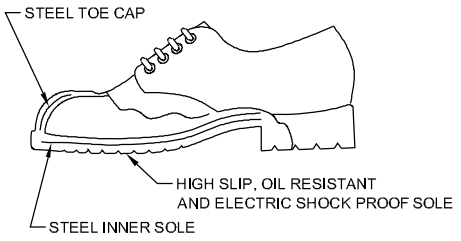
PROCEDURE

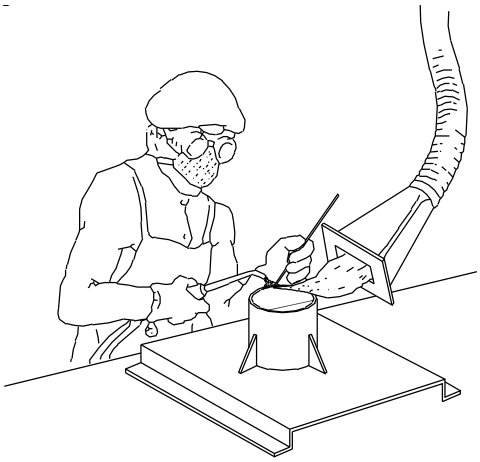
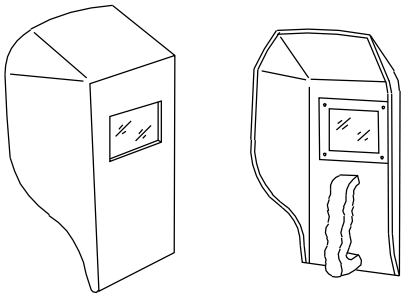
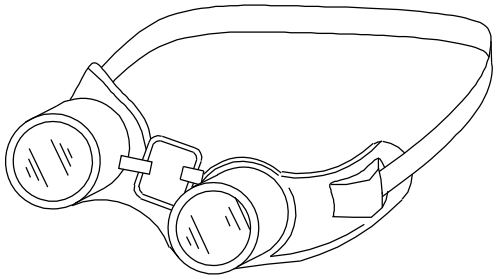
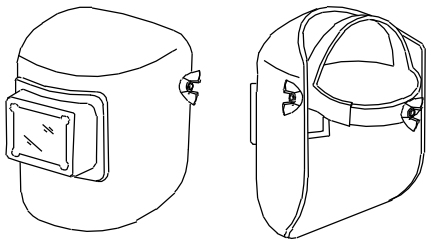
Instructor may arrange the available different types of PPEs in the table (or) provide the chart showing the PPEs. Explain the types of PPEs and their uses for corresponding hazards.

1 Identify the type of PPEs and write their names to the corresponding PPE, by referring from chart (or) read PPEs in Table 1.

2 Write their type of protection and uses in the blank space provided against each PPE in Table 1.

TABLE - 1

Sl. No.	Sketches	Name of PPE	Type of protection	Uses
1	 HELMET			
2	 INDUSTRIAL SAFETY SHOE  INDUSTRIAL SAFETY BOOT			

Sl. No.	Sketches	Name of PPE	Type of protection	Uses
3				
4				
5				
6				

Construction

Surveyor - Safety — Exercise 1.1.06

Safety signs Danger

Objectives: At the end of this exercise you shall be able to
- **identify the safety symbols from the chart and their basic category**
- **write their meaning and description and the place of use**
- **identify the road safety sign with traffic signal from the chart**
- **read and interpret the different types of occupational hazards from the chart.**

Requirements

Materials

- Basic safety signs chart -1 No.
- Road safety signs and traffic signal chart - 1No.
- Occupational hazards chart - 1 No.

PROCEDURE

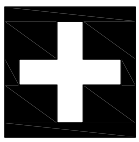
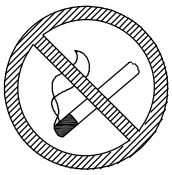
TASK 1 : **Identify the safety symbols and interpret their meaning and colour with shape**

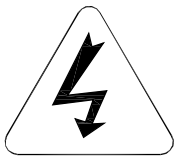
Instructor may provide various safety signs chart for basic categories and road safety with traffic signals. Then explain their categories meaning and colour. Ask the trainees to identify the sign and record in table 1.

1 Identify the basic category of each sign from the chart.

2 Write the categories name of the each sign meaning description and the place of use of that safety sign in Table 1.

Table 1

No.	Safety signs	Name of the basic category and sign	Place of use
1			
2			
3			

No.	Safety signs	Name of the basic category and sign	Place of use
4	 RISK OF ELECTRIC SHOCK		
5	 DO NOT EXTINGUISH WITH WATER		
6	 WEAR HEAD PROTECTION		
7	 TOXIC HAZARD		
8	 WEAR EYE PROTECTION		

No.	Safety signs	Name of the basic category and sign	Place of use
9	 RISK OF FIRE		
10	 PEDESTRIANS PROHIBITED		
11	 WEAR HEARING PROTECTION		
12	 SMOKING AND NAKED FLAMES PROHIBITED		
13			

— — — — — — — — —

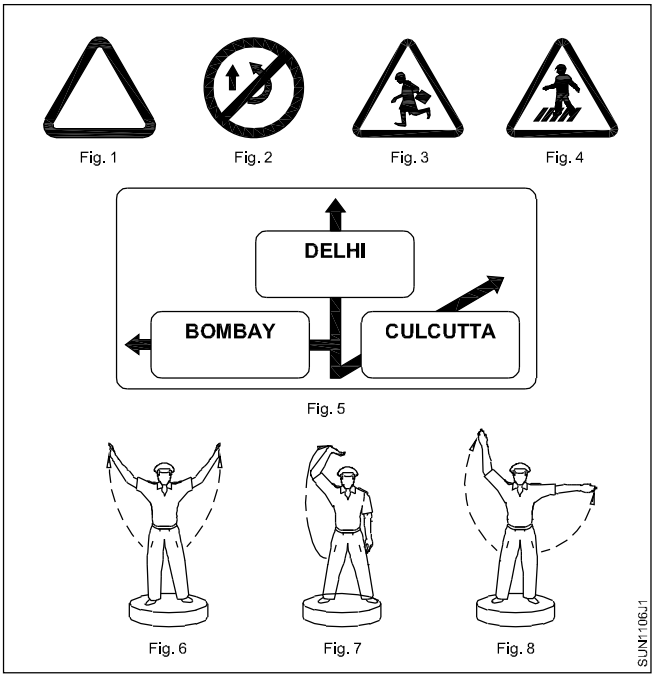
TASK 2 : **Identify the road safety sign and traffic signals**

Instructor will explain all the road safety sign and traffic police signals.

1 Read the sign given and mention their kinds and the meaning in the table 1.

2 Get it checked by the instructor.

Table 2

No.	Safety signs	Name of the basic category and sign	Place of use
			

TAKS 3: **Read and interpret the different types of personal protective devices from the chart**

Instructor may brief the various types of occupational hazards and their causes.

1 Identify the occupational hazard to the corresponding situation with a potential harm given in table 3.

2 Fill up and get it checked by your instructor.

Table 3

Sl.No.	Source or potential harm	Type of occupational hazards
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non control device	
7	No earthing	
8	Poor housekeeping	

Hazard - Identification Avoidness

Objectives: At the end of this exercise you shall be able to

- **explain various occupational hazard**
- **state occupational hygiene**
- **describe occupational disease disorders and its prevention.**

All jobs, primarily provides many economic and other benefits, But equally there are a wide varieties of workplace dangers and hazards, which are risky to the health and safety of people at work.

Basic hazards

Employers have a responsibility to protect workers against health and safety hazards at work. Workers have the right to know about potential hazards and to refuse work that they believe is dangerous. Workers also have a responsibility to work safely with hazardous materials. Health and Safety hazards exist in every workplace. Some are easily identified and corrected, while others create extremely dangerous situations that could be a threat to your life or long-term health. The best way to protect oneself is to learn to recognize and prevent hazards in the workplaces.

Prevention is better than cure :

No place of work can always be completely safe all the time and whilst some work places present greater risks than others. Industry nowhere is immune to the possibility of an accident. Hence all industries should develop the ability to carry out risk assessment processes and to take all precautionary steps to ensure the safety of the workforce. It is a group collective effort that includes each and every member of the workforce. Employers should always ensure they do the following.

- Provide adequate control of the health and safety risks.
- Consult with employees on matters affecting their health and safety.
- Provide and maintain safe plant and equipment.
- Ensure safe handing and use of substances.
- Provide information, instruction, supervision and training so that employees are competent to carry out their role.
- Review and revise all these policies regularly.

Health and Safety programmes

For all of the reasons (Fig 3), it is crucial that employers, workers and unions are committed to health and safety, addressing the following areas.

Fig 1

- Workplace hazards are controlled - at the source whenever possible ;
- Records of any exposure are maintained for many years.
- Both workers and employers are informed about health and safety risks in the workplace.
- Establish an active and effective health and safety committee that includes both workers and management.
- To observe that the workers' health and safety efforts are ongoing.

Effective workplace health and safety programmes can help to save the lives of workers by reducing hazards and their consequences. Health and safety programmes also have positive effects on both worker morale and productivity, which are important benefits. At the same time, effective programmes can save employers a great deal of money.

Healthy workplace, hazard free work environment, zero accident work-life can help to save the lives of workers by reducing hazards and diseases. Effective programmes can also have positive effects on both worker morale and productivity. All put together enhance the human values at work and prosperity of the nation.

1 Occupational health and safety encompasses the social, mental and physical well-being of workers in all occupations.

2 Poor working conditions have the potential to affect a worker's health and safety.

3 Unhealthy or unsafe working conditions can be found anywhere, whether the workplace is indoor or outdoor.

4 Poor working conditions can affect the environment workers live in. This means that workers, their families, other people in the community, and the physical environment around the workplace, can all be at risk from exposure to workplace hazards.

5 Employers have a moral and often legal responsibility to protect workers.

6 Work-related accidents and diseases are common in all parts of the world and often have many direct and indirect negative consequences for workers and their families. A single accident or illness can mean enormous financial loss to both worker and employers.

7 Effective workplace health and safety programmes can help to save the lives of workers by reducing hazards and their consequences.

8 Effective programmes can also have positive effects on both worker morale and productivity, and can save employers a great deal of money.

Occupational hazard

Objectives: At the end of this exercise you shall be able to

- **explain various occupational hazard**
- **state occupational hygiene**
- **describe occupational disease disorders and its prevention.**

All jobs, primarily provides many economic and other benefits, But equally there are a wide varieties of workplace dangers and hazards, which are risky to the health and safety of people at work.

Basic hazards

Employers have a responsibility to protect workers against health and safety hazards at work. Workers have the right to know about potential hazards and to refuse work that they believe is dangerous. Workers also have a responsibility to work safely with hazardous materials. Health and Safety hazards exist in every workplace. Some are easily identified and corrected, while others create extremely dangerous situations that could be a threat to your life or long-term health. The best way to protect oneself is to learn to recognize and prevent hazards in the workplaces.

Physical hazards are the most common hazards and are present in most workplace at some point of time. Examples include; live electrical cords, unguarded machinery, exposed moving parts, constant load noise, vibrations, working from ladders, scaffolding or heights, spills, tripping hazards. Physical hazards are a common source of injuries in many industries. Noise and vibration, Electricity, Heat, Ventilation, Illumination, Pressure, Radiation etc.

- **Ventilation** and air circulation have major say on the health and working comfort of the worker. There must be good ventilation, a supply of fresh, clean air drawn from outside is required. It must be uncontaminated and circulated around the workspace. Closed of confined spaces also present a work hazard, which has limited openings for entry and exit and unfavorable natural ventilation, and which is not intended for continuous employee occupancy.
  Spaces of this kind can include storage tanks, ship compartments, sewers, and pipelines. Asphyxiation is another potential work hazard in certain situations. Confined spaces can pose a hazard not just to workers, but also to people who try to rescue them.

- **Noise and Vibration :** Noise and vibration are both fluctuations in the pressure of air (or other media) which affect the human body. Vibrations that are detected by the human ear are classified as sound. We use the term 'noise to indicate unwanted sound. Noise and vibration can harm workers when they occur at high levels, or continue for a long time. (Fig 1)

Fig 1

- **Electricity** poses a danger to many workers. Electrical injuries caused by contact with electric energy can be divided into four types
- fatal electrocution,
- electric shock,
- burns,
- falls .

Wires and electrical equipment pose safety threats in the workspace. When employees mishandle electrical equipment and wires, they are taking risks. (Fig 2)

Fig 2

Temperature (Heat Stress) : A reasonable working temperature, for strenuous work, local heating or cooling where a comfortable temperature is to be maintained which is safe and does not give off dangerous or offensive fumes, Thermal clothing and rest facilities where necessary (for example, for 'hot work' or work in cold storage areas). Sufficient space in workrooms etc. are under the legislation for implementation by the owner of the factories.

- **Illumination (lighting) :** Good light lighting is essential for productivity Natural light is preferred where possible. Glare and flickering should be avoided.

HEAT EXHAUSTION/HEAT STROKE & TREATMENT

- NORMAL BODY CORE TEMPERATURE - 37°C
- HEAT EXHAUSTION - 38°C - 40°C
- HEAT STROKE 41°C AND HIGHER

SIGNS AND SYMPTOMS

HEAT EXHAUSTION	HEAT STROKE
• RESTLESS	• REDUCED LEVEL OF CONCIOUSNESS
• WEAK	• IRRITABLE
• DIZZY	• MUSCULAR PAIN
• RAPID PULSE	• RAPID PULSE
• LOW BLOOD PRESSURE	• HIGH BLOOD PRESSURE
• NAUSEA	• NAUSEA
• VOMITTING	• VOMITTING
• MENTAL STATUS - NORMAL	• MENTAL STATUS - CONFUSED
• BEHAVIOR - NORMAL	• BEHAVIOUR - ERRATIC
	• HOT, DAY, RED SKIN
	• DEATH

TREATMENT

• LAY PERSON DOWN & ELEVATE LEGS	• MOVE PERSON TO COOL VENTILATED AREA
• ENSURE NORMAL BREATHING	• CHECK FOR BREATHING, PULSE & CIRCULATION
• IF THIRSTY GIVE WATER TO DRINK	• IF POSSIBLE COVER THE PERSON WITH ICE PACKS OR COLD WATER TO REDUCE THE BODY TEMPERATURE
• REPORT INCIDENT TO SUPERVISOR	• GIVE WATER TO DRINK
	• MONITOR VITAL SIGNS
	• GET PERSON TO HOSPITAL
	• REPORT INCIDENT TO SUPERVISOR

Chemical hazards are present when you are exposed to any chemical preparation (solid, liquid or gas) in the workplace. Examples include: cleaning products and solvents, vapours and fumes, carbon monoxide or other gases, gasoline or other flammable materials. Chemicals hazards are the major causes of concern. Many chemicals are used not on generic names but on brands. The chemicals have biological effects on the human body if digested, inhaled or if direct skin contact with the chemicals, injuries occurs.

Accidents involving chemical spills, exposure and inhalation can lead to burns, blindness, rashes and other ailments. Most of them cause acute poisoning when taken orally, eye-skin irritation, Respiratory injuries etc. Long term effects of chemicals on blood, nerve, bones, kidneys, livers etc., my lead to serious diseases/ disorders. The only way is to understand their chemical nature and handle them very carefully.

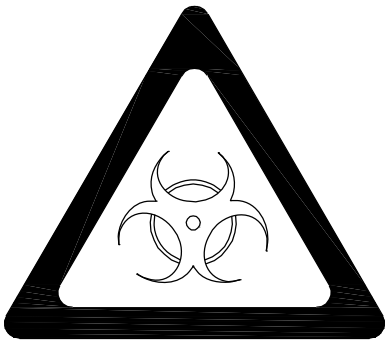
CHEMICAL POISONING

Poison : An agent or substances which may cause structural damage or functional disorders when introduced into the body by :

- **Ingestion**
- **Inhalation**
- **Absorption or**
- **Injection**

Biological hazards (Fig 3) come for working with people, animals or infectious plant material. Examples include; blood or other bodily fluids, bacteria and viruses, insect bites, animal and bird droppings. Biological hazards are due agent like bacteria, virus, fungi, mold, blood-borne pathogens etc., are main agents to cause various illness. (Fig 4)

Fig 3



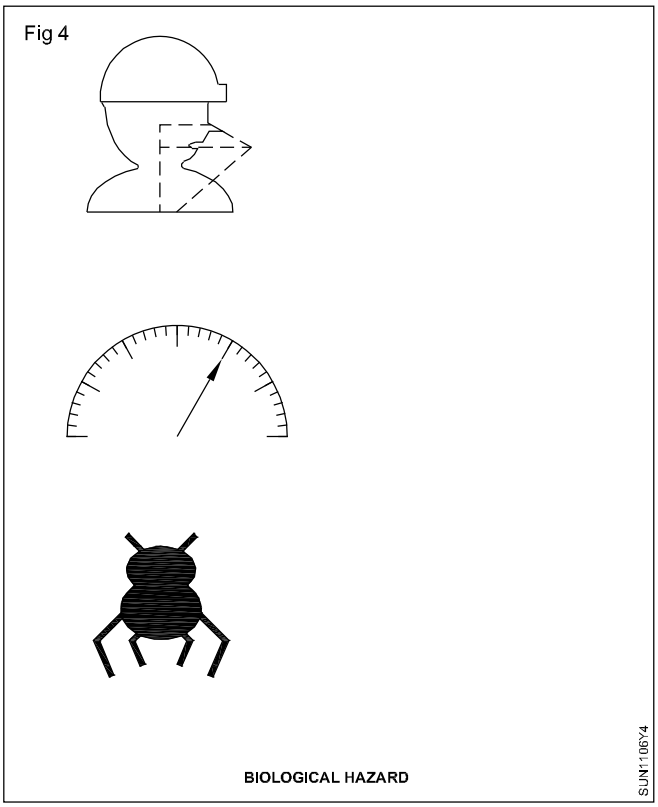
BIOLOGICAL HAZARD

SUNT106Y3

Ergonomic hazards (Fig 5)

Ergonomic hazards occur when the type of work you do, your body position and/or your working conditions put a strain on your body. They are difficult to identify because you don't immediately recognize the harm they are doing to your health. Examples include : poor lighting, improperly adjusted workstations and chairs, frequent lifting, repetitive or awkward movements. Musculo Skeletal Disorders (MSDs) affect the muscles, nerves and tendons. Work related MSDs are one of the leading causes injury and illness.

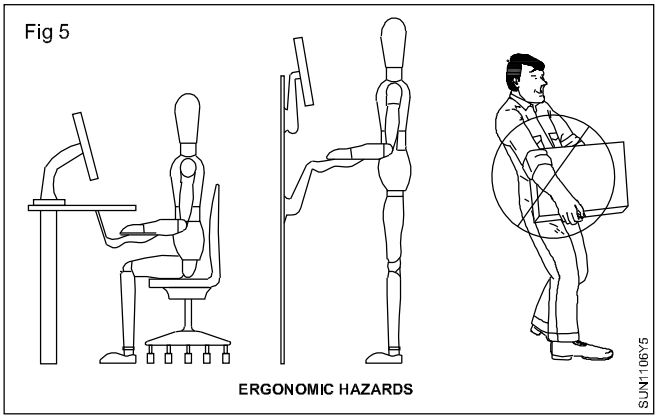
Fig 4



BIOLOGICAL HAZARD

SUN1106Y4

Fig 5



ERGONOMIC HAZARDS

SUN1106Y5

Workers in many different industries and occupations can be exposed to risk factors at work, such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures and performing the same or similar tasks repetitively. Exposure to these known risk factors for MSDs increases a worker's risk of injury.

Mechanical hazards are factor arise out of varieties of machines in industries including manufacturing, mining, construction and agriculture. They are dangerous to the worker when operated without training and experience. Operating machines can be risky business, especially large, dangerous machines. When employees don't know how to properly use machinery or equipment, they risk such injuries as broken bones, amputated limbs and crushed fingers. Many machines involve moving parts, sharp edges, hot surfaces and other hazards with the potential to crush, burn, cut, shear, stab or otherwise strike or wound workers if used unsafely.

Various safety measures exists to minimize these hazards, lockout-tagout procedures for machine maintenance and roll over protection systems for vehicles. Machines are also often involved indirectly in worker deaths and injuries, such as in cases in which a worker slips and falls, possibly upon a sharp or pointed object. Safeguarding machinery decreases accidents and keeps employees who use the machine safer.

Falls (Fig 6) are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance. Slips and falls to be the leading cause of workplace injuries and fatalities. From slippery surfaces to un-railed staircases, the possibility of slipping, tripping or falling on the job is a workplace safety hazard. Broken bones, fractures, sprained wrists and twisted ankles constitute some of the physical injuries caused by falling accidents.

Fig 6

SUN1106Y6

Falls in the workplace is effectively prevented by putting caution signs around slippery surfaces (Fig 7), having rails on every staircase and making sure that wires on the floor are covered to avoid tripping. They are perhaps unavoidable in certain industries, such as construction and mining, but over time people have developed safety methods and procedures to manage the risks of physical danger in the workplace. Employment of children may pose special problems.

Fig 7

CAUTION BOARD

SUN1106Y7

Psychosocial hazards : psychosocial hazards are related to the way work is designed, organized and managed, as well as the economic and social contexts of work and are associated with psychiatric, psychological and/or physical injury or illness. Linked to psychosocial risks are issues such as occupational stress and workplace violence which are becoming a major challenge to occupational health and safety.

Workplace inspections prevent hazards

Regular workplace inspections are another important factor in preventing injuries and illnesses. By critically examining all aspects of the workplace, inspections identify and record hazards that must be addressed and corrected.

A workplace inspection should include

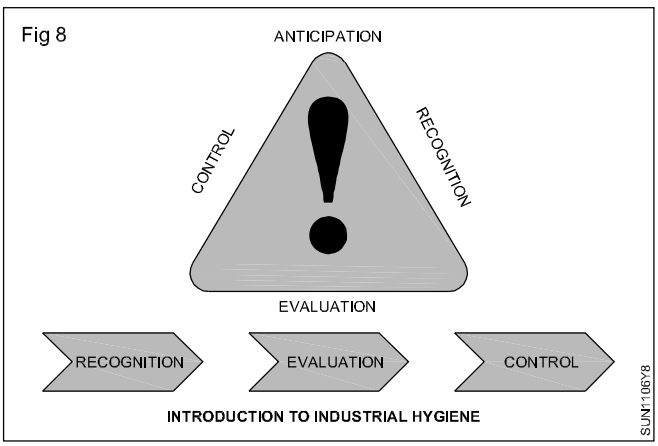
- Listening to the concerns of workers and supervisors.
- Gaining further understanding of jobs and tasks.
- Identifying existing and potential hazards.
- Determining underlying causes of hazards.
- Monitoring hazard controls (Personal protective equipment, engineering controls, policies, procedures)
- Recommending corrective action.

Occupational hygiene

Occupational hygiene (Industrial hygiene) (Fig 8) is the discipline of anticipating, recognizing, evaluating and controlling health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large.

Occupational hygiene uses science and engineering to prevent ill health caused by the environment in which people work. It helps employers and employees to understand the risks and improve working conditions and working practices. (Fig 9)

Fig 8



Occupational disease/Disorders & its prevention

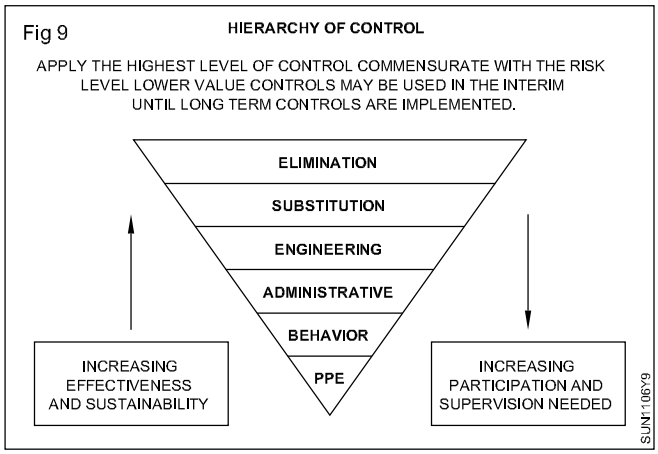
Occupational disease, illness incurred because of the conditions or environment of employment. Unlike with accidents, some time usually elapses between exposure to the cause and development of symptoms. In some instances, symptoms may not become evident for may years and hence the relationship between work and disease is ignored.

Among the environmental causes of occupational disease are subjection to extremes of temperature leading to heatstroke, air contaminants of dust, gas, fumes causing diseases of the respiratory tract, skin, or muscles and joints or changes in atmospheric pressure causing decompression sickness, excessive noise causing hearing loss, exposure to infrared or ultraviolet radiation or to radioactive substances. The widespread use of X rays, radium and materials essential to the production of nuclear power has led to an special awareness of the dangers of radiation sickness. Hence careful checking of equipment and the proper protection of all personnel are now mandatory.

In addition there are industries in which metal dusts, chemical substances, and unusual exposure to infective substances constitute occupational hazards. The most common of the dust and fiber inspired disorders are the lung diseases caused by silica, beryllium, bauxite and iron ore to which miners, granite workers and many others are exposed causing pneumoconiosis and those caused by asbestos is cancer - mesothelioma, Fumes, Smoke and Toxic liquids from a great number of chemicals are other occupational dangers. Carbon monoxide, Carbon tetrachloride, Chlorine, Creosote, Cyanides, Dinitrobenzene, Mercury, Lead Phosphorus and nitrous chloride are but a few of the substances that on entering through the skin, respiratory tract or digestive tract cause serious and often fatal illness.

Occupational hazards also are presented by infective sources. Persons who come into contact with infected animals in a living or deceased state are in danger of acquiring such diseases as anthrax. Doctors, Nurses and other hospital personnel are prime targets for the tuberculosis bacillus and for many other infectious organisms.

Fig 9



Regulations safety

Objectives: At the end of this exercise you shall be able to
- **state different type of fire**
- **state the differemt types of fire extinguishers and their basic function.**

Fire safety : Fire is the most common serious hazard that one faces in a typical chemistry laboratory. While proper procedure and training can minimize the chances of an accidental fire, you must still be prepared to deal with a fire emergency should it occur.

Typically, a fire extinguisher consists of a hand-held cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.

There are two main types of fire extinguishers :

- Stored pressure
- Cartridge-operated.

In stored pressure units, the expellant is stored in the same chamber as the firefighting agent itself. Depending on the agent used, different propellants are used. With dry chemical extinguishers, nitrogen is typically used, water and foam extinguishers typically use air. Stored pressure fire extinguishers are the most common type.

Carbon-dioxide extinguishers contain the expellant gas in a separate cartridge that is punctured prior to discharge, exposing the propellant to the extinguishing agent. This type is not as common, used primarily in areas such as industrial facilities, where they receive higher-than-average use. They have the advantage of simple and prompt recharge, allowing an operator to discharge the extinguisher, recharge it and return to the fire in a reasonable amount of time. Unlike stored pressure types, these extinguishers use compressed carbon dioxide instead of nitrogen, although nitrogen cartridges are used on low temperature (-60 rated) models.

Cartridge operated extinguishers are available in dry chemical and dry powder and in water, wetting agent, foam, dry chemical (classes ABC and B.C.) and dry powder (class D) types in the rest of the world.

Class A : This is suitable for cloth, wood, rubber, paper, various plastics, and regular combustible fires. It is usually filled with 2 ½ gallons (9.46 litres) of pressurized water.

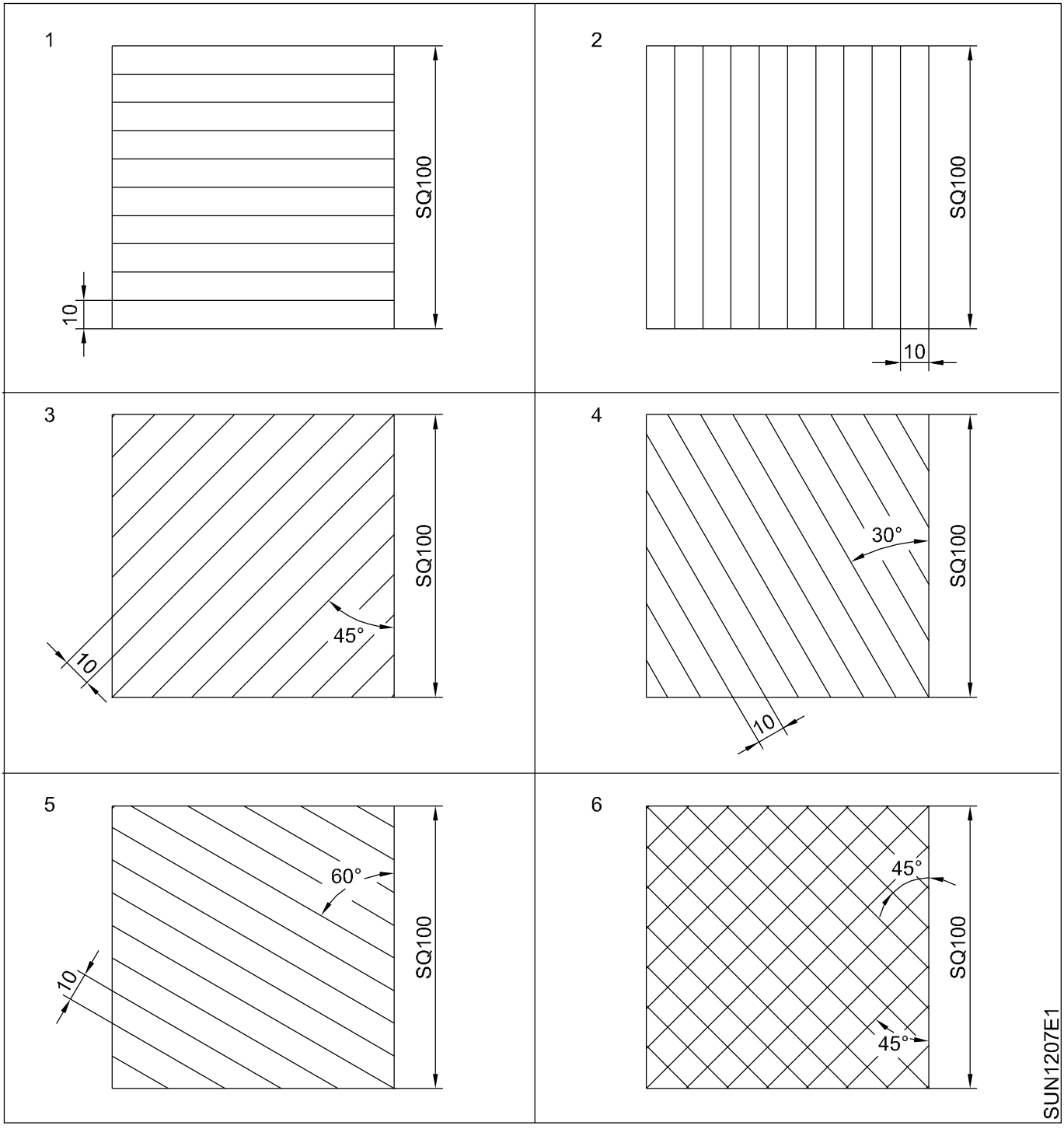
Class A fire extinguishers are designed to put out fires that have started from household items that are made out of materials that will quickly ignite. These materials include paper products and furniture made from wood. The Type A fire extinguisher contains water. The number on the canister represents how much water it contains. If there is a No. 1, the extinguisher will have a little more than I gallon of water. The higher the number, the more water it contains. The letter A stands for ash. A fire that burns from household items will leave ashes.

Class B : This is suitable for grease, gasoline or oil-based fire is usually filled with a dry chemical. Extinguishers smaller than 6lbs (2.72kg) are not recommended.

Use of drawing instrument and equipment with care (line, angle and patterns)

Objectives: At the end of this exercise you shall be able to
- **draw figures involving horizontal, vertical and inclined lines using drawing instruments**
- **independently using 'T' square, setsquares, scale, divider and protractor.**

Exercise 1 to 14: Draw the following patterns and components using straight lines.



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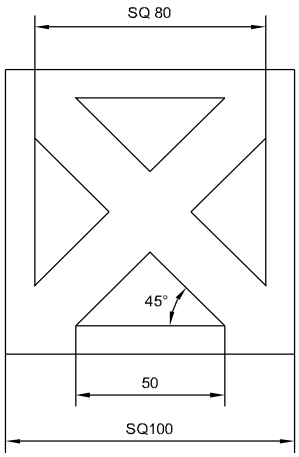

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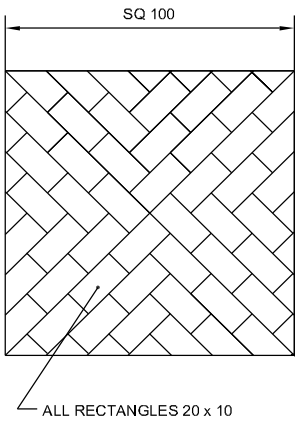

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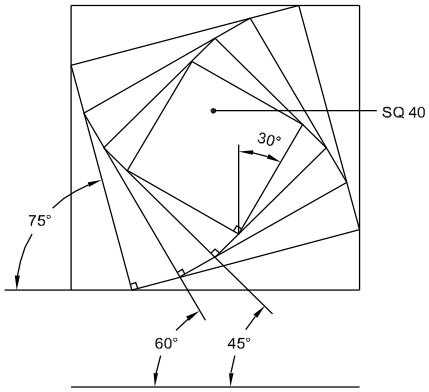

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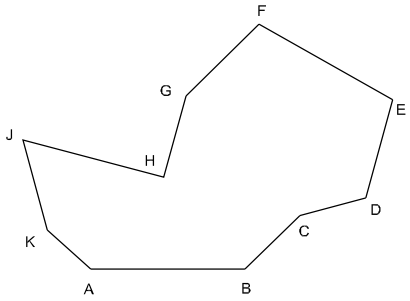
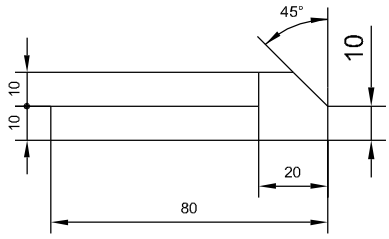


AB = 90	FG = 60
BC = 45	GH = 50
CD = 40	HJ = 85
DE = 60	JK = 55
EF = 90	KA = ?

∠B = 135°	∠G = 150°
∠C = 150°	∠H = 75°
∠D = 120°	∠J = 60°
∠E = 105°	∠K = ?°
∠F = 135°	∠A = ?°

11



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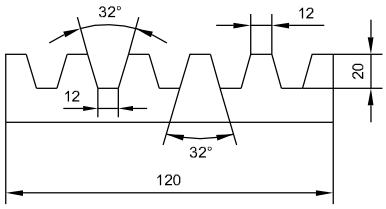

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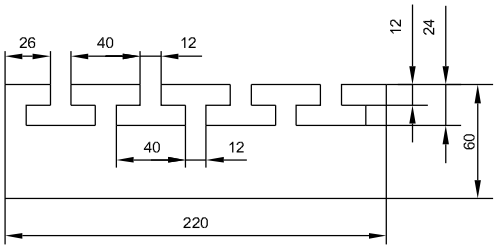
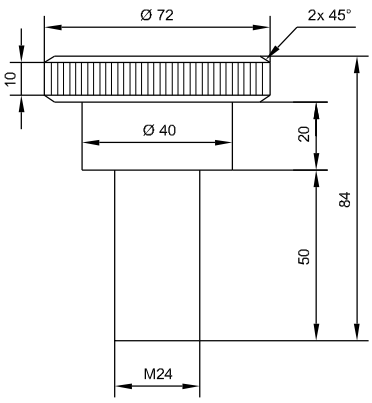


14



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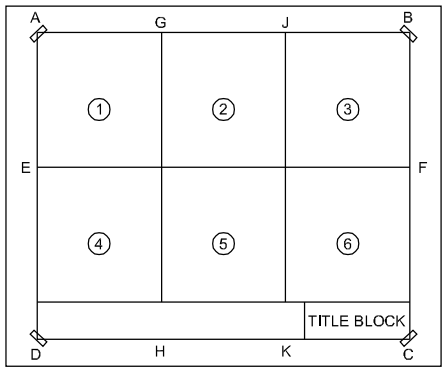
PROCEDURE

Exercise 1 : Horizontal line

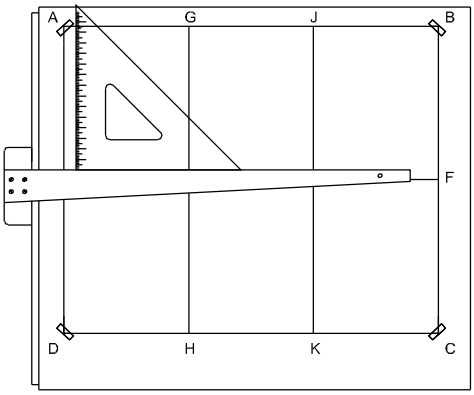
- Layout lines as shown in Fig 1 on an A2 drawing sheet.

Fig 1



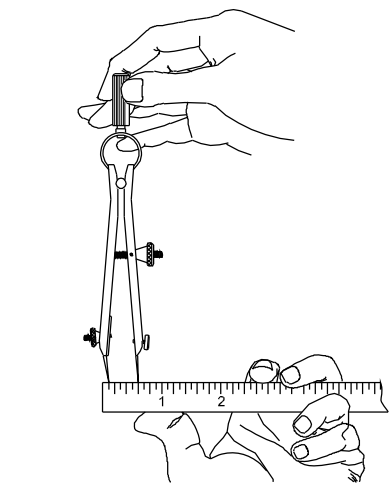
- Butt the 'T' square approximately 5 mm above the line EF.
- Draw a horizontal line 100 mm long left to right. (15 mm from AE)
- Draw a vertical line 100 mm long from the left end of the drawing paper as shown in Fig 2.

Fig 2



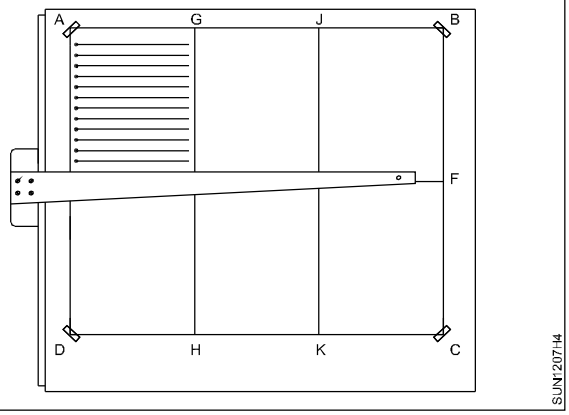
- Mark of points on the vertical line at 10 mm intervals using divider. (Fig 3)

Fig 3



- Draw horizontal lines through the points using 'T' square. (Fig 4)

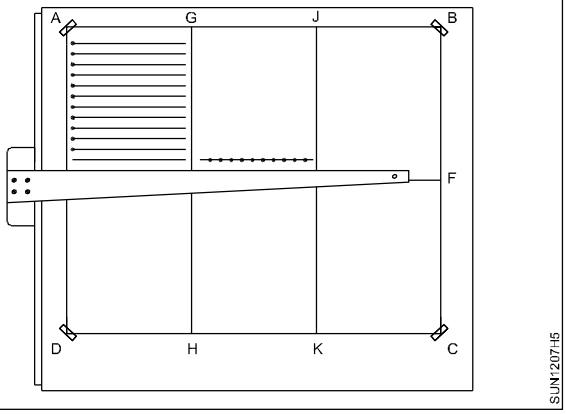
Fig 4



Exercise 2 :

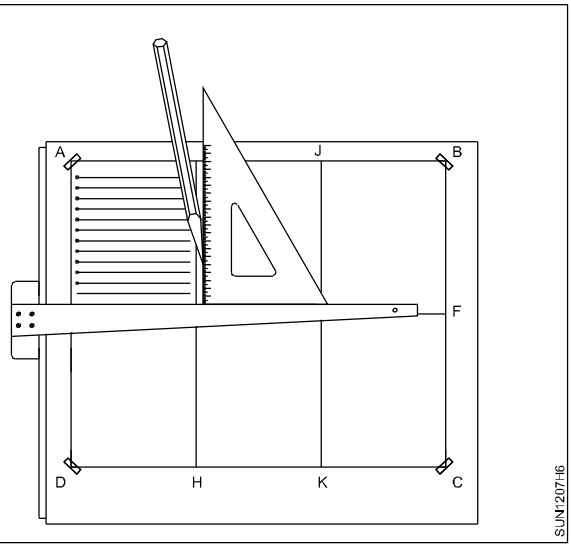
- Draw the thin horizontal line and mark 10 mm spaces as in (Fig 5).

Fig 5



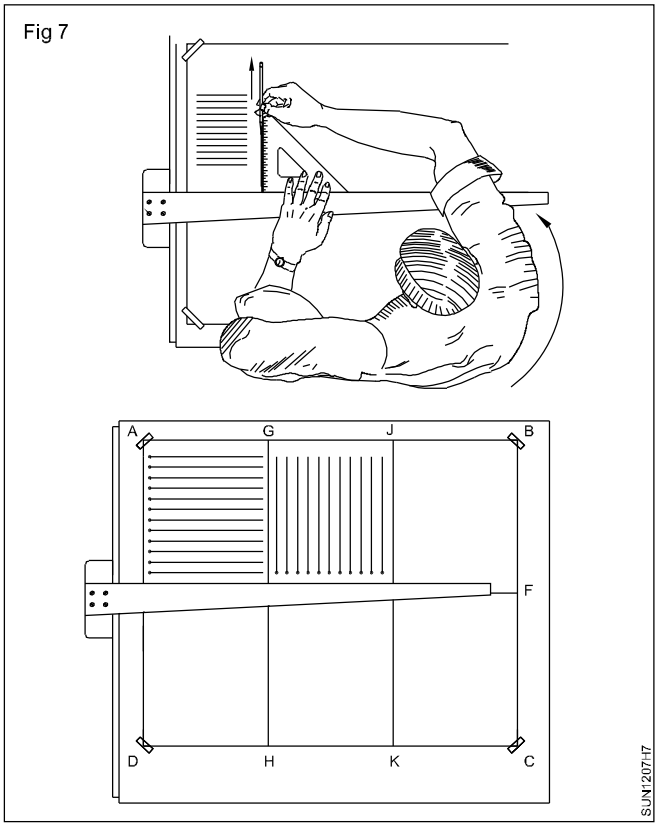
- Place the 30°/60° setsquare on the 'T' square in such a way that its vertical edge is towards the left side of the board, approximately 15 mm from the line GH. (Fig 6)

Fig 6



- Move your left hand onto the 'T' square blade and hold the setsquare firmly in position.
- Hold the pencil approximately at 60° with the paper. (Fig 6)

Fig 7

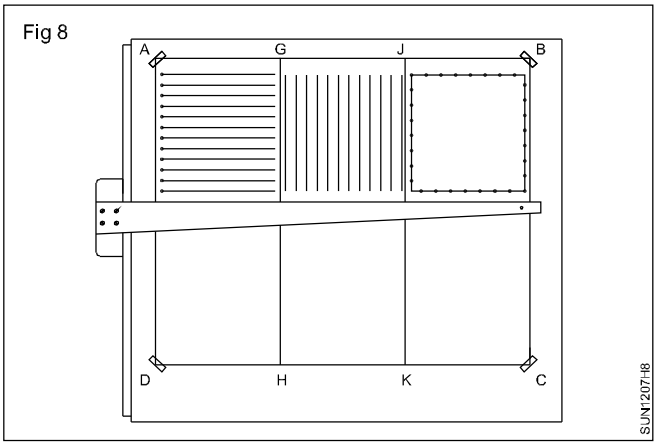


- Draw a line upwards approximately to a height of 100 mm twisting your body as shown in Fig 7.
- Continue to draw the remaining vertical lines.

Exercise 3 to 6 : Inclined lines

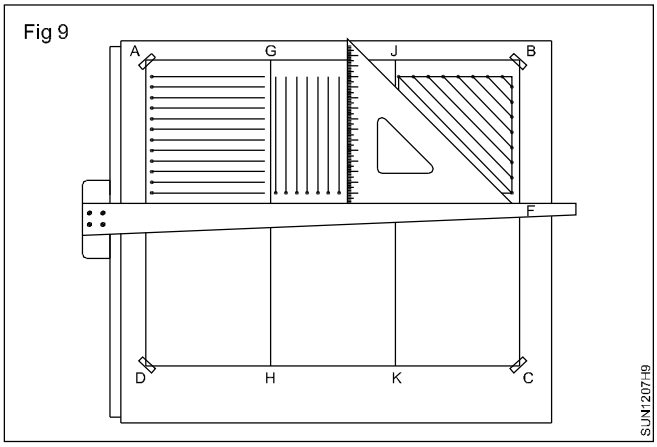
- For drawing 45° lines.
- Place the working edge of the 'T' square 15 mm above the line EF and draw horizontal lines in block (3) as shown.
- Draw vertical lines parallel to JK as shown in the block.
- Using divider, mark points from top corner at 10 mm intervals on horizontal and vertical line. (Fig 8)

Fig 8



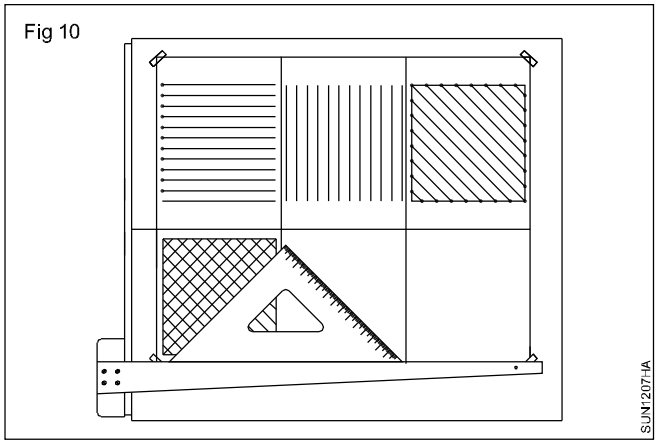
- Butt, slide and take the working edge of 'T' square to line EF.
- Place the 45° setsquare and draw the 45° inclined lines from the corner, top to downwards. (Fig 9)
- Hold the blade of the 'T' square and setsquare intact while drawing lines.

Fig 9



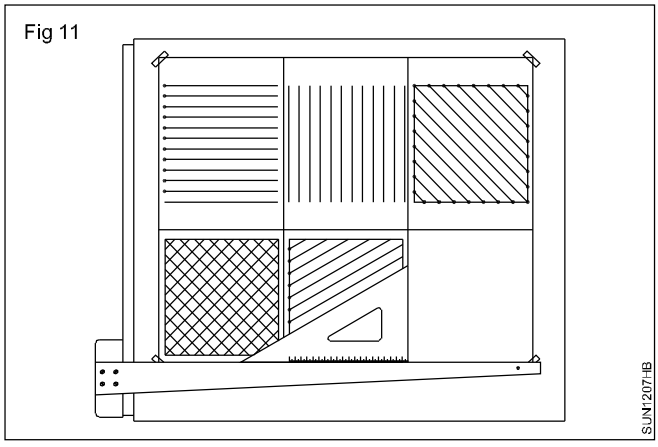
- Following the same procedure complete block 4, 5 & 6.
- Draw 45° inclined line in the opposite direction in block 4. (Fig 10)

Fig 10



- 30° or/and 60° inclined lines can be drawn with the help of 30° /60° setsquare and 'T' square.
- Draw 30° inclined lines in block 5. (Fig 11)

Fig 11

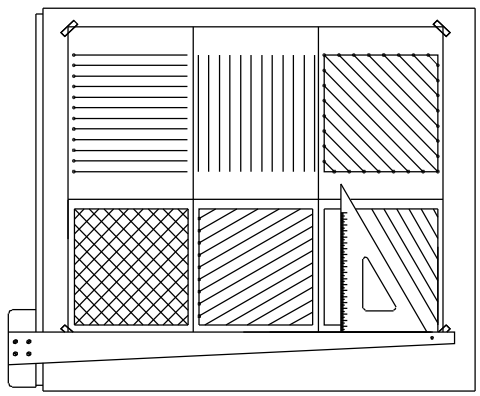


In the block 6, draw 60° inclined lines. (Fig 12)

Exercise 7 : Triangles in a square

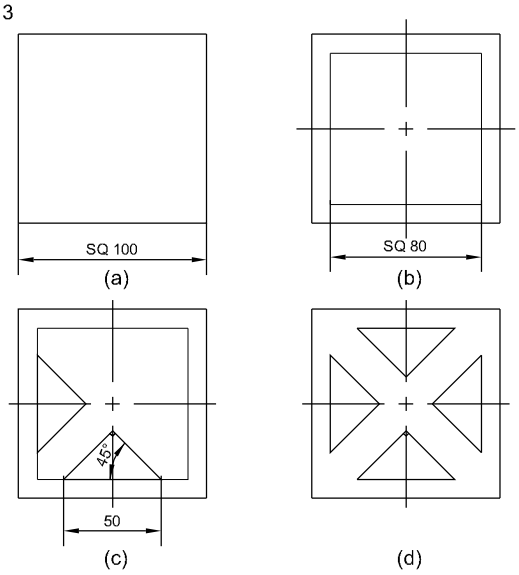
- Draw a square of side 100 mm long. (Fig 13a)
- Draw another square of side 80 mm as shown in Fig 13b.
- Draw four triangles using 45° setsquare and 'T' square. (Fig 13c & 13d)

Fig 12



SUN1207-IC

Fig 13

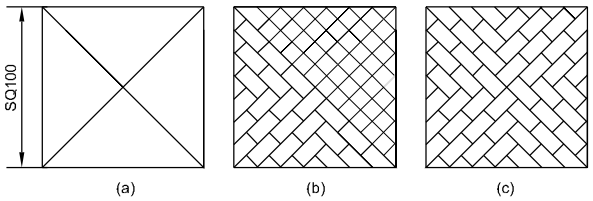


SUN1207-HD

Exercise 8: Tile pattern

- Draw a square of side 100 mm and its diagonals. (Fig 14a)
- Draw lines parallel to both the diagonals at a distance of 10 mm. (Fig 14b)
- Complete the tile pattern by forming 20 mm x 10 mm rectangles as shown in Fig 14c.

Fig 14

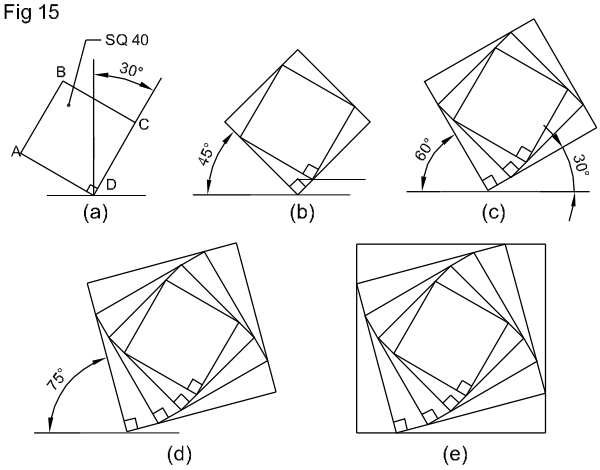


SUN1207-HE

Exercise 9 : Square pattern

- Draw a square ABCD of side 100 mm with side CD marking 30° to the vertical line. (Fig 15a)
- Draw the next square by drawing straight lines through points A, B, C & D using 'T' square and 45° setsquare. (Fig 15b)
- Draw the subsequent squares with the same procedure but with the inclination of 60°, 75° & 90°. (Fig 15c, d, e)

Fig 15

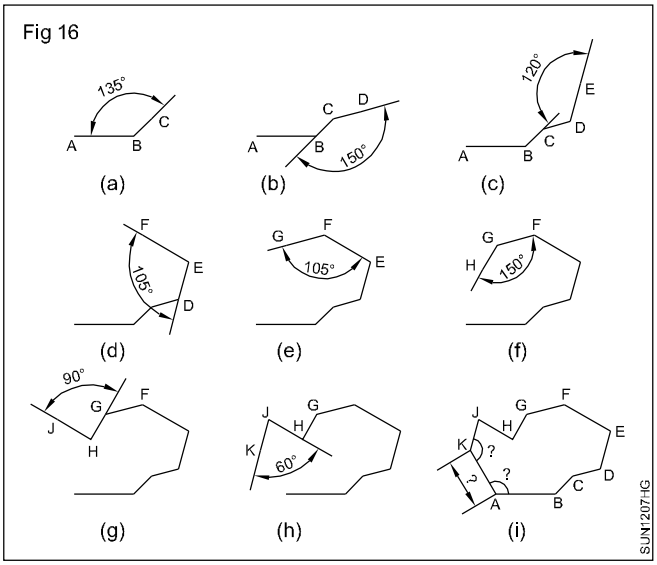


SUN1207-HF

Exercise 10 : Irregular pattern (Fig 16)

- Draw a horizontal line AB to a length of 90 mm.
- Draw the remaining lines BC, CD, DE, EF, FG, GH, HJ, JK to the suitable length and angle as in Fig. 16.
- Join the points KA and measure the length of KA.
- Measure the angles JKA and KAB.

Fig 16

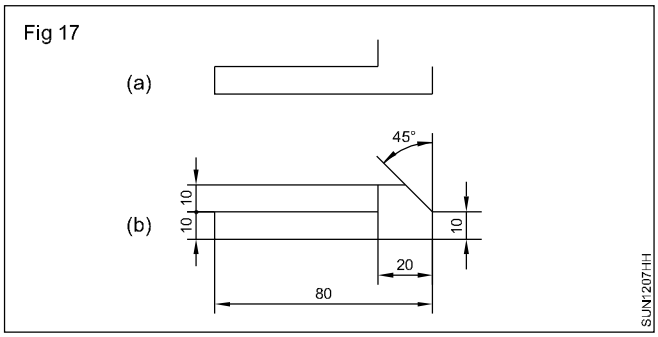


SUN1207-HG

Exercise 11

- Follow the procedure shown in Fig 17 (i) and (ii) and complete the component.

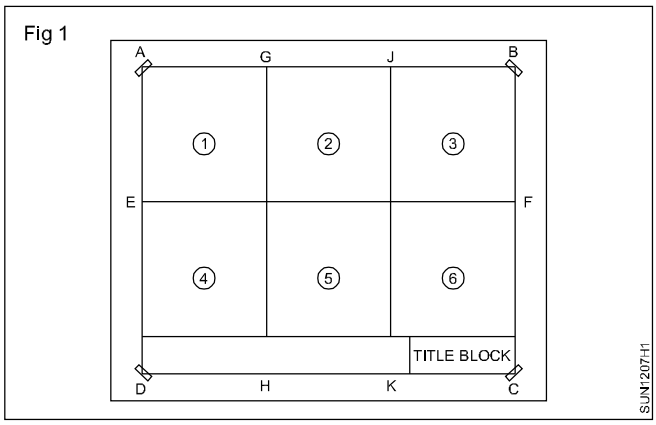
Fig 17



Exercise 12

- Draw a horizontal line AB to a conventional length and BC perpendicular to AB of 40 mm height.
- Draw an another layout line through the mid point of BC parallel to AB.
- Through C draw a line parallel to AB.
- From C mark the point D, such that CD is equal to 12 mm.
- Draw DE at an agnle of 16°.
- Set off EF equal to 12 mm.
- Draw FG at an angle of 16°.
- Repeat the above sequence for the remaining part of the drawing and complete the drawing. (Fig 18)

Fig 1



Exercise 13

- Follow the steps shown in Fig 19 (i to iv) and complete the drawing (v).

Exercise 14

- Follow the steps shown in Fig 20 (i to iv) and complete the drawing.

Fig 19

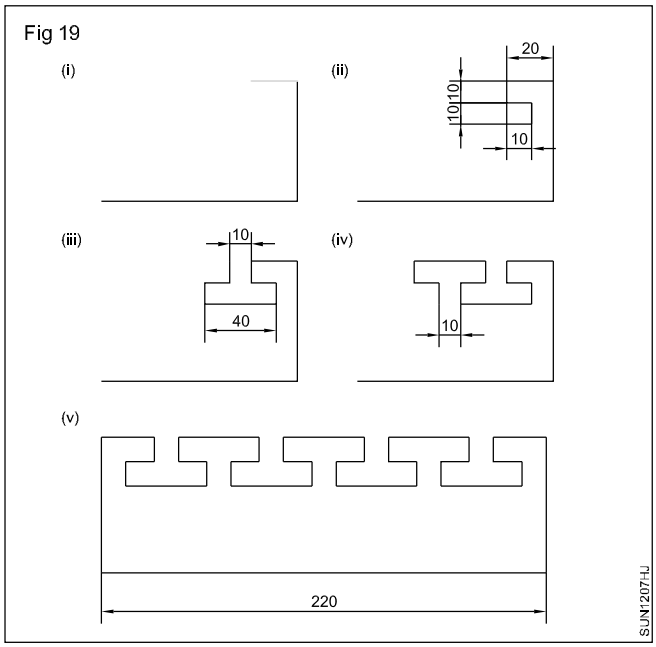
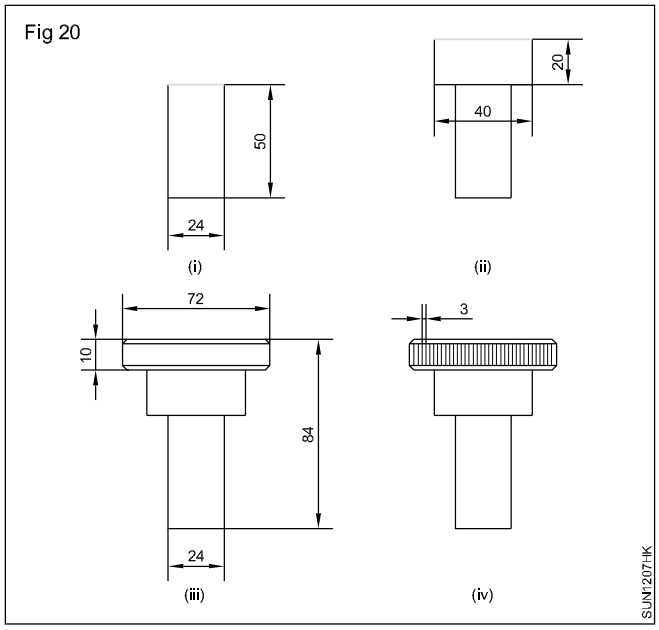


Fig 20



Skill sequence

Drawing horizontal lines

Objective: At the end of this exercise you shall be able to
- **draw horizontal lines using 'T' square.**

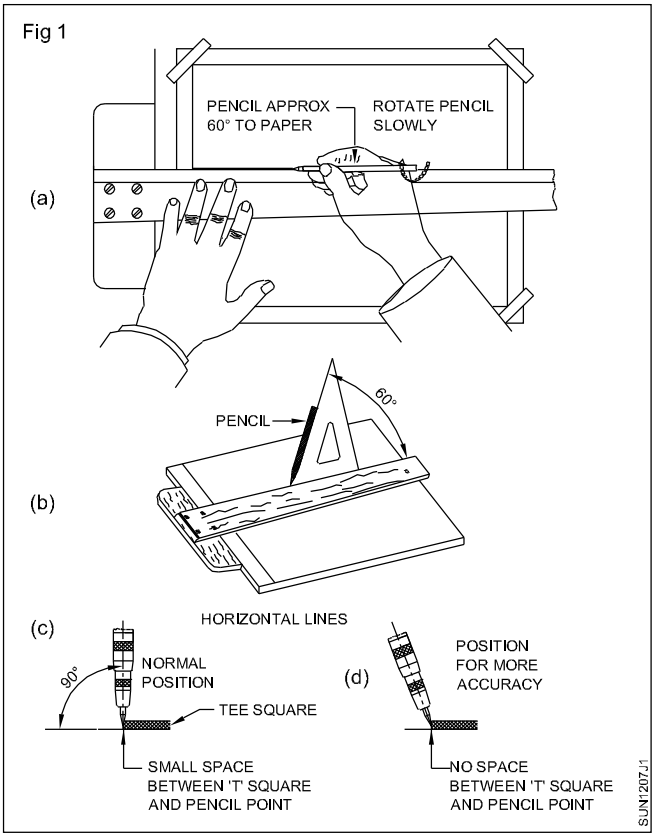
Press the head (stock) of the 'T' square firmly against the drawing board with left hand.

With your left hand press the blade tightly against the paper.

Learn the pencil in the direction of the line at an angle approximately 60° with paper.

Draw the line from left to right, maintaining the pencil in the vertical planes as shown in Fig 1.

Fig 1



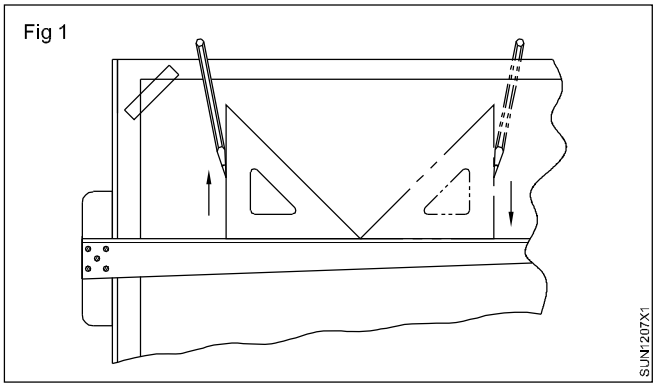
Drawing vertical and inclined lines 30°, 45° & 60°

Objective: At the end of this exercise you shall be able to
- **draw vertical lines using setsquares**
- **draw inclined lines of 30°, 45° and 60° using setsquares**
- **draw inclined lines at angles in multiples of 15°**

Vertical lines

- Place the 'T' square in position.
- Place the setsquare such that one of its right angle edges rests on the working edge of the 'T' square.
- Depending on the position of the setsquare, draw lines upward/downward along the vertical edge of the setsquare. (Fig 1)

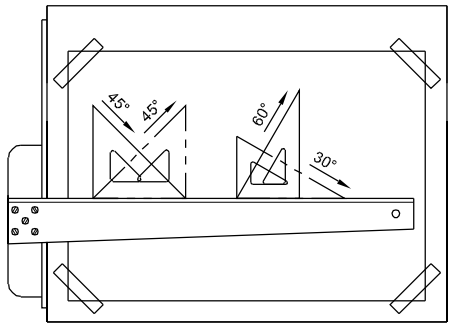
Fig 1



Inclined lines - 30°, 45° & 60°

- Place the 'T' square in position.
- Place the setsquare as shown in Fig 2.
- Draw inclined lines. (45°,60° & 30°)

Fig 2



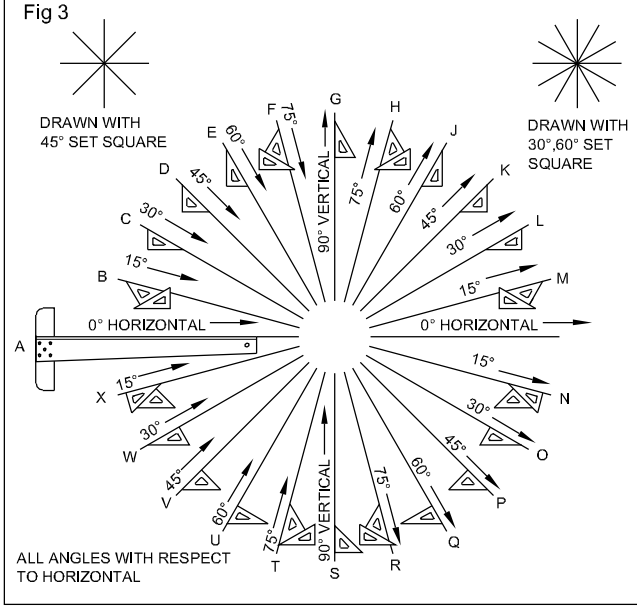
INCLINED LINES

SUN1207X2

Inclined lines at angles - in multiplies of 15°

- Place the 'T' square in position as indicated in the Fig 3.
- Use the setsquare singularly or in combination of two for the angle required. (15°, 30°, 45°, 60°... etc... and draw lines)

Fig 3



SUN1207X3

Drawing parallel lines using setsquares

Objective: At the end of this exercise you shall be able to
- **draw parallel lines to a given line through a given point.**

Place any one edge of the setsquare to coincide with the given line.

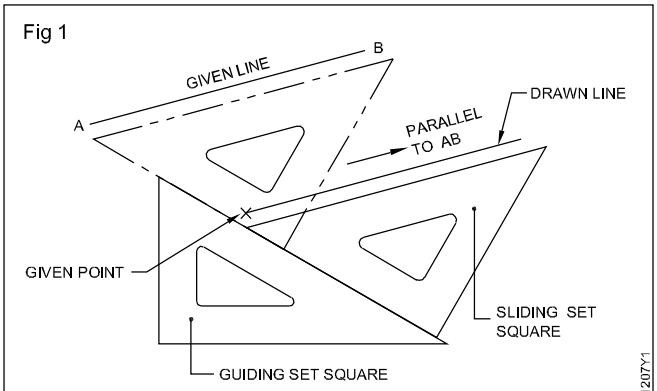
Place the other setsquare (guiding setsquare) with one of its edges butting the first square as shown in Fig 1.

While holding the guiding setsquare firmly, slide the first setsquare (sliding setsquare) till edge touches the given point.

Draw the line along the edge of the sliding setsquare through the given point.

Be sure that the guiding setsquare does not move from its initial position.

Fig 1



TO DRAW A LINE PARALLEL TO A GIVEN LINE

SUN1207Y1

Drawing perpendicular using setsquares

Objective: At the end of this exercise you shall be able to
- **draw a perpendicular to a given line through the given point.**

Method 1 (Fig 1a)

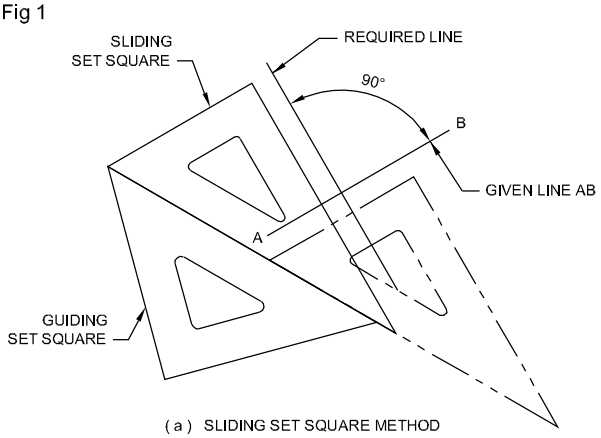
Place one of the perpendicular edges of the setsquare (sliding setsquare) such that in coincides with the given line.

Place the longer edge of the other setsquare (guiding setsquare) against the hypotenuse of the sliding set square.

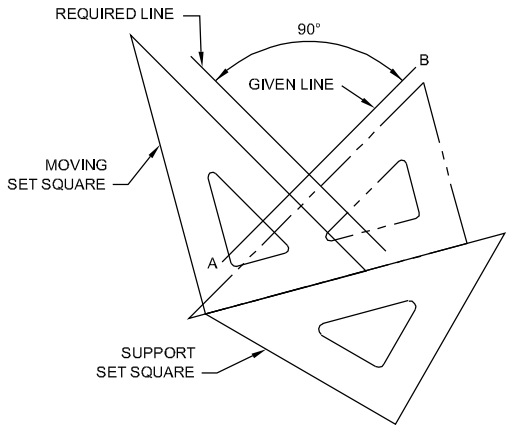
Slide the sliding setsquare till the other edge forming right angle touches the given point.

Through the given point, draw the required perpendicular line along the edge of the sliding setsquare.

Fig 1



(a) SLIDING SET SQUARE METHOD



(b) REVOLVED SET SQUARE METHOD

TO DRAW A LINE PERPENDICULAR TO ANOTHER LINE

SUN*2072.1

Method 2 (Fig 1b)

Place the hypotenuse of one setsquare to coincide with the given line.

Place the other setsquare (moving setsquare) with one of its edges butting against one of the perpendicular edges of the moving setsquare as shown in figure.

Holding the supporting setsquare firmly, revolve the moving setsquare and place it on the supporting setsquare such that the hypotenuse of the setquare passes through the given point.

Draw the required perpendicular line as shown in Fig 1b.

Method of fixing drawing sheet

Objectives: At the end of this exercise you shall be able to
- **mark the standard folding marks on the designated drawing sheet**
- **fixing of drawing sheet.**

PROCEDURE

- Set the drawing paper ON the board.
- Top edge of the drawing paper and edge of drawing should be parallel.
- Check the parallelism of the paper with the T -square.
- If it found correct, fix the paper by tape.
- If not adjust the paper with the edge of the T-square (Fig 1)
- Study the sequence of marking of folds on the designated drawing sheet.
- Start the folding in the sequence means fold vertically first.
- Fold horizontally in such a way so that Title block to be on the top most folds for easy reference.
- Folded drawing sheets filed neatly for submission/ reference in the file.

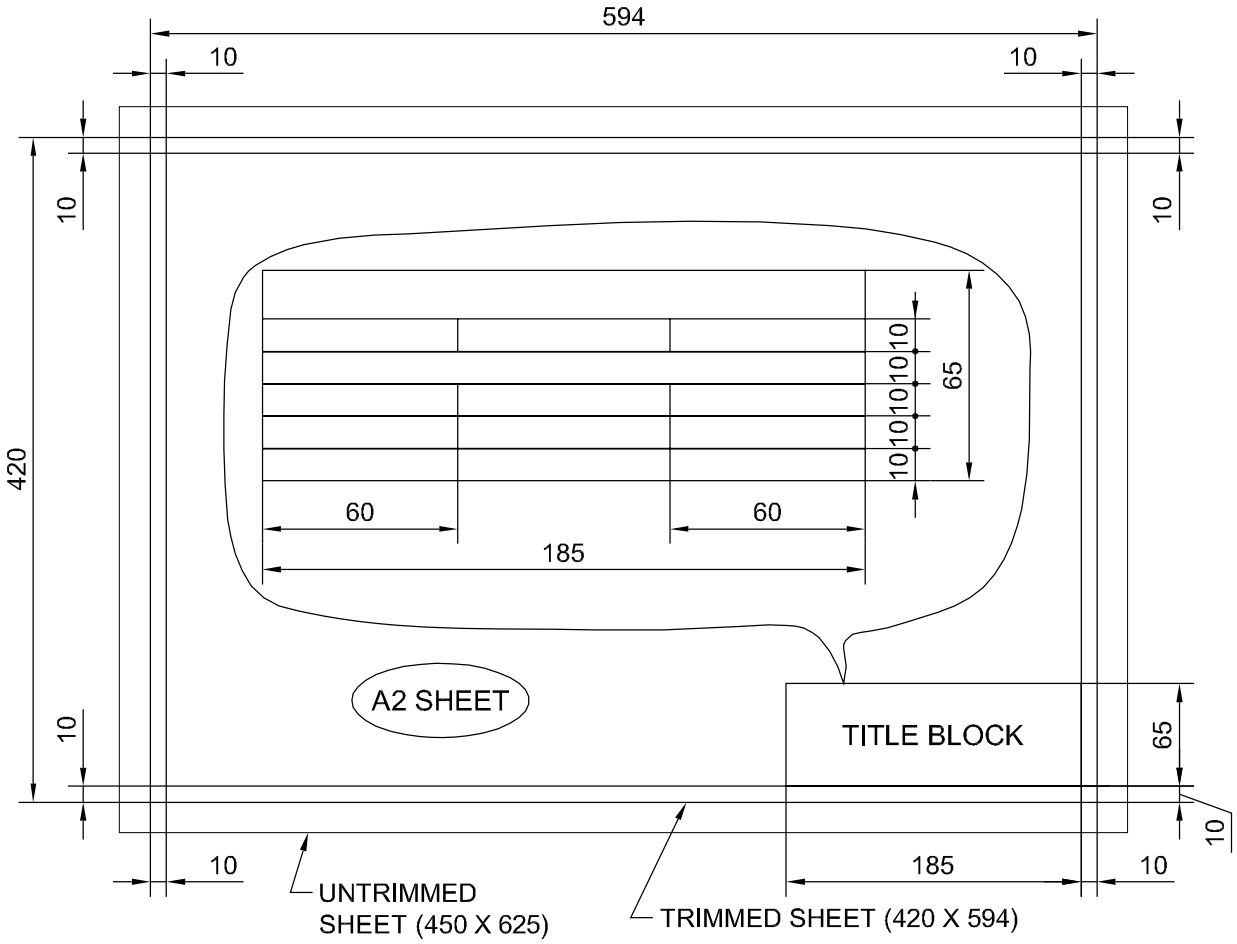
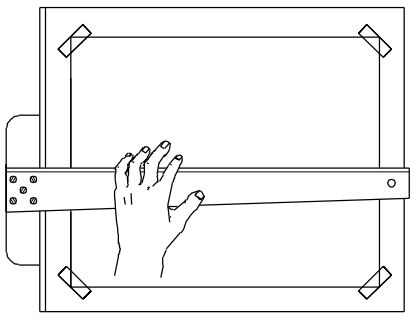


Fig 1



SCALE :	**LAYOUT OF DRAWING SHEET**	EX NO. 1
		TIME : 5hrs
PROJECTION		CODE : DCN1211H1

Method of folding drawing sheet

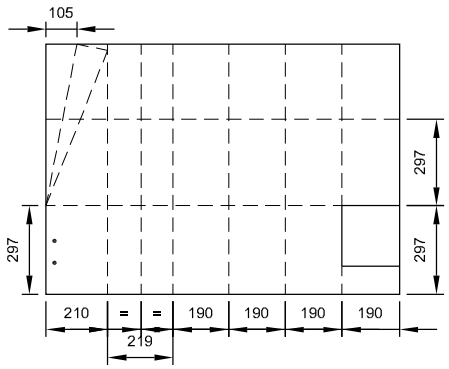
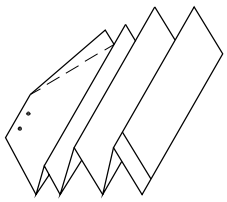
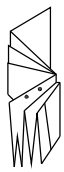
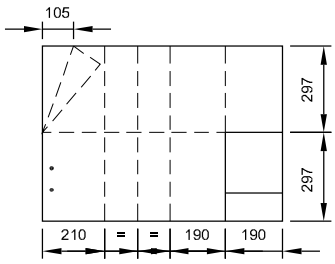
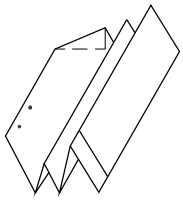
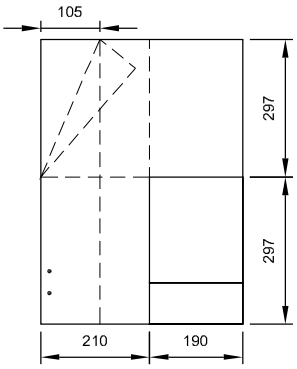
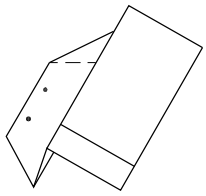
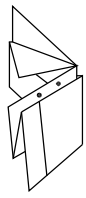
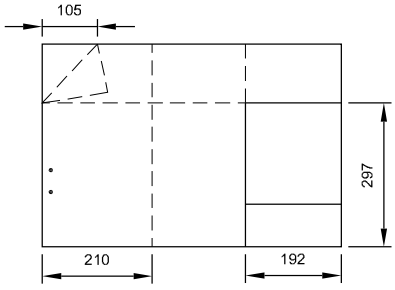
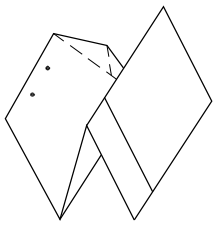
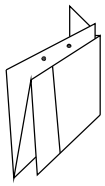
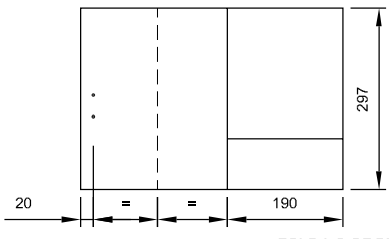
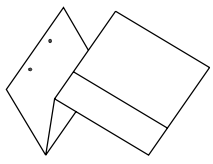
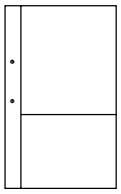
Objectives: At the end of this exercise you shall be able to
- **Fold the drawing sheet sequential as per marking for filling it.**
- **Fold the different size of drawing sheet.**

Fold Ao - Sheet (841 x 1189)

- Observe carefully folding marks on the drawing sheet which is started from left to right and bottom to top.
- Start the folding sequentially from left side as showing in (Fig 1)
- Then fold it horizontally as shown, so that title block appear on the top of right hand bottom.

Practice for follding other designated drawing sheet, as showing in the figure.

Fig 1

A0 **841 X 1189**			
A1 **594 X 841**			
A2 **420 X 594**			
A2 **420 X 594**			
A3 **297 X 420**			

FOLDING OF PRINTS

SUN1209H1

To print letters single stroke and double stroke by freehand IN 7:4 and 5:4 & dimensioning

Objectives : At the end of this exercise, you shall be able to,

- **select and calculate the size of letters**
- **draw the layout for printing a letters and numerals, as height and width of letter**
- **print single stroke letters and numerals**
- **print double stroke letters and numerals.**

PROCEDURE

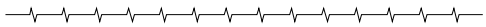
- Select the size of letters and calculate the height & width of each letter.(Fig 1)
- Arrange and draw the guidelines for the required size.
- Prepare the layout for printing of letters
- Mark the width and spacing for each letters
- Draw vertical guide lines
- Print the letter by freehand, using H or HB pencil.

To draw types of convention lines

Objectives : At the end of this exercise, you shall be able to,
- **sketch and describe the illustration of the types of conventional lines**
- **apply illustrations of lines in the drawing.**

PROCEDURE

- Draw the table as shown in the figure.
- Write the descriptions and draw the illustration in the table.

Line	Description	General applications see figure and other relevant figure
A	Continuous thick	A1 Visible outlines A2 Visible edges
B	Continuous thin (straight or curved)	B1 Imaginary lines of intersection B2 Dimension lines B3 Projection lines or extension line B4 Leader lines B5 Hatching B6 Outline of revolved sections in place B7 Short centre lines B8 Thread lines B9 Diagonal line
C	Continuous thin free hand	C1 Limits of partial or interrupted views & sections, if the limit is not a chain thin
D 	Continuous thin (straight) with zig-zags	D1 Line (see figure)
E	Dashed thick	E1 Hidden outlines E2 Hidden edges
F	Dashed thin	F1 Hidden outlines F2 Hidden edges
G	Chain thin	G1 Centre lines G2 Lines of symmetry G3 Trajectors
H	Chin thin, thick at ends & changes of direction	H1 Cutting planes
J	Chain thick	J1 Indication of lines or surfaces to a special requirement applies
K	Chain thin double dashed	K1 Outlines of adacent parts K2 Alternative and extreme positions of movable parts K3 Centroidal lines K4 Initial outlines prior to forming K5 Parts situated in front of the cutting plane.

Dimensioning techniques

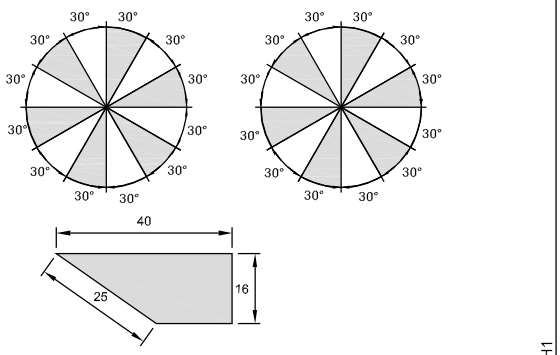
Objectives : At the end of this exercise, you shall be able to,
- **draw different systems of dimensioning**
- **dimension the drawings by aligned system and unidirectional system**
- **follow the standard of system of dimensioning with different arrangements of dimensional values.**

PROCEDURE

To show aligned system of dimensioning

- Draw the figures as shown (Fig 1).

Fig 1



ALIGNED SYSTEM

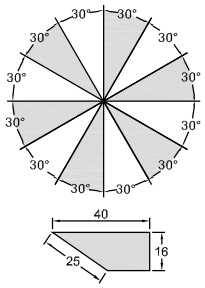
SUN1211H1

- Show the dimension lines in the figures.
- Place the dimension value above the dimension line centrally as direction.

To show unidirectional system of dimensioning

- Draw the figures as shown (Fig 2).

Fig 2



UNIDIRECTIONAL SYSTEM

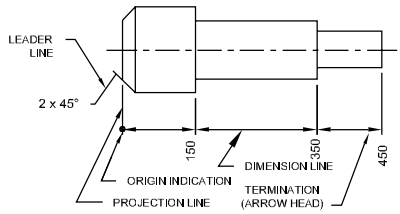
SUN1211H2

- Show the dimension lines in the figures.
- Cut the dimension line at center to place the dimen sion value horizontally.

To show various notations used in dimensioning (Fig 3)

Arrangements of Dimensional Values

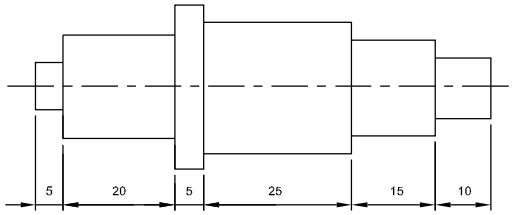
Fig 3



ELEMENTS OF DIMENSIONING

SUN1211H3

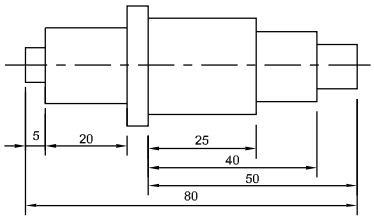
Fig 4



CHAIN DIMENSION

SUN1211H4

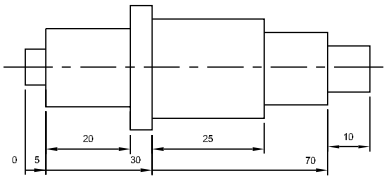
Fig 5



COMBINED DIMENSIONING (CHAIN AND PARALLEL)

SUN1211H5

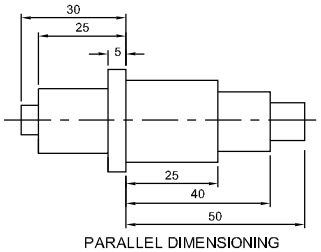
Fig 6



COMBINED DIMENSIONING (CHAIN AND SUPERIMPOSED RUNNING)

SUN1211H6

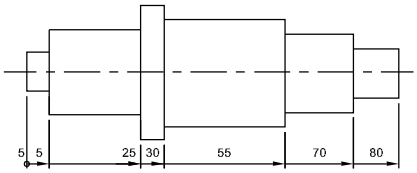
Fig 7



PARALLEL DIMENSIONING

SUN1211H7

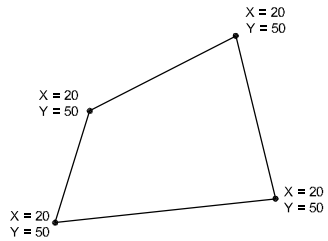
Fig 8



SUPERIMPOSING RUNNING DIMENSIONING IN ONE DIRECTION

SUN1211H8

Fig 9



DIMENSIONING BY CO-ORDINATES

SUN1211H9

Construction of plane geometrical figures

Objectives : At the end of this exercise, you shall be able to,

- **construct equilateral triangle**
- **construct a scalene triangle**
- **construct a right angled triangle**
- **construct an isosceles triangle**
- **construct various quadrilaterals**

PROCEDURE

TASK 1: **Construct an equilateral triangle (Fig 1A)**

- Draw a horizontal line of length 70mm and name AB.
- From A, draw an arc as radius of length of line AB
- Similarly, from B draw an arc as radius of length of line AB to intersect the first arc.
- Name the intersect point C.
- Joined AC and BC points with a line to form a triangle.
- Constructed triangle is an equilateral triangle.

— — — — — — — — —

TASK 2: **To Construct a scalene triangle (Fig 1B)**

Length of all three sides are given, AB =35mm, AC=60mm&BC =40mm

- Draw base line AB=35 mm
- 'A' as centre draw an arc of radius 60 mm
- 'B' as centre draw an arc of 40 mm, cutting the previous arc at 'C'.
- Join CA & CB ,ABC is the required scalene triangle

— — — — — — — — —

TASK 3: **To Construct a right angled triangle (Fig 1C)**

AB = 80mm, BC = 60mm

- Draw the horizontal line BC to length 60mm.
- Erect a perpendicular to length 80mm at B.
- Join AC
- ABC is the required right angled triangle

— — — — — — — — —

TASK 4: **To Construct an isosceles triangle (Fig 1D)**

AB = 50mm and ∠CAB= ∠ABC= 65°

- Draw line AB = 50mm
- Set an angle 65°at A and B
- Extent the line meeting at C, ABC is the required an isosceles triangle.

— — — — — — — — —

TASK 5: **To construct quadrilaterals**

Constructing square (Fig 1E)

A square of side 50mm by erecting perpendicular.

- Draw a line AB 50mm long
- A as centre, draw an arc of convenient radius 'r' touching the line AB at 'P'
- 'P' as centre and radius 'r' draw another arc cutting the earlier draw arc at 'Q'
- 'Q' as centre and radius 'r', draw another arc 'R'.
- Bisect QR at S and extend.
- Mark 50mm on AS extended line. AD = 50mm.
- From points B and D, draw parallels to AD and AB and complete the square ABCD.

— — — — — — — — —

TASK 6: **Constructing rectangle (Fig 1F)**

- Sides 75mm and 45mm
- Draw a line 75mm.
- From A and B, errect perpendicular .
- Mark C and D as AD=BC=45mm
- Join CD and complete the rectangle.

TASK 7: **Constructing parallelogram (Fig 1G)**

Sides = 75mm and 40mm , Angle between them: 50° - Draw line AB 75mm long.

- Draw line AD equal to 40 mm and make one angle of 50° to AB.
- D as centre draw an arc of radius equal to AB.
- B as centre draws an arc of radius equal at AD, up wards such that they meet at a point 'C'.
- Join BC and DC. ABCD is the required Parallelogram.

— — — — — — — — —

TASK 8: **Constructing rhombus (Fig 1H)**

- Draw two adjacent lines AB and AD equal to 75mm at 50^0 angle
- B and D as centres draw R75 arcs interecting at C.
- Join DC and BC, ABCD is the required rhombus.

— — — — — — — — —

TASK 9 : **Constructing Trapezium (Fig 1I)**

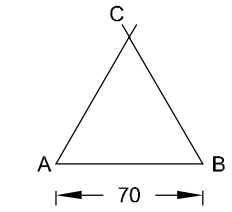
Parallel sides AB = 60mm, CD = 30mm, Distance between parallel sides = 40mm, Side DA = 45mm.

- Draw the base AB equal to 60mm.
- With radius 40mm, draw arcs from A and B.
- Draw a tangential line (parallel to AB)
- Draw an arc with radius 45mm and A as centre, cut ting the line at two places D and D^1
- From D or D^1mark length of 30mm towards right side,
- Join B and C or C^1.
- Join A and D or D^1.ABCD/ABC^1D^1 is the Trapezium

Try to construct all these figures with different methods as you can

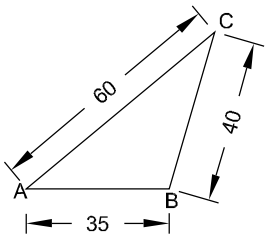
— — — — — — — — —

Fig 1



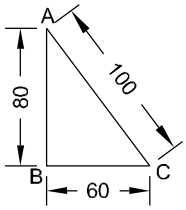
EQUILATERAL TRIANGLE

Fig .1A



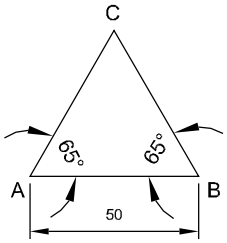
SCALENE TRIANGLE

Fig .1B



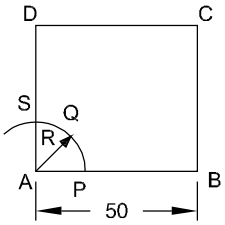
RIGHT ANGLED TRIANGLE

Fig .1C



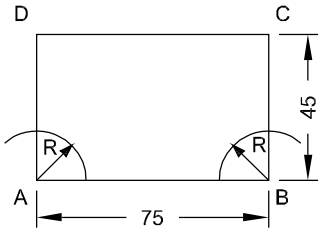
ISOSCELES TRIANGLE

Fig .1D



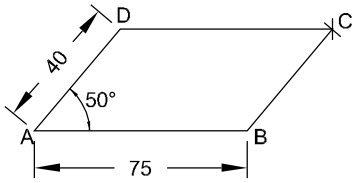
SQUARE

Fig .1E



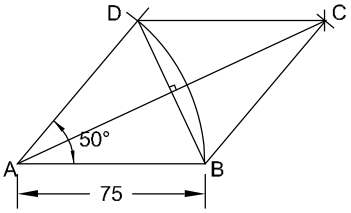
RECTANGLE

Fig .1F



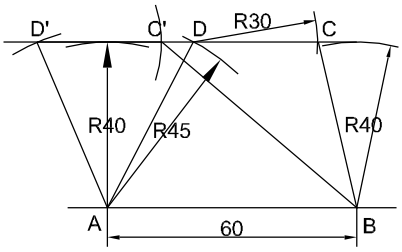
PARALLELOGRAM

Fig .1G



RHOMBUS

Fig .1H



TRAPEZIUM

Fig .1I

SUN1212H1

To construct polygons

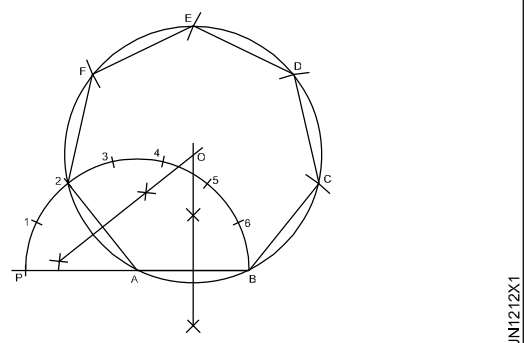
Objective : At the end of this exercise, you shall be able to,
- **construct a regular polygon from given data.**

PROCEDURE

TASK 1 : **Regular heptagon of side 30 mm**

Semi-circular method - Type A (Fig 1)

Fig 1

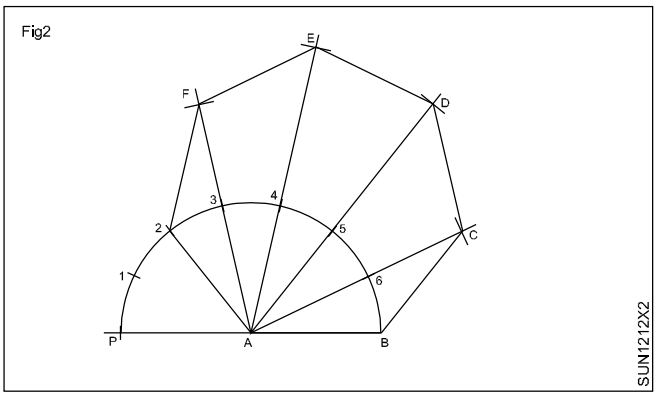


- Draw a line AB equal to 30 mm.
- Extend BA to a convenient length.
- A as centre and radius AB describe a semi-circle.
- Divide the semi-circle into seven equal parts (number of sides) using divider.
- Number the points as 1,2,3,4,5,6 starting from P.
- Draw the perpendicular bisectors from 2A and AB intersecting at 0.
- 0 as centre and OA or OB as radius describe a circle.
- Mark the points C,D,E,F and 2 on the circle such that BC = CD = DE = EF = F2 = AB = 2A.
- Join the line BC, CD, DE, EF and F2.
- ABCDEF2 is required heptagon.

Semi-circle method - Type B (Fig 2)

Follow the procedure of Type A upto dividing the semi-circle into number of equal parts.

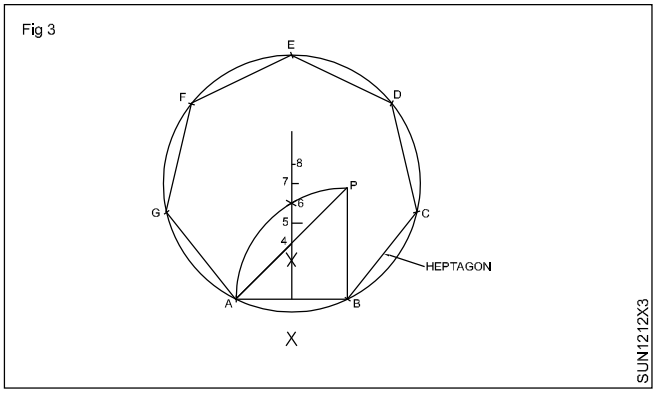
Fig2



- Join A2
- Join A3, A4, A5 and A6 and extend to a convenient length.
- With centre B and radius AB draw an arc cutting A6 extended line at C.
- C as centre and same radius, draw an arc cutting the line A5 at D.
- Locate the points E & F in the same manner.
- Join BC, CD, DE, EF and F2.
- ABCDEF2 is the required heptagon.

Perpendicular bisector method - Type A (Fig 3)

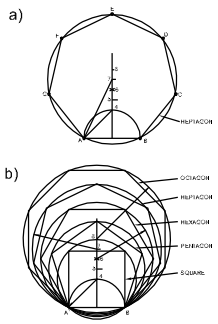
Fig 3



- Draw a line AB equal to 30 mm.
- At B, draw a line BP perpendicular AB and equal to AB.
- Join AP
- B as centre BA as radius, draw an arc AP.
- Bisect AB and draw the bisector cutting the line AP and the arc AP at 4 & 6 respectively.
- Mark 5 the mid point of 4-6.
- Set off 6-7, 7-8, 8-9, 9-10 equals to 4-5.
- 7 as centre, 7A as radius, draw a circle on AB.
- On the circumference set off BC, CD, DE, EF, FG equals to AB.
- Join BC, CD, DE, EF, FG and GA.
- ABCDEFG is the required heptagon.
- Mark point 5 at the mid-point of 4 and 6.(Fig 4a) and complete the heptogon.

In this method also any regular polygon of different sides can be constructed.(Fig 4b)

Fig 4

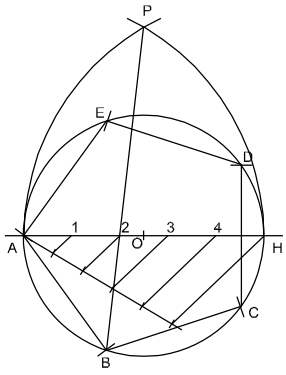


SUN1212X4

Pentagon inside a circle of diameter 80 mm (Fig 5)

- Draw the line AH equals to 80 mm. (Diameter of circle)

Fig 5



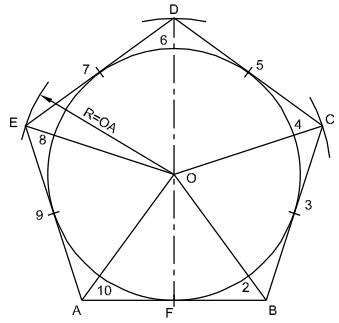
SUN1212X5

- `O' as centre OA as radius describe a circle.
- Divide AH into 5 equal parts (as many equal parts as the sides).
- A and H as centres, AH as radius describe arcs intersecting at P.
- Join P2 and extend it to meet the circle at B.
- Set off BC, CD, DE, EF equals to AB on the circle.
- Join the points
- ABCDEF is the required pentagon.

Pentagon outside a circle of diameter 80 mm (Fig 6)

- O as centre and OF as radius describe a circle of dia 80 mm.
- Draw the line DF vertically beyond the top of the circle.

Fig 6



SUN1212X6

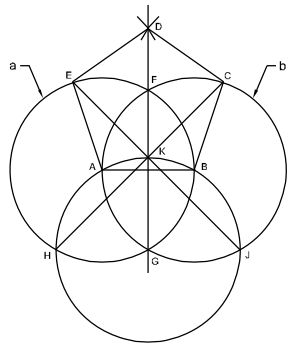
- Divide the circle into 10 equal parts. (Twice as many equal parts as the number of sides)
- Points 1,3,5,7 and 9 are the tangent points of the pentagon.
- Join 02, 04, 06, 08, 010 and extend to a convenient length.
- Draw a tangent to the circle through point 1 (F).
- The tangent cuts the lines 0-2 and 0-10 lines at A & B.
- Draw tangents on points 3,5,7,9 & locate C,D & E in the same manner.
- Join BC, CD, DE, EA
- ABCDE is the required pentagon.

Three circle method (Fig 7)

Pentagon of 38 mm side

- Draw the line AB equal to side of polygon 38 mm.
- Draw two circles of radius equal and AB, with center A and B, cutting at two points F and G.
- Join G and F extend upwards.
- AB as radius, G as centre, draw a circle passing through A and B cutting both the circles at H and J, and also cutting the line FG at K.
- Join HK and extend to cut the circle (b) at C.
- Join JK and extend to cut circle (a) at E.

Fig 7



SUN1212X7

- Join AE and BC.
- E and C as centers, AB as radius, draw arcs to cut at D.
- Join ED and CD. ABCDE is the regular pentagon.

Conic sections

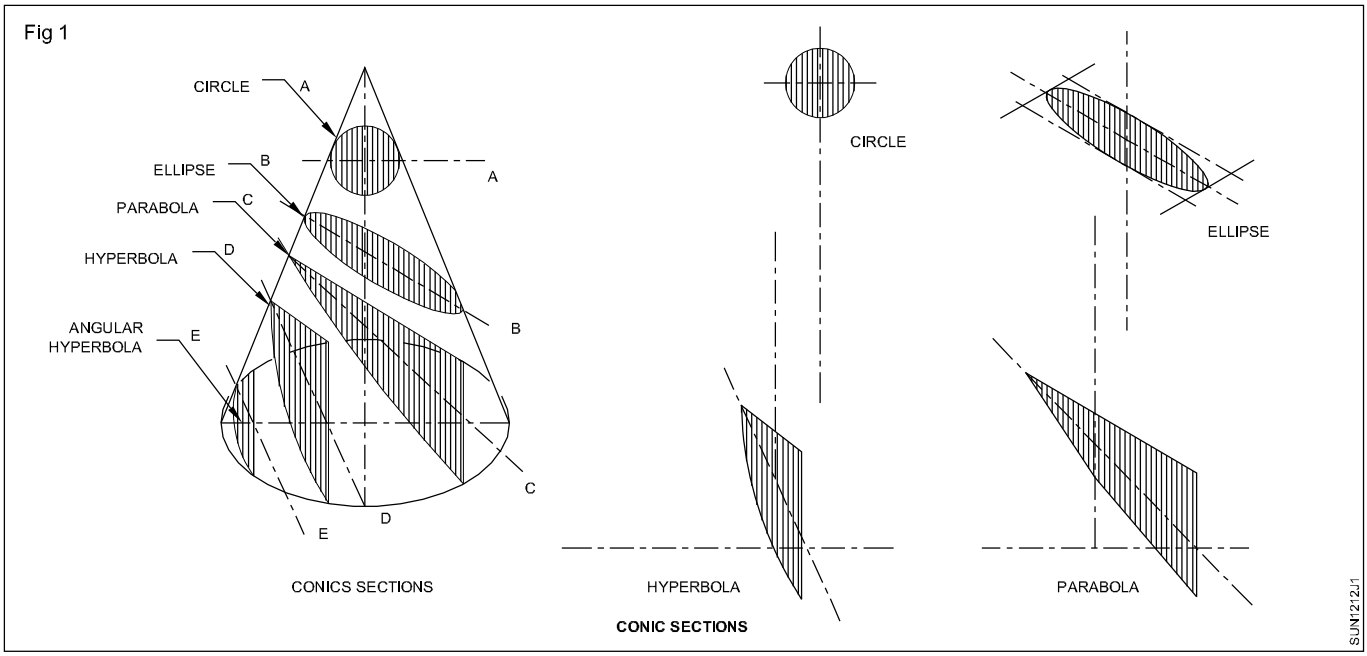
objectives : At the end of this exercise, you shall be able to,

- **draw conic section to standard form to determine whether it yields a circle, a parabola, an ellipse, or a hyperbola.**

PROCEDURE

- A right circular cone is having the axes perpendicular to its base
- AA gives Circle.
- BB gives Ellipse
- CC gives parabola.
- DD gives hyperbola.

Fig 1



Constructing of ellipse by different methods

Objectives : At the end of this exercise, you shall be able to,

- **construct ellipse with the given conditions.**

PROCEDURE

TASK 1: **Rectangle/Oblong method (Fig 1A)**

Construct an ellipse of major axis 100mm and minor axis 60mm.

- Draw a rectangle EFGH of sides 100mm and 60mm.
- Draw the 4 major axis AB and minor axis CD and mark the intersection as 'O'.
- Divide AO and OB into 5 equal parts each and name them as shown.
- Divide AE, AG, BF and BH into 5 equal parts and number them as shown.
- Draw lines and form C1, C2, C3, C4, D1, D2, D3, and D4.
- Draw lines such as Ca, Cb, Da, and Db, etc to meet the corresponding lines drawn from C and D at points P1, P2 etc.
- Join A, P1, P2etc with a smooth curve and form the ellipse.

— — — — — — — — —

TASK 2: **Concentric circle method (Fig 1B)**

Major axis = 100mm, Minor axis = 60mm

- Draw the major axis AB (100mm) and minor axis CD (60mm), bisecting at right angle at O.
- 'O' as centre OA and OC as radius, draw two concetric circles.
- Draw a number of radial lines through 'O' say 4 cut ting the two circles.
- Mark the point on the outer circle as a, b, c.
- Similarly mark the intersecting points on inner circles as a1, b1, c1.
- From points such as a, b, c… draw lines parallel to minor axis.
- From points such as a1, b1…..draw lines parallel to the major axis to intersect with the corresponding ver tical lines at point's p1, p2.....etc.
- Join all these points with a smooth curve using "French curve" and form the ellipse.
- To find the 'foci'- with half the major axis (a) as radius and with 'c' on the minor axis as centre. Draw an arc cutting the major axis, at two points; mark them as F1, F2, and the focus points of the ellipse.

Check

Mark any point P on the curve and measure its distance from X axis and Y axis.

You will observe that X2/a2 + Y2/b2 = 1

Where a = 50mm and b =30mm.

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TASK 3: **Intersecting arc method (Fig 1C)**

- Draw AB (100mm) and CD (55mm) bisecting at right angles represent major and minor axis.
- C as centre, half major axis as radius, draws an arc on AB cutting F1 and F2.
- Mark any number of parts between on F1. F2 as 1, 2, 3 etc.
- F1 and F2 as centers and A-1 as radius, draw arcs on either side of AB.

— — — — — — — — —

- F1 and F2 as centers. B-1 as radius and draw arcs cutting the previous corresponding arcs at P1.
- Repeat previous two steps and obtain points such as P2, P3 etc.
- Join all the P1& P2etc with a smooth curve passing through vertex A and B to complete the ellipse.

Fig 1

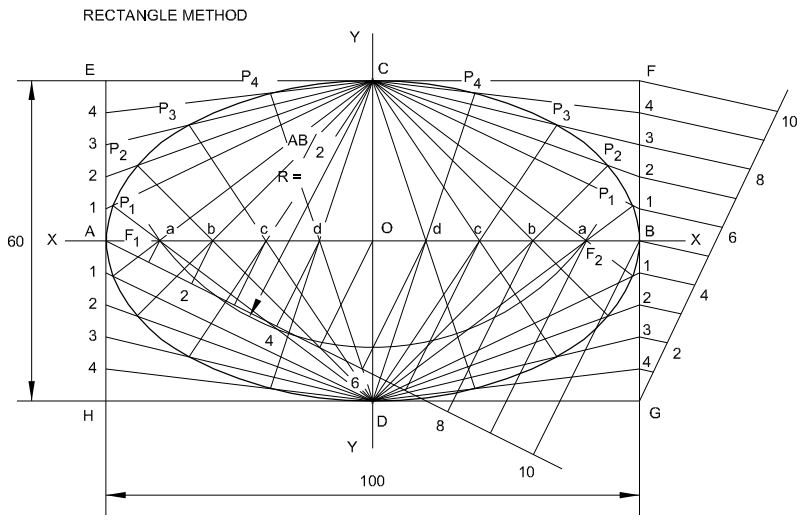


Fig 1A

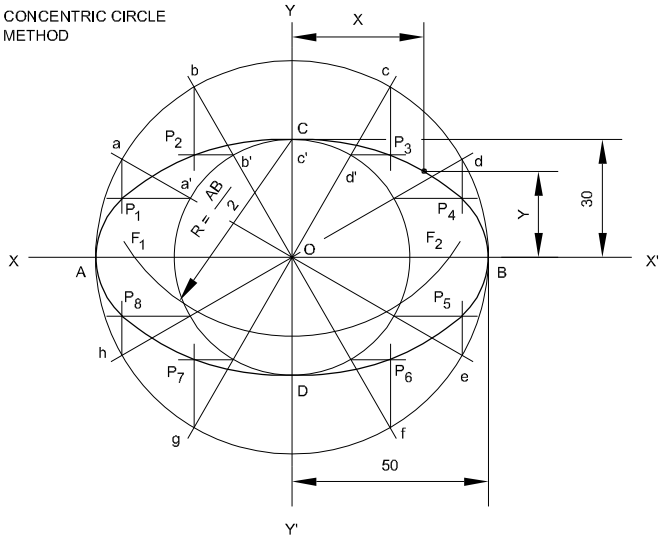


Fig 1B

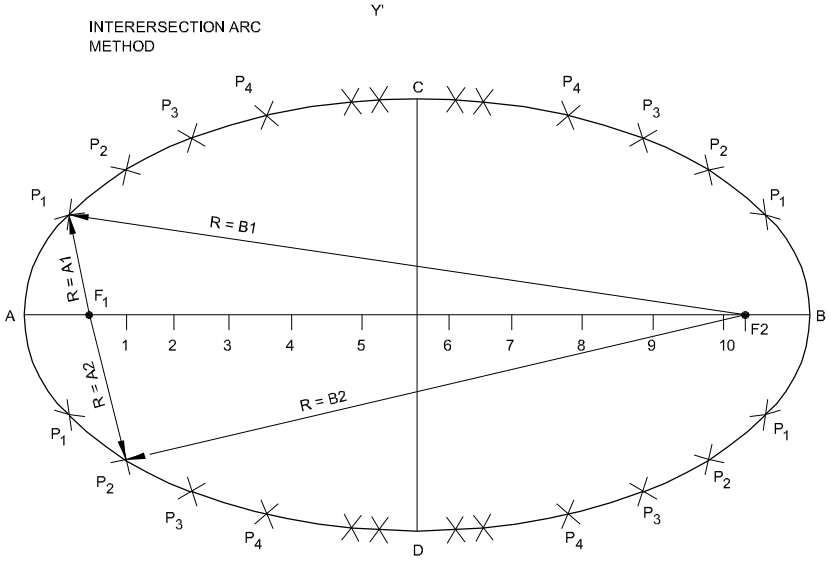


Fig 1C

SUN1212Y1

Parabola and hyperbola

Objectives : At the end of this exercise, you shall be able to,

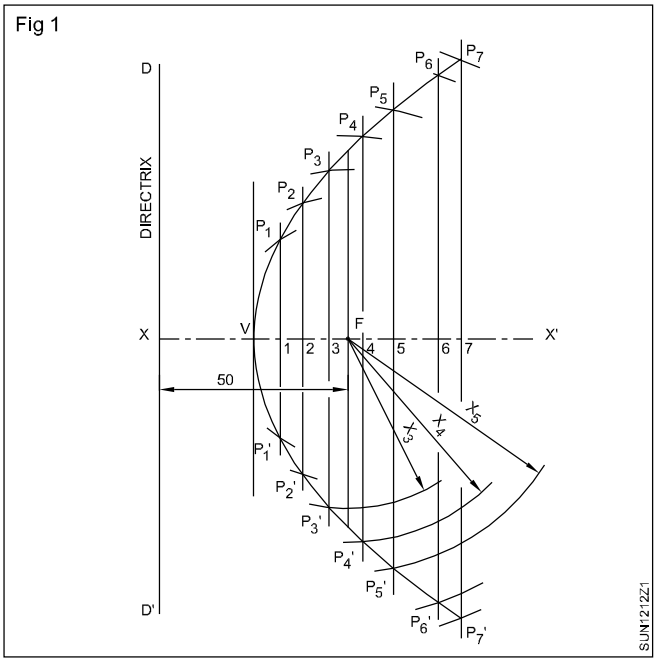
- **construct parabolic curves using the various conditions given.**

PROCEDURE

TASK 1**: A Parabola trom the given focus is at 50mm from the directrix (Fig 1)**

- Draw a vertical line D-D^1 the directrix.
- Draw horizontal line XX^1, the axis through any point X on the directrix.
- Mark the focus 'F' on XX^1 = 50 mm from X (on the directrix).
- Mark the mid point of XF, as V.
- Mark a number of points from V towards right side on the axis as 1,2,3,4.....
- Draw vertical lines through these points as shown, forming double ordinates.
- Point 'F' as centre, X-1 as radius, draw arcs on the co-ordinates (vertical lines) passing through 1, mark points P^1 & P$_1{}^1$.
- X-2 as radius, F as centre, draw arcs on the 2nd ordinate, mark P^2 & P$_2{}^1$.
- Similarly get point P$_3$, P$_4$.... P$_3{}^1$, P$_4{}^1$ etc. on the axis as above.
- Join all the points with a smooth curve, using french curve and form the parabola curve.

Fig 1



- From the points 1,2 & 3 draw parallels (offset)to XX
- On these offsets mark off distance as below

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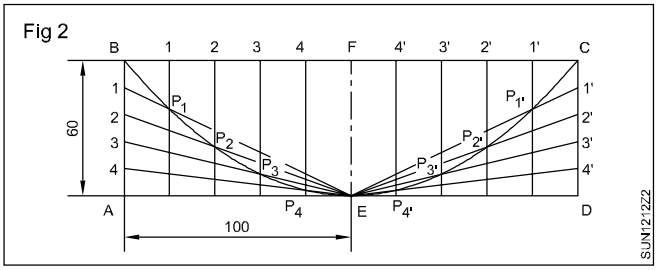
TASK 2: **Parabola, given the base and axis of a rectangle, base 200 mm axis 60 mm- Rectangle method** (Fig2)

- Draw a rectangle ABCD of sides 200 mm & 60 mm.
- Mark centre points of AD and BC, as E and F, join EF.
- Divide AB & CD and into any number of equal parts say 5. Also divide AE and ED into the same number of equal parts and number them as shown.
- From point E on AD, draw lines to the divisions on AB & CD.
- From the points on AED, draw parallel lines to EF.
- Mark the intersecting points P$_1$, P$_2$, P$_3$, P$_4$ on either side of axis.
- Form the parabola by joining the points BEC and intersecting with a smooth curve, passing through P$_1$, P$_2$.

Fig 2



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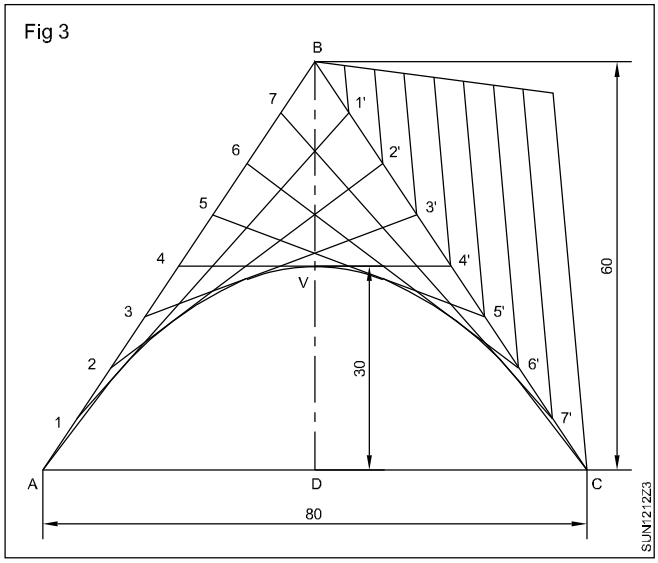
Task 3: Parabolic curve with base as 80 mm and axis 30 mm (Tangent method) (Fig 3)

- Draw an isosceles triangle of base 80 mm and altitude 60 mm (double the abscissa).
- Join BD and mark mid point V, the vertex.
- Divide AB and BC into same number of equal parts using divider/other methods.
- Mark the points on AB as 1,2,3 etc in ascending order..
- Similarly mark 1', 2', 3' etc on CB but in descending order.
- Draw lines 1-1', 2-2'..... 7-7'.
- Join the points with A, V and C with a smooth curve. AC is tangential to line 1'1', 2 2' etc and form the required parabola.

Fig 3



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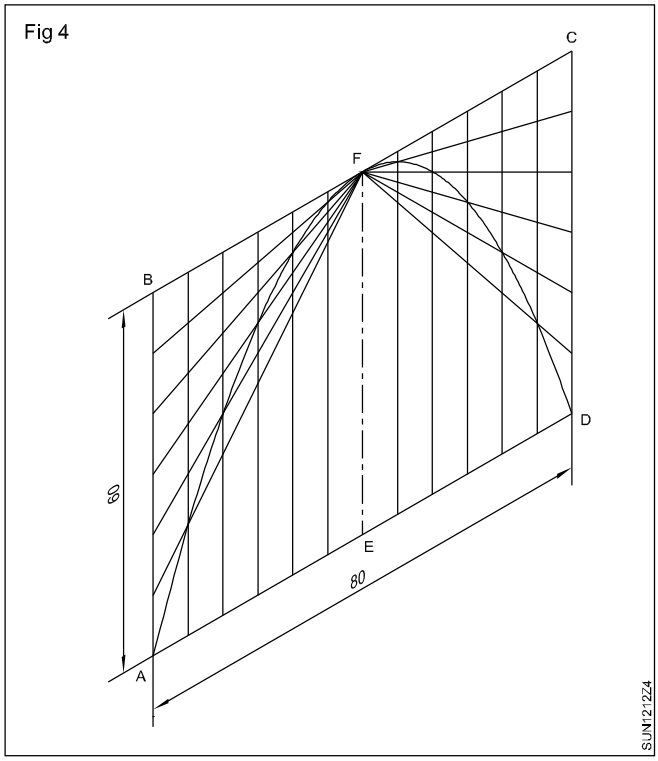
Task 4 : Parabolic curve of sides 80 and 60 making 60°/120° - Parallelogram method (Fig 4)

- Procedure is similar to the Fig 3.
- Assume any point O.
- Join points A & B to O by straight lines.
- Divide AO and BO into same number of parts and number them as shown.
- Join the corresponding point's i.e. 1-1,2-2.....5-5.

Fig 4



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Task 5 : Draw a parabola given double ordinate 80 mm and abscissa 60 mm 'offset method' (Fig 5)

- Draw the rectangle ABCD and draw XX through the mid point of AB and CD.
- Divide AX and XB into same number of equal parts say 4 and mark them as 1,2,3 as shown.
- From the points 1,2 & 3, draw parallels (offset) to XX.

- On these offsets mark off distances as below:

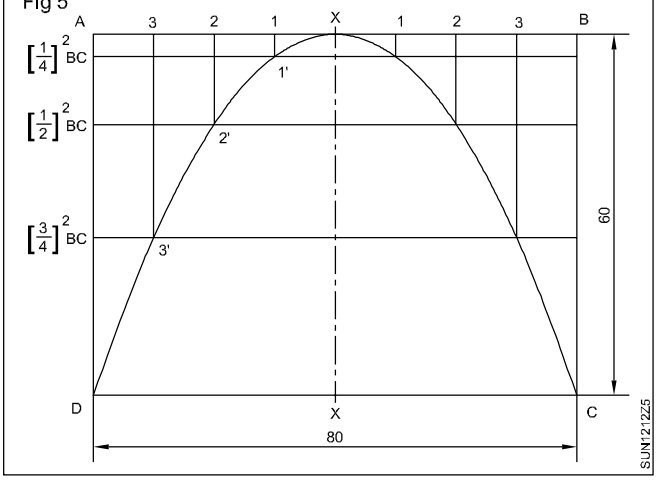
  1-1' equal to $(1/4)^2$ of BC = 1/16 x 60 = 3.75 mm

  2-2' equal to $(2/4)^2$ of BC = 1/4 x 60 = 15 mm

  3-3' equal to $(3/4)^2$ of BC = 9/16 x 60 = 33.75 mm

- Join D-X-C through parts 3', 2', 1' etc with a smooth curve and form the parabola.

Fig 5

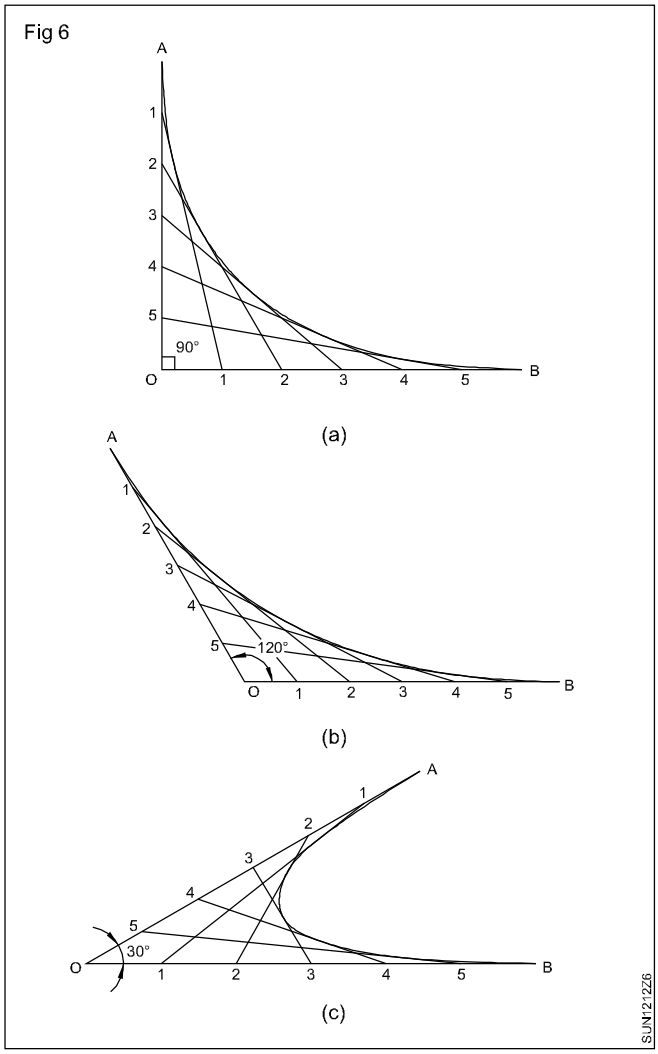


Task 6 : Parabolic curves joining two points A & B as shown (Fig 6)

Let the points A and B are in different positions as shown.

- Assume any point O.
- Join points A & B to O by straight lines.
- Divide AO and BO into same number of equal parts and number them as shown.
- Join the corresponding points i.e 1-1, 2-2.....5-5.
- Draw a smooth curve, tangential to line 1-1, 2-2, 3-3, 4-4, 5-5 etc and form this.
- Check the curve and draw thick parabola curve.

Fig 6



To construct plain scale,comparative scale and diagonal scale

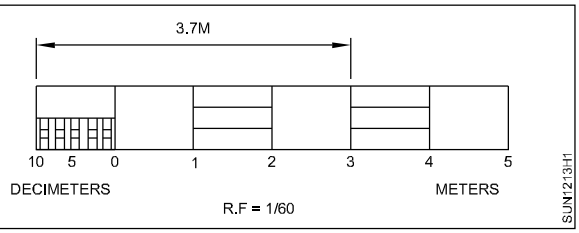
Objectives : At the end of this exercise, you shall be able to,
- **find out R.F of the scale**
- **calculate the length of scale on drawing**
- **construction of plain scales, comparative scales, diagonal scale**
- **mark the distance on the scale**
- **construct a scale of chords.**

PROCEDURE

TASK 1: **Construct a plain sale of 1:60 to show metres and decimeters and long enough to measure up to 6 meters.Find and mark on it a distance of 3.7 metres**.

- R.F=Drawing size/Actual size=1cm/60cm=1/60
- Length of scale=R.F. x maximum length to be mea sured.
- length of scale=1/60x6m=1/10metre=10cm
- Draw a horizontal line of length 10cm (Fig 1).

Fig 1



- Draw a rectangle of size 10cmx0.5 cm.
- Divide the rectangle into 6 equal divisions, each divi sion representing 1m.
- Mark 0 (zero) at the end of the first main divisions and 1,2,3,4 and 5 at the end of each subsequent division to its right,
- Divide the first main division into 10 equal sub- divi sions, each representing 1dm.
- Construct a plain scale of RF $\frac{1}{40}$ to measure metres and decimetres and mark a distance of 3.7m.
- Draw the lines for sub-divisions slightly shorter as shown.
- Draw thick and dark horizontal lines in the middle of all alternate divisions and sub-divisions. This will help in taking measurements.
- Below the scale , print METRES on the right hand side, DECIMETRES on the left-hand side, and R.F in the middle.
- Indicate on the scale a distance of 3.7 metres = 3 main divisions to the right side of 0(zero)+7sub-divi sions to the left of 0(zero).

SOLVE THE PROBLEM BY YOURSELF

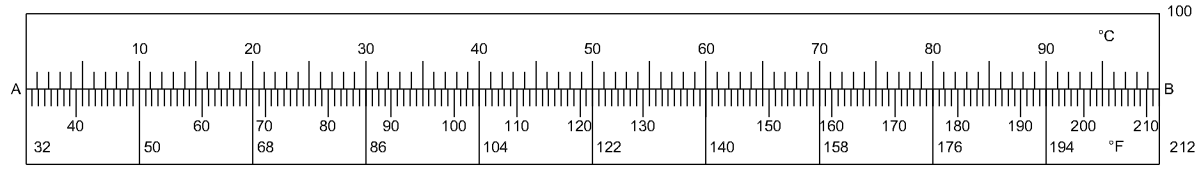
- Construct a plain scale of RF $\frac{1}{20}$ to measure upto 10cm (min) and mark a distance of 1.2 metres on the scale.

— — — — — — — — —

TASK 2: **Construct a comparative scale to convert Fahrenheit (°F) into Celsius °C and vice-versa (Fig 2)**

- Draw a line AB of 15 cm long. (Top part will read °C and bottom part will read °F)
- Divide the line into 10 equal divisions.
- Top side mark 0,10,20....100 for °C scale (100 divisions) and on bottom side, mark 32, 50, 68.... 212 for °F scale 180 divisions as shown.
- On °C side divide one division into 10 equal parts. (Now each small division represents 1°C)
- On °F side, divide each division into 18 equal parts. (Now each small division represents 1°F)
- Mark other numbers and complete drawing the scale.

Fig 2



COMPARATIVE SCALE

TASK 3 : **Construct a diagonal scale for 4 m length and show the lengths 2.69 m, 1.09 m and 0.08 m. (RF = 1/25) (Fig 3)**

Length of scale required = RF x length to be measured

$= \frac{1}{25}$ x 4 m x 100 = 16 cm.

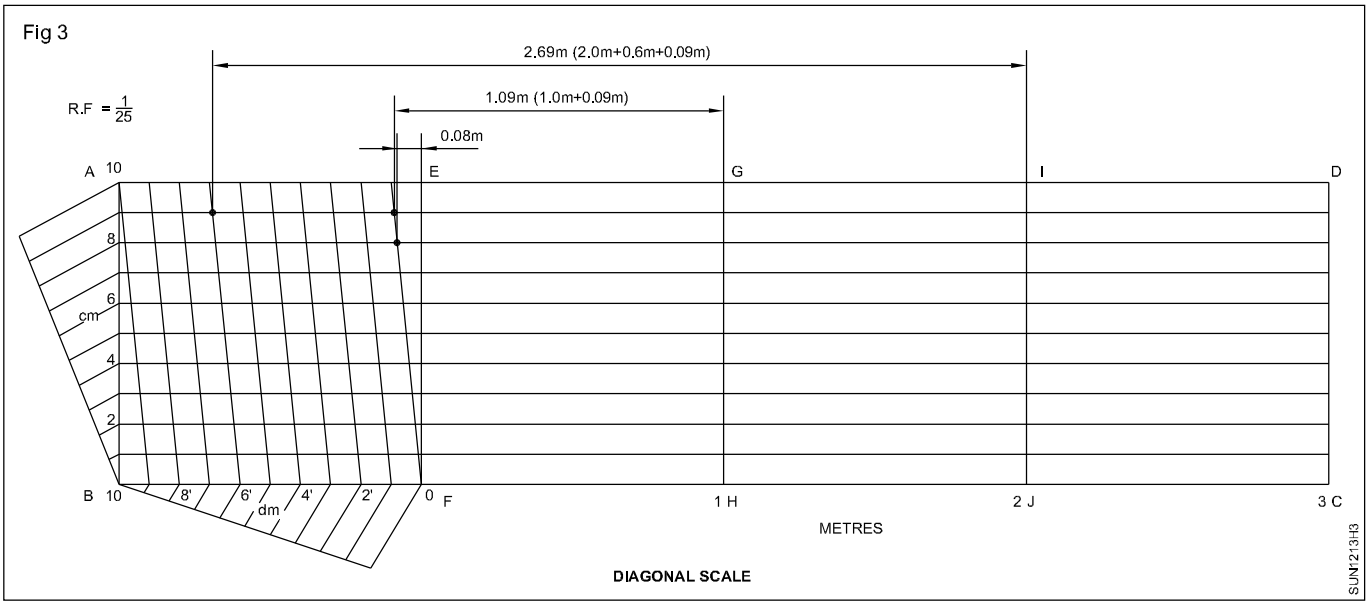
- Draw a rectangle ABCD of 16 cm x 4 cm.
- Divide the rectangle ABCD into 4 equal parts and mark them EF, GH & IJ and each division represents one metre.
- Divide the line AB into ten equal parts and mark them 1_1, 2_1, 3_1.....10_1.
- Draw vertical lines from points 1, 2..... etc.
- Divide the BF into 10 equal parts and mark them as 1'2'3' etc and each division representing 10 cm (1 dm).
- Draw diagonals on all ten small rectangles in the 1st (lower) block ABFE and complete the diagonal scale.
- Metres are read on EF or line parallel to it i.e GH, IJ & DC. Decimetres are read on the division of line AE and centrimetres are read on points where the diagonals intersect with the vertical parallel lines drawn through the divisions of line AB.
- Mark 2.69 in using the diagonal scale. (Fig 3)

  2.00 m on metre division

  0.60 m on decimetre division

  0.09 in the diagonal cm division

  1.09 m and 0.08 m are also marked in the fig 3 in the same way.



To construct vernier scale and scale of chords

Objectives : At the end of this exercise, you shall be able to,
- **Construction of verier scale and scale of chords**

PROCEDURE

TASK : 1 **Construct a retrograde vernier scale (Fig 1)**

RF = $\frac{1}{25}$; Least count:1 cm; Maximum length: 4 m

Length of scale: $\frac{1}{25}$ x 4 m x 100 = 16 cm

- Construct the main scale as in to 4 length of each part equal and representing 1 metre.
- Extend the left end of the main scale temporarily by one division.
- Draw the secondary (vernier) scale of 11 MSD length as shown.
- Divide the secondary (vernier) scale into 10 equal divisions each representing 1.1 dm or 0.11 mm and complete the retrograde vernier scale.

To mark the reading, refer Figure 1.

(i) 0.21 metres = 0.1 + 0.11 = 0.21

– With reference to zero on the vernier scale, one division on the right hand side and 1 division on the left side.

– Draw extension lines and mark the reading.

(ii) 2.74 metres = 2.3 + 0.44 = 2.74

– Mark 4th division on the vernier scale represents 0.44 from `O' and mark 2.3 m on the main scale.

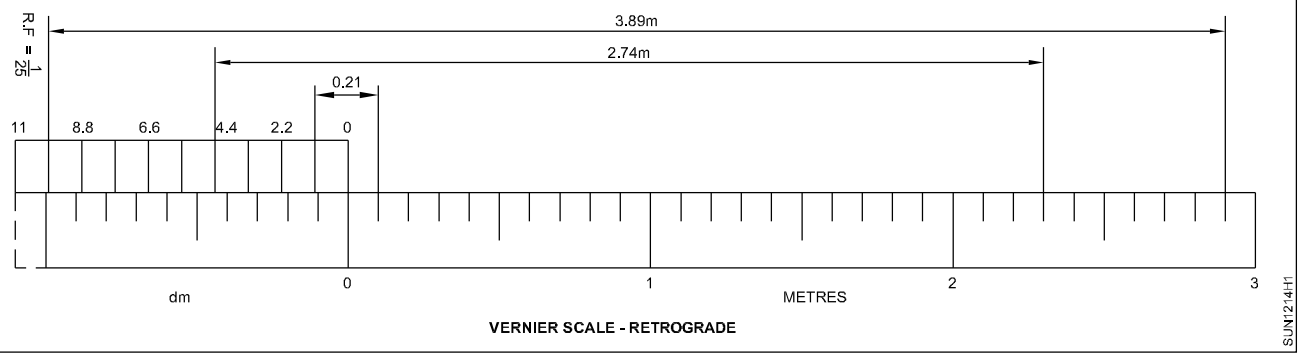
– Draw extension lines and mark the reading.

(iii) 3.89 metres = 2.9 + 0.99

– Mark the 9th division on the vernier scale represents 0.99 m from `O' and mark 2.9 m on the main scale.

– Draw extension lines and mark the reading.

Fig 1

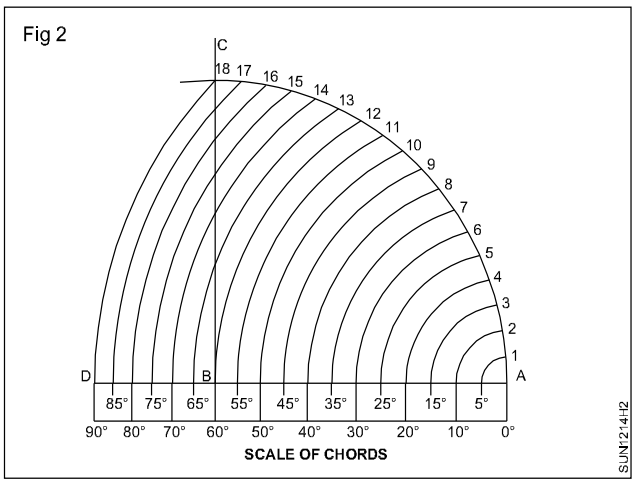


VERNIER SCALE - RETROGRADE

Construct a scale of chord and draw an angle 35° (Fig2,3)

- Draw a quadrant ABC and extend the line AB.
- 'A' as centre AC as radius, draw the arc CD. (Now AB represents the chord of arc CD)
- Divide the arc AC into 18 equal parts, so that each division will represents 5°.
- 'A' as centre, draw arcs with radil A_1', A_2'.... A_{18}' to intersect line DA and mark them 5°, 10°.... 90° as shwon in Fig 2.

Fig 2

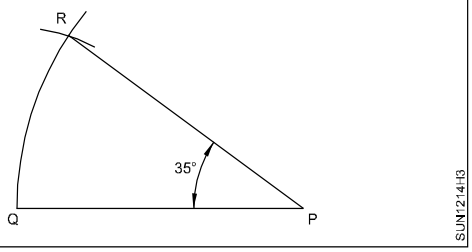


SCALE OF CHORDS

To draw the angle of 35° (Fig 3)

- Draw a line PQ equal to AB.
- 'P' as centre PQ as radius, draw arc.
- Set the compass to A-35° and 'Q' as centre, draw an arc to intersect the previous arc at R.
- Join PR by a straight line and now angle RPQ = 35°.

Fig 3



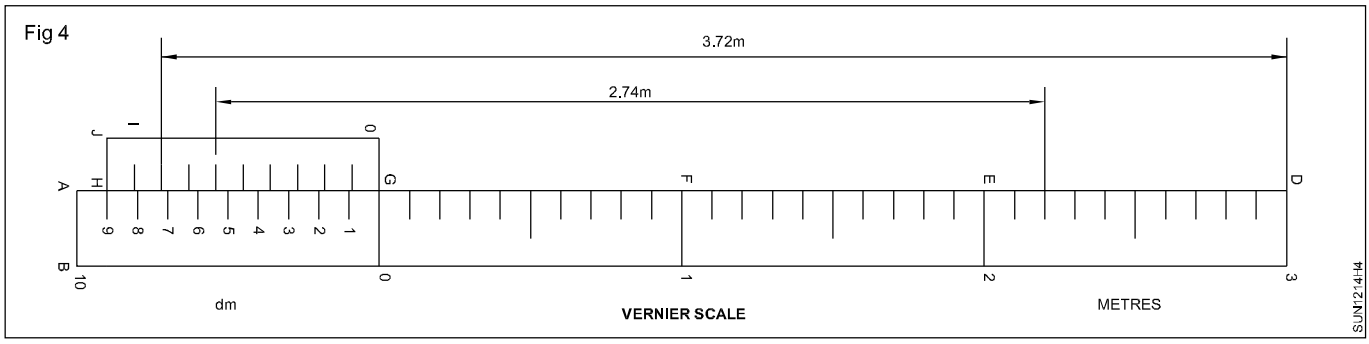
TASK :4 Construct a direct verier scale of RF = $\frac{1}{25}$ to read centimeters for 4 m, 3.72m and 2.74m, (Fig 4)

Length of scale **=** $\frac{1}{25}$ x 4m x 100 = 16cm**.**

- Draw a rectangle ABCD (16 cm x 1 cm) representing main scale.
- Divided the main scale into 4 length of each part equal and representing 1 metre.
- Divide each line AG, GF, FE & ED into 10 equal and divisions and each division is caled one main scale division. (1 dm)
- Add another rectangle GO, J, H as secondary scale (vernier) to a length of 9 MSD (9 dm).
- Divide GH into 10 equal division on secondary (vernier scale) side and complete the vernier scale.

Lowest main scale block and vernier side portion of Fig1 is shown with more detail.

Fig 4



Three views in orthographic - Projection of line, plane, solid object and section of solids

Objectives : At the end of this exercise, you shall be able to,
- **draw first angle projection method**
- **draw third angle projection method**

PROCEDURE

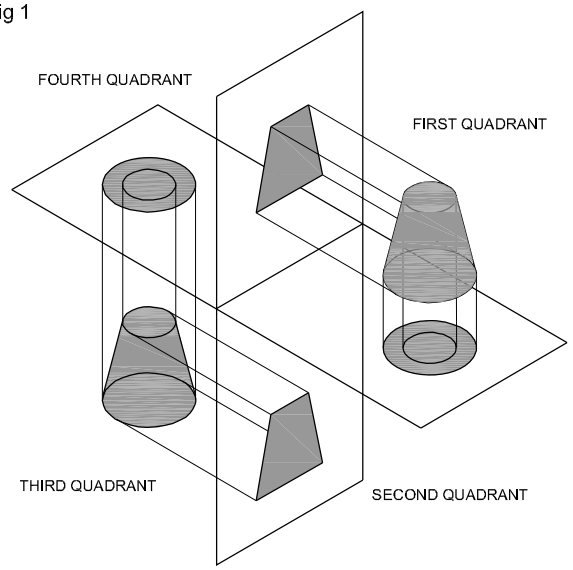
TASK 1: **First angle projection (Fig 1)**

- Draw the views with reference to the front directions indicated.
- The view from top is placed underneath
- The view from bottom is placed above
- The view from left is placed on the right
- The view from the right is placed on the left
- The view from the rear may be placed on the left or on the right as may be found convenient.

TASK 2: **Third angle projection (Fig 1)**

- Draw the views with reference to the front directions indicated.
- The view from top is placed above
- The view from bottom is placed underneath
- The view from the left is placed on the left
- The view from the right is placed on the right
- The view from the rear may be placed on the left or on the right as may be found convenient.

Fig 1



MULTI VIEW ORTHOGRAPHIC PROJECTION

TASK 3: **(Fig a)**

- Draw the plan, elevation and side views in first angle projection.

TASK 4: **(Fig b)**

- Draw the plan, elevation side views in 3rd angle projection.

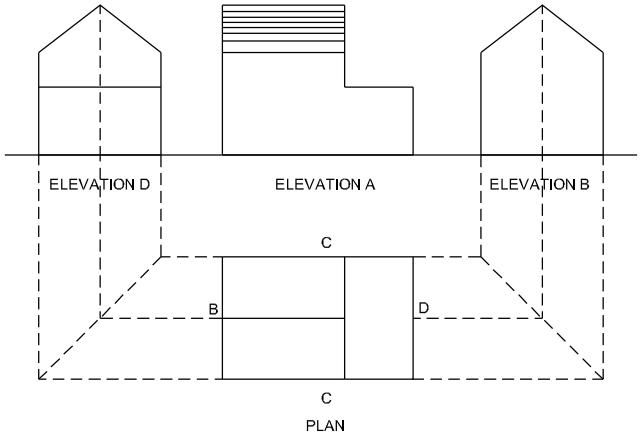
TASK 5: **(Fig c)**

- Draw the combenation of first angle and thired angle projection of the object.

TASK 6: **(Fig d)**

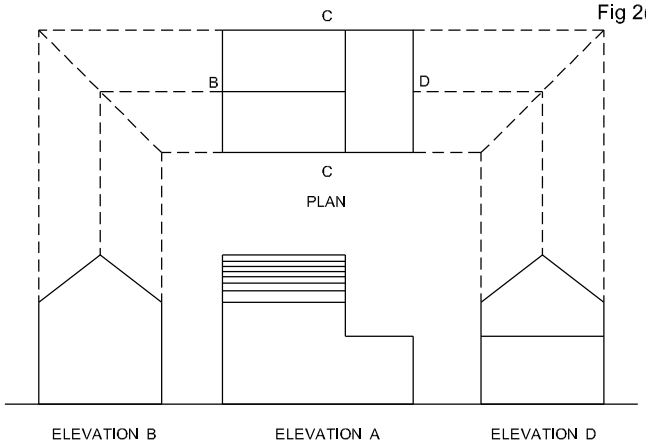
- Reproduce the single room drawing and study.

Fig 2 (a)



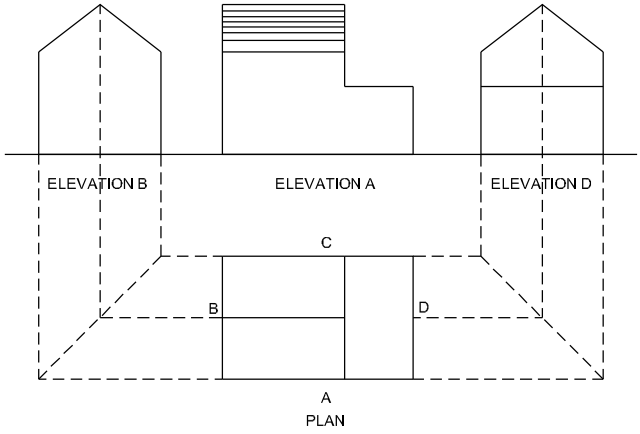
FIRST ANGLE PROJECTION

Fig 2(b)

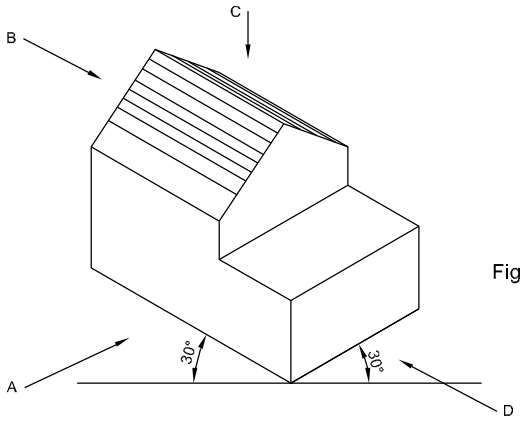


THIRD ANGLE PROJECTION

Fig 2 (c)



COMBINATION OF FIRST AND THIRD ANGLE PROJECTION

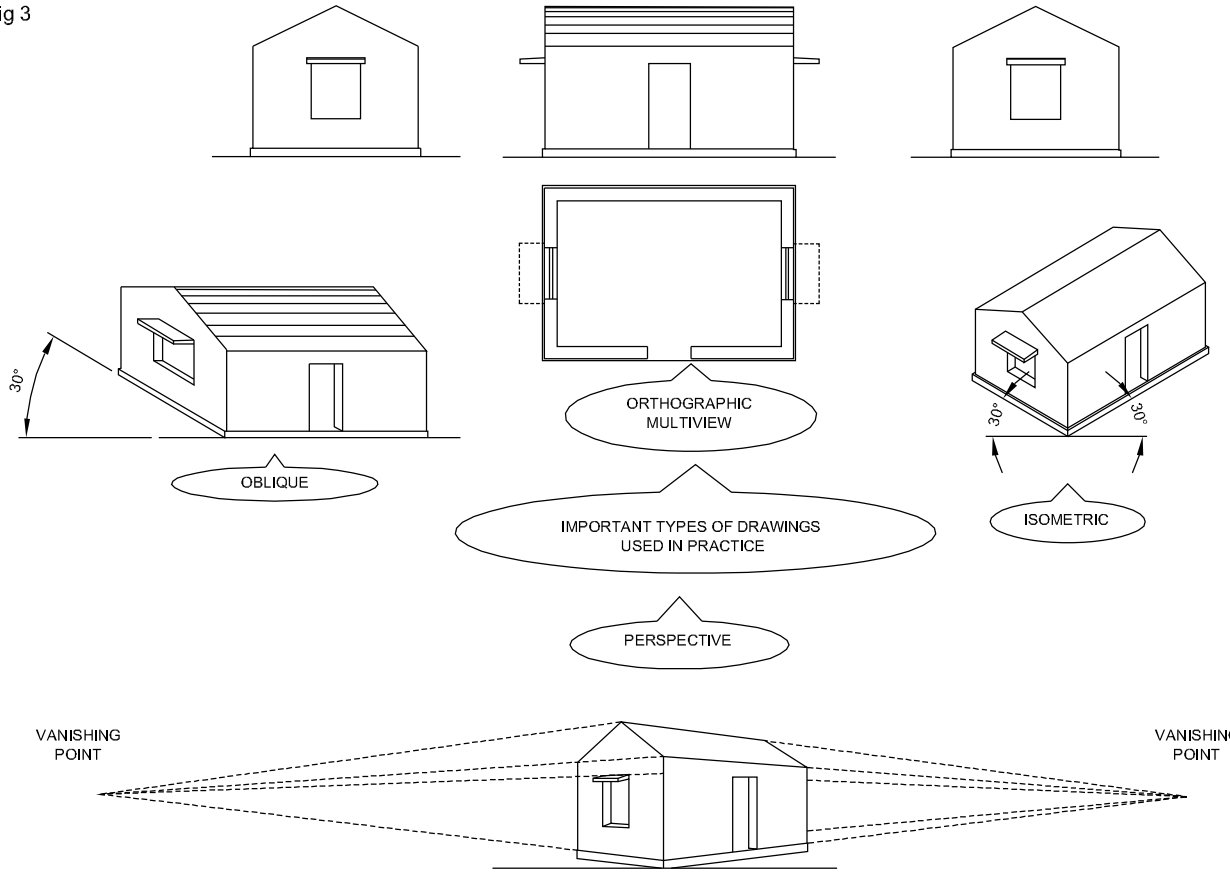


ISOMETRIC VIEW

Fig 2

SUN'215H2

Fig 3



SUN'215H3

Projections of points and lines

Objectives : At the end of this exercise, you shall be able to
- **draw projections of point for the given positions in the four quardrants**
- **draw projections of lines in first angle and 3rd angle for the given positions.**

PROCEDURE

TASK 1: **Draw the projections of point "P" situated at 15mm in front of VP and 25mm above HP (Fig 1).**

As the point situated in the first quadrant, the plan P lies below the XY line and elevation 'P' lies above the XY line

- Draw XY line
- Draw vertical line perpendicular to XY line intersect at "O"
- Draw vertical line perpendicular to XY line intersect at "O".
- Mark P and P such that OP = 15mm and OP = 25 mm

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TAsk 2: **Draw the projections of point "Q" situated at 15mm in front of VP and 25mm below HP (Fig 2).**

As the point situated in the second quadrant, the plan q lies above the XY line and elevation of lies below XY line.

- Draw Xy line
- Draw vertical line perpendicular to Xy line intersect at "O"
- Mark q and 'q' such that oq^1 = 25mm

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TASK 3 : **Draw the projections of point "R" situated at 15mm in behind VP and 25mm below HP (Fig 3).**

As the point situated in the third quadrant, the plan r lies below the XY and elevation 'r' lies above the XY line.

- Draw XY line
- Draw vertical line perpendicular to XY intersect at "O"
- Mark r and 'r' such that or = 15mm and or = 25mm

TASK 4: **Draw the projections of point 'S' situated at 15mm in front of VP and 25mm above HP (Fig 4).**

As the point situated in the fourth quadrant, the plan lies below the XY line and elevation lies above XY line.

- Draw XY line
- Draw vertical line perpendicular to XY line intersect at "O"
- Mark s and s' such that os = 15mm and os' = 25mm

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TASk 5: **Draw the projections of point "T" situated at 15mm in front of VP and in HP (Fig 5).**

As the point situated in the first quadarant, the plan lies below the xy line and the point is in HP elevation t' lies above the XY line

- Draw XY line
- Draw vertical line perpendicular to XY line intersect at "O"
- Mark t and t' such that ot = 15mm and t' is at O

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TASK 6 : **Draw the projections of a line AB of 50mm long, parallel to both HP and VP, situated 25mm above HP and 30mm in front of VP (Fig 6).**

- Draw XY line
- Draw ab (plan) 50mm long such that 30mm below XY
- Draw a'b' (elevation) 50mm long,25mm above XY line

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TASK 7: **Draw the projections of line CD of 50mm long, parallel to HP and perpendicular to VP,situated 25mm above HP and the nearest end to VP 30mm front of VP (Fig 7).**

- Draw XY line
- Draw cd (plan) 50mm long below XY line such that line cd is perpendicular to XY line and oc = 30mm
- Project cd vertical upwards and mark c'd' (elevation),25mm above XY line

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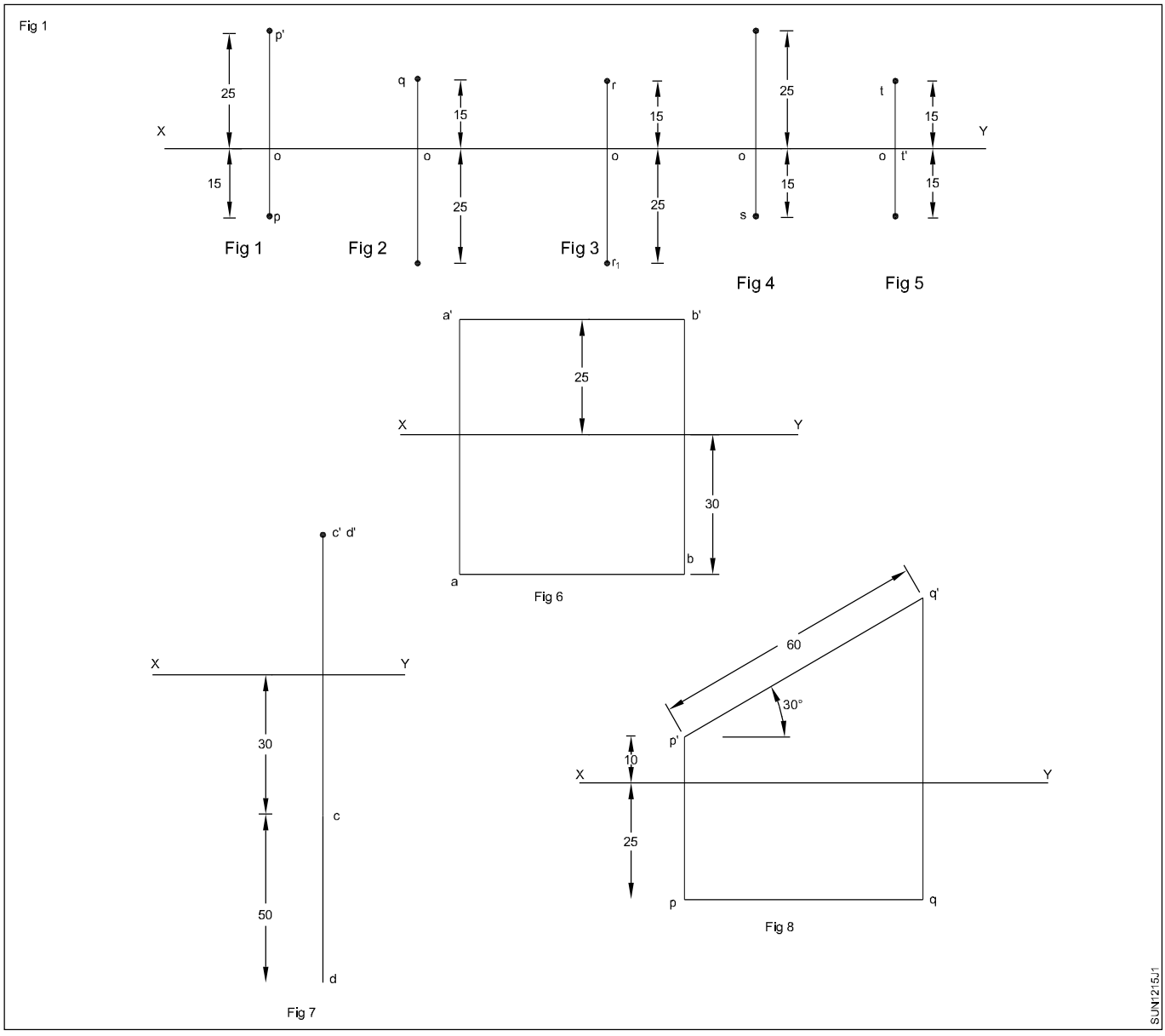
TASK 8: **Draw the projections of a line PQ of 60mm long, situated in such a way that the P is 10mm above HP, 25mm in front of VP.The line PQ is inclined at 30° to HP and parallel to VP (Fig 8).**

In this case as the line is inclined to HP, the elevation shows the actual length

- Draw XY line
- Draw p' q', such that p is 10mm above XY line and p' q' = 60mm and inclined 30° to the XY line.
- Project p'q' vertical downwards and mark pq,25mm below XY line

Solve more problem at different quadrants and various positions



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Drawing the projection of plane figures (Lamina)

Objectives : At the end of this exercise, you shall be able to,

- **draw projections of surface, when they are parallel to one plane, but perpendicular to the other plane**
- **draw projections of surface when they are inclined to one plane, but perpendicular to the other plane**
- **draw the projections of surface when they are perpendicular to both the planes**
- **draw the projections of surface when they are inclined to both the planes**

PROCEDURE

TASK 1: **(Square of 60 mm side) (Fig 1)Draw the projections (elevation, plan and side view) of the square having its position defined under as**

- Surface parallel to VP
- Surface perpendicular to HP
- One of its edges parallel to HP
- Centre point 40mm above HP and 20mm in front of VP

• Draw the xy line.

• Draw the square with its centre 40 mm above the xy line and one edge parallel to xy line.

• Mark the corners of the figure a', b', c' & d'. This will be the elevation of the square.

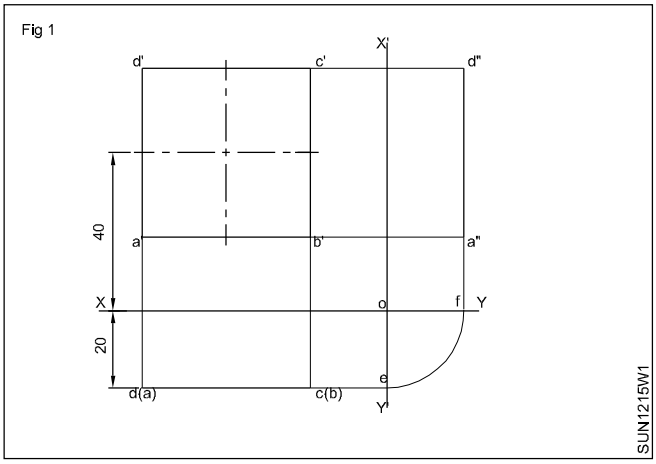
• Draw the vertical projectors from a'b' downward beyond the xy line.

• Draw a horizontal line dc at a distance of 20 mm below the xy line. Line dc will be the plan.

• Draw a X'Y' line at a convenient distance from b'c', intersecting the xy line at 'O'.

• Project the plan to the X,Y, line meeting at e.

Fig 1



• By arc method transfer Oe to xy and mark the point 'f'.

• Project 'f' upwards.

• Projct b' and c' to meet the the projected line from 'f' at a" and d" respectively. Now the line a"d" is the side view.

TASK 2: **Draw the projections (elevation, plan and side view of a rectangle having the position defined as (Rectangle of 40 mm x 80 mm) (Fig 2)**

- Surface parallel to HP
- Surface perpendicular to VP
- One of its edges parallel to VP
- Centre point 20mm above HP and 40mm in front of VP

• Longer side parallel to xy.

• Draw the xy line.

• Draw the rectangle with its centre 40 mm below xy line and its longer side parallel to xy. Mark the corners as a,b,c & d and join them.

• Figure a,b,c,d will be the plan.

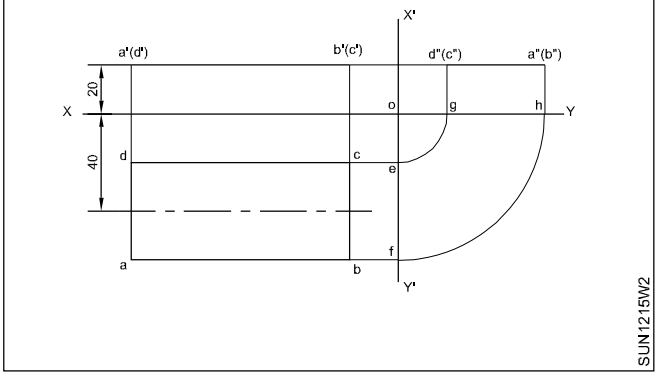
• Draw the vertical projectors from d and c upwards beyond xy line.

• Draw a horizontal line a'b' at a distance of 20 mm above xy line.

• Now the line a'b' will be the elevation.

• Draw a vertical line x'y' line at a convenient distance from b'.

Fig 2



• Project c and b, meeting x'y' line at ef.

• By arc method transfer the point e & f to xy line and mark g & h respectively.

• Project the points g & h upward beyond xy line.

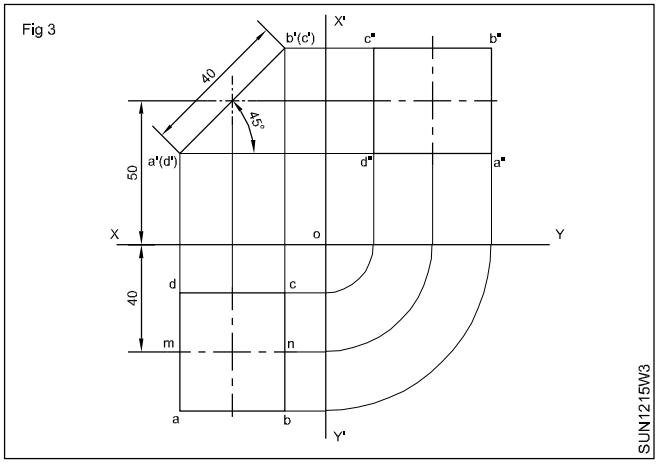
• Project a horizontal projectors from the point b' intersecting the vertical projectors, projected from g & h at d" & a" respectively.

• Now the line d"a" is the side view.

TASK 3: **Draw the projection (elevation, plan and side view) of the square having its position defined as (Square of 40 mm side) (Fig 3)**

- Surface inclined to HP at on given angle 45°
- Surface perpendicular to VP
- One of the edges perpendicular to VP
- Axis major on it perpendicular to VP
- Centre point 50mm above HP and 40mm in front of VP

- Draw xy, X',Y' axis.
- Draw a'b' equal to the side of the square (40) at 45° and its centre point 50 mm above xy.
- Now a'b' is the elevation.
- Project a'b' downwards beyond xy line.
- Draw centre line mn at a distance of 40 mm below xy.
- Mark points a,b,c & d at a distance of 20 mm above and below and project a'b' down and complete the rectangle a,b,c,d and this will be the plan.
- Draw the projectors from elevation and plan.



In this exercise we have started with the elevation as the true length of the side will be available in the elevation.

The plan and side view are rectangles one side is equal to 40 mm and another side is fore-shortened and complete the side view d",a", b" & c" as shown in Fig 3

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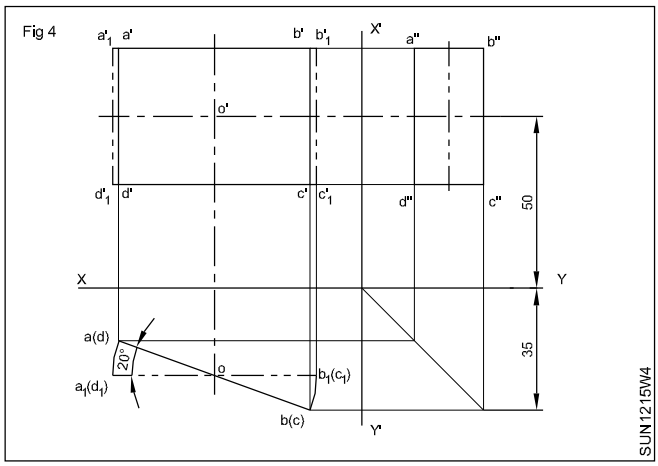
TASK 4: **Draw the projection (plan, elevation and side view) of a rectangle given its position as (Rectangle of 60 mm x 40 mm) (Fig 4)**

- Inclined to VP at a given angle 20^0
- Surface perpendicular to HP
- One of its edges perpendicular to HP
- Centre point 50mm above HP and 35mm in front of VP

Surface perpendicular to HP, standing on its longer edge and also rotated about the vertical centre line to an angle. (say 20°)

- Since the surface is perpendicular to HP and inclined to VP the true length of the rectangle will be shown in the plan.
- Draw xy and X',Y' lines.
- Draw the plan and elevation as if the rectangle is parallel to VP and perpendicular to HP.
- Mark the centre point `0' and draw the plan ab in the rotated position. (i.e. 20°)



- Project the point a & b and complete the elevation a'b'c'd'.
- Complete the side view a"b"c"d" by drawing the projectors from plan and elevation.

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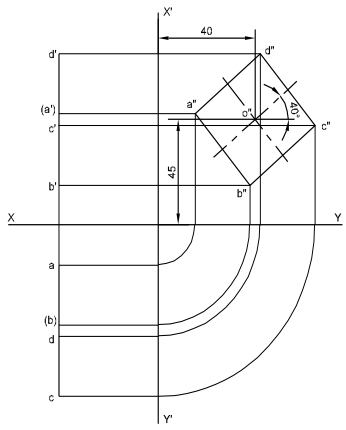
TASK 5: **Draw the plan, elevation and side view of a rectangle given its position as Square of side 40mm (Fig 5)**

- Surface parallel to HP
- Surface perpendicular to VP
- One of its edge axis 40° to the HP
- Centre point 45mm above HP and 40mm in front of VP

- Surface is perpendicular to both HP and VP.
- One of its edges is 40° to HP. Centre point is 45 mm above HP 40 mm in front of VP.
- According to the conditions listed above, true shape of the square can be seen only in side view. Draw the side view first.
- Draw xy line and draw parallel line 45 mm above xy.
- Mark point 0" the centre point of the square.
- Draw a line 40° with xy passing through the point 0".
- Mark of 20 mm both sides of point 0" and draw perpendiculars to 40° line from the points marked.

Fig 5



- Draw two lines parallel to 40° line at distances of 20 mm both sides.
- These lines cut the earlier lines at points a",b",c",d".
- a"b"c"d" is the side view.
- Draw X,'Y,' line 40 mm from the centre point of the square.
- Project the side view and draw plan and front view.

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TASK 6: **Draw the plan, elevation and side view of a square given its position as below (Square of side 60 mm) (Fig 6)**

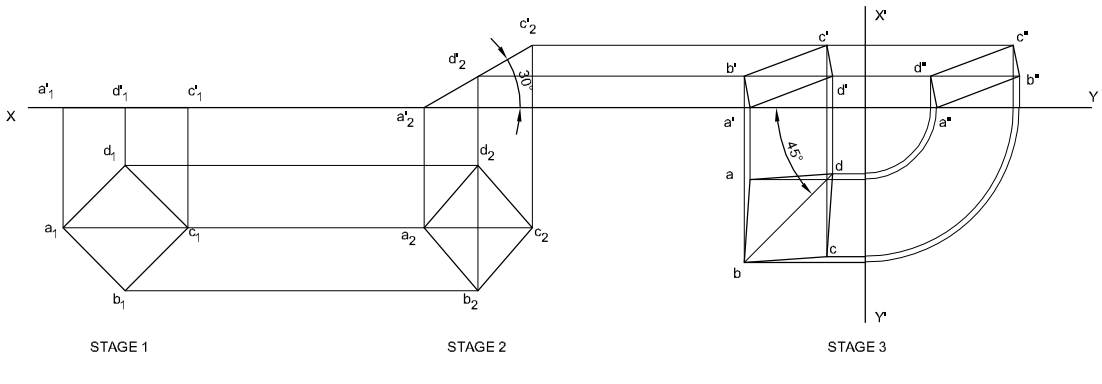
- Corner `a' is on HP diagonal. ac makes 30° to HP and the diagonal bd makes 45° to VP, but parallel to HP

This is a case when the surface is inclined to both VP and HP. As the diagonal BD is parallel to HP its projection on HP will have its true length.

The procedure has three stages.

- In the first stage, draw a plan a_1, b_1, c_1, d_1 assuming the diagonal ac is parallel to HP and the diagonal bd is perpendicular to VP. Plan is a true square.
- In the second stage, assume corner a_2 (A) of the square is on HP and the diagonal ac makes 30° to HP and diagonal b_2d_2 is parallel to HP.
- Draw the line $a'_2b'_2c'_2$ the elevation of the second stage.
- Draw the plan a_2, b_2, c_2 d_2 by projecting from the first stage plan and the second stage elevation. The diagonal b_2d_2 will be of true length and the diagonal a_2c_2 will be fore-shortened. In the third stage the diagonal b_2d_2 is to be tilted to an angle of 45° to VP and parallel HP.
- Even though the diagonal bd makes 45° to VP, the plan will be same as that of the plan of second stage, but rotated through 45°.
- Draw the plan abcd as shown in Fig $a_2b_2c_2d_2$ making bd at 45° to xy line.

Fig 6



Projection of solids

Objectives : At the end of this exercise, you shall be able to,
- **draw orthographic views of solids in the given positions.**

PROCEDURE

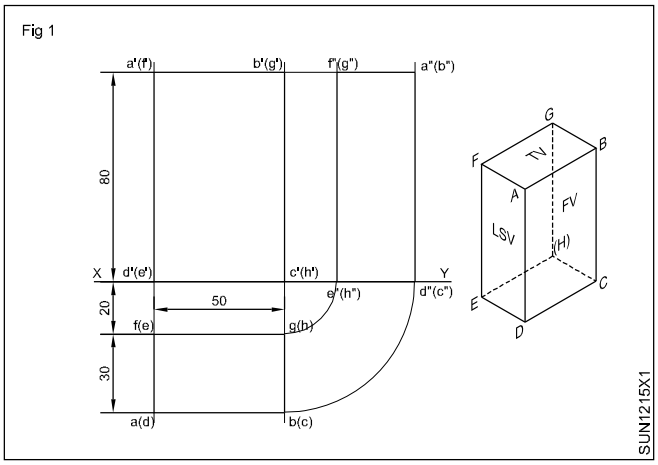
TASK 1 **: Draw the plan, elevation and side view of a rectangular prism of size base 50 x 30 and height 80 mm given its position as below (Fig 1).**

- The base 50 x 30 is resting on HP.
- The vertical face 80 x 50 nearest to VP is 20 mm in front of it.

Note: In this problem the face of prism are parallel to the planes of projection. Therefore the plan, elevation and side view will be rectangles.

- The prism is shown pictorially in the figure and its eight corners are marked as abcd-efgh.
- Draw the plan (50 x 30) 20 mm below XY line.
- Project from plan and draw elevation (80 x 50)
- Draw the side view by drawing projection from elevation and plan. (Fig 1)

Fig 1



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TASK 2 **: Draw the plan, elevation and side view of an hexagonal prism whose side is 25 mm and length 60 mm given its position as below: (Fig 2)**

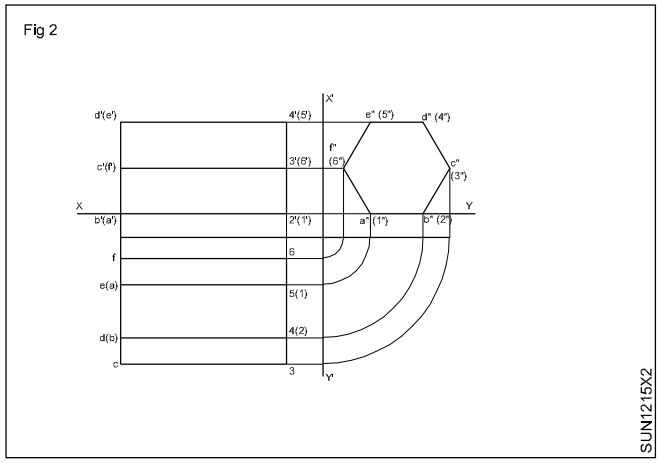
– One of its lateral surfaces lying on HP

– The axis is parallel to vertical plane.

From the position described above, it is clear that the hexagonal face of the prism is parallel to AVP. Therefore the end view is a true hexagon and hence this view should be drawn first.

- Draw the end view (hexagon of side 25 mm) with one side on HP line. (Fig 2)
- Draw horizontal projectors from side view and complete the elevation. (In the elevation two lateral faces are visible, but they are fore-shortened)
- Draw projectors from elevation and side view and complete the plan.

Fig 2



(Three lateral faces are visible, of which one is of true shape and the other two are fore-shortened)

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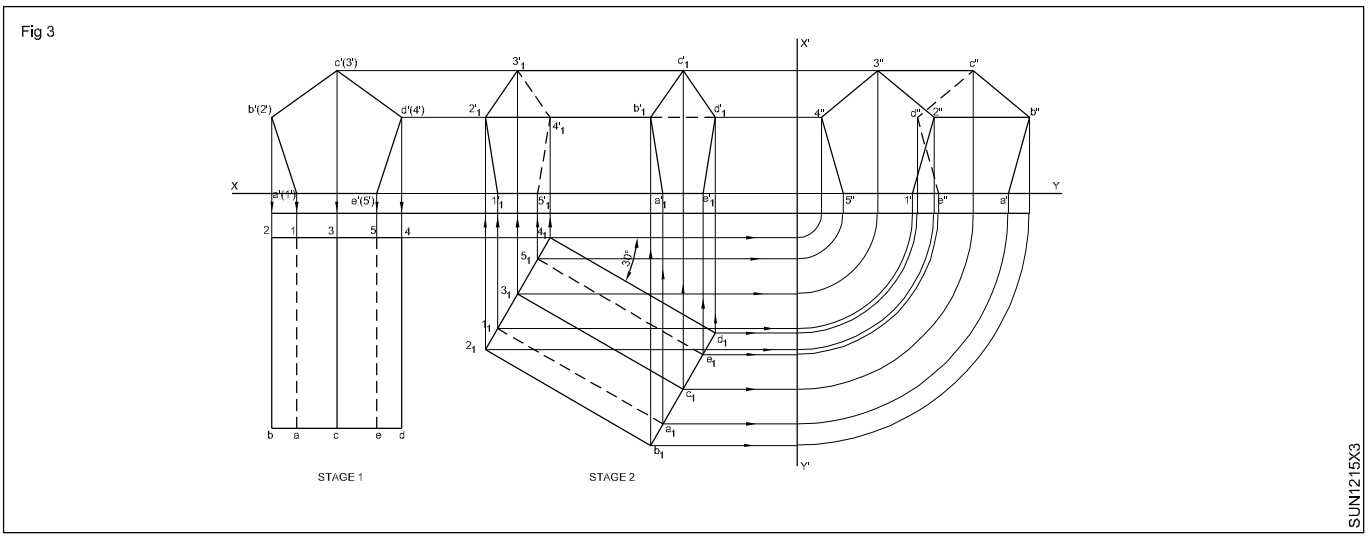
TASK 3 **: Draw the plan, elevation and side view of a pentagonal prism of side 30 mm and length 70 mm given its position as below**: **(Fig 3)**



- One of its lateral surfaces rests on HP
- The axis makes 30° with HP.

In this exercise none of the three views required will confirm to the true shape. Therefore the final views cannot be drawn straight away. The views have to be arrived at by first drawing some views using given data. Therefore we first draw plan and elevation as if it is lying on HP and axis perpendicular to VP.

- As stated above, start by drawing the elevation (Pentagon of side 30 mm) and mark corners as a',b',c',d', and e',. (Fig 3)
- Draw the plan projecting from the above elevation.
- Reproduce this plan with the axis making 30° with XY line as shown in figure. This is required plan.
- Draw the horizontal projectors from the elevation of first stage and vertical projectors from plan of second stage and complete the required elevation as shown.
- Complete the side view by drawing horizontal projectors from the elevation and by transfering the distances from plan of the second stage.

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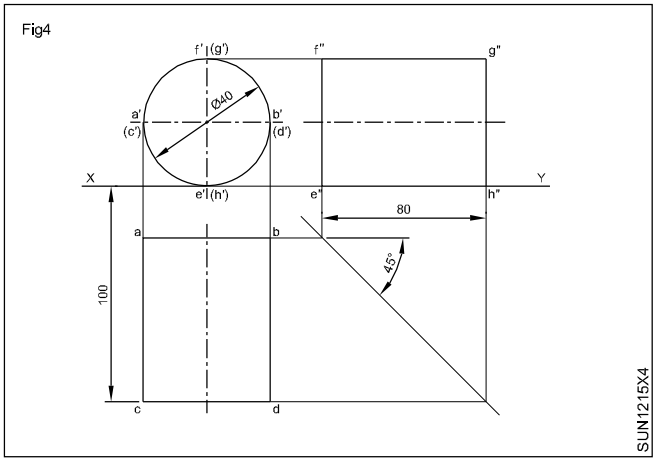
TASK 4 :**Draw the plan, elevation and side view of a cylinder of diameter 40 mm and length 80 mm given its position as below: (Fig 4)**

- Cylinder resting on the HP with its axis perpendicular to VP.
- Face farthest from VP is 100 mm away from VP.

In this problem the circular faces are parallel to VP. Therefore the elevation is a circle resting on XY line. Plan an end views are rectangles of size 80 mm x 40 mm.

- Draw the circle of diameter 40 mm touching XY line. (Fig 4)
- Draw the plan projecting it from the elevation.
- Draw the end view by drawing projection on it, from the plan and elevation.



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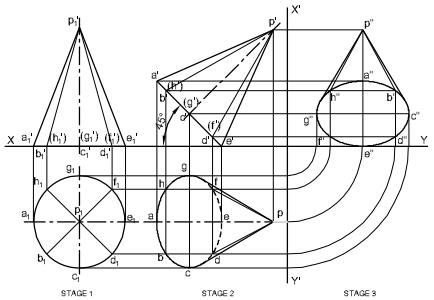
TASK 5 : **Draw the projections of a cone of base diameter 60 mm and height 80 mm when its position is as under (Fig 5)**

- Its circular base touching HP and making an angle of 45° with HP.
- Axis parallel to VP.

The elevation of a cone, which is standing vertical is a triangle. The base of the cone will be elliptical in both the plan and side view.

- Draw the plan and elevation of cone as if it is standing vertically on HP. (Stage 1) (Fig 5)
- Divide the circumference of the plan into number of equal parts. (say 8) and mark them. From these points draw projectors to XY line and mark the intersection is a',b' (h') c' etc.
- Draw the required elevation, same as in stage 1, but with the axis 45° to XY line and mark the points as a'b'(h') c'(g') etc.
- Draw the ellipse through the intersection of the corresponding points of the vertical and horizontal projectors and complete the required plan.

Fig 5



- From the final plan and elevation, draw projectors and complete the required end view.

Solve more problems by changing the position of solids

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Section of solids

Objectives: At the end of this exercise you shall be able to
- **draw the true shapes / sectional views when geometrical solids are cut by cutting planes.**

PROCEDURE

Exercise 1

Draw elevation, sectional plan and the true shape of the section of a square prism.

- Length of side of square prism standing vertically.
- One diagonal of the base is perpendicular to VP and anotehr diagonal parallel to VP.
- Cutting plane makes 45° to the axis and intersects the axis 40 mm above the base.

Draw the plan and elevation of the prism. (Fig 1)

- Draw the cutting plane in the elevation of the drawing.
- From the point m' draw projector to meet the plan at mn.
- Hatch the portion of the plan and complete the required sectional plan.

To get the true shape

- Draw a line parallel to the cutting plane.
- Draw projectors perpendicular to the cutting plane from points m', b' & c' and extend beyond the line, drawn parallel to the cutting plane.
- Transfer the distances mn and db symmetrically about the line and also mark c''.
- Join m''-n'', n''-d'', d''-c'', c''-b'' & b''-m'' and hatch the area to complete the required true shape. (auxilliary view)

Exercise 2

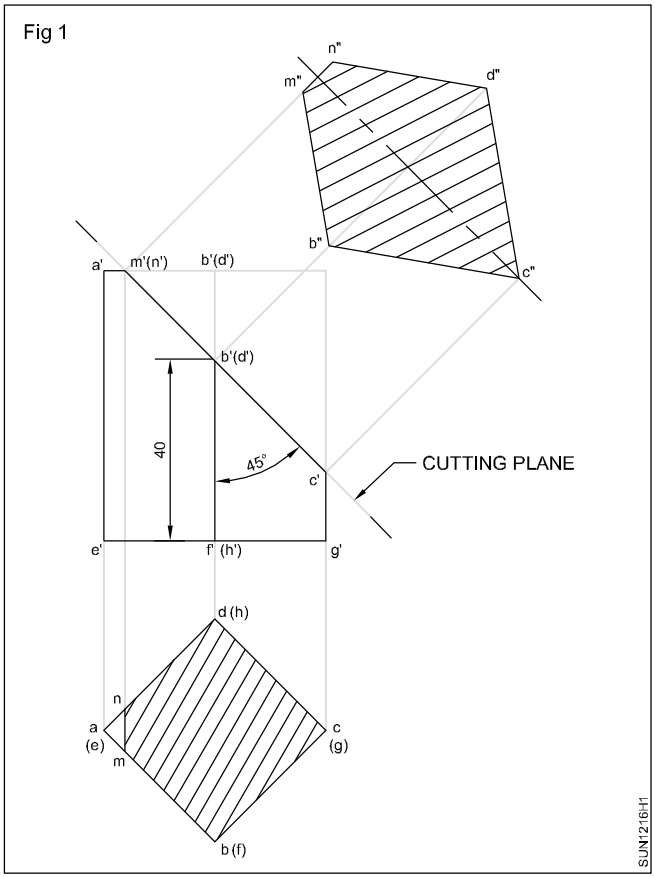
Draw the sectional plan, elevation and true shape of the cut surface of a cylinder given the details as under.

- Cylinder is of diameter 50 mm and height 60 mm stands on HP with its axis vertical.
- Cutting plane makes 40° to the horizontal and intersecting the axis at the mid-point of the vertical axis.

Draw the plan and elevation of the cylinder. (Fig 2)

- Indicate the cutting plane in the elevation.
- Divide the plan into any number of equal parts, (say 12) and mark the points a, b, c... I.
- Project the points a to I vertically to intersect the cutting plane line at a' b' c' etc.

Fig 1



- Project horizontally the points a, b, ... I in the plan by transfer method for the side view.
- Mark the intersection points of the corresponding projection in the previous two steps and complete the end view.

To draw the true shape of the section

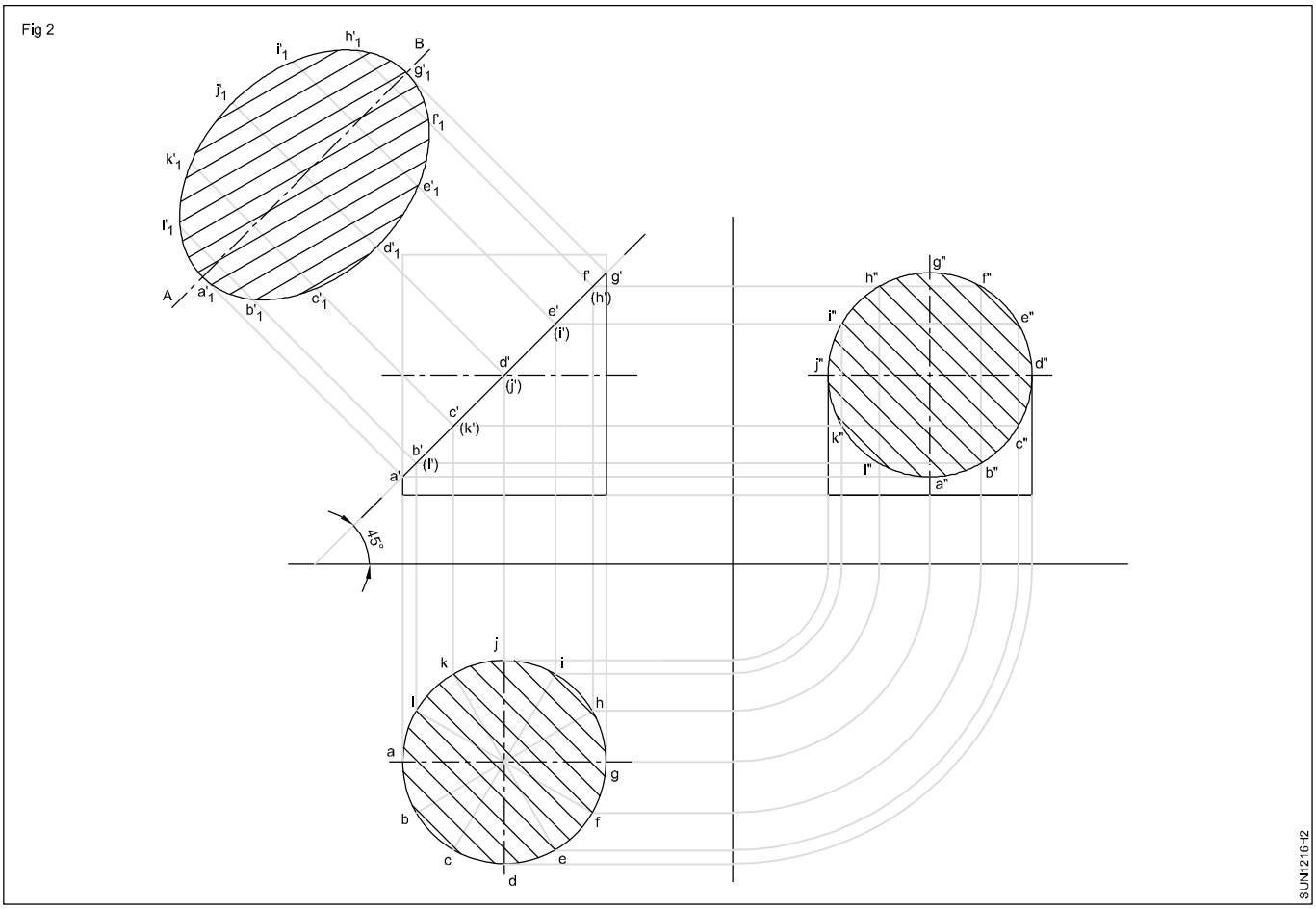
- Draw a line AB parallel to the cutting plane line.
- Draw perpendicular projectors perpendicular to the cutting plane line.
- From points a', b', c' extend beyond the line AB.
- Mark the points a'_1, b'_1, c'_1 etc such that the distance I'' b'' k'' c'' at in the end view are equal to Ib, kc etc in the plan.

Join the points a'_1 b'_1, c'_1 and complete the true shape.

Exercise 3

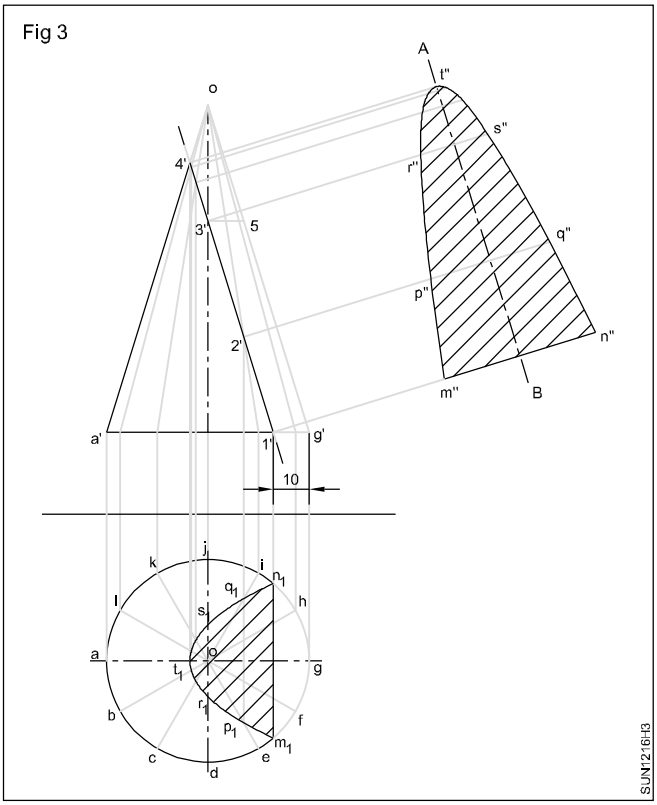
Draw the sectional plan, elevation and true shape of the surface of a cone given with the following details.

- Diameter of cone is 50 mm and height of cone is 65 mm.



- Standing vertically on HP.
- Cutting plane is parallel to stant length of the cone in the elevation at a distance of 10 mm.

Draw the plan and elevation of the cone for the given positions. (Fig 3)



- Draw the cutting plane in the elevation and mark the points 1', 3' & 4'.
- Divide the plan into 12 equal parts and mark a, b, c, d... l.
- Project the points upwards and get the intersecting point 2.
- Project the point 1', 2', 3' & 4' downwards and obtain the points m_1 n_1 q_1 s_1 t_1 r_1 & p_1.
- Joint the points and hatch the space. This is the required plan.
- Draw a line AB parallel to cutting plane at a suitable distance.
- Project the point 1', 2', 3' & 4' from the cutting plane, intersecting AB and extend beyond AB.
- Transfer the dimensions m_1 n_1, p_1 q_1, r_1 s_1 and point t_1.
- Joint the line m'' n'' and draw a smooth curve through the points m'', p'', r'', t'', s'', q'' & n'' and hatch the required auxillary view.

Exercise 4

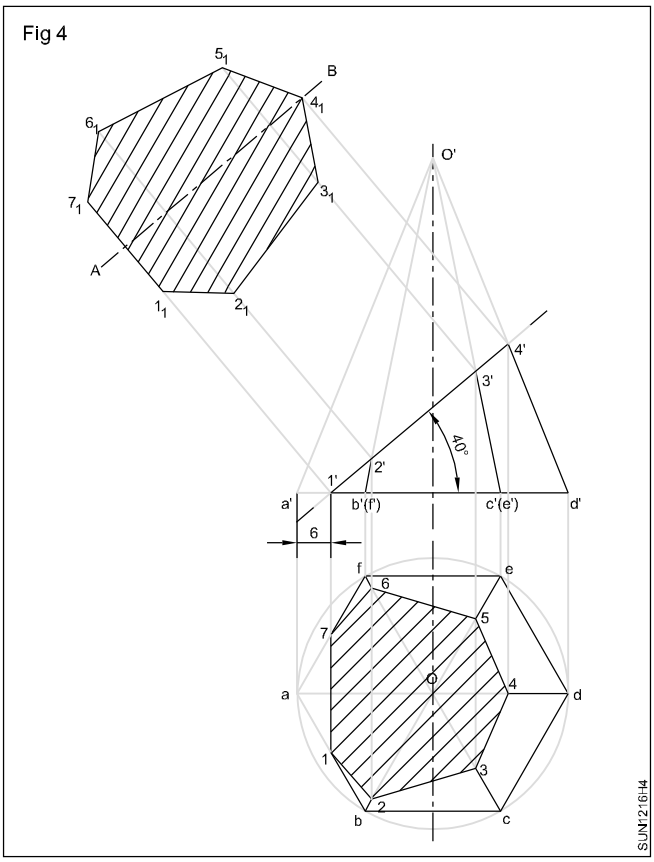
Draw the sectional plan, elevation and true shape of the cut surface of the hexagonal pyramid given the details as under.

- Side of the hexagon is 25 mm height of the pyramid is 65 mm.

- Stands vertically on its base with one edge of the base is parallel to VP.
- Cutting plane makes 40° to HP and intersects the base at a distance of 6 mm from the left corner of the base.

Draw the elevation and plan for the given position. (Fig 4)

Fig 4



- Draw the cutting plane in the elevation and mark points 1', 2', 3' & 4'.
- Project these points downward and beyond the line ad in the plan.
- Mark the points of intersection of the radial lines in the plan and projectors drawn in the previous step.
- Join the points marked in the previous step to form a closed figures and hatch the area. This together with the hexagon already drawn is the required plan.

To draw the true shape

- Draw a line AB parallel to the cutting plane.
- Draw projectors perpendicular to the cutting plane from points 1', 2', 3' & 4' and extend beyond AB. On the projectors drawn set off 1-7 equal to 1-7 of plan. Similarly set off the other points 2-6, 3-5 by transfering from the plan equals to 2-6, 2-5 respectively. The point 4 obtained by projecting the point 4'.
- Join all the points to form a closed figure and hatch the same to get the required true shape of the section.

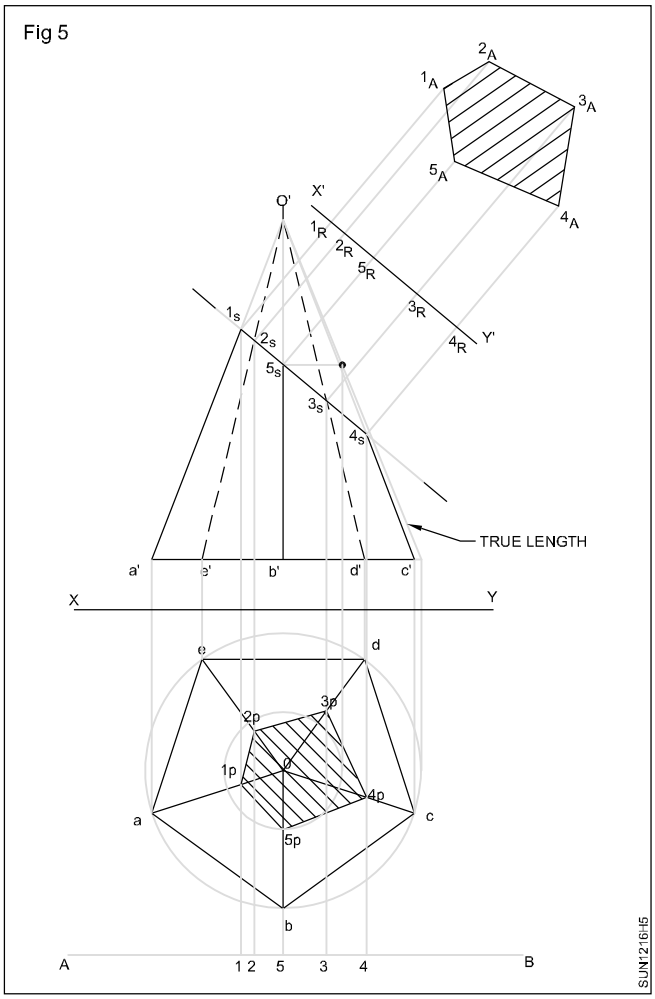
Exercise 5

Draw the plan, elevation and (true shape) auxiliary view of a pentagonal pyramid of base 35 mm and height 65 mm given the condition as under.

- Standing vertically with one edge of the pentagonal base parallel to VP.
- The pyramid is cut by a cutting plane sloping towards left, at an inclination of 45° to HP passing through the axis at a point 40 mm above the base.

Draw the plan and elevation of the pentagonal pyramid. (Fig 5)

Fig 5



- Draw the cutting plane line and mark 1s, 2s, 3s, 4s & 5s at the intersection of this line.
- Draw the vertical projectors from the intersecting points cutting the radial line ao, co, do and eo at 1p, 2p, 3p and 4p respectively.

Note : To obtain the point 5p in the plan. Draw a line parallel to base through 5s meeting the true length. Take the distance as radius set off with 'O' as centre in the plan and 05p on the line Ob.

- Join 1p, 2p, 3p, 4p & 5p and hatch the space, this is the required sectional plan.
- Draw a reference line x' y' parallel to the cutting plane line.

- Draw perpendicular projectors to the cutting plane line from the points 1s, 2s, 5s & 4s beyond the reference line X', Y'.
- Draw line AB parallel to XY below plan.
- Project points 1p, 2p, 3p, 4p & 5p down to touch the line and mark points 1, 2, 5, 3 & 4.
- Transfer the distance 1-1P from 1R and mark 1_A.
- In the same way transfer 2-2p, 5-5p, 3-3p & 4-4p and get point 2A, 5A, 3A & 4A.
- Join points 1A, 2A, 3A, 4A & 5A and form the auxiliary view.

Exercise 6

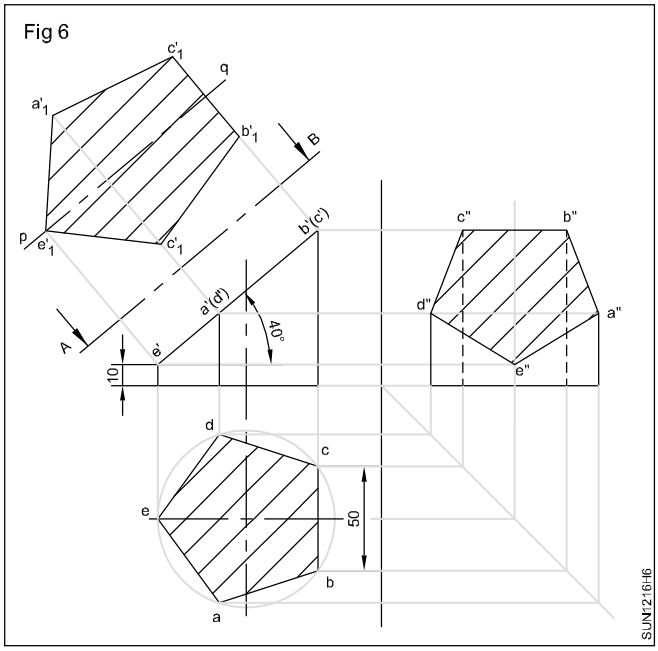
Draw the plan, elevation, side view and true shape of the truncated surface of the prism of side 50 mm given the following details. (Fig 6)

- Side of prism 50 mm.
- Prism standing vertically.
- One side of the prism is perpendicular to VP.
- The truncated surface makes 40° to the horizontal and at a height of 10 mm to the base.

Draw the plan and elevation of the truncated prism.

- Mark the corners.
- Draw the centre lines of the prism.
- Draw the side view by projecting from plan and elevation.
- Mark the corners of the side view.
- Draw a line pq parallel to the inclined surface at a suitable distance.
- Project from the truncated surface and transfer the dimensions from side view to locate the corner points of the auxiliary view.
- Join the points to complete the required auxiliary view.

Fig 6

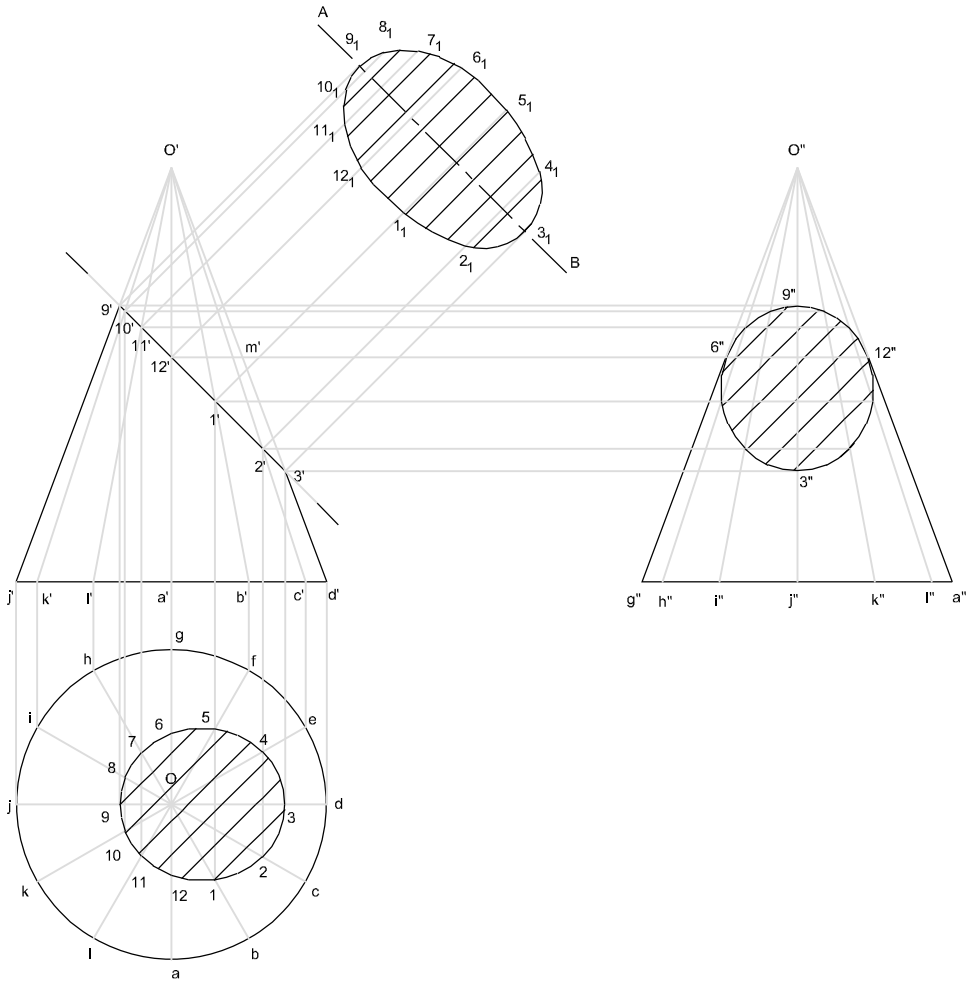


Exercise 7

Draw the plan, side view and true shape of a truncated cone shown in figure given its position as under.

- The truncated cone is standing on HP.
- Draw the plan and elevation of the cone before it is truncated. (Fig 7)

Fig 7



Isometric Projections of Geometrical solids

Objective: At the end of this exercise you shall be able to
- **construct an Isometric scale to a given length**
- **draw the isometric projection of regular solids**
- **draw the isometric views of components with horizontal, vertical, slant and curved surfaces**
- **draw the isometric views for the given multi-views.**

Ex.1 : Construct an Isometric scale to measure upto 150mm with minimum reading of 10mm.

Draw Isometric projection of the following regular solids.

(Horizontal/ Vertical position)

Ex.2 : Cube of side 50mm

Ex. 3 : Rectangular prism of length 60mm, width 30mm and height 20mm.

Ex. 4: Hexagonal prism of side 25 mm and height 60mm.

Ex. 5 : Hexagonal pyramid of side 30 mm and height 75 mm.

Ex. 6 : Cylinder of diameter 50mm and heigh/length of 70mm.

Ex. 7 : Cone of diameter 45mm and height 65mm.

Ex. 8 : Draw the Isometric view of the stepped blocks.

Ex. 9.10.11.12 : Draw the Isometric views of slant cut blocks.

Procedure

Exercise :1

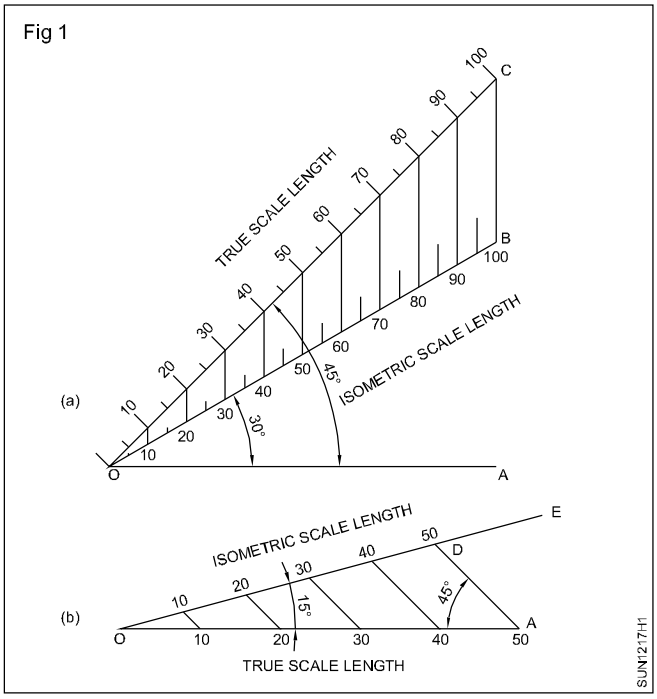
- Draw a horizontal line OA.
- Draw a line OC at 45° to OA and mark 10 mm, 20 mm.....150 mm.
- Draw another line OB at 30° to OA.
- Draw vertical projectors from divisions on OC on to OB and mark the divisions as on OC.

The scale on OC is the true scale and the scale on OB is the Isometric scale. (Fig 1a)

Another way of constructing isometric scale.

- Draw a horizontal OA to a known length.
- Draw another line OE at 15° to OA.
- Draw another line from point A making 45° and meet the line OE at D.
- Divide the line OA into number of equal divisions (say 5) and mark 10,20,30,40 and 50 mm.

Fig 1



- From the points on the line OA, draw lines parallel to AD and mark off 10,20,30,40 and 50 on line OE.

Now the scale on OA is the true scale and the scale on OD is the isometric scale. (Fig 1b)

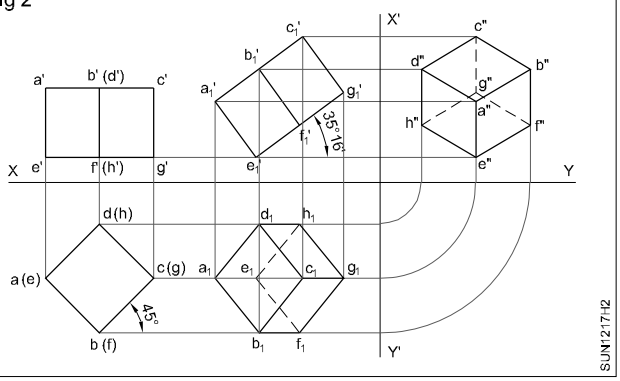
Exercise : 2

Draw the isometric projection of a cube of side 30 mm. (Fig 2)

- Draw the plan and elevation of a cube of given size with solid diagonal parallel to VP or two of the vertical faces making equal (45°) angles with VP.
- Note : These two views should be drawn to the true scale.
- Tilt the front view about corner e', so that the line a'g' is parallel to VPI and HP or it is perpendicular to AVP.
- Project from the second elevation and draw the top view.
- (2nd top view)

- Draw the projectors from the tilted elevation and 2nd top view and draw the side view. Now the side view is the required isometric projection of the cube.

Fig 2

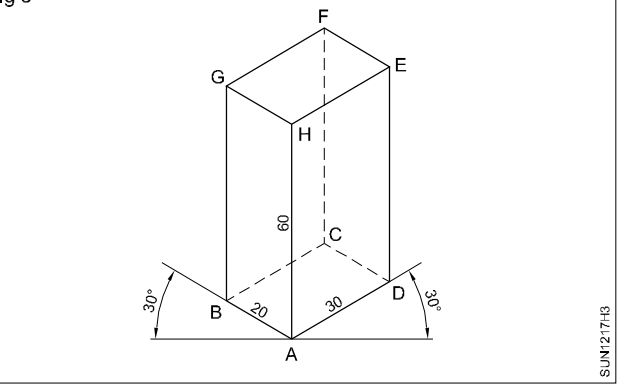


Exercise : 3

Draw the isometric projection of a rectangular prism of base 30mm x 20 mm and height 60m. (Fig 3)

- Use isometric scale for all measurements.
- Draw the lines AB, AD, AH to 20,30 & 60 representing the isometric axes.
- Draw lines parallel to isometric axes as shown and complete the isometric projection required.

Fig 3



Exercise : 4

Draw the Isometric projection of the hexagonal prism of 2.5 cm side of base and 60 mm height. (Fig 4)

- Draw a hexagon of side 25 mm of its edge is horizontal.
- Draw a rectangular prism of base pqrs and height 60 mm.
- Draw the isometric view of the hexagonal base abcdef of the prism using offset method.
- Draw the top hexagonal face by drawing projection from the corners of the base.
- Make the visible edges by drawing thick lines and draw the invisible edges in hidden line.
- Rub off the unwanted lines and complete the isometric projection.

Use isometric scale for all measurements. (Fig 5)

Fig 4

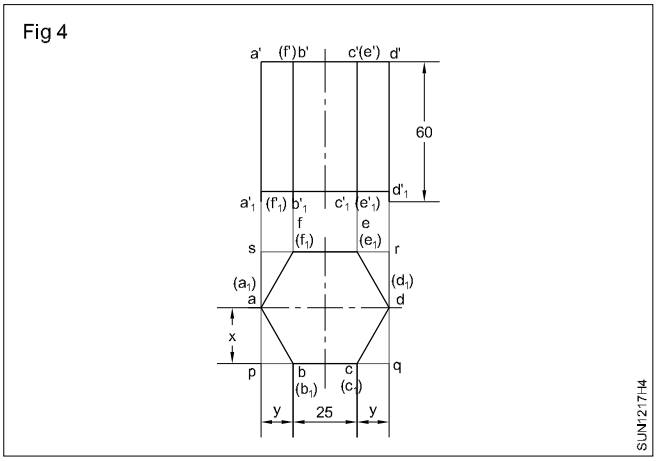
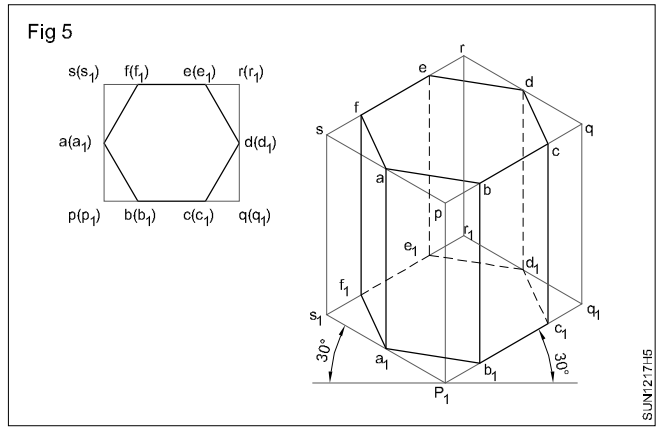


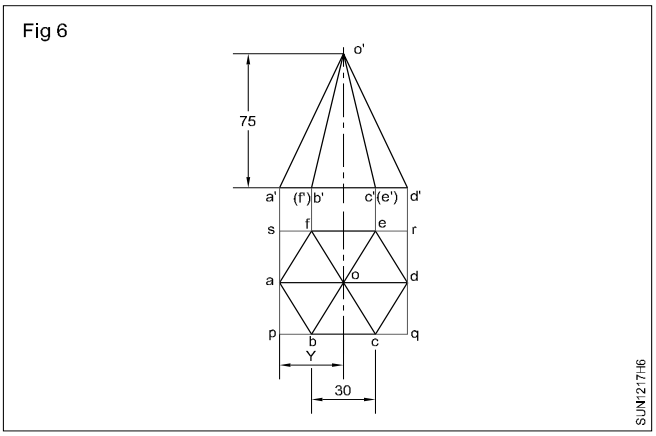
Fig 5



Exercise : 5

- Draw the Isometric projection of a hexagonal pyramid of side base 30mm and height 65 mm given its position as under:
- its base resting on HP and the edge of the base parallel to VP.(Fig 6)
- Draw the plan and elevation of the pyramid (true scale) and enclose the plan in the rectanglePQRS.

Fig 6



- Draw the parallelgram with two of its adjacent edges at 30° to the horizontal. (Fig 7) PQ = Isometric length of pq and PS = Isometric length of PS.
- Draw an isometric hexagon ABCDEF in the parallelogram - PQRS.
- Mark the centre O and draw a vertical line from point O of height to 75mm in isometric scale.
- Join O, with ABCDE & F to complete the required Isometric projection of the hexagonal pyramid. (Fig 8)

Fig 7

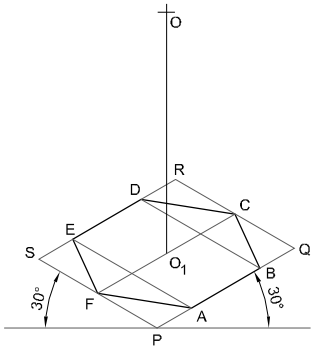


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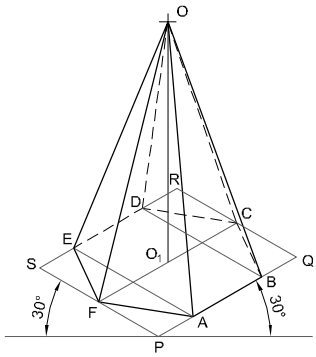
Fig 8



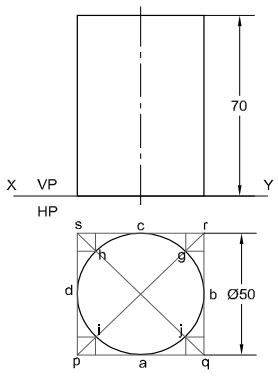
SUN1217H8

Exercise : 6

Draw the Isometric projection of a cylinder of base 50mm and height/length of 70mm with its base resting on HP by offset method and four centre arc method.

Off-set method

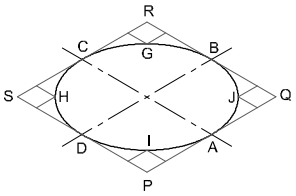
Fig 9



SUN1217H9

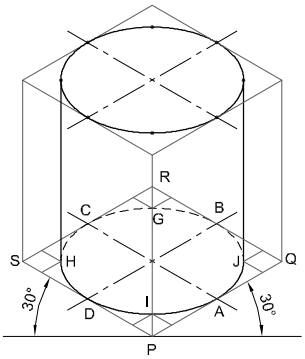
- Draw the elevation and plan of the cylinder. (Fig 9)
- Draw the isometric projection of a square of side equals to the dia of cylinder. (Fig 10)
- Draw the isometric projection of a square prism of height 70 mm on the square drawn.
- The mid points of the sides of the square given four points ABCD and four more points HIJG by intersection of the diagonals with circles (located by offset method) join the points to form isometric circle.
- Draw the isometric circles for the bottom and top face of the cylinder inside the square prism using offset method.
- Draw common tangents to top and bottom isometric circles.
- Complete projection by drawing visible lines thick and invisible lines thin. (Fig 11)

Fig 10



SUN1217HA

Fig 11

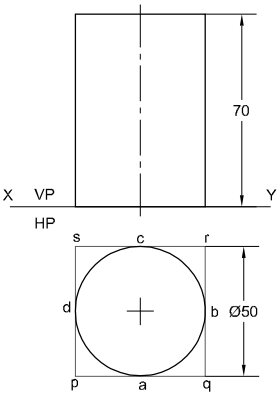


SUN1217HB

Four Centre arc method

- Draw the elevation and plan of cylinder. (Fig 12)

Fig 12



SUN1217HC

- Draw the isometric projection of a square of side equals to the dia of cylinder.(Fig 13)
- Draw the isometric projection of a square prism of height 70 mm on the square drawn.
- Draw the bisectors RD and RA from R and PC and PB from P.
- Draw arcs with O_1 and O_2 as centres and radius O_1D and O_2A
- Draw arcs with P and R as centres and radius PC and RD.
- Draw vertical lines from the end of the ellipse.
- Draw the base as half of the ellipse.
- Complete the isometric view of the prism. (Fig14)
- Fig15 shows the cylinder in horizontal position.
- Follow the procedure of the cylinder in vertical position and complete the prism.

Fig 13

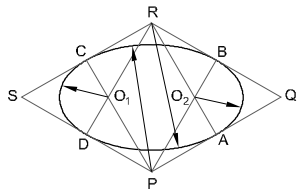


Fig 14

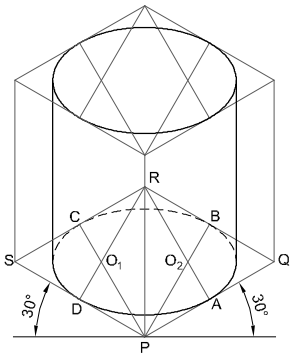
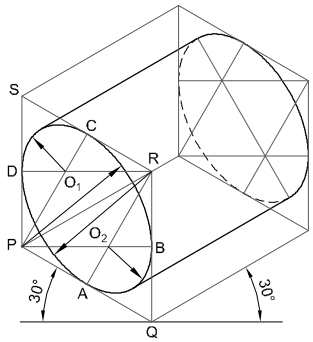


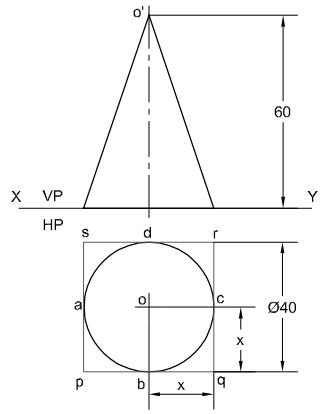
Fig 15



Exercise : 7

- Draw the Isometric projection of a cone whose base diameter 40 mm and height 60mm when its base rest on HP.(Fig 16)

Fig 16



- Draw the plan and elevation of the cone in the true scale as shown in the Fig 16.
- Draw the Isometric projection of the base circle.(By four centre method) (Fig 17)
- Mark the centre and draw a vertical line 0.01 such that 0.0 equals to 60 mm in isometric scale.
- From '0' draw tangents to the isometric circle of the base and complete the required isometric projection of the cone. (Fig 18)

Fig 17

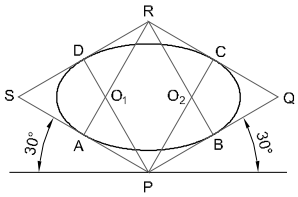
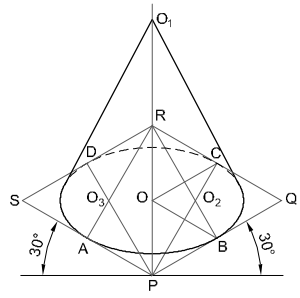


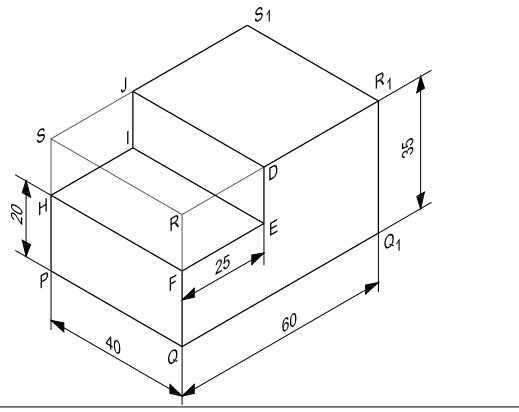
Fig 18



Exercise : 8

- Draw the isometric projection of a stepped block.
- Draw the isometric view of a rectangular prism of dimension equal to the overall size of the block 60 x40 x 35.
- Using the measurements given. Draw the lines JD, DE, EF,FH,HI and IJ to factilitate removal of unwanted portion.
- Rub off lines SR, RD, SJ, SH and RF.
- Darken the remaining lines of the stepped block.

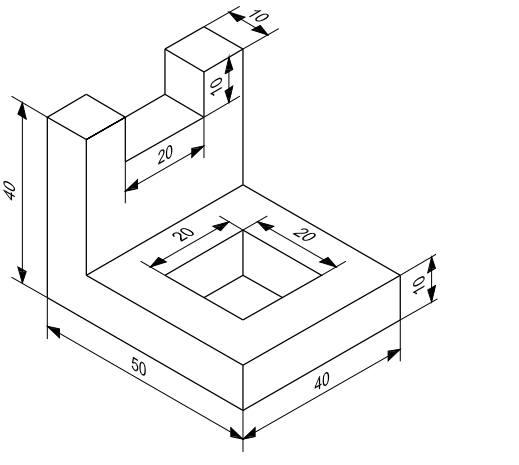
Fig 19



Exercise : 9

Draw the isometric projection of the component shown. (Fig 20)

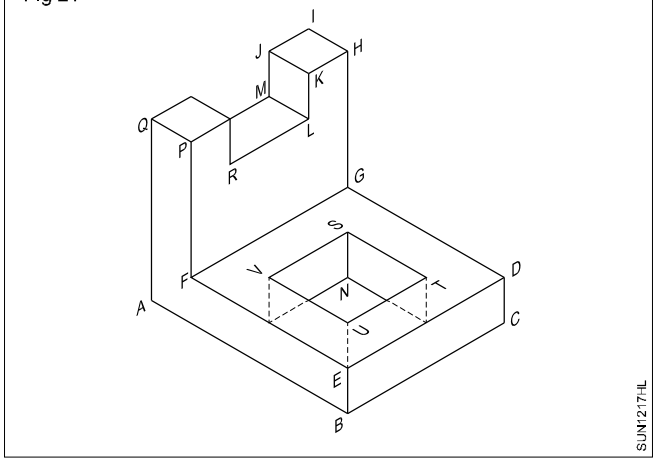
Fig 20



- Draw the stepped block with slot as shown in figure. follow the procedure given in the previous exercise 8
- Mark point UTSV as per the dimensions on the top surface EDGF. (Fig 21)
- Join UTSV
- Project verticallly downwards from the points UTSV and obtain the point WXYZ at bottomm surface such that SZ, VN, UX & TY are equal to 10mm. Join the point WXYZ and draw the thick lines which are all visible and complete the required isometric view of the stepped block. (Fig 21)

Note : use thin lines.

Fig 21



Exercise 9,10,11,12

Reproduce the blocks shown in Fig 22,23,24 & 25 in isometric projection.

With the experiences gained in previous exercises of drawing isometric views, draw these exercises and complete the same.

Note : All construction lines should be in thin lines. After completion of the Isometric views, in each case erase the unwanted lines and construction lines.

Fig 22

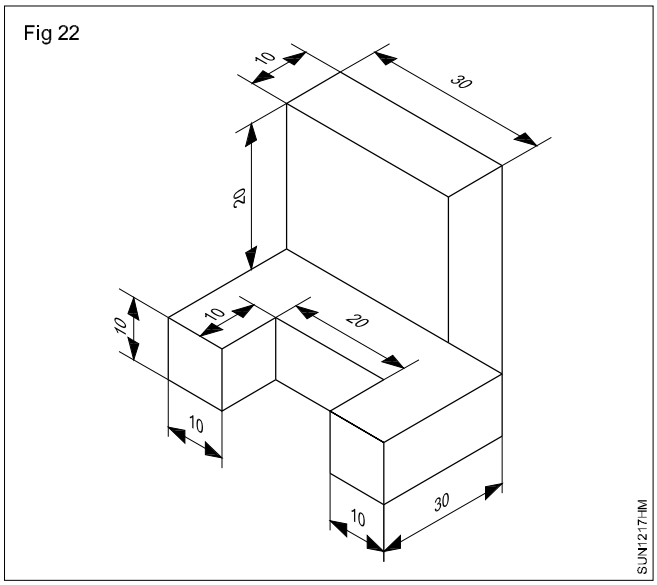


Fig 23

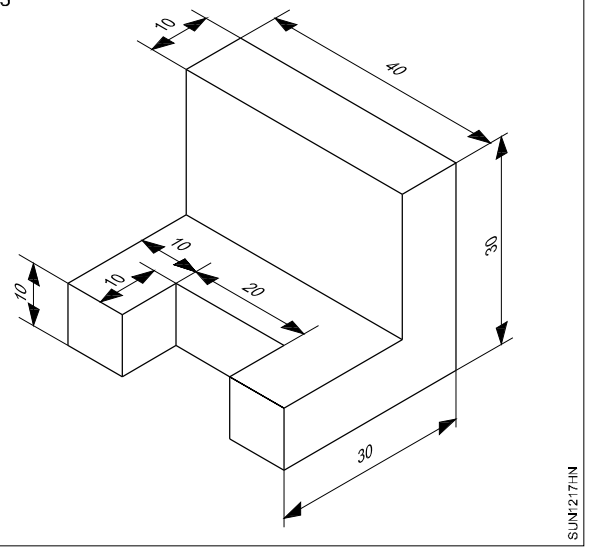


Fig 24

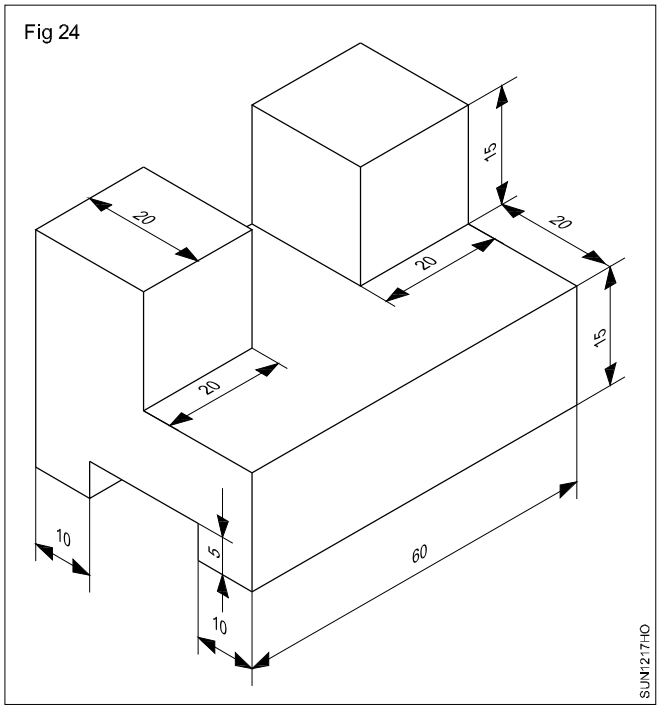
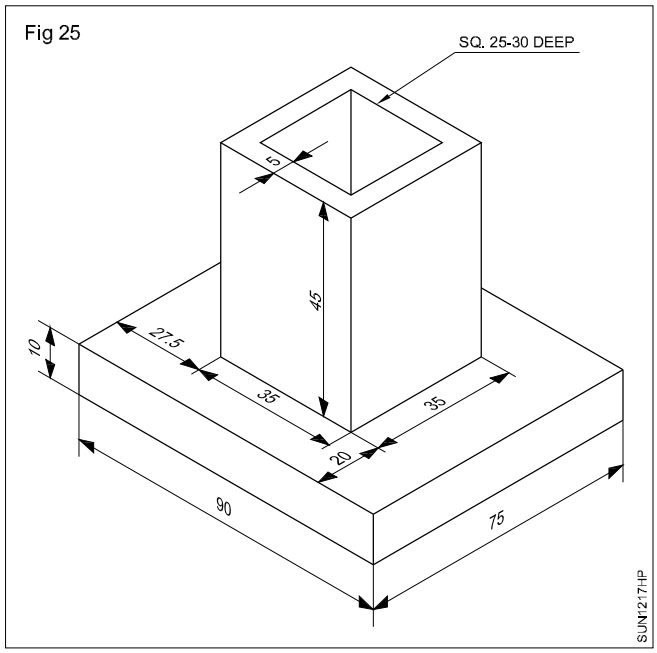


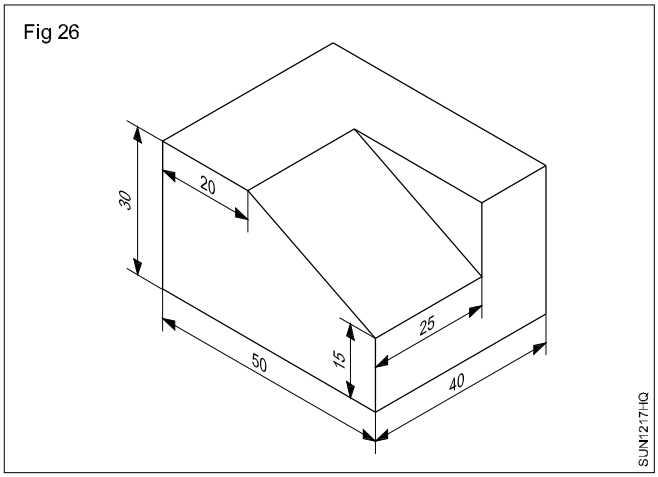
Fig 25



Exercise : 13

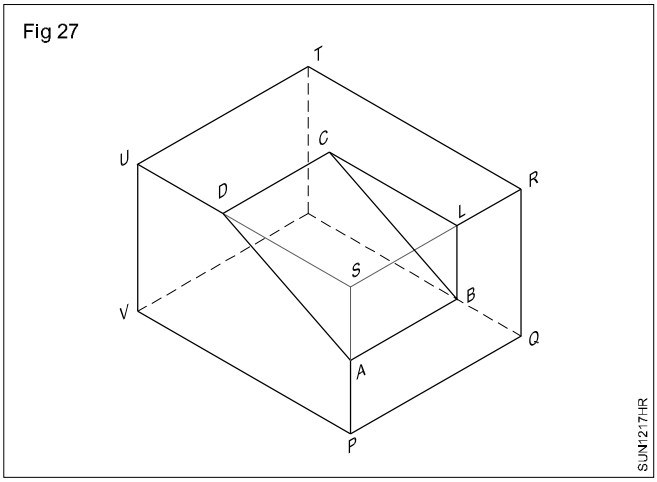
Draw the isometric projection of the machined block shown.(Fig 26)

Fig 26



- Draw the isometric projection of the rectangular prism that envelopes the given block to dimensions shown.(Scale 1:1) (Fig 27)
- Mark point A on PS at a distance of 15mm from P.
- Draw line AB = 25 mm parallel to PQ.
- From B, draw a vertical line cutting RS at L.
- Mark point D on US such that UD = 20mm.
- Draw a line Dc parallel to UT equal to AB.
- Join AD, BC and CL parallel to UT equal to AB.
- Join AD, BC and CL to complete the required Isometric view of the block.
- Remove the extra lines and darken required visible edges.
- Show hidden edges by dashed lines.

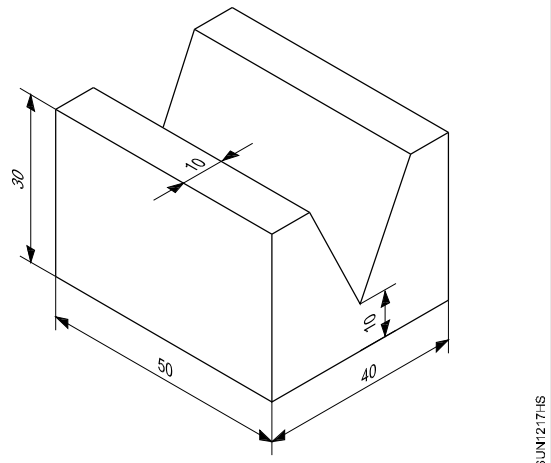
Fig 27



Exercise : 14

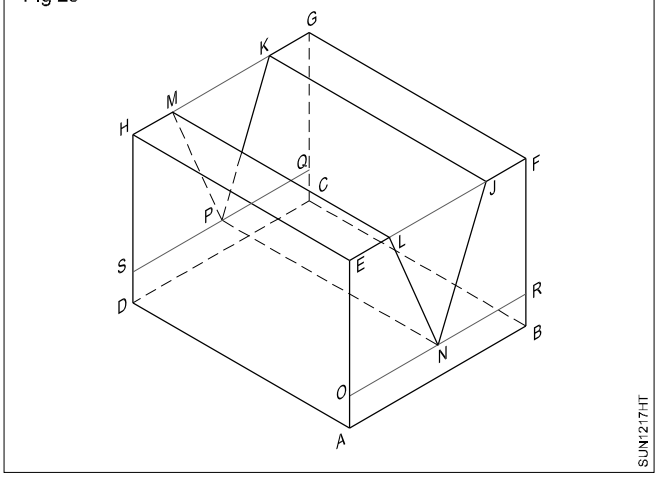
Draw the ISometric projection of the 'V' block.(Fig 28)

Fig 28



- Draw the Isometric projection of the rectangular prism.
- (size 50mmx 40mmx 30mm) (Fig 29)
- On the face ABFE, draw the lines JN & LN by offset method.
- Similarly draw lines KP & MP.
- Join MI,KJ and PN
- Erase construction lines and make the remaining lines thick hidden as the case may be.

Fig 29



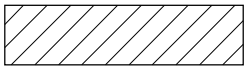
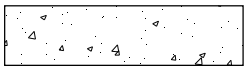
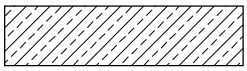
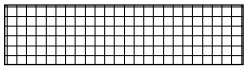
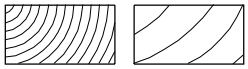
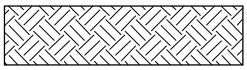
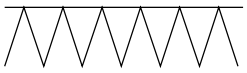
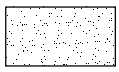
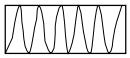
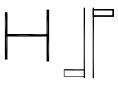
Symbols for Materials and survey

Objectives: At the end of this exercise you shall be able to
- **identify the signs and symbols of various materials**
- **know the designated colour of the various materials**
- **illustrate the signs and symbols of various materials**
- **use appropriate signs and symbols for showing used of materials in drawing.**

PROCEDURE

TASK 1: **Draw the symbols for various materials as shown in figure**

Fig 1

METERIAL	SYMBOL	COLOUR
BRICK		VERMILION
CONCRETC		HOOKERS GREEN
NATURAL OF RECONSTRUCTED STONE		COBALT BLUE
PARTITION HLOCKS		PAYNES GREY
WOOD		BURNT SIENNA
EARTH		SEPIA
HARDCORE		YELLOW OCHRE OR CHROME YELLOW
PLASTER AND PLASTER PRODUCTS		GREEN
GLASS	 APPLICABLE TO LARGE SCALES ONLY	BLUE
FIBRE BUILDING BOARD AND INSULATION BOARD		SEPIA
METAL SECTIONS		BLACK

SUN1218E1

SL. NO.	OBJECT	CONVENTIONAL SIGN	COLOUR
1.	CHAIN LINE		CRIMSON LAKE
2.	TRIANGULATION STATION	A	CRIMSON LAKE
3.	TRAVERSE STATION	A	CRIMSON LAKE
4.	BENCH MARK	OR B.M. 10.000	CRIMSON LAKE
5.	BUILDING (PUCCA)		CRIMSON LAKE
6.	BUILDING (KATCHA)		BURNT UMBER
7.	TEMPLE, CHURCH, MOSQUE		CRIMSON LAKE
8.	WALL & GATE		CRIMSON LAKE
9.	BOUNDARY WITH PILLARS		CRIMSON LAKE
10.	DAM		CRIMSON LAKE
11.	CITY OR TOWN		BUILDINGS - CRIMSON LAKE ROADS - BURNT SIENNA
12.	CEMETRY		BLACK
13.	RIVER		PRUSSIAN BLUE
14.	CANAL OR STREAM (PERENNIAL)		PRUSSIAN BLUE
15.	CANAL OR STREAM (NON-PERENNIAL)		EDGES - BLACK
16.	CANAL WITH LOCK		PRUSSIAN BLUE
17.	LAKE OR POND		PRUSSIAN BLUE
18.	WELL		PRUSSIAN BLUE
19.	DRAIN (KATCHA)		PRUSSIAN BLUE
20.	DRAIN (PUCCA)		DRAIN - PRUSSIAN BLUE DIRECTION - CRIMSON LAKE
21.	WIRE FENCING		BLACK
22.	WOOD FENCING		YELLOW
23.	PIPE RAILING		BLACK
24.	BOUNDARIES		BLACK
25.	HEDGE		HEDGE GREEN
26.	TREE	OR	HEDGE GREEN

SL. NO.	OBJECT	CONVENTIONAL SIGN	COLOUR
27.	JUNGLE		HEDGE GREEN
28.	ORCHARD		HEDGE GREEN
29.	CULTIVATED LAND		DRAINS - PRUSSIAN BLUE CULTIVATION - GREEN
30.	BARREN LAND		BLACK
31.	ROUGH PASTURE		BLACK
32.	MARSH OR SWAMP		BLACK
33.	SAND HILL		BLACK
34.	EMBANKMENT		BLACK
35.	CUTTING		BLACK
36.	FOOTH-PATH		BURNT UMBER
37.	VILLAGE CART-TRACK		BURNT UMBER
38.	UNMETALLED ROAD		BURNT SIENNA
39.	METALLED ROAD		BURNT SIENNA
40.	RAILWAY SINGLE LINE	OR	BLACK
41.	RAILWAY DOUBLE LINE		BLACK
42.	ROAD BRIDGE		BURNT SIENNA
43.	RAILWAY BRIDGE		BLACK
44.	ROAD & RAIL LEVEL CROSSING		RAIL - BLACK ROAD - BURNT SIENNA
45.	TELEPHONE OR TELEGRAPH LINE		BLACK
46.	ELECTRIC LINE		BLACK
47.	NORTH DIRECTION	N	BLACK
48.	DEMARCATED PROPERTY BOUNDARY		
49.	UNDEMARCATED PROPERTY BOUNDARY		
50.	CULVERT		
51.	ELECTRIC LINE		

SUN1218E2

Free hand sketching of plane figures

Objectives: At the end of this exercise you shall be able to
- **sketch the isometric views for different objects**
  - **plain paper**
  - **isometric lines paper**
- **sketch the linear measurement of metric chain and tape**
- **sketch the survey tools.**

PROCEDURE

TASK 1 : **To draw horizontal thick and thin lines. (Fig 1)**

Lengthy lines can be drawn with the forearm motion and short lines are drawn with the wrist motion.

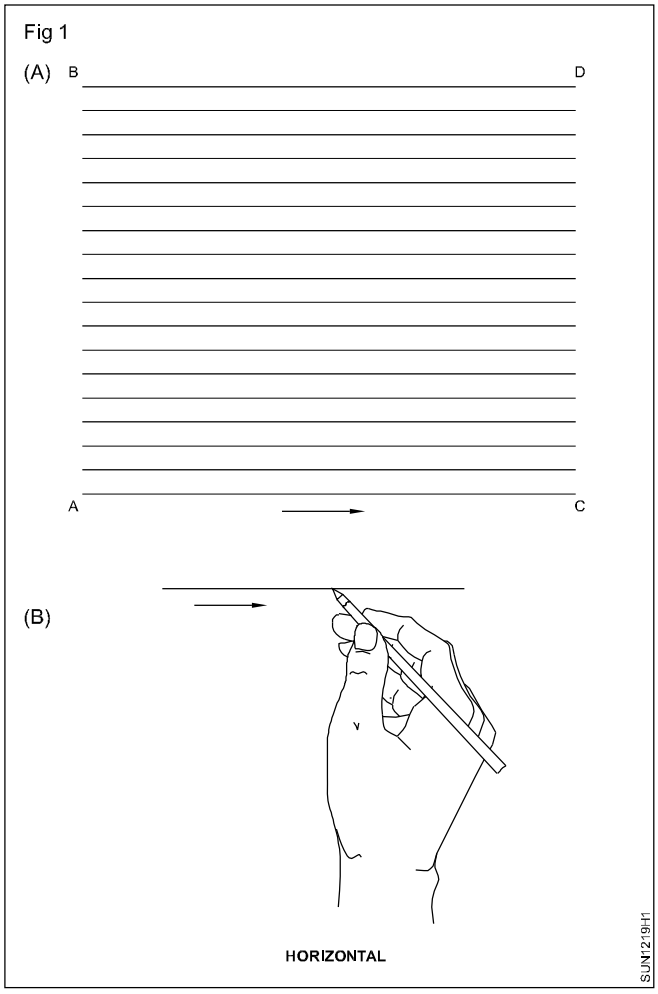
Keep uniform pressure while sketching.

Horizontal lines are drawn from left to right. (Fig 1B)

While sketching straight lines between two points keep your eyes on the point to which the line is to go rather than the point of pencil.

Avoid of drawing whole length of line in one single stroke.

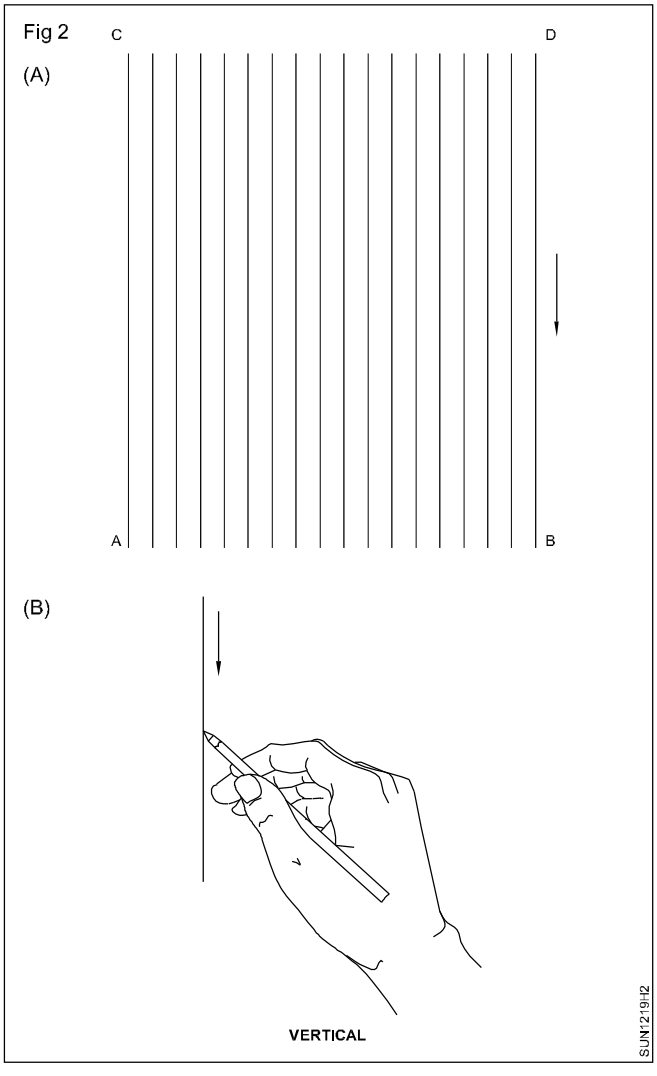
Prevent using eraser often.



To draw vertical lines in thick and thin. (Fig 2)

- Sketch two horizontal thin guide lines AB & CD.
- Mark points on the horizontal lines AB & CD, 5 mm intervals.
- Sketch the line in free hand between the two points with thick and thin alternatively.

Vertical lines are drawn from top to bottom. (Fig 2B)



Sketch the inclined lines as shown in figure with thick and thin lines. (Fig 3)

- Sketch two axis AB & CD.
- On the horizontal and vertical axis AB and CD, mark points with 5 mm intervals.
- Draw thick and thin lines in the direction as shown in the figure alternatively.

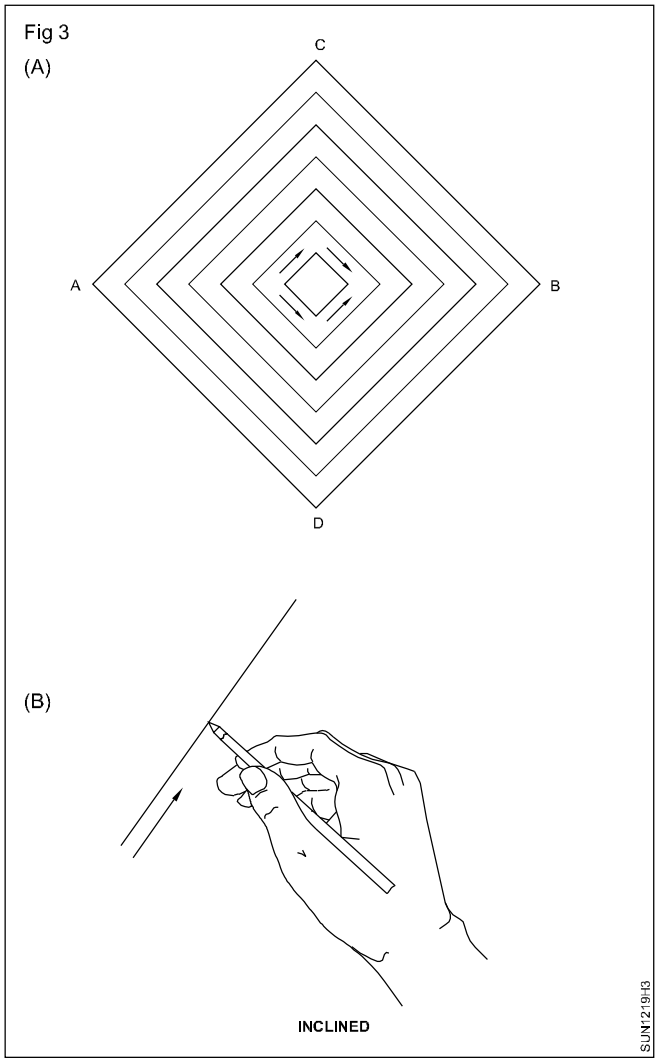
Inclined lines running upward are drawn left to right i.e bottom to top. (Fig 3B)

The pencil point need not to be too sharp.

Hold the pencil freely and not close to the point.

It is better that the pencil can be hold 30 mm away from the tip of the pencil lead.

Fig 3

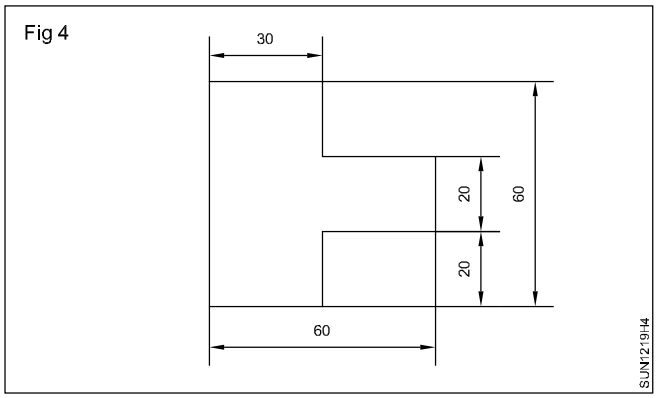


Sketch the given plane figure as shown. (Fig 4)

- Draw the horizontal straight line in free hand and mark off 60 mm approximately.
- Draw a vertical straight line of 60 mm long from the base.
- Draw horizontal & vertical parallel lines and form a square box of 30 mm sides.
- Darken the lines of the surfaces in figure using thickline.
- Erase the unwanted lines and complete the planefigure.

Do not place any dimensions in the figure.

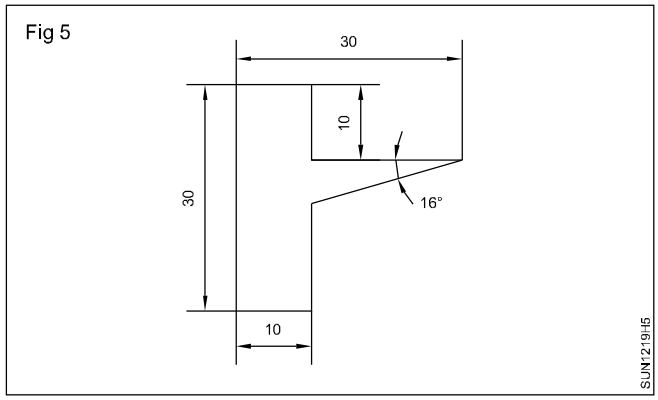
Fig 4



Sketch the plane figure as shown. (Fig 5)

- Sketch a square box of 30 mm side in thin lines.
- Mark off the dimensions as shown in figure approximately.
- Thick the required lines.
- Erase the unwanted lines and complete the figure.

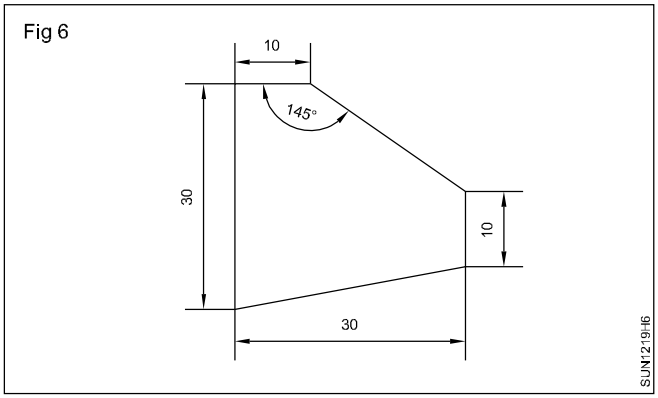
Fig 5



Sketch the plane figure as given. (Fig 6)

- Form a square box of 30 mm side in thin lines.
- Set of the dimensions and angle as shown in figure.
- Draw the lines and remove the unwanted lines.
- Complete the figure.

Fig 6

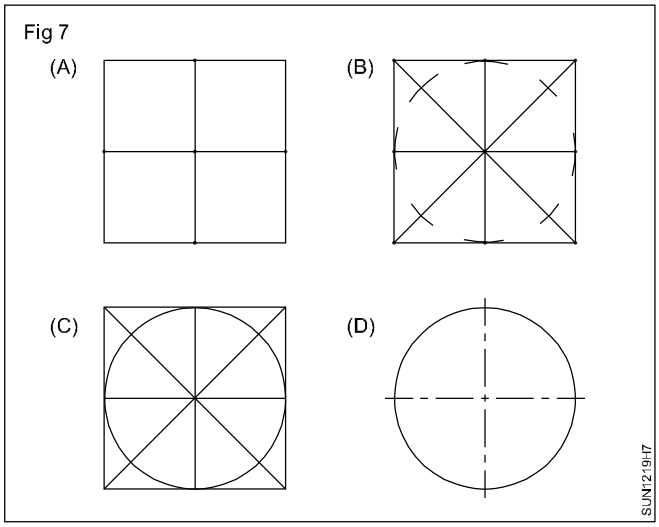


- Sketch a square box of given diameter, mark the mid points and join the mid points of horizontal and vertical sides. (Fig 7A)
- Join the corners (diagonals) of the square box and mark the radius of the given diameter. (Fig 7B)
- Join all the 8 points by a smooth curve and complete the circle. (Fig C)
- Erase the unwanted lines and darken the curve. (Fig 7D)

Side of the square = Diameter of the circle

Radius of circle = Half of the square side.

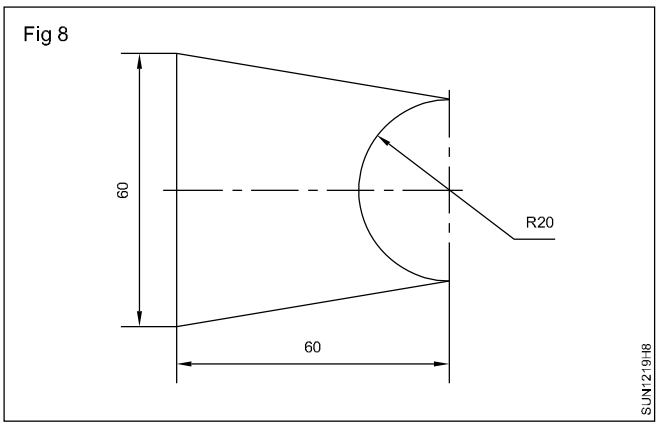
Fig 7



Sketch the template as shown in figure. (Fig 8)

- Sketch a square box of 40 mm side.
- Sketch the semi-circle on right side of the square as shown in figure.
- Darken the lines as in figure and complete the shape of the template.

Fig 8

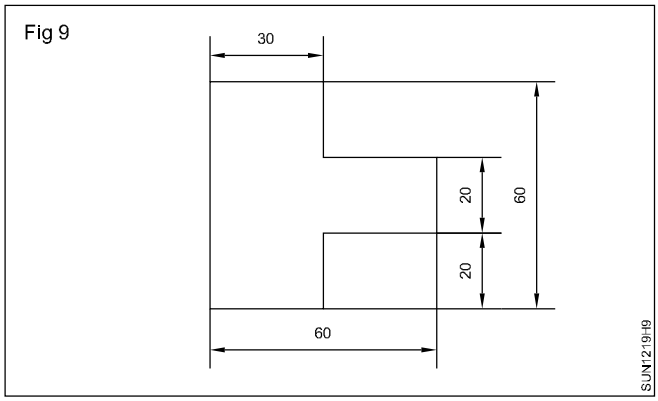


Sketch the given figure. (Fig 9)

- Sketch a rectangular box of 85 mm x 60 mm.
- Mark of the dimensions as shown in figure.
- Follow the method given in Ex.8.7 and sketch the circle.
- Thick the required lines.
- Erase the unwanted lines and complete the figure.

Sketch the blank shown in figure. (Fig 10)

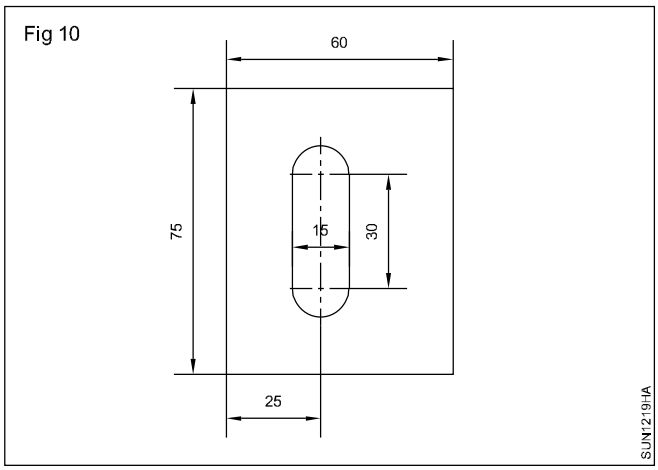
Fig 9



- Sketch a rectangular box of 75 mm x 60 mm as is figure.
- Mark the other dimensions as shown in figure.
- Thick the required lines of the template.
- Erase the unwanted lines and complete the figure.

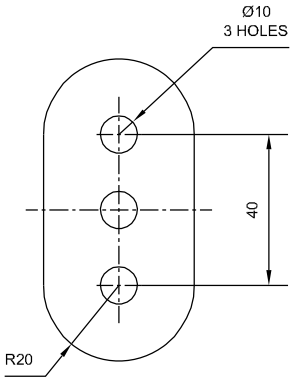
Sketch the curved shape blank plane figure as given in figure. (Fig 11)

Fig 10



- Draw a vertical straight line and horizontal straight line intersecting each other at right angles.
- Mark off 20 mm on either side of the vertical line from the intersecting point of the straight lines.
- Sketch semi-circle of R 20 mm top and bottom as in figure.
- Join the two semi-circles with vertical lines.
- Sketch the three circles of ϕ 10 mm.
- Darken the lines and complete the figure.

Fig 11

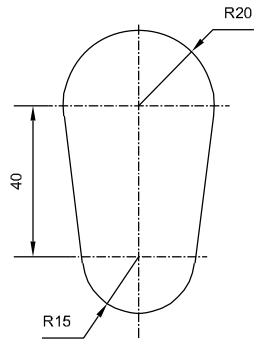


Sketch the template as shown. (Fig 12)

- Draw a vertical straight line.
- Draw two horizontal straight lines intersecting the vertical line keeping 40 mm away.
- Sketch the two curves as in figure and join the curves.
- Erase the unwanted lines and complete the figure.

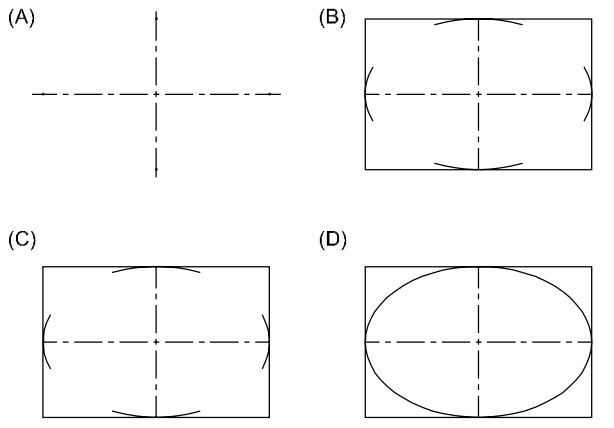
To sketch an ellipse of given major and minor axis. (Fig13)

Fig 12



- Draw a horizontal and a vertical line intersecting each other at right angles.

Fig 13

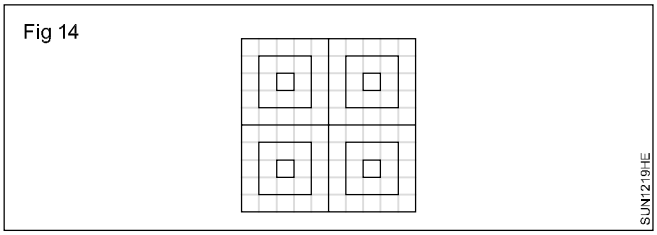


- On the horizontal line mark the half of the major axis on either side of the centre and similarly half of the minor axis on the vertical line.
- Through these points draw horizontal and vertical parallel lines and form a rectangular box.
- Sketch the small arcs with thin lines.
- Join the other portion by smooth curve and complete the ellipse.

Draw the pattern of 50 mm side by free hand. (Fig 14)

- Draw a square by free hand.
- Divide one horizontal and one vertical side into each ten equal parts.
- Draw a thin horizontal and vertical line through the parts marked.
- Darken the squares as per exercise drawing.
- Rub off the thin construction lines and complete the exercise.

Fig 14



Draw the pattern of sides 70 mm and 35 mm by free hand proportional to the size. (Fig 15)

- Draw a rectangle proportionately.
- Join the diagonals.
- Draw parallel lines to the diagonals approximately at 10 mm distance from each other as shown in the exercise.

Fig 15

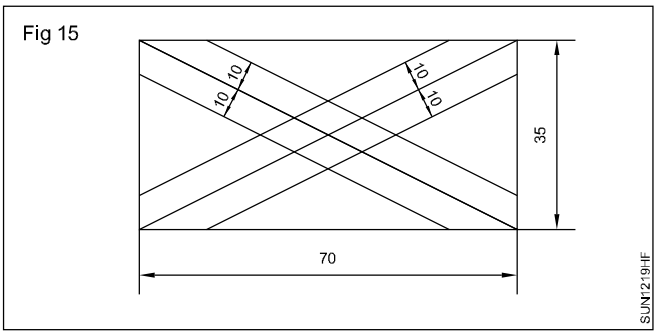
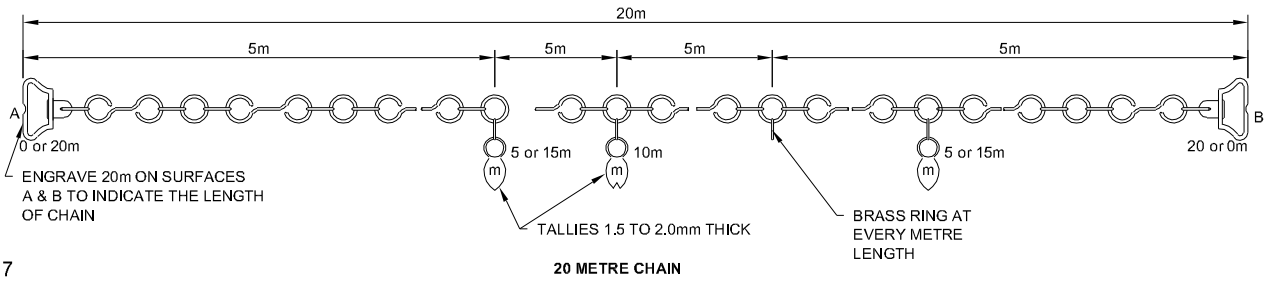
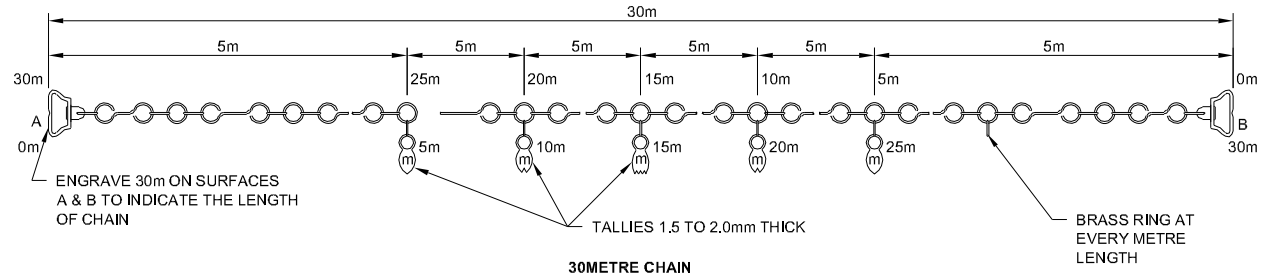


Fig 16



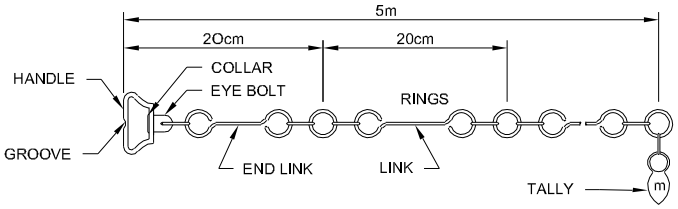
20 METRE CHAIN

Fig 17



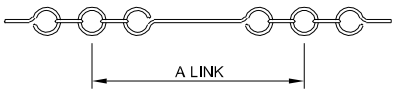
30METRE CHAIN

Fig 18



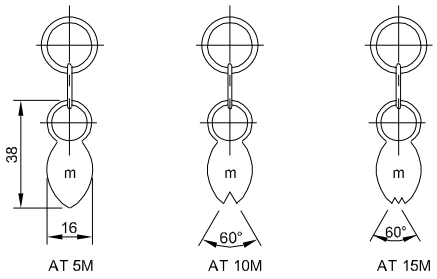
DETAILS OF A METRIC CHAIN

Fig 19



A LINK OF A CHAIN

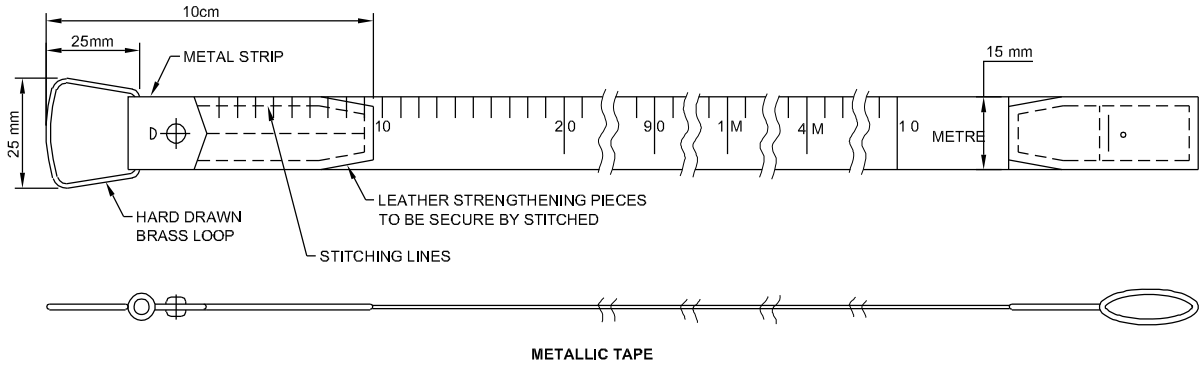
Fig 20



SHAPE OF TALLIES IN 30m METRIC CHAIN

SUN1219HG

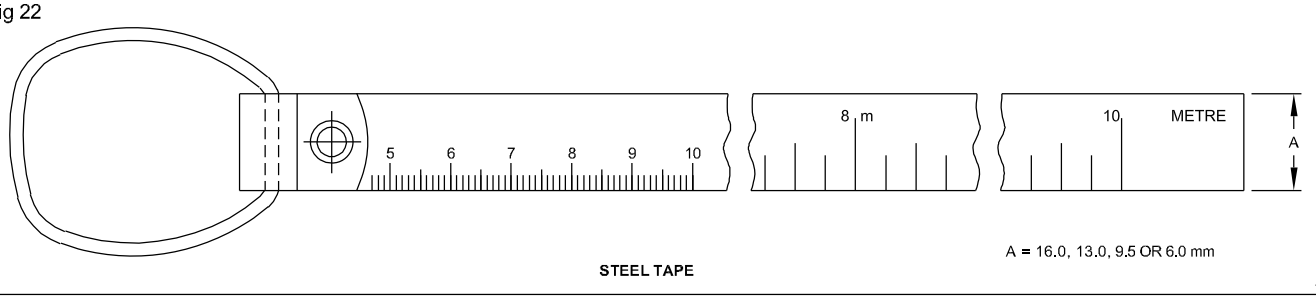
Fig 21



METALLIC TAPE

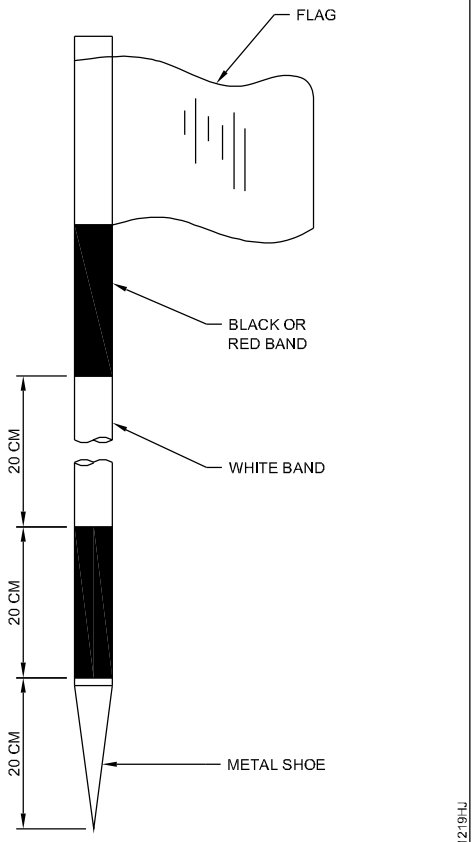
SUN1219HH

Fig 22



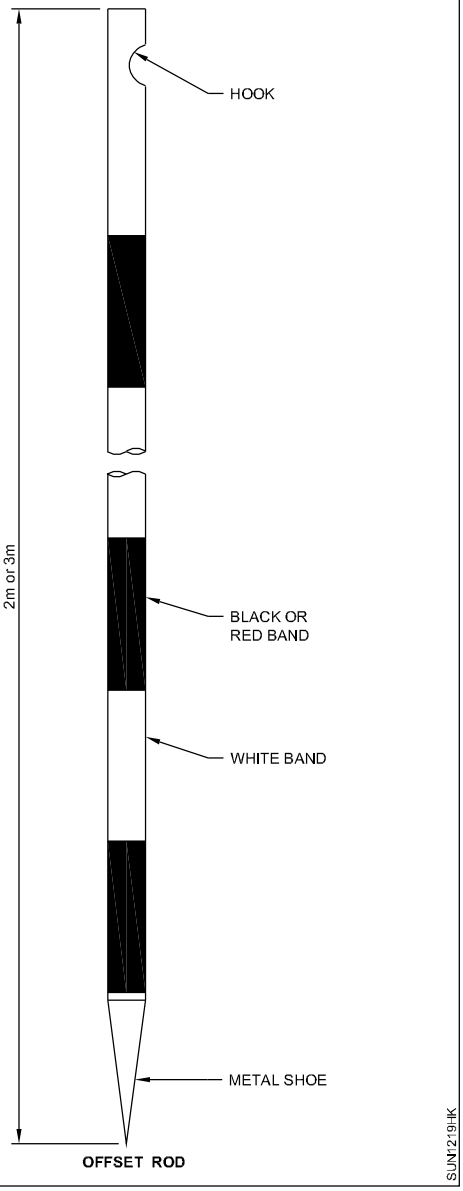
STEEL TAPE

Fig 23



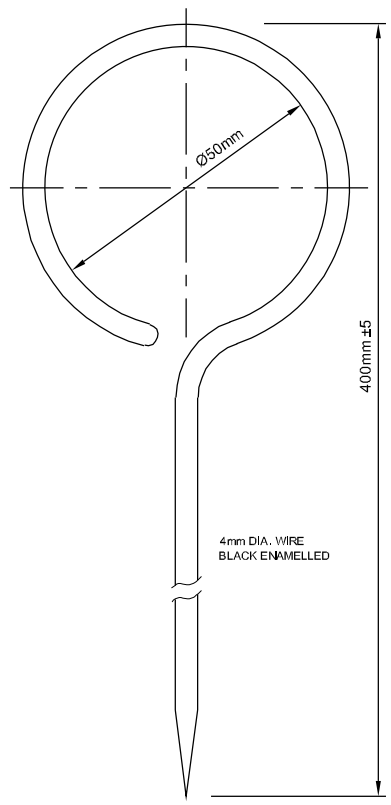
RANGING ROD

Fig 24



OFFSET ROD

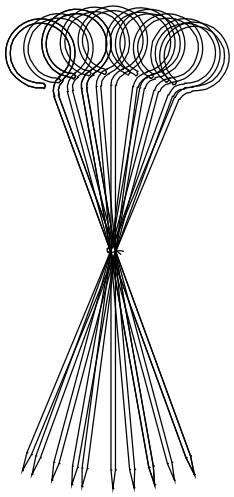
Fig 25



ARROW

SUN1219HL

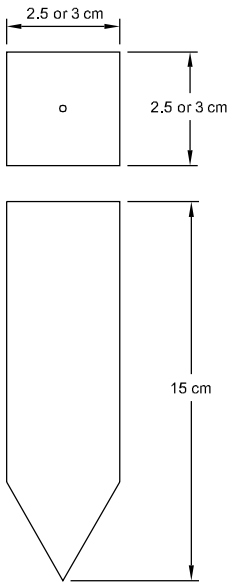
Fig 26



ARROWS

SUN1219HM

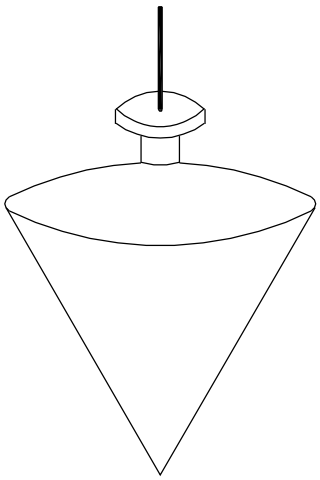
Fig 27



WOODEN PEG

SUN1219HN

Fig 28



PLUMB BOB

SUN1219HO

Practice on Unfolding, stretching and folding of metric chain

Objectives: At the end of this exercise you shall be able to
- **unfold a metric chain to start the work**
- **drag and stretch the chain in line**
- **fold the metric chain after completing the work.**

Requirements

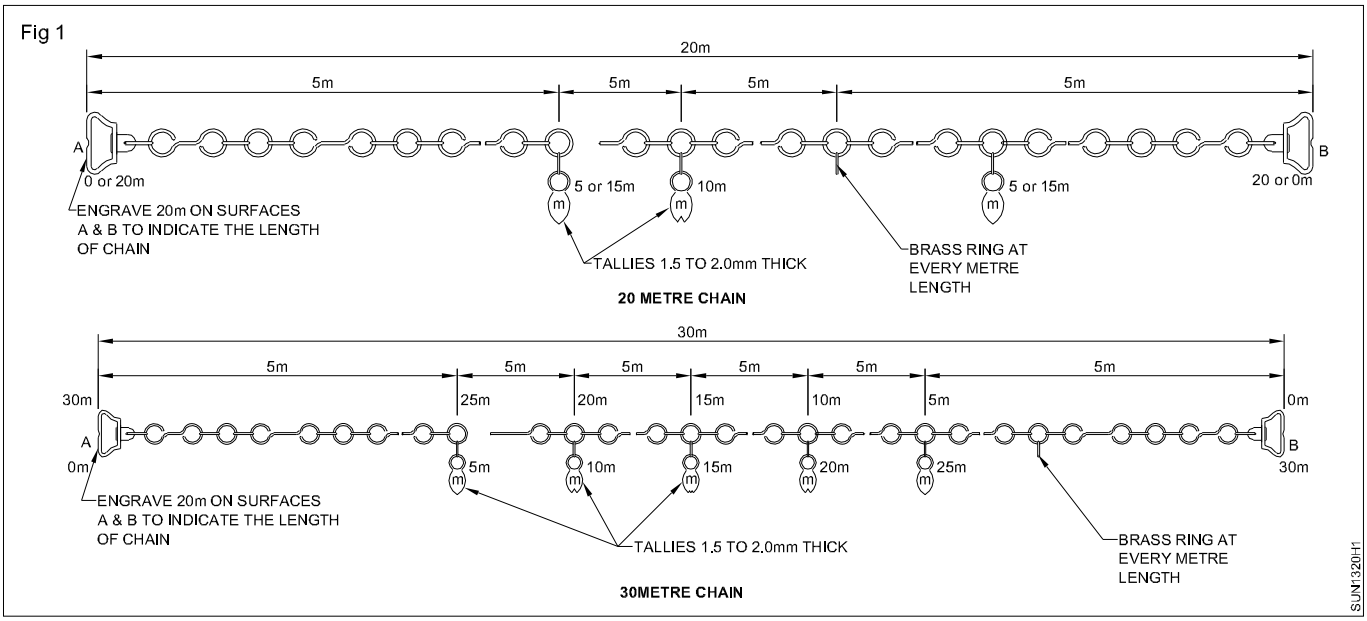
Tools/Equipments/Instruments

- Metric chain 20m/30m - each one

PROCEDURE

TASK 1: **Unfold a chain (Fig. 1)**

Fig 1



1 Remove the leather strap from the bundle of chain.

2 Follower: Take both the handles of the chain in left hand and throw the chain well forward with right hand.

3 Leader : Take one handle of the chain and move forward until it extends to its full length.

— — — — — — — — —

TASK 2 : **Drag and stretch the chain in line**

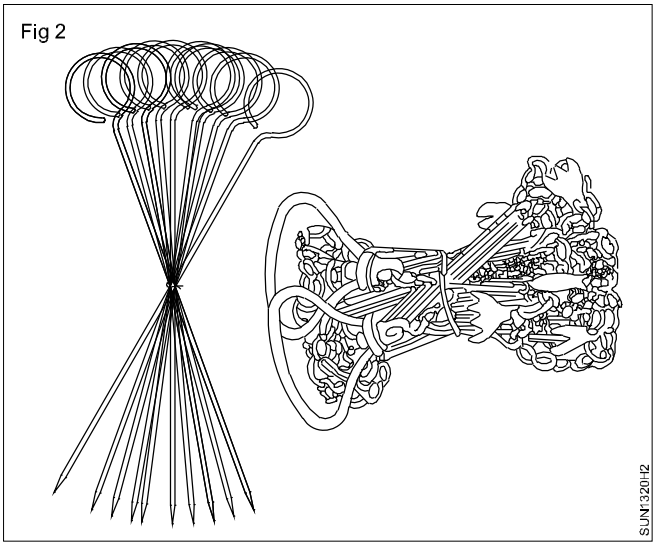
1 Follower: keep the heel at one end of the handle.

2 Leader: jerk the chain and straighten its full length.

— — — — — — — — —

TASK 3: **Fold the chain**

Fig 2



1 Leader to take the middle of the chain with his left hand, after completing the work.

2 Commence from middle, take two pairs of links at a time with right hand.

3 Place them with zig zag manner, arrange all pairs upto reach of the handle in the left.

4 Fasten the bundle of chain with leather strap tightly. (Fig 2)

Practice on testing of chain, tape, optical square and cross staff

Objectives: At the end of this exercise you shall be able to
- **test the metric chain**
- **test an optical square**
- **test the cross staff.**

Requirements

Tools/Equipments/Instruments

- Wooden peg 15cm length, 3 to 5cm square - 2 Nos.
- Nail 2" - 2 Nos.
- Steel tape (30m) - 1 No.
- Cross staff - 1 No.
- Ranging Rods 2 or 3mm - 3cmØ - 5 Nos.
- Optical square - 1 No.
- Plumb-bob - 1 No.

PROCEDURE

TASK 1: **Test a metric chain (20m/30m) and steel tape 30m**

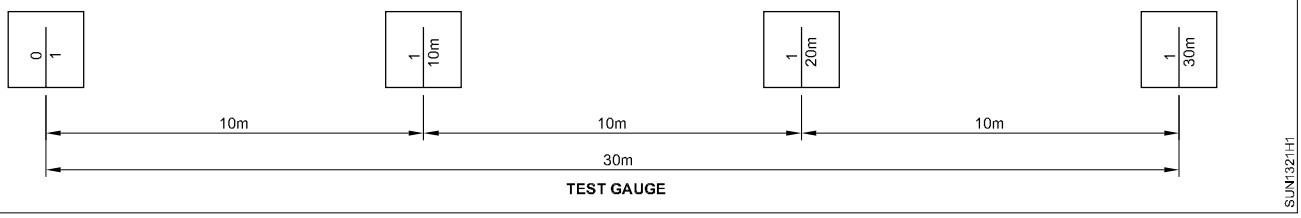
Method 1

1 Mark the standard distance of 30m/20m on a nearest verandah floor or Railway platform or copings of walls etc. with a standard chain or a steel tape which should kept in the surveyor's office for the sole purpose.

2 Mark points at 10m interval in the above standard distance. (Fig 1)

3 Stretch the chain to be tested over the standard marking.

Fig 1



4 Check whether the chain is too short or too long.

Method 2

5 Establish a test gauge on a level ground.

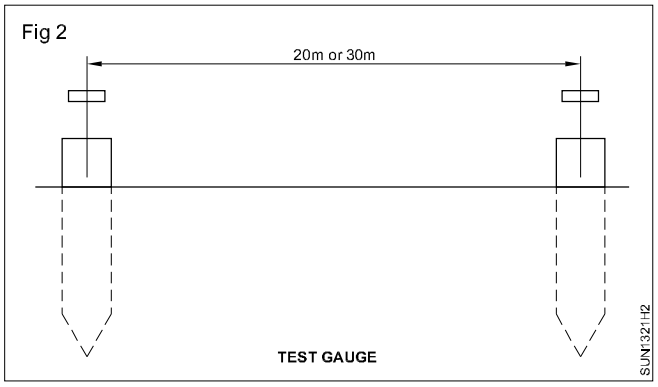
6 Drive two strut wooden pegs to the required distance of 30m/20m with a standard chain or steel tape.

7 Insert nails in the tops of pegs to mark exact points as shown in the Fig 2.

8 Drive a third peg in the middle of above two markings by standard chain/steel tape.

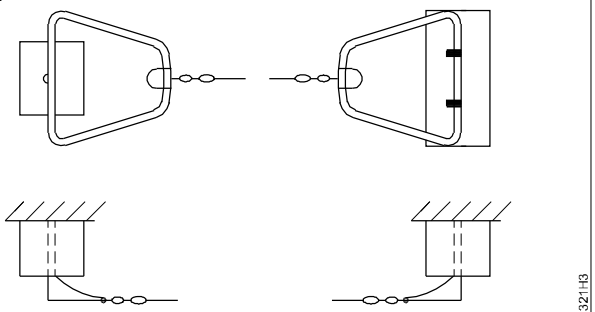
9 Stretch the chain to be tested over the standard marking. (Fig 3)

Fig 2



10 Check whether the chain is too short or too long.

Fig 3



FIELD TESTING OF CHAIN

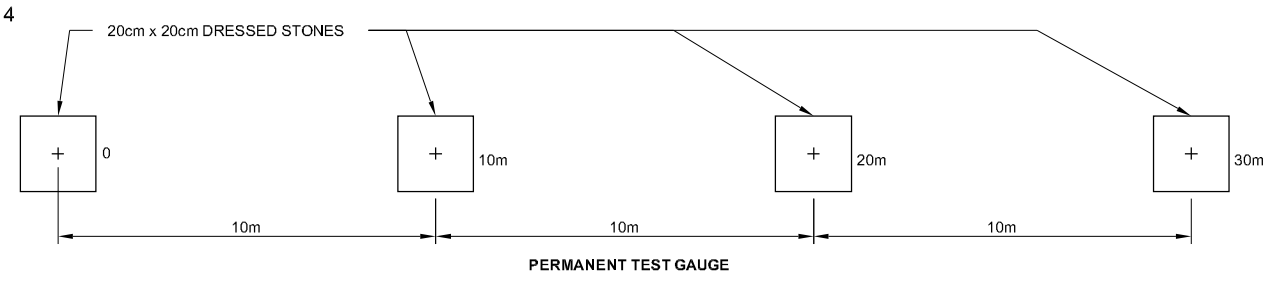
SUN1321H3

It is preferable to establish a permanent test gauge by using dressed stones about 20cm square instead of pegs. (Fig 4)

In both the above methods adjustments must be done symmetrically without altering the central tally of the chain.

Similarly the steel tape can be tested for its standard length 20m/30m

Fig 4



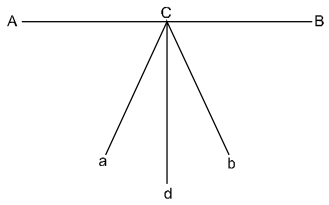
PERMANENT TEST GAUGE

SUN1321H4

TASK 2: **Test on Optical square**

1 Select and Mark a line AB to a distance of 30m on a level ground and middle point C (15m). (Fig 5)

Fig 5



TESTING AN OPTICAL SQUARE

SUN1321H5

2 Hold the optical square on the intermediate point C and sight the ranging at 'A' and fix ranging rod at 'a' such that the images of 'A' and 'a' will be coincides in the instrument

3 Turn round to face 'B' and sight 'a', such that the images of the ranging rods 'B' and 'a' coincides in the instrument then it is in adjustment

4 If not in adjustment fix another ranging rod at the new position 'b'

5 Mark a point 'd' mid way between 'a' and 'b' fix ranging rod at 'd'

6 Turn the adjustable mirror till the image 'd' coincides with image B

7 Repeat the above process till it corrects.

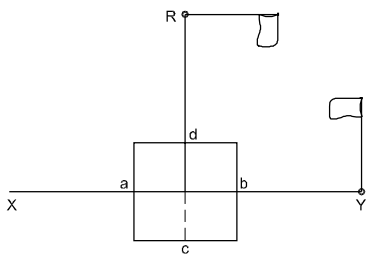
— — — — — — — — —

TASK 3: **Test on cross staff**

1 Select a line XY more than 30m length. (Fig 6)

2 Hold the ranging rods at X and Y

Fig 6



TESTING A CROSS-STAFF

SUN1321H6

3 Hold the cross staff approximately in the middle of the line XY.

4 Leader Sight one of the saw cut of the cross staff say 'ab' groove towards Y.

5 Follower Sight through 'cd' groove of the cross staff and fix ranging rod R.

6 Turn the cross staff through 90^0 such that the 'cd' is along xy

7 Check whether the instrument is correct by sighting the other groove 'ab' will point towards the ranging rod R.

— — — — — — — — —

Construction

Surveyor - Chain Surveying — Exercise: 1.3.22

Practice on ranging

Objectives: At the end of this exercise you shall be able to

- **range a line in a plain ground**
- **lay the chaining in plain ground**
- **ranging indirect (or) reciprocal ranging**
- **ranging across a valley**
- **ranging on random line ranging.**

Requirements

Tools/Equipments/Instruments

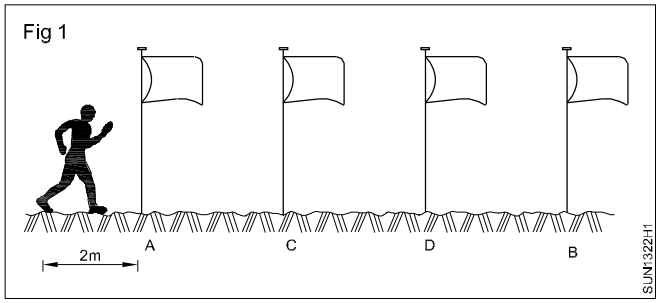
- Metric chain 20m/30m - 1 No.
- Ranging rods 2/3m-3cm Ø - 3 Nos.(min.)
- Arrow 40cm long-4mm Ø - 10 Nos.
- Measuring tape steel 30m - 1 No.

PROCEDURE

TASK 1: **Range a line AB in a plain ground**

1 Mark two stations A and B approximately 50m apart. (Fig 1)

Fig 1



2 Fix the ranging rods at stations A and B.

3 The surveyor stands about 2m behind the ranging rod at A on the line A, B.

4 Direct the assistant to hold a ranging rod vertically at arms length, at the point where the intermediate station 'C' is to be established.

5 Direct the assistant to move the rod to the right or left to the line AB until the three ranging rods appear to be exactly in a straight line.

6 Step down and check the position of the rod by sighting the lower end of the rod.

7 After ascertaining the three ranging rods are in a straight line, signal the assistant to fix the ranging rod at the position.

8 Repeat the same procedure for fixing other intermediate points.

— — — — — — — — —

TASK 2: **Do chaining the line AB in a plain ground**

1 Keep one end of the chain at A and run the chain towards B passing through C.

2 Fix an arrow at the end of the chain

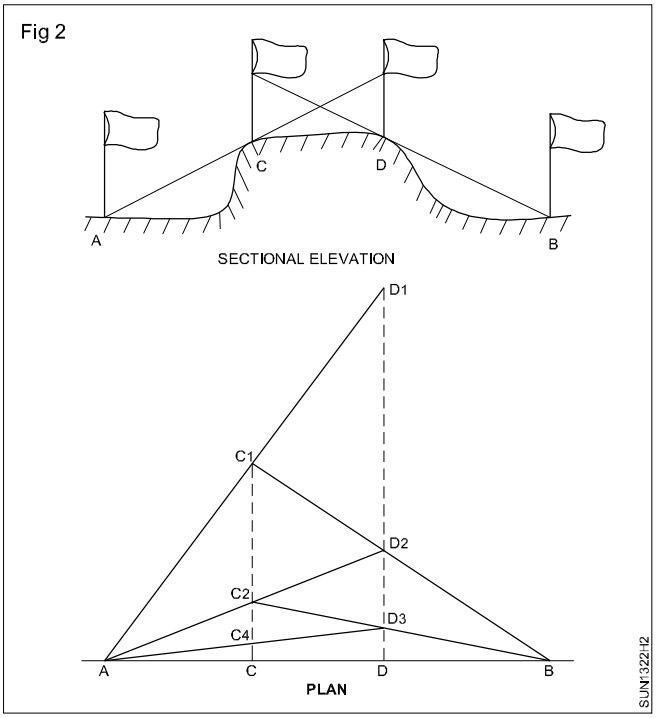
3 Drag the chain towards end B

4 Read the remaining chain length

5 Total distance AB = No. of full chain + remaining chain length.

— — — — — — — — —

TASK 3: **Indirect ranging or reciprocal ranging (Fig. 2)**



1 Indirect ranging between two end points are not intervisible due to inter ranging high ground.

2 A and B are the two end stations

3 C and D are the two intermediate points to be fixed in line with A and B.

4 Select two positions of C and D on high ground and denoted as C_1 and D_1.

5 Surveyor at C_1 able to see D_1 and end ranging at B.

6 The surveyor at D_1 able to see C_1 and end ranging at 'A'.

7 Direct the assistant to move the position F. (Top of ranging rod at 'F' is in line of right points to the bottom of ranging rod at 'X'.

8 Surveyor at C_1 direct the surveyor D_1 to move D_2 to be line with B.

9 The surveyor at D_2 directs C_1 to move to C_2 in line with A surveyor at C_2 directs D_2 to move D_3 in line with B.

10 The same procedure to be adopted till no further movemetns of stations C and D.

11 Run the chain from A, C, D and D.

12 This is the desired positions of intermediate points in line with the end points i.e A as B.

— — — — — — — — —

TASK 4: **Ranging across a valley (Fig. 3)**

1 X, Y are the two station points at the ends of the velley.

2 The intermediate points A, B, E etc. are to be fixed in line with x and y across the valley.

3 Surveyor at 'X' directs the assistant at the station A to be in line with Y. (i.e) the top of ranging rod at A is brought in line with the bottom of the ranging rod at Y).

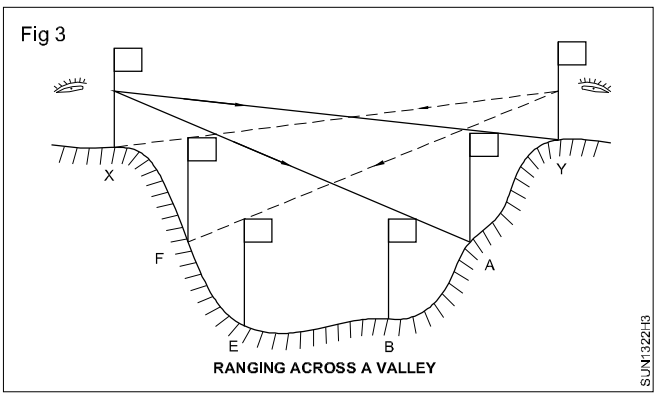
4 Surveyor at X again directs the assistant to move down wards to 'B' (i.e top of ranging rod at 'B' is in line of sight, pointing the bottom of ranging rod at 'A').

5 Continue this process untill the point is reached near the lowest portion and which is invisible from X.

6 Surveyor goes to the other end 'Y'.

7 Continue the same process.

8 The station X, F, E, B, A and Y are in same straight line



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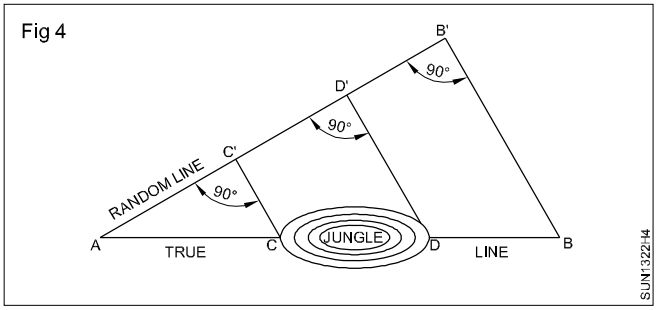
TASK 5: **Random line ranging**

1 Let A and B are the terminal station which are intervened by a jungle as shown in a Fig 4.

Fig 4



2 Form a random line AB1 from A.

3 Select B1 such that the line BB1 should be perpendicular to AB1.

4 Measure the length of AB1 and BB1.

5 From that the distance AB can be calculated using the formula

$$AB = \sqrt{AB1^2 + BB1^2}$$

6 The distance CD can also be calculated using the same procedure as shown in the fig. 4.

— — — — — — — — —

Practice on taking measurements by 30m/20m chain and 30m/15m tape

Objectives: At the end of this exercise you shall be able to
- **measure the distance between two given points within 30m/20m**
- **measure the distance if it exceeds by one chain length**
- **measure the distance between two given points by using 15m/30m steel tape.**

Requirements

Tools/Equipments/Instruments

- Chain 20m/30m - 1 No.
- Steel tape 15m/30m - 1 No.
- Metallic tape15m/30m - 1 No.
- Ranging rod 2/3m-3cm Ø - 3 Nos.
- Arrows 40cm long - 10 Nos.

PROCEDURE

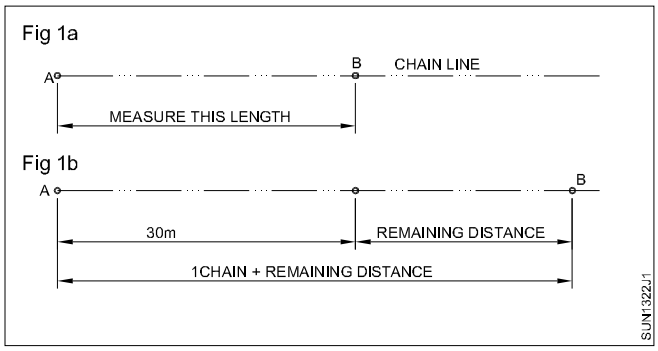
TASK 1: **Measure the distance between two given points within 30m/20m by using 30m/20m chain.**

1 Select a point A on ground and fix an arrow at that point.

2 Unfold and stretch the 20m/30m chain from A to B inline with AB.

3 Count the tallies and links from A to B

4 This is the distance between A and B (Fig 1a)



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TASK 2: **Measure the distance if it exceeds by one chain length.**

1 Fix an arrow at the end of the chain length

2 Drag the chain forward to B

3 Count as previously done

4 Distance AB = No of full chain+ Remaining distance measured. (Fig 1b)

— — — — — — — — —

Task 3: **Measure the distance between two given points by using 15m/30m steel tape.**

Case (a)

If the distance is within 15m/30m length

- Select two points A,B.
- Unwind the tape, hold the zero point (Ring) at A.
- Pull the tape until to reach B.
- Read the measurements on tape.

Case (b)

If the distance exceeds one tape length 15m/30m

- Mark the 15m/30m on the line.
- Measure the remaining length from this point and add.

Booking in the field book

Entering all the readings with respect to figure in the field book

Construction
Surveyor - Chain Surveying — Excersice1.3.23
Practice in Offsetting in chain surveying

Objectives: At the end of this exercise you shall be able to
- **take perpendicular offsets to corners of an existing building**
- **take perpendicular offsets to a given Irregular fields**
- **take oblique offsets to an existing corner of a building.**

Requirements

Tools/Equipments/Instruments

• Metric chain 30m	1 No.
• Arrows	10 Nos.
• Cross staff	1 No.
• Ranging rod	2 Nos.
• Offset rod	2 Nos.
• Steel tape (30m)	1 No.

Materials

• Field book	1 No.
• Pencil	1 No.
• Eraser	1 No.

PROCEDURE

TASK 1: **Take perpendicular offsets to corners of an existing building**

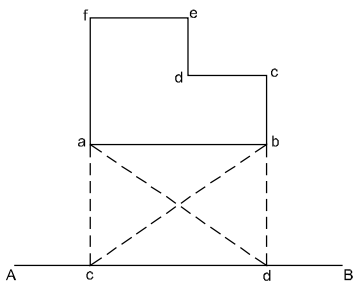
Method (i) By using cross staff. (Fig 1)

1 Run a chainline AB approximately parallel to the side of building a,b on ground.

2 Find the foot of the perpendicular offset C on the chain line AB at the first corner of the building ‘a’ by using cross staff.

3 Repeat the same process to locate the foot of the perpendicular ‘d’ on the chain line AB to the second corner of the building ‘b’.

Fig 1



ca, db ARE THE PERPENDICULAR OFFSETS.
USING CROSS STAFF

SUN1323H1

Method (ii) By swinging arc method (Fig 2)

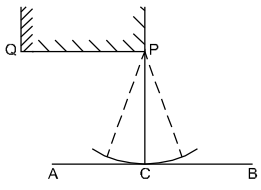
4 Run a chain line AB approximately parallel to the one side of the Building PQ.

5 The leader hold the zero end of the tape at the point ‘p’.

6 The follower carries the tape box and swings the tape along the chain

7 At the same time the follower finds the shortest distance from P at C on the line AB.

Fig 2



BY SWINGING ARC METHOD

SUN1323H2

TASK 2: **Take perpendicular offsets to a given Irregular fields.** (Fig 3)

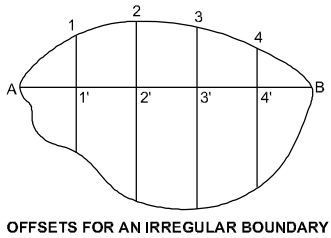
1 Run a chain line AB along the centre of the field.

2 Take offsets on both sides at suitable intervals and at such points where the direction suddenly changes.

3 Note the chainage and measure the offset.

4 Record the chainages at A,1',2',3' ..... etc and offset 11', 22', 33', ... etc in the field book.

Fig 3



OFFSETS FOR AN IRREGULAR BOUNDARY

SUN1323H3

— — — — — — — — —

TASK 3: **Take oblique offsets to an existing corner of a building.** (Fig 4)

1 Run a chain line AB Approximately parallel to the existing building.

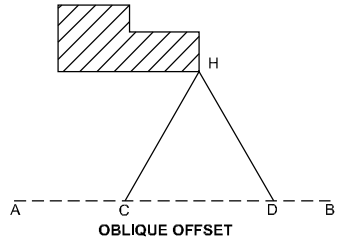
2 At a convenient full chainage say 2,3,4,5m..... etc select a point C and D on the chain line.

3 The points C, D and H should form approximately an equilateral triangle.

4 Measure oblique offsets CH and DH.

5 Record the chainages and offsets in the field book.

Fig 4



OBLIQUE OFFSET

SUN1323H4

Skill Sequence

Finding the foot of the perpendicular offset

Objectives: This shall help you to
- **find the foot of the perpendicular offset on the chain line.**

1 Hold the ranging rod at corner of object 'a'. (Fig 1)

2 Hold another ranging rod at B on the end of the chain line.

3 The leader moves the cross staff along the chainline AB by sighting Ranging rod at B through one groove.

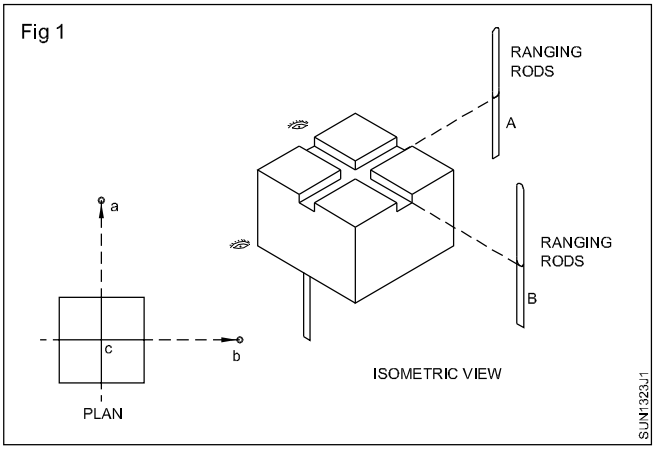
4 At the same time the follower sight the ranging rod at 'a' by the other groove.

5 Fix the cross staff at a point on the chain line AB where the two ranging rods are sighted through the grooves simulataneously. (Fig 1)

This is the point 'C' which is the foot of the perpendicular to the chain AB.

Note the chainage and measure the offset.

Fig 1



SUN1323J1

6 Record the chainage and offset in the field book

The above same procedure to be followed to locate the foot of the perpendicular 'd' to the object 'b'.

Skill Sequence

Finding the foot of the perpendicular offset (Optical Square)

Objectives: This shall help you to

- **find the foot of the perpendicular offset on the chain line by optical square.**

1 Fix one ranging rod at the object point ‘a’.

2 Fix another ranging rod at the end of the chain line ‘B’.

3 Hold the optical square and stand on the chain line ‘AB’.

4 Sight the ranging rod at ‘B’ through the smaller slot (eye hole) of the unsilvered mirror.

5 Move forward or backward on the chain line ‘AB’ until the trinage of the ranging rod at the object ‘a’ appeared in the silvered postion of the mirror.

6 Move until the image of the ranging rod at ‘a’ coincides with the ranging rod at ‘B’, through the mirror.

7 Mark the position ‘C’ on the ground in the chain line ‘AB’.

8 Note the chainage and measure the offset.

9 Record the above chainage and offset in the field book.

Practice on Setting out right angle using chain and tape

Objectives: At the end of this exercise you shall be able to
- **erect a perpendicular offset to chain line from a point on it**
- **drop a perpendicular offset to the chain line from a point outside it .**

Requirements

Tools/Equipments/Instruments

- 30m chain - 1 No.
- Steel tape 30m - 1 No.
- Pegs 15cm length-2.5/3cmθ - 10 Nos.
- Arrow 40cm long-4mm thick - 10 Nos.

PROCEDURE

TASK 1: **Erect a perpendicular offset to a chain line from a point on it**

Common to all three methods A, B and C.

1 Stretch and run a chain line AB on ground.

2 Mark a point 'C' where a perpendicular is required.

Method A (Fig 1a)

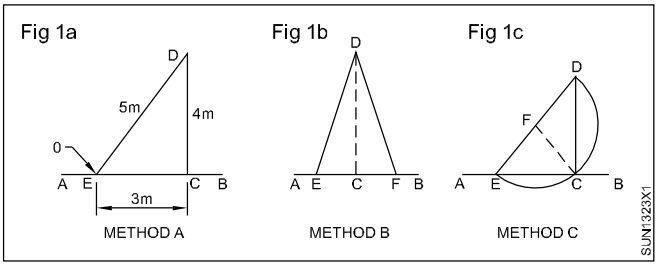
3 Establish a point E at distance of 3m from c on the chain line AB.

4 Make an arc of 5m on ground from E to a convenient distance.

5 Similarly make another arc of 4m from C.

6 Find the point where the above mentioned two arcs cross each other and denote it as D.

7 The angle ⌊DCB will be 90^0.



Method B (Fig 1b)

8 Mark E and F from C on chainline AB such that the distances EC and CF will be equal.

9 Make an arc of 5m radius from E and also from F.

10 Find the intersection of the two arcs and denote as D.

11 The angle ⌊DCE will be 90^0.

Method C (Fig 1c)

12 Select any point F outside the chain line AB, preferably at 5m distance from C.

13 Hold the 5m mark at F and zero mark at C.

14 Make a semicircle with F as centre and FC as radius (5m)

15 Mark E where the semi circle cuts the chain line AB

16 Join EF and extend it upto cut the arc at 'D'

17 Now EF = FD = 5m

18 Join DC.

19 The angle ⌊DCE will be 90^0.

TASK 2: **To drop a perpendicular offset to a chainline from a point outside it**

Method A (Fig 2a)

1 Stretch and run a chain line AB.

2 Select any point E on the chain line.

3 Select any point D on the outer side of the line AB.

4 With D as centre and DE as radius, draw an arc to cut the chainline in F.

5 Bisect EF at C.

6 CD will be perpendicular to AB.

Method B (Fig 2b)

7 Stretch and run a chainline AB.

8 Select any point E on the chain line

9 Select any point D on the outer side of the chain line AB.

20 Join 'ED' and bisect it to get F.

21 With 'F' as centre and EF (or) FD as radius, make an arc to cut the chainline in C.

22 CD will be perpendicular to the chainline AB.

Fig 2a

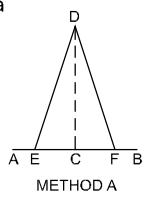
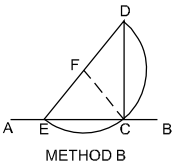


Fig 2b



SUN1323X2

Skill Sequence

Marking an arc on ground

Objectives: This shall help you to
- **make an arc of 5m on ground.**

1 Hold zero end of tape at E with the Helper. (Fig 1)

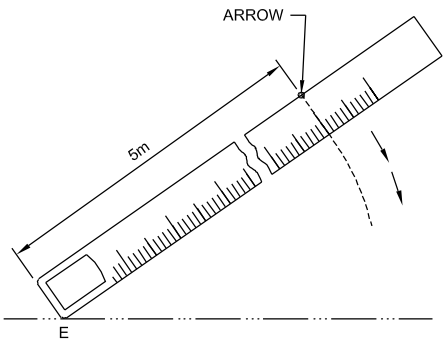
2 Stretch the tape for more than 5m in the direction in which the arc is to be made.

3 Straighten the tape.

4 Take an arrow and mark a 5m distance.

5 Take E as centre, make an arc of Radius 5m by swing the tape and arrow.

Fig 1



SUN1323Y1

Practice on chaining is free but vision obstructed

Objectives: At the end of this exercise you shall be able to
- **run the chain line even vision is obstructed.**

Requirements

Tools/Equipments/Instruments

• Chain 30m	- 1Nos.
• Ranging rods 2/3m-3cmØ	- 4 Nos.
• Tape 30m	- 1 No.
• Cross staff	- 1 No.
• Arrows - 40cm long	- 10Nos.

PROCEDURE

TASK 1: **Run the chain line even vision is obstructed**

Case (i) Both ends may be visible from any intermediate point lying on the line such as in the case of a hill.

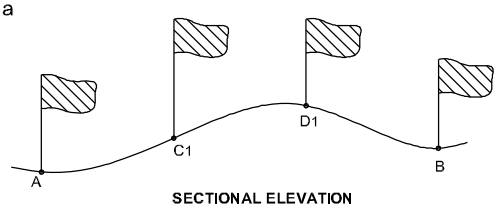
1 Let station A and B are not intervisible from each other.

2 Select two intermediate stations C1 and D1 in such a way that

C1 can see D1 & station B and D1 can see C1 & station A. (Fig 1a)

3 Surveyor at D1 directs C1 in a such a way that D1, C2 and A are in straight line. (Fig 1b step 1)

Fig 1a



4 Surveyor at C2 directs D1 to bring the ranging rod to D2 in line with C2D2 B by sighting end station B. (Fig 1b step 2)

5 Surveyor at D2 directs C2 to bring the ranging rod to D2 in line with D2C3A by sighting end station A. (Fig 1b step 3)

6 The above procedure is repeated until the person at C finds the person at D in line with CB and the person at D finds the person at C inline with DA.

7 Thus the intermediate positions C and D are established in line with AB. (Fig 1b step 4 and 5)

8 Run the chain through C and D to B (Fig 2)

Fig 1b

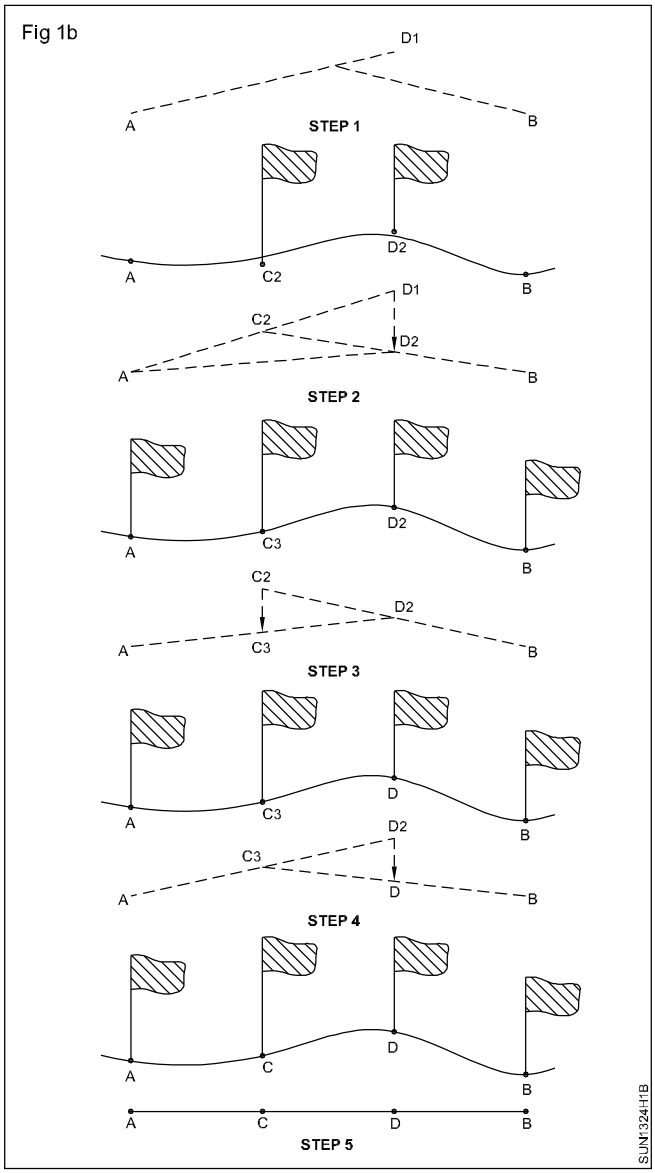
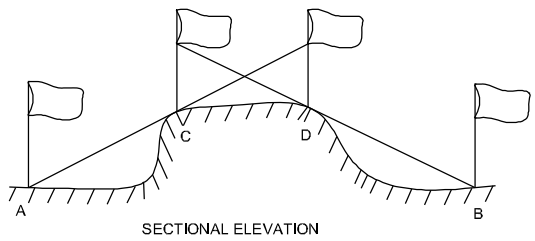
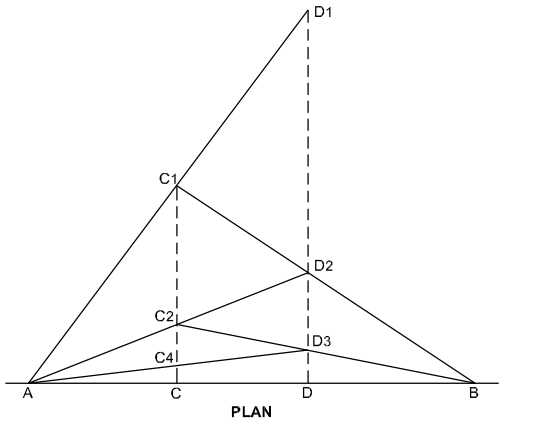


Fig 2



SECTIONAL ELEVATION

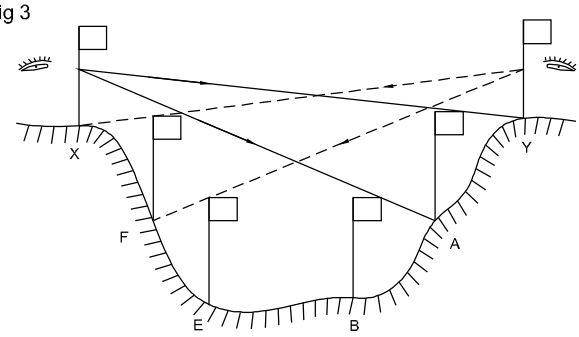


PLAN

SUN1324-H2

9 The same procedure can be adopted for valley portion also. (Fig 3)

Fig 3



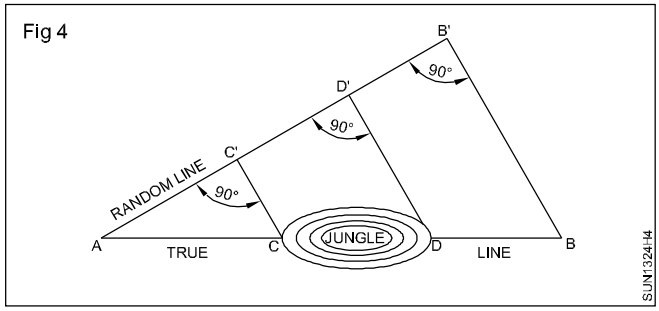
RANGING ACROSS A VALLEY

SUN1324-H3

Case (ii) Both ends may not be visible from any intermediate point such as in the case of Jungle.

10 Let A and B are the terminal station which are intervened by a jungle as shown in a Fig 4.

Fig 4



SUN1324-H4

11 Form a random line AB1 from A.

12 Select B1 such that the line BB1 should be perpendicular to AB1.

13 Measure the length of AB1 and BB1.

14 From that the distance AB can be calculated using the formula

$$AB = \sqrt{AB1^2 + BB1^2}$$

15 The distance CD can also be calculated using the same procedure as shown in the fig. 4.

Practice on chaining is obstructed but vision free

Objectives: At the end of this exercise you shall be able to
- **measure the distance even chaining is obstructed.**

Requirements

Tools/Equipments/Instruments

• Chain 30m	- 1 No.
• Ranging rods 2/3m, 3cmØ	- 5 Nos
• Tape 30m	- 1 No.
• Cross staff	- 1 No.
• Arrows 40cm long	- 10 Nos.
• Junior drafter	- 1 No.

Materials

Field note book	- 1 No
Spncil	- 1 No
Eraser	- 1 No
Set of seale	- One set
Drawing sheet A3	- 1 No
Cellotape	- 1 No

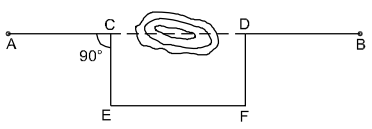
PROCEDURE

TASK 1: **measure the distance even chaining is obstructed**

Case (i) When the obstacle can be chained around.

Method 1 (Fig 1)

Fig 1



1 Let stations A & B be the terminal stations of chain line.

2 Choose the stations C & D on either side of the obstacle on the chain line AB.

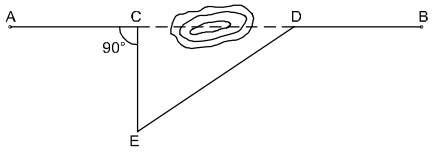
3 Erect a perpendicular to a convenient distance from station 'C' and denote it as 'E'.

4 Erect another perpendicular with the same distance of CE from D and denote F.

5 Measure the distance EF which is equal to the obstructed distance CD. i.e. EF = CD

Method 2 (Fig 2)

Fig 2



6 Let stations A & B be the terminal stations of a chain line.

7 Choose the stations C & D on either side of the obstacle on the chain line AB.

8 Erect a perpendicualr to a convenient distance from station 'C' and denote as E.

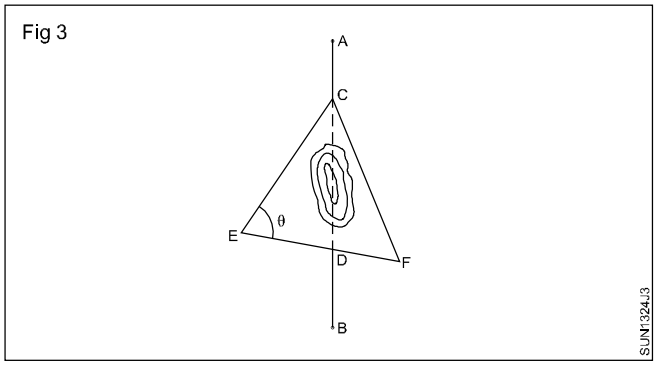
9 Measure the distance CE and DE.

10 The obstructed distance CD can be calculated from the formula.

$$CD = \sqrt{DE^2 - CE^2}$$

Method 3 (Fig 3)

Fig 3



11 Let stations A and B be the terminal station of the chain line AB.

12 Select two convenient stations C and D on the opposite sides of the obstacles on the chain line AB.

13 Select stations E & F such that stations E, D and F are in a straight line and clear from the obstrucle.

14 Measure the distances of ED, DF, FC and CE.

15 The obstructed distance CD can be calculated from the following calculations.

Assign the angle $\angle CEF$ as θ
In Triangle CEF
$CF^2 = CE^2 + EF^2 - 2CE.EF.\cos\theta$
$2CE.EF.\cos\theta = CE^2 + EF^2 - CF^2$

$$\text{Cos } \theta = \frac{CE^2 + EF^2 - CF^2}{2\ CE.EF} \quad \text{-----> (1)}$$

In Triangle CED

$$CD^2 = CE^2 + ED^2 - 2CE.ED.\text{Cos } \angle$$

$$2CE.ED.\text{Cos } \angle = CE^2 + ED^2 - CD^2$$

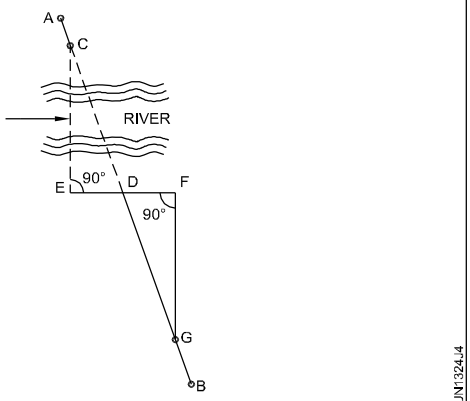
$$\text{Cos } \theta = \frac{CE^2 + ED^2 - CD^2}{2\ CE.ED} \quad \text{-----> (2)}$$

Equating 1 and 2

$$\frac{CE^2 + EF^2 - CF^2}{2CE.\ EF} = \frac{CE^2 + ED^2 - CD^2}{2CE.ED} \quad \text{-----> (3)}$$

substituting the field measurements in 3 we get the distance of CD.

Fig 4



Case (ii) When the obstacle cannot be chained around (Fig 4)

16 Let stations A & B be the terminal stations of the chain line AB.

17 Select two convenient stations C and D on the banks of the river.

18 Find station 'E' such that CE perpendicular to ED ie

$\angle CED = 90^0$

19 measure the distance ED.

20 Extend the line ED to F such that ED = DF.

21 Select the station G on the chainline AB such that FG perpendicular to the FD.

22 Measure the distance DG, then DG will be equal to the obstructed distance of CD.

Practice on both chaining and vision are obstructed

Objectives: At the end of this exercise you shall be able to
- **measure the obstructed distance even both chaining and ranging obstructed.**

Requirements

Tools/Equipments/Instruments

• Chain 30m	- 1 No.
• Ranging rods 2/3m,3cmØ	- 6 Nos
• Steel tape 30m	- 1 No.
• Cross staff	- 1 No.
• Arrows 40cm long	- 10 Nos.
• Junior drafter	- 1 No.

Materials

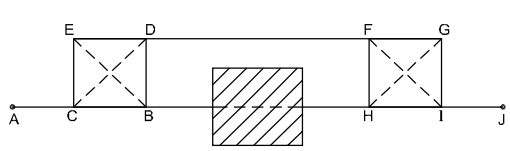
Field note book	- 1 No
Spncil	- 1 No
Eraser	- 1 No
Set of seale	- One set
Drawing sheet A3	- 1 No
Cellotape	- 1 No

PROCEDURE

Task 1: **Measure the obstructed distance even both chaining and ranging obstructed**

1 Let BH be the obstructed distance passing through the building in the chain line AB. (Fig 1)

Fig 1



2 Erect a perpendicular to a convenient distance BD such that BD is perpendicular to BA.

3 Mark the point C on the chain line AB such that BD = BC.

4 From C, erect a pendicular and mark E such that BD = CE.

5 To check the accuracy of the framework, measure the diagonals BE and CD. BE and CD will be equal.

6 Prolong ED to past the obstacle.

7 Choose the two points F and G on the prolonged line.

8 Erect the perpendicular from F and G to a distance which is equal to BD.

9 Denote, it as H and I as shown in figure which is in line with AB produced.

10 Prolong the line through HI.

11 Now obstructed distance BH can be measured by measuring DF.

Case (ii)

1 Let BK be the obstructed distance passing through the building in the chain line AB in Fig 2.

2 With AB as base construct an equilateral triangle ABC by swinging equal arcs with a tape.

3 Produce AC to D and take a point E on DA.

4 Again construct an equilateral triangle DEF with DE as base.

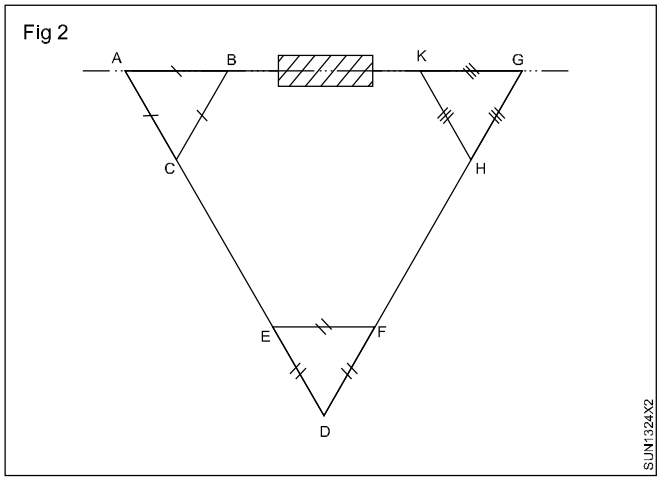
5 Produce the line DF to G such that DG = DA. Now ADG forms an equilateral triangle and G is a point on the chain line. AB produced.

6 Choose the second point K on the chain line by forming an equilateral triangle GHK on GH as base.

7 The line joining KG determines the direction of the chain line past the obstacle.

8 The obstructed length BK = AG - AB - GK.

Fig 2



Practice on Ranging and chaining in sloping ground

Objectives: At the end of this exercise you shall be able to
- **range and chaining in sloping ground.**

Requirements

Tools/Equipments/Instruments

- Metric chain 20m/30m - 1 Nos.
- Ranging rod 2/3m-3cm φ - 5 Nos.
- Measuring tape steel (30m) - 1 No.
- Plumb bob, spirit level. - each one
- Arrows - 10 Nos.

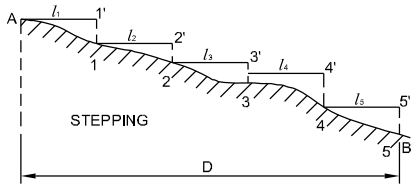
PROCEDURE

Task 1: **Ranging and chaining on sloping ground**

1 Select a small hilly area to be surveyed.

2 Fix the station points A and B and erect ranging rods. (Both A & B are intervisible) (Fig 1)

Fig 1



(a)
METHOD OF STEPPING

SUN1325H1

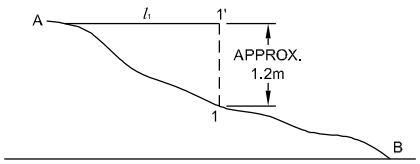
3 Hold the zero end of the steel tape at A on the ground by follower.

4 Hold the other end of the tape by the leader and moves suitable length l_1 (not exceeding 6m) towards B and stretch it horizontally.

5 The follower directs the leader in line with B.

6 Leader holds the plumb bob at 1' and transfer it on the ground say 1 and record the distance l_1 (Fig 2).

Fig 2



(b)
THE VERTICAL DISTANCE 1'1, 2'2, 3'3....etc.,
SHOULD BE APPROXIMATELY 1.2m

SUN1325H2

7 The follower then moves to the point 1 and holding the zero ends of the tape.

8 The leader moves to the point 2' and stretches the tape horizontally.

9 The leader hold the plumb bob at 2' and transfer a point 2 on the ground and the record distance l_2.

10 Similarly moving towards B measure all the distances say l_3, l_4 and l_5.

11 The length of AB = $l_1 + l_2 + l_3 + l_4 + l_5$

Set out a rectangular plot 100m x 50m in an open ground

Objectives: At the end of this exercise you shall be able to
- **set out a rectangular plot on the ground**
- **check the size of the plot.**

Requirements

Tools/Equipments/Instruments

- Metric chain 20m/30m - 1 No.
- Metallic or steel tape 30m - 1 No.
- Cross staff - 1 No.
- Ranging rods 2/3m,3cmØ - 5 Nos
- Arrows 40cm lon - 10 Nos.
- Mini drafter - 1 No.

Materials

- Drawing sheet A3 - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale -One set.
- Cello tape
- Field note - 1 No.

PROCEDURE

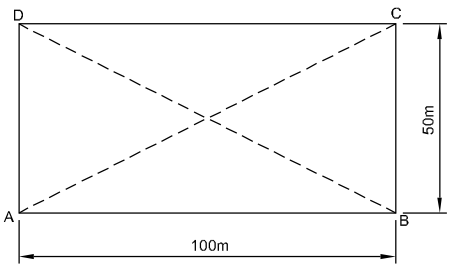
Task 1: **Set out a rectangular plot on the ground**

1 Run a chain line AB of given distance 100m (Fig 1).

2 Erect a perpendicualar AD from point A to a distance 50m.

3 Erect another perpendicular BC from the point B. to a distance 50m. (i.e. AD = BC = 50m)

Fig 1



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Task 2: **Check the size of the plot**

1 Measure the diagonals AC and BD

2 That is equal to AC = $\sqrt{AB^2 + BC^2}$

3 AC = BD

Practice on Chain survey around a given small building by triangulation, and traversing

Objectives: At the end of this exercise you shall be able to
- **chain survey around a given small building by triangulation**
- **chain survey around a given small building by traversing**
- **chain survey around a given small building by traversing using chain angle method.**

Requirements

Tools/Equipments/Instruments

• 30m chain	- 1 No.
• Arrows 40cm long	-10 Nos.
• Ranging rod 2/3m long	- 4 Nos.
• 30m steel tape	- 1 No.
• Cross staff	- 1 No.
• Peg 15cm long	-5 Nos.

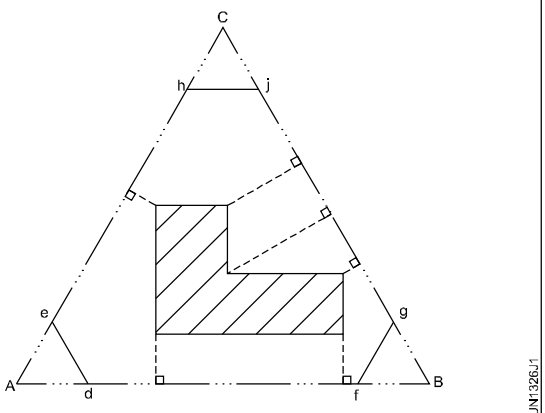
Materials

• Drawing sheet A3	- 1 No.
• Pencil HB	- 1 No.
• Eraser	- 1 No.
• Set of scale	-One set.
• Cello tape	
• Field note	- 1 No.

PROCEDURE

TASK 1: **Chain survey around a given small building by Triangulation.** (Fig 1)

Fig 1



Field work

1 Prepare a rough sketch of the given small building in the field book.

2 Fix the Triangulation station points A,B and C around the building which are intervisible.

3 Prepare reference sketches to stations A,B and C.

4 Run the chain line from A to B.

5 Take chainages and offsets of the corners of the building and enter in the field book.

6 Mark a point 'd' & 'f' on the chainline AB to check chain angle.

7 Similarly follow the same procedure for chain lines 'BC' and 'CA'

8 Also mark a points 'g' and 'j' on the chainline 'BC' and 'e' and 'h' on the chainline 'CA' and fix arrows.

9 Measure checklines distances 'de','fg' and 'hj' and enter in the field book.

Office work

10 Draw the chainline 'AB' to a suitable scale on the drawing sheet.

11 Draw an arc of radius equal to AC with centre 'A'.

12 Draw an arc of radius equal to BC with centre as 'B'.

13 Denote the point 'c' where the above arcs meet each other.

14 Join AC and BC.

15 Mark the checkline points 'd' and 'f' on the chainline 'AB'.

16 Similarly mark the checkline points g, j and 'h','e' on the checkline BC and CA respectively.

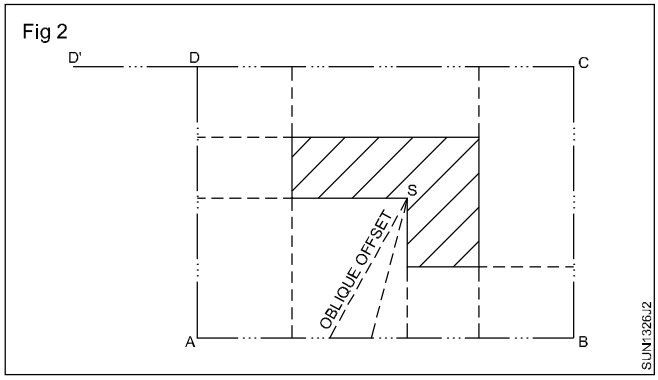
17 Measure the checkline distances 'de' , 'hj' and 'gf' in the drawing.

18 Check the measured distances with field measurements for accurancy of the frame work.

19 Plot the chainages and offsets to all chainlines according to the field book.

20 Join all the offset points to get the actual shape of the building.

Task 2: **Chain survey around a given small building by traversing** (Fig 2)



Field work

1 Prepare a rough sketch of the given small building in the field book.

2 Select and fix survey stations ‘A’ and ‘B’ which are intervisible to each other.

3 Prepare reference sketches to stations ‘A’ and ‘B’.

4 Run the chain line from A to B for a known length.

5 Note the chainages and measure the offsets.

6 Enter the chainages and offsets in the field book.

7 Locate the interior corner (s) of the building by taking oblique offsets from any two fixed round chainages.

8 Locate the station ‘c’ by sighting station ‘A’ using the cross staff at B.

9 Run the chainline from B to C and locate the details along BC.

10 From station ‘c’, erect perpendicular line ‘CD’ to ‘BC’ which is approximately equal in length ‘AB’.

11 Fix a ranging rod on D’.

12 Fix a cross staff at ‘A’ and sight ‘B’.

13 Move the ranging rod along CD’ to locate D by sighting through the another Groove in the cross staff at A.

14 Run the chainline from C to D and locate the details along CD

15 Similarly, Run the chainline from D to A, and locate the details along DA.

Office work

16 Draw a chainline ‘AB’ to a suitable scale.

17 Draw a perpendicular line to AB from B for a distance BC to locate ‘C’.

18 Similarly locate the station D and check it from station A.

19 Mark the chainages on the correspond chain lines.

20 Draw the offsets from the correspond chainlines

21 Connect all the offset points to get the actual outlines of the buildings

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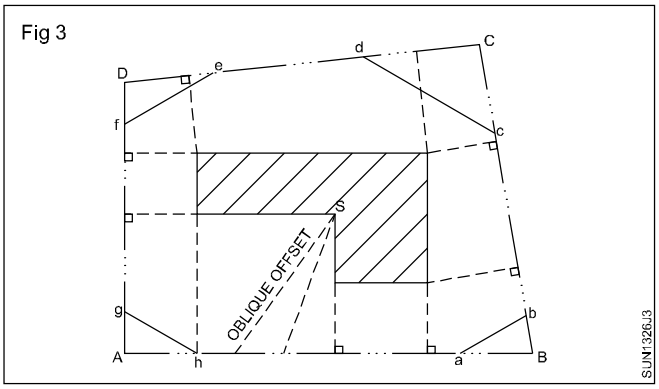
Task 3 : **Chain survey around a given small building by travering using chain angle method.** (Fig 3)



Field work

1 Prepare a rough sketch of the given small building in the field book.

2 Fix survey stations A and B which are intervisible to each other.

3 Prepare reference sketches to the station A and B.

4 Run a chain line from A to B to a known length and note the chainages.

5 Measure the offsets and enter in the field book.

6 Fix a check line point ‘a’ on the chainline ‘AB’ where more than 3m from station B and fix an arrow.

7 According to the ground conditions run the chainline from B to C at any angle using chain angle method.

8 Take chainages and offsets on the chainline BC.

9 Fix a chainline point ‘b’ in the chain line BC.

10 Measure the distance ‘ab’ and enter in the field book.

Use chain angle method when the chain line is not possible to run at right angle to each other.

11 Similarly follow the above procedure for the chain lines CD and DA.

Office work

12 Draw the chain line AB to a suitable scale.

13 Mark the chain lines and offsets on the chainline AB as per field book measurements.

14 Mark the check line point ‘a’ on the chainline AB.

15 Draw an arc with centre as ‘a’ and radii as ‘ab’.

16 Draw another arc with centre as B and radii as ‘Bb’.

17 Denote the checkline point ‘b’ where the above two arcs intersect each other.

18 Join Bb and prolong it up to station C.

19 Mark the chainages and offsets on the chain line BC.

20 Follow the above procedure for remaining chain lines CD and DA.

— — — — — — — — —

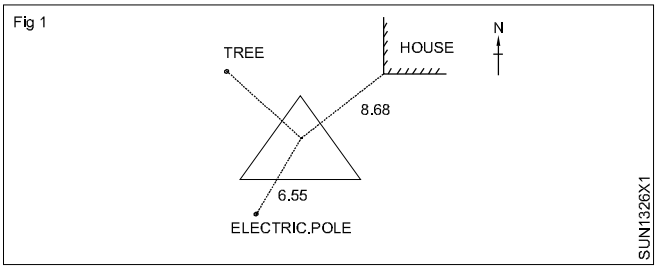
Skill Sequence

Preparing reference sketch to stations

Objectives: This shall help you to
- **prepare reference sketch to the stations.**

1 Mark the station on the field book as shown in Fig 1.

Fig 1



2 Observe the permanent objects which are located around the station.

3 Mark the permenant objects in the field book by drawing rough sketch.

4 Measure the distances.

5 Note the distances in the field book.

Plotting a chain survey

Objectives: This shall help you to
- **plot a chain survey.**

Choose a suitable scale according to the importance of the work.

1 Allocate a margin of 2cm around the paper.

2 Select a suitable position of the baseline.

3 Draw the base line by pencil.

The accuracy of entire framework is mainly depends upon the accuracy of base line.

4 Mark the intermediate stations on the base line.

5 Similarly complete the frame work.

6 Check the accuracy of the plotted frame work by means of check and Tie lines.

7 Mark the chainage of the points along the chain line from where offsets were measured.

8 Draw the perpendicular lines with set square and scale of length of the offsets.

9 Keep the field book side by side in the same direction when plotting.

10 Ink the lines and objects after completing and checking.

11 Write the title of the survey in right hand corner at the bottom of the drawing.

12 Write the scale of the plan below the title.

13 Mark the north direction at the Right hand corner above the drawing.

Practice on Chain survey around a given group of buildings by triangulation and plotting the same

Objectives: At the end of this exercise you shall be able to
- **prepare key plan of the site**
- **select and fix stations, base lines, check lines, tie lines**
- **take reference sketches for stations**
- **run the chain line and locate the details.**

Requirements

Tools/Equipments/Instruments

- 30m chain - 1 No.
- Metallic tape 30m length - 1 No.
- Ranging rods 2 to 3m length - 4 Nos.
- Cross staff (or) optical square - 1 No.
- Pegs 15cm long - 24 Nos.
- Arrows - 10 Nos.
- Junior drafter - 1 No.

Materials

- Drawing sheet A3 - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale -One set.
- Cello tape
- Field note - 1 No.

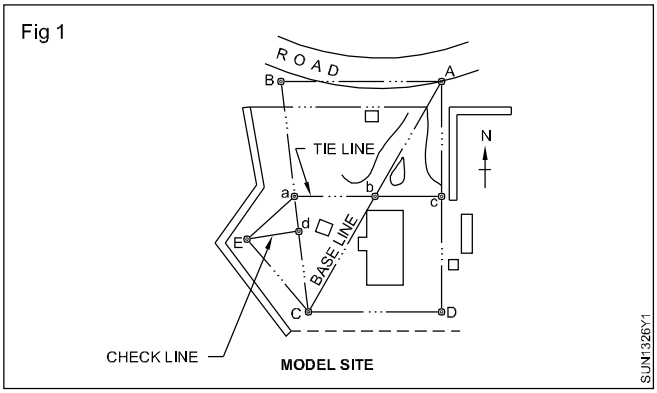
PROCEDURE

TASK 1:**Prepare key plan of the site (Fig 1)**

Field work

1 Make reconnaissance survey, prepare a rough sketches of the given site in the field book.

Fig 1



TASK 2: **Select and fix stations, base lines, check lines and tie lines (Fig 2)**

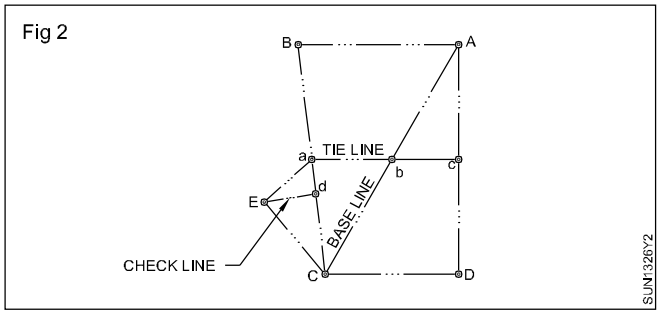
1 Select and mark the main line control stations ABCD and E on the site, to cover the whole area to be surveyed.

2 Select the base line AC.

3 Select and mark the check line Ea, Ed.

4 Select and mark the tie lines ab and bc.

Fig 2



TASK 3: **Take reference sketches for stations**

1 Take reference sketches for the main stations A,B,C, D and E.

Fig 2 shows about the selection of main stations, base line, tie line and check line.

Task 4: **Run the chain line and locate the details**

1 Run the chain and measure the baseline AC and main lines AB,BC,CD, DA and CE enter in the field book.

2 Measure check line Ea and Ed and enter in the field book.

3 Measure Tie lines ab and bc and enter in the field book.

4 From the above measurements draw the frame work joining all the control points to a suitable scale on the drawing sheet.

5 To check the accuracy of the frame work, measure check lines Ed and Ea tie lines ab and bc in the plotting and verify with the field measurements.

Limit of permissible error

6 The maximum permissible error is 1 in 1000 (for example ± 1m for every 1000m)

If the error is within the maximum permissible value then adjust the lengths of the sides of the wrong triangles after that continue to locate the interior offset details.

If the error exceeds the permissible value then resurvey the wrong lines to continue the survey.

If there is no error, continuing the survey work, measuring the chainages offsets on both sides of the chain lines and enter in the field book.

7 Plot the details as per field book entries.

8 Print the title of the survey in right hand corner at the bottom or at the top of the drawing thus note the scale of the drawing below it.

9 Mark the north direction in right top corner of the drawing sheet.

10 Determination of area of a plot from plan using planimeter and from field notes.

Practice on Chain survey around campus, locating details, booking, plotting, inking and colouring

Objectives: At the end of this exercise you shall be able to
- **survey and plot your ITI with chain.**

Requirements

Tools/Equipments/Instruments

• 30m chain	- 1 No.
• Metallic tape 30m length	- 1 No.
• Ranging rod 2/3m length	- 4 Nos.
• Cross staff	- 1 No
• Pegs 15cm long	-24 Nos.
• Field book	- 1 No.
• Nails	
• Arrows 40cm long	-10 Nos.
• Junior drafter	- 1 No.

Materials

• Drawing sheet A2	1 No.
• Pencil HB	1 No.
• Eraser	1 No.
• Set of scale	Oneset.
• Cello tape	
• Field note book	1 No.

PROCEDURE

Task 1 : **Survey and plot your ITI with chain**

Fig 1 shows the model site of the exercise.

Field work

1 Make reconnaissance survey prepare rough sketch of the given site in the field book.

2 Select and mark the control stations for the main line/ base line A to N covering the whole area to be surveyed.

3 Select the Base line AB and main lines BC, CD, DE, EF, FG, GH, FJ, JK & KL etc. (Fig 2)

4 Select the check line BC, BN,NT etc.

5 Select the tie stations T1,T2 etc as required for taking internal details.

6 Take reference sketches for the main stations.

7 Run the chain and measure the baseline AB, main lines check lines, and Tie lines and enter in the field book.

8 From the above measurements plot the frame work joining all points to a suitable scale and check the accuracy.

If the error is within maximum permissible value, then adjust the lengths of the sides of the wrong triangles, after that continue the survey.

If the error exceeds the permissible value then resurvey the wrong lines after that continue the same.

If there is no error, continuing the survey work measuring the chainages, and offsets on both sides of the chainlines and enter in the field book.

Office Work

9 Plot the details with conventional signs as per field book entries.

10 Print the title of the survey in right hand corner at the bottom or at the top of the drawing. Then note the scale of the drawing below it .

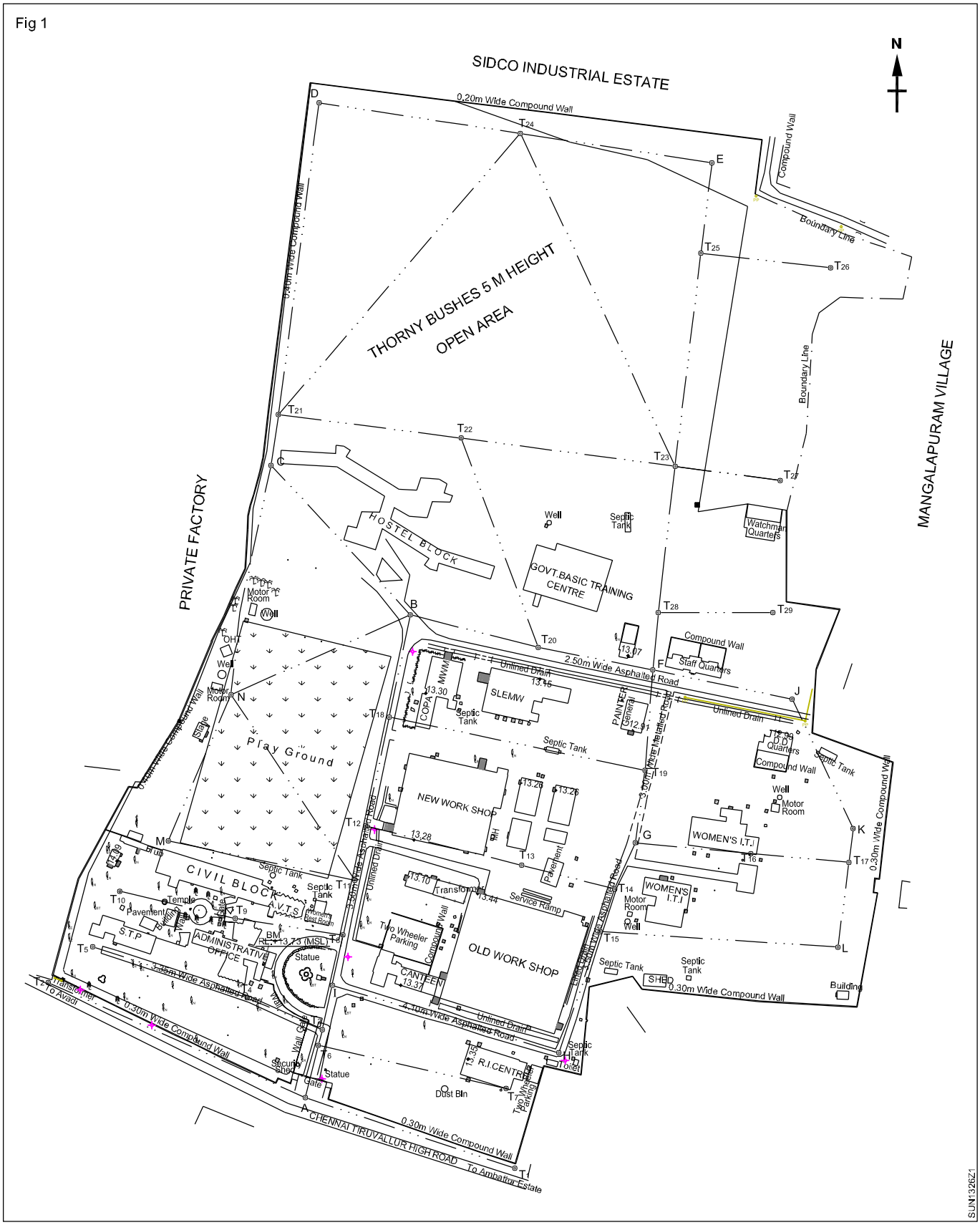
11 Mark the north direction its right top corner of the drawing sheet.

Use the conventional signs for the various types of objects

12 Draw all the boundary lines with Indian ink.

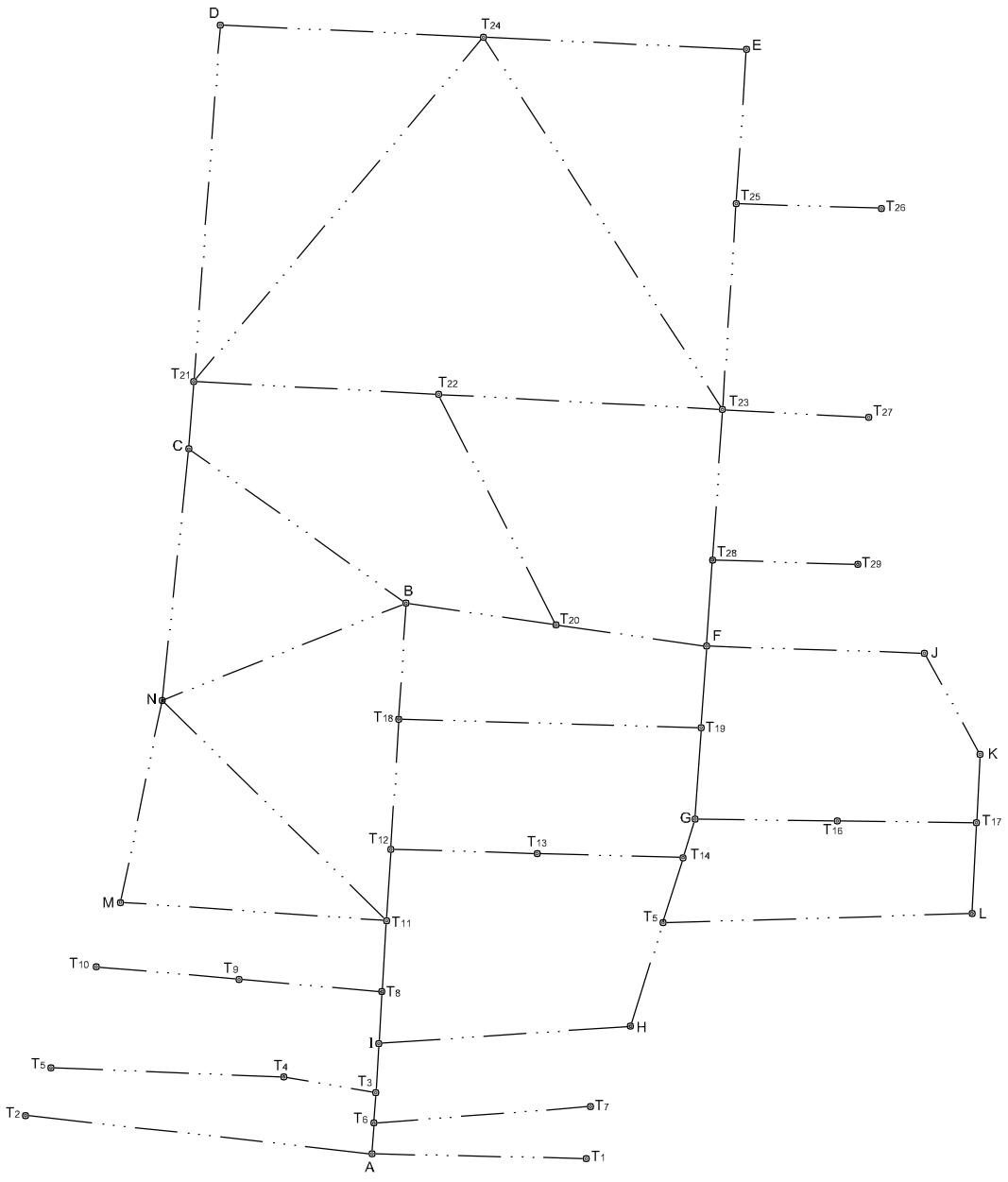
13 Give colouring according to the symbol.

Fig 1



Construction - Surveyor (NQSF Level -5) Exerise : 1.3.26

Fig 2



Plot and calculate the area of the given closed polygonal shape of field ABCDE & F on a ground by cross staff

Objectives: At the end of this exercise you shall be able to
- **calculate the area of the polygonal shaped land**
- **calculate the same by planimeter.**

Requirements

Tools/Equipments/Instruments

- Metric Chain 30mm - 1 No.
- Arrow 40cm long - 10 Nos.
- Ranging Rods 2/3m - 6 Nos.
- Cross staff - 1 No.
- Junior drafter - 1 No.

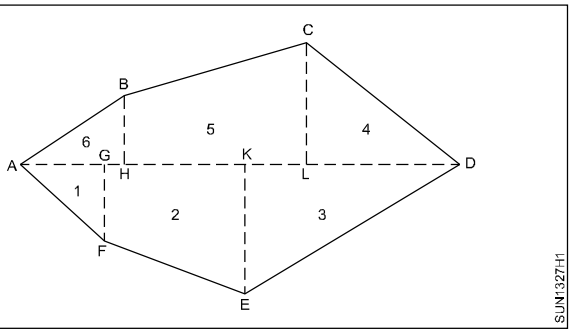
Materials

- Drawing sheet A2 - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale - One set.
- Cello tape

PROCEDURE

Task 1: **Calculate the area of the polygonal shaped land**

Fig 1



Field work

1 Mark the given points ABCDE & F on the ground. (Given by the Instructor) (Fig 1)

2 Select the longest distance between any two points say AD as the base line.

3 Run the chainline along AD.

4 Locate the perpendicular offset FG.

5 Note the chainage at G and measure off set FG and enter in the field book.

6 Repeat the above process for locating the perpendicular offsets BH,EK and CL.

7 Note the chainages at H,K and L and measure offset BH, EK and CL and enter in the field book.

Office work

8 Draw the baseline AD to a suitable scale on the drawing sheet.

9 Mark the chainages G,H,K and L on AD.

10 Draw perpendicular offsets say FG,BH,EK and CL as per the field book.

11 Divide the polygonal shaped area into number of triangles and trapezium by joining the polygonal points A,B,C,D,E,F & A.

12 Calculate the area of the divided triangles and trapezium.

13 Calculate the total area by adding the area of above segments. (1 to 6)

— — — — — — — — —

Task 2 : **Calculate the area of the polygonal shaped land by planimeter**

1 Set the vernier of the index mark to the corresponding to the scale. (i.e) If the scale is 1:100, the index mark should be set to 33:33 as per the manufacturer's guide and so on.

2 Fix anchor point outside the figure. If the area is large, it should be divided into sections.

3 Fix the anchor point is firmly in the paper inside (or) outside of the figure.

4 Reach the tracing point is easily every point on the boundary line.

5 Select a point on the boundary of the map and the tracing point is placed on it.

6 Observe the disc, wheel and the vernier, the initial reading is recorded i.e. (I.R).

7 Move the tracing point is gently in a clockwise direction along the boundary of the area.

8 Observe the number of times (N) the zero mark of the dial passes the index mark in clockwise (or) anticlockwise direction.

9 Observe the disc, wheel and the vernier, the final reading (F.R) is recorded, after reaching the starting point.

10 Calculate area of the figure by applying the formula. (i.e) Area = M (F.R - I.R ± 10N + C)

where

M = Multiplying constant given in the table

N = Number of times the zero mark of the dial passes the index mark.

C = The constant given in the table

F.R = Final reading

I.R = Initial reading

'N' is considered to be positive when the zero of the dial passes the index mark in clockwise direction.

'N' is considered to be negative when the zero of the dial passes the index mark in anticlockwise direction.

The value of C is added only when the anchor point is inside the figure.

While using the planimeter, the following points to be remembered.

1 The map must be placed over a horizontal plane.

2 The anchor point should preferably be kept outside the figure to avoid additive constant.

11 Measure the area of the figure twice from different starting points.

12 If the area is large, divide into a number of sections, the area of each section may be calculated separately and then added to obtain the total area.

13 Set the initital reading to zero for the sack of simplicity.

14 Move the tracing point gently and exactly along the boundary line.

15 The map should not be folded.

16 The surface of the map should be smooth.

— — — — — — — — —

Practice on Chain survey to an open land for layout plots

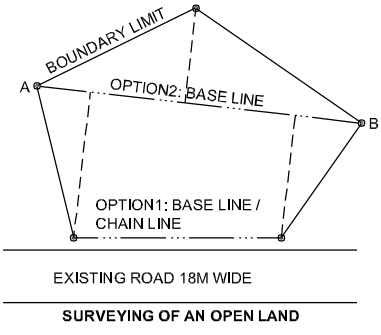
Objectives: At the end of this exercise you shall be able to
- **survey the open land for layout planning**
- **mark the layout as per prepared drawing.**

PROCEDURE

TASK 1: **Prepare detailed survey for layout plan**

1 Fix a baseline following boundary line or diagonal to the boundary corners (Fig 1).

Fig 1



2 Same baseline/chainline to be retained or permanently marked for laying of layout plots.

3 Locate all boundary corners and extising or access roads, natural and man made features if it required.

4 Prepare a detailed survey drawing of the land.

5 Prepare the layout plan as per requirements with norms which is applicable to the particular land.

6 Planning to be made without wasting of any land, necessary access roads and regular plots.

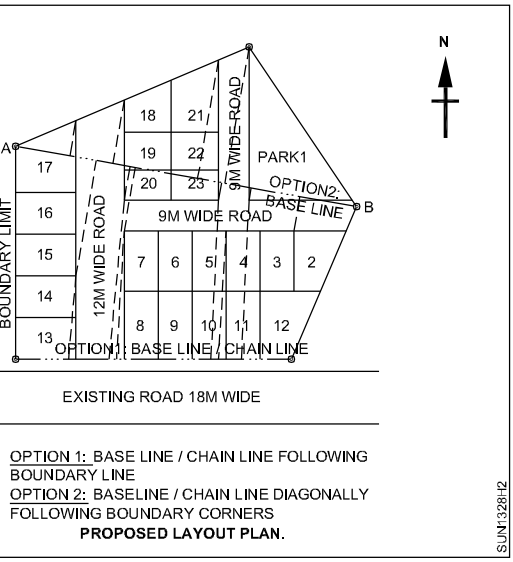
7 To mark the layout at the ground take right angle offsets with reference to baseline/chain line.

— — — — — — — — —

TASK 2: **Mark the layout as per prepared drawing**

1 In the layout plan draw baseline diagonally or following boundary corner to corner. (Fig 2)

Fig 2



2 Take right angle offsets to road and site corners.

3 Check the boundary and diagonal distance of the land where the layout to be laid.

4 After checking boundary distance and diagonal distance, establish baseline on the ground.

5 Set out right angle offsets with reference to baseline as per layout plan.

6 Mark layout plans as per size with reference to Road and side corners.

Stones to be fixed at Road and site corners and painted in yellow colour and numbered in red.

Centering of compass / Temporary adjustment of compass

Objectives: At the end of this exercise you shall be able to
- **center the compass exactly over the station.**

1 Drive an iron or wooden peg on the station.

2 Spread the tripod legs by loosening the leather strap

3 Place the tripod legs firmly on the ground approximately over the station.

4 Take out the compass from leather/plastic cover.

5 Remove the metal cover of the compass

6 Fix the compass on the top of the tripod.

7 Bring the object vane to vertical position as shown in Fig 1(a) and Fig 1(b).

8 Bring the prism arrangement from position I to position II as shown in Fig 1(a) and Fig 1(b).

Fig 1(a)

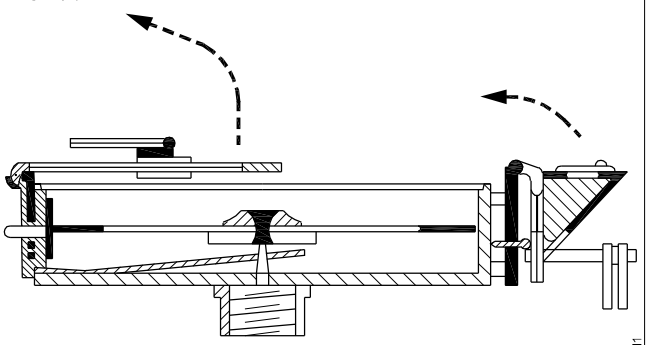


FIGURE SHOWING POSITION 1

Fig 1(b)

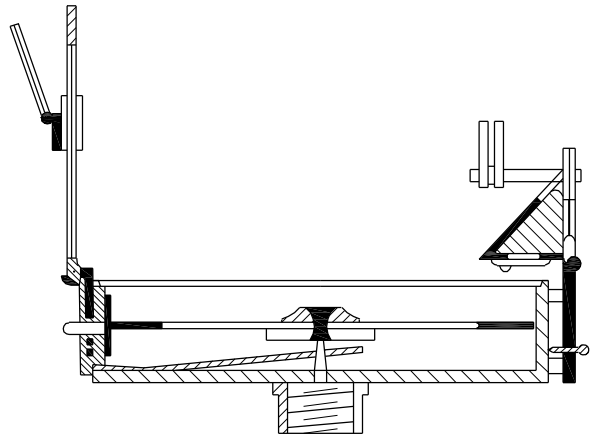


FIGURE SHOWING POSITION 2

9 Drop a small pebble from centre of the tripod

If the pebble falls on the centre of the peg, the compass is exactly centered over the station.

If the pebble does not fall on the peg, adjust the legs of the tripod

Again drop a small pebble from centre of the tripod.

10 Repeat the above procedure till the pebble falls exactly over the peg.

Levelling the compass

Objectives: This shall help you to
- **level the instrument**

1 Adjust the compas by using the ball and socket arrangement till the graduated ring swings freely after centering

2 Level it by eye judgement.

Check:

Place a spirit level on glass cover of the compass

If the bubble of the spirit level is at its centre, the compass is in levelled position.

It the bubble is not at it's centre repeat the above procedure to being it at it's centre.

Focusing the prism

Objectives: This shall help you to

- **Focus the prism**

1 Move the prism attachment slightly upward or downward till the readings can be seen sharp & clear. after levelling.

Determine the bearings of a given line AB

Objectives: At the end of this exercise you shall be able to
- **observe and record the bearings**
- **check the accuracy of the instrument.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Measuring tape 30m - 1 No.
- Ranging rod 2/3m long - 2 Nos.
- Arrows 40cm long - 2 Nos.

Materials

- Field book - 1 No.
- Ink pen - 1 No.

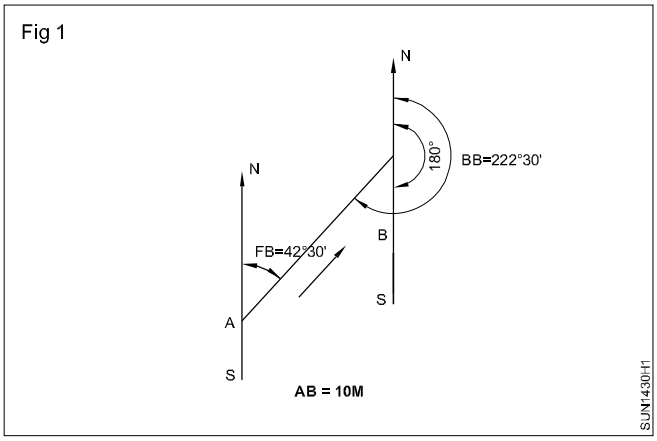
PROCEDURE

Task 1: **Observe and record the bearings and personal error**

1 Select a line AB on a firm ground to a given length of 10m. (Fig 1)

The stations A and B should be selected free from local attraction.

Fig 1



2 Fix arrows at stations ‘A’ and ‘B’.

3 Setup the prismatic compass over the station ‘A’.

4 Centre the compass over the station ‘A’ and level it.

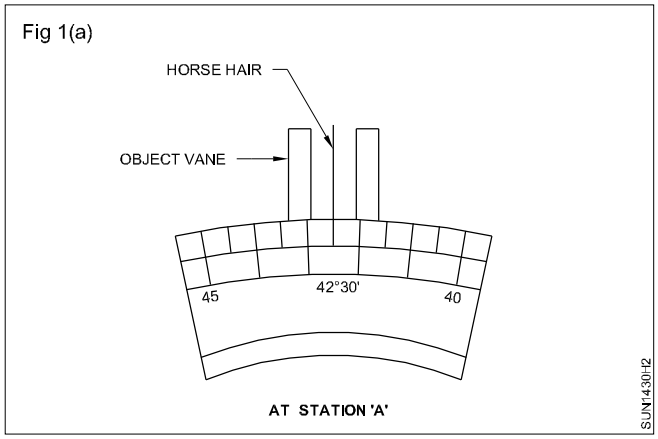
5 Fix a ranging rod at the station ‘B’.

6 Turn the compass box until the ranging rod at station ‘B’ is bisected by the vertical hair of the object vane through the slit of the eye vane.

7 When the graduated ring comes to rest look through the prism and note the reading (42^0 30’) at which the hair line produced appears to cut the image of the graduated ring (Fig 1(a)).

8 Thus the required fore bearing of line AB is $42^0$30’ and record it in the Field Book.

Fig 1(a)



The sighting of the object and reading of the graduated ring are done simultaneously

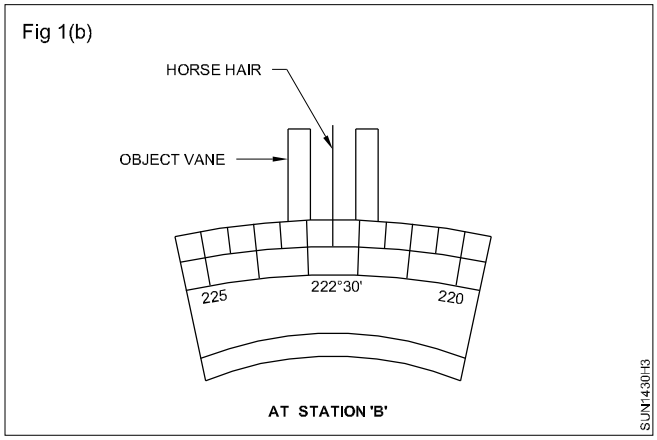
9 Shift the instrument, and setup at station ‘B’.

10 Fix the Ranging rod at station ‘A’.

11 Turn the compass Box, to sight the station ‘A’.

12 Observe the bearing i.e. Back Bearing of the line ‘AB’ (222^0 30’) Fig 1(b) and record it in the Field book.

Fig 1(b)



Task 2: **Check the accuracy of the instrument and personal error**

(i) Back bearing of the given line AB is equal to fore bearing of the given line AB ± 180^0

Caution : If the above condition is not satisfied with the observed back bearing of AB, then the instrument is having some error due to local attraction or wrong observation or wrong entry in the field book.

Observing the bearings

Objectives: This shall help you to
- **observe the bearings.**

1 Fix a ranging rod where the bearing is to be found.

2 After centering levelling and focussing the prism, turn the compass box until the ranging rod is bisected by the hair when looked through the slit in the prism.

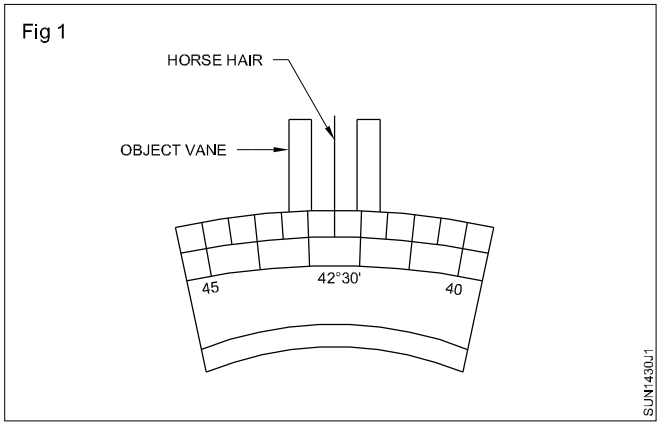
3 Allow the magnetic needle comes to rest.

4 Observe through the prism

5 Note the reading at which the hair line cuts the image of the graduated ring as shown in Fig 1.

Sighting of the object and reading of the graduated ring should be done simultaneously.

Fig 1



— — — — — — — — —

Plotting

Objectives: This shall help you to
- **plot the observed bearings of the traverse.**

1 Before starting the plotting work calculate the included angles of the closed transverse

2 Sum all the included angles.

3 Check the included angles with (2n±4) x right angles (where 'n' is the number of sides).

4 Select a suitable size of drawing sheet according to the size of the site to be plotted.

5 Fix the drawing sheet on the board.

6 Draw border line and indicate the North direction on the right hand top corner of the sheet.

Method I - Parallel meridian method (Fig 1)

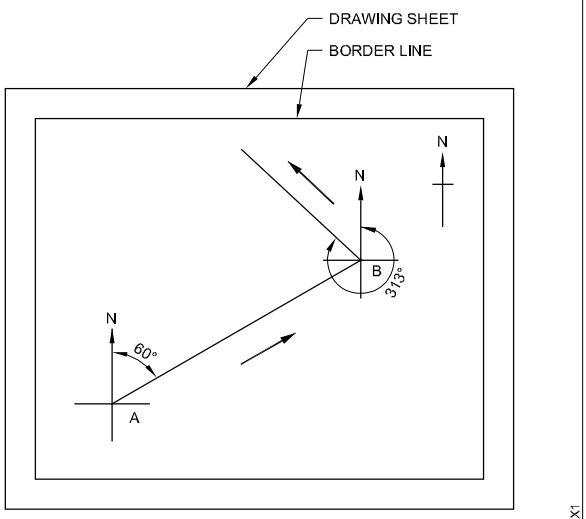
7 Select a suitable position to plot the first station 'A' such that all the stations can be plotted with in the drawing sheet.

8 Set the drafter parallel to the North direction and draw a vertical line on the first station 'A'

9 Coincide the zero mark of the circular protractor with North direction already drawn on 'A'.

10 Mark a point corresponding to the bearing of the first line 'AB'.

Fig 1



PARALLEL MERIDIAN METHOD

11 Join the station 'A' and the point noted for the bearing.

12 Extend it to a convenient length.

13 Choose a suitable scale and mark the distance of the line 'AB'.

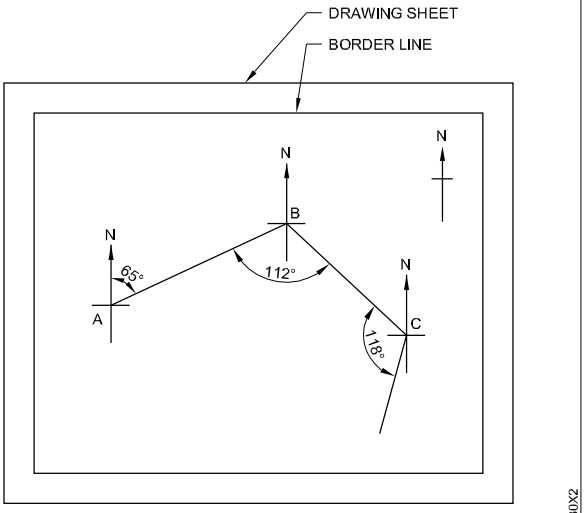
14 Denote the station as 'B'

15 Set the drafter again parallel to the North direction at 'B'

16 Continue the plotting work as mentioned above till all the stations are plotted.

Method II - Included Angle Method (Fig 2)

Fig 2



INCLUDED ANGLE METHOD

1 Mark the station 'A' and draw the first chain line AB to a suitable scale as mentioned in the method I.

2 Mark the station 'B' to a convienent scale.

3 Place the zero end of the circular protractor along BA.

4 Mark a point such that ∠ABC should be the same as calculated earlier.

5 Prolong the line through the point from B.

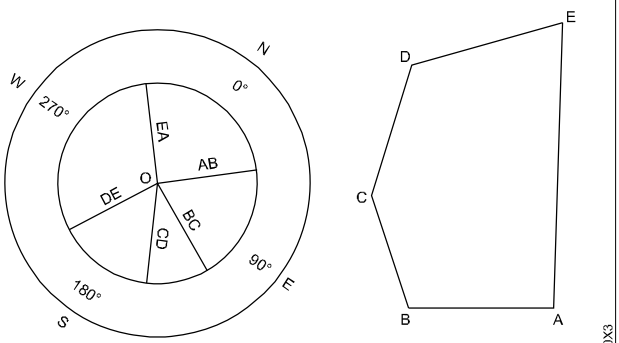
6 Mark the 'C' on the line to the same scale.

7 Continue the above process till all stations are plotted.

Method III - Central Meridian (or) Paper Protractor method (Fig 3)

1 Select a point '0' in the centre of the drawing sheet.

Fig 3



CENTRAL MERIDIAN METHOD

2 Mark the North direction (meridian) on the point.

3 Keep the 0^0 and 180^0 graduations of the circular protractor coinciding with the north & south direction line with centre point 'O'.

4 Plot the bearing of all the lines with reference to the north direction as shown in Fig 3.

5 Select a suitable location to plot the first station 'A' such that all the stations can be plotted within the drawing sheet.

6 Select a suitable scale for marking field distances on the drawing sheet.

7 Set the drafter parallel to the line AB in the paper protractor which is already drawn.

8 Keep the drafter on A and draw a line parallel to the line AB which is in the paper protractor to a convenient length.

9 Mark the station B on the line, with the selected scale.

10 Set the drafter parallel to the line BC in the paper protractor which is already drawn.

11 Keep the drafter on B and draw a line parallel to the line BC which is in the paper protractor to a convienent length.

12 Mark the station 'C' on the line to the same scale.

13 Continue the above procedure till all the stations are plotted.

14 Erase the excess lines.

Observe the bearings of a given triangular plot of ABC and calculate the included angles

Objectives: At the end of this exercise you shall be able to
- **observe the bearings of a given triangular plot**
- **calculate and check the included angles**
- **plot the area.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Ranging rods - 2 Nos.
- Wooden peg - 3 Nos.
- Chain or tape 30m - 1 No.
- Arrows - 10 Nos.

Materials

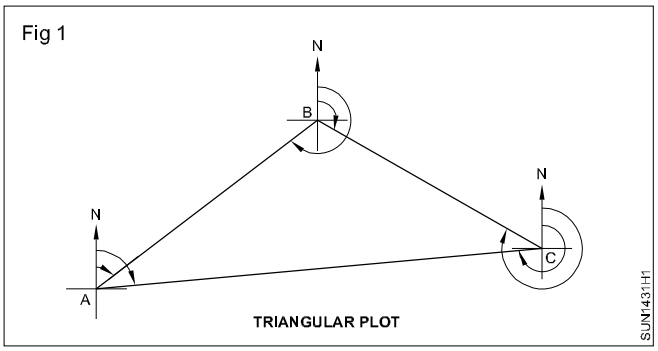
- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape
- Set of scale - 1 set

PROCEDURE

Task 1: **Observe the bearings of a given triangular plot**

1 Select and drive pegs at A,B and C stations which are intervisible to each other. (Fig 1)

Fig 1



2 Measure the horizontal distance of AB,BC and CA and note the readings at (1),(2) and (3) in the table respectively.

3 Fix ranging rods at stations ‘B’ and ‘C’.

4 Set up and level the compass over the station ‘A’.

5 Observe the reading by sighting ‘B’ and note it on (4) in the table.

6 Similarly observe the reading by sighting ‘C’ and note it on (5) in the table.

7 Shift the compass to station ‘B’.

8 Fix the ranging rod at ‘A’.

9 Setup the compass over the station ‘B’.

10 Observe the readings by sighting ‘C’ and ‘A’ andnote them on (6) and (7) in the table respectively.

11 Shift and setup the compass to station ‘C’.

12 Fix the ranging rods at ‘B’.

13 Observe the readings by sighting ‘A’ and ‘B’ and note them on (8) and (9) in the table.

Table

Line	Length in (m)	Fore bearing	Back bearing
AB	(1)	(4)	(7)
BC	(2)	(6)	(9)
CA	(3)	(8)	(5)

— — — — — — — — —

Task 2: **Calculate and check the included angles**

1 Calculate the included angles using fore bearing and back bearing.

2 Check the calculated the included angels of the triangles with the theoretical sum of angels is equal to 180^{o}.

— — — — — — — — —

Task 3 : **Plot the area**

1 Plot the triangular plot with the observed readings

— — — — — — — — —

Observe the bearings of a given hexagonal plot of ABCDEF and calculate the included angles

Objectives: At the end of this exercise you shall be able to
- **observe the bearings of a given hexagonal plot**
- **calculate and check the included angles**
- **plot the area.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Ranging rods - 2 Nos.
- Wooden peg - 6 Nos.
- Chain or tape 30m - 1 No.
- Arrows - 10 Nos.

Materials

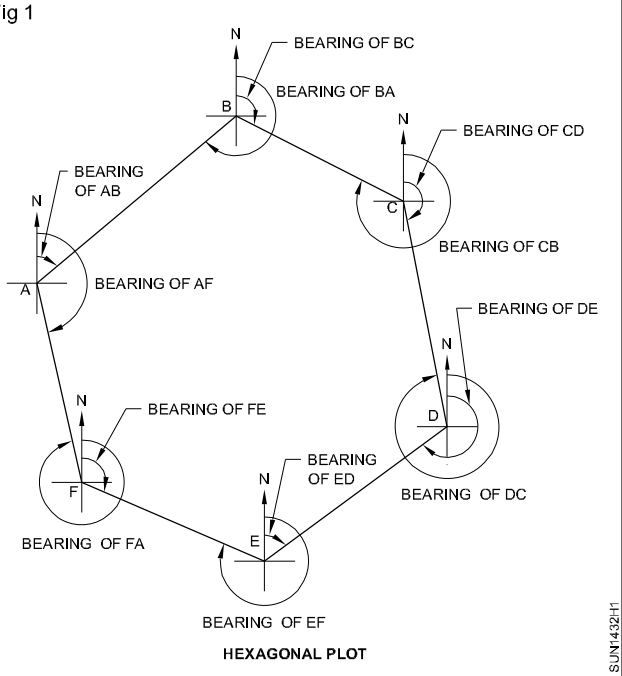
- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape
- Set of scale - 1 set

PROCEDURE

Task 1 : **Observe the bearings of a given hexagonal plot**

1 Select and drive pegs at all the stations A, B, C, D, E and F which are intervisible to each other. (Fig 1)

Fig 1



2 Measure the horizontal distance of AB, BC, CD etc. and note them as mentioned in the previous method against each line.

3 Set up the compass on first station 'A' and level it.

4 Fix ranging rods at station 'B' and 'F' where the bearing is to be located and observe the bearings.

5 Note down the bearings in the field book.

6 Repeat the procedure as explained in the previous exercise and note the bearings.

Task 2: **Calculate and check the included angles**

1 Calculate the included angles using fore bearings and back bearings.

2 Check the included angles by using the theortical formula (2 N ± 4) Right angles

Where N is the number of sides

Task 3: **Plot the area**

1 Plot the polygonal figure and check it with the calculated included angles.

Plot the given station A to F in the field by taking bearings from angles as a open traverse

Objectives: At the end of this exercise you shall be able to
- **observe the bearings of a given stations**
- **calculate & check the fore bearing & back bearing**
- **find the local attraction in any**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Ranging rods - 2 Nos.
- Wooden peg - 6 Nos.
- Chain or tape 30m - 1 No.
- Arrows - 10 Nos.

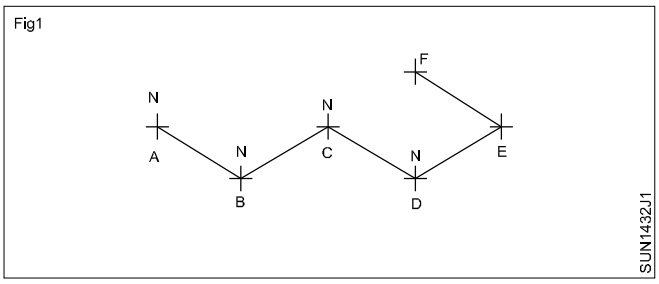
Materials

- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape
- Set of scale - 1 set

PROCEDURE

Task 1 : **Select and drive the pegs ABCDE & F which are intervisible to each other**

Fig1



Task 2: **Observe the bearing (Fore bearing & Back bearing)**

1 Take bearing & check F.B with B.B

2 Measure the horizontal distance of AB,BC,CD,DE& EF. and note in field book

3 Setup the compass on station 'A' & Level it

4 Fix the ranging rods at station B to E where the bearings is to be located and observe the bearings

5 Note down the bearings in the field book at each station BCD&E

6 While proceding the survey taking beaings check fore bearing with back beaing

7 The F.B & B.B are tallied/ other wise there is local attraction.

Task - 3 **Plot the open traverse with bearings.**

Set out the closed traverse of a Recti-linear (Rectangular) field ABCDA for the given bearings and lengths in an open field

Objectives: At the end of this exercise you shall be able to
- **set out the rectilinear field as a per the given readings.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass - 1 No.
- Ranging rods - 2 Nos.
- Wooden peg - 4 Nos.
- Chain or tape 30m - 1 No.
- Arrows - 10 Nos.

Materials

- Drawing sheet A3 - 1 No.
- Field book with given data - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape
- Set of scale - 1 set

PROCEDURE

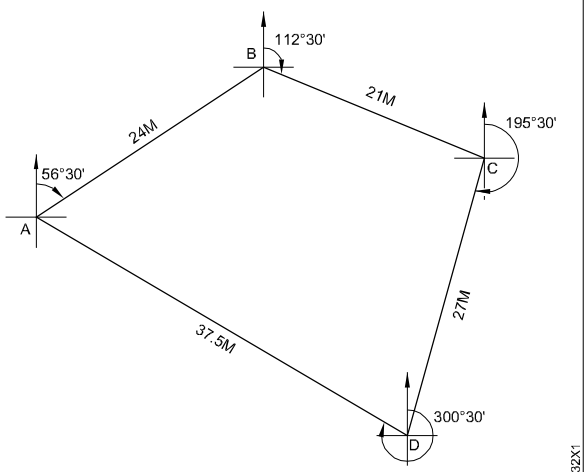
TASK 1: **Set out the rectilinear field as a per the given readings**

1 Before setting out the traverse in the field, calculate the interior angles for the station A,B,C and D and check it with the sum of included angles. $(2n \pm 4)90^0$.

2 Plot the traverse ABCDA with the given bearings and lengths.

3 Select a field without local attraction as far as possible for settingout a rectangular plot. (Fig 1)

Fig 1



CLOSED TRAVERSE OF A RECTANGULAR PLOT

4 Select a station 'A' in the field.

5 Set up the compass over the station 'A'.

6 Set the given bearing of AB $56^0 30'$ in the compass.

7 Sight through eye vane and object vane and fix a ranging rod approximately equal to the given distance in the line of sight.

8 Mark the distance AB of 24m along the above line and fix a peg at 'B'.

9 Shift the compass and setup over the station 'B'.

10 Observe the back bearing of AB and check it with the given bearing of $236^0 30'$.

If the observed back bearing of AB is not same as the given bearing the occured error maybe,

Instrumental error (or)
Personal error (or)
Natural error

To rectify the above error, repeat the whole process from the beginning.

11 Set the given bearing of BC of $112^0 30'$ in the compass and sight through the line of sight.

12 Mark the given distance of BC of 21m and drive a peg at C.

13 Repeat the above procedure to complete the traverse ABCDA.

Line	Length in (m)	Fore bearing	Back bearing
AB	24.00	$56^0 30'$	$236^0 30'$
BC	21.00	$112^0 30'$	$292^0 30'$
CD	27.00	$195^0 30'$	$15^0 30'$
DA	37.50	$300^0 30'$	$120^0 30'$

Understanding computer

Objectives : At the end of this exercise, you shall be able to,

- **identify basic computer terms**
- **start auto CAD four ways.**

HARDWARE

Microprocessor

The complex procedure that transforms raw input data into useful information for output is called “processing”. The Processor is the “brain” of the computer. The processor interprets and carries out instructions. In personl computers the processor is a single chip plugged into a circuit board. This chip is called a microprocessor.

Central processing Unit (CPU)

The CPU is the term used for the computer’s processor. The CPU contains the intelligence of the machine. It is where the calculations and decisions are made.

Memory (RAM)

Your CPU needs memory to hold pieces of information while it works. While this information remains in memory, the CPU can access it directly. This memory is called random access memory (RAM). RAM holds information only while the power is on. When you turn off or reset the computer, the information disappears.

The more RAM a computer has, the quicker it works and the more it can do.

The most common unit of measurement for computer memory is the byte. A byte can be described as the amount of memory it takes to store a single character. A kilobyte (KB) equals 1,024 bytes. A Megabyte (MB) equals 1,024 kilobytes, or 1,048,576 bytes. So a computer with 64 MB of memory actually has (64 x 1,048,576) 67,108,864 bytes. This is equal to approximately 1024 pages of information.

Input/ Output devices

Input devices accept data and instructions from the user. The most common input devices are the keyboard, mouse and scanner. Output devices return processed data back to the user. The most common output devices are the monitor, printer, speaker and plotter.

Storage

The purpose of storage is to hold data that the computer isn’t using. When you need to work with a set of data, the computer retrieves the data from storage and puts it into memory. When it no longer needs the data, it puts it into memory. when it no longer needs the data, it puts it back into storage. There are 2 advantages to storage. First, there is more room in storage and second, storage retains its contents when the computer is turned off. Storage devices include: Hard disks (inside your computer), per drives, zip disks, CDR//w, pocket harddiscs, etc.

SOFTWARE

Operating Systems

When you turn on the computer, it goes through several steps to prepare itself for use.

Thefirst step is a self-test. This involves:

a. Identifying the devices attached to it (such as the monitor, mouse and printer).

b. Counts the amout of memory available.

C. Checks to see if the memory is functioning properly.

The second step is searching a for a specifal progarm called the Operating System. When the computer finds the operating system, it loads it into memory (remember RAM), The operating system enables the computer to:

a. Communicte with you.’

b. Use devices such as the disk drives, keyboard and monitor.

The oprating system is now ready to accept commands form you. The operating system continues to run until the computer is turned off. Exmples of opeating systems are: Windows 7,8 windows NT, ME, 2000, XP, OS/2, Unix and more.

Note: 1. Apple/Macintosh computers have their own operating system.

2. AutoCAD new version will not work with windows 98 or Apple/ Macintosh.

Application software

The operating system is basically for the computer. The application Software is for the user. Application Software is designed to do a specific task.

There are basicallh four major categories:

Business, Utility, Personal, and Entertainment.

Business application software would be desktop publishing, spreadsheet programs, database software and graphics. AutoCAD is a “graphics” business application software.

Utility application software helps you maintain your computer. You would use a utility program to recover an accidentally deleted file, improve the efficiency of your computer and help you move, copy or delete files. Norton Utilities is an example of a “utility application” software.

Pesonal application software is basically what is sounds like. This software is designed for your personal needs, such as: balancing your checkbook, making an address book, creating a calendar and many more tasks.

Entertainment application software are video games, puzzles, flight simulators and even educational programs.

STARTING AutoCAD

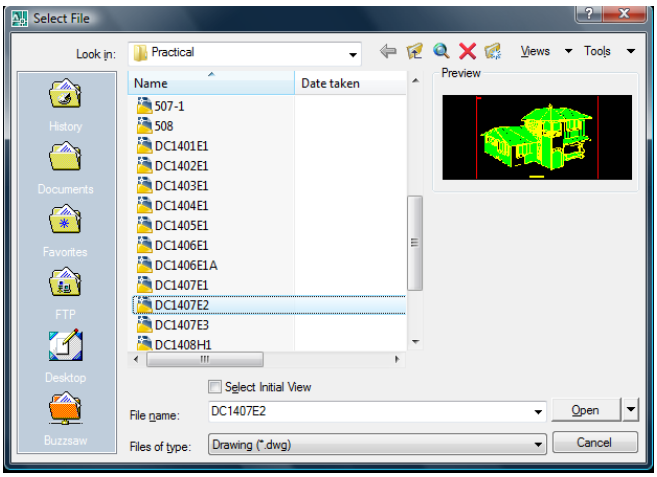
To Starat AutoCAD, select the START button/PROGRAMS/AutoCAD. If one of the dialog boxes shown below does not appear automatically. Select the system take to change your settings.

Prefer these dialog boxes for trainee new to AutoCAD. But after you become an “expert” you may disable this option.

Notice the four buttons located in the upper left corner of this dialog box. Each button provides a different way to start a drawing. A brief description of each is listed below.

Open a Drawing

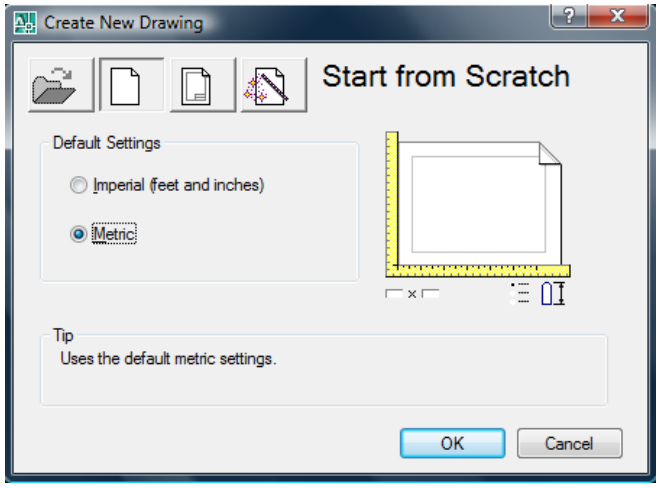
Allows you to select a drawing from a list of the most recently opened drawings or select the “Browse” button to search for more drawing files. After you select the file desired, select the OK button. The file selected will appear on your screen. (This option is only active when you first enter AutoCAD. Normally you will use **File/Open**.



Start From Scratch

Allows you to begin a new drawing from scratch. Starting from scratch means all settings are preset by AutoCAD.

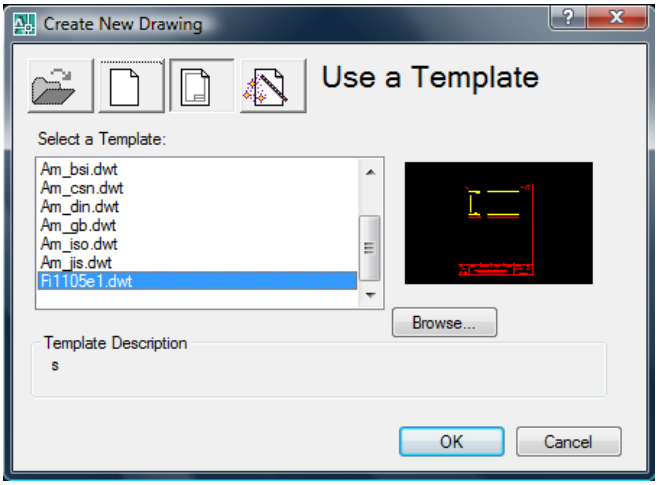
You must select the measurement system on which to base your new drawing; Imperial or Metric.



Use a Template

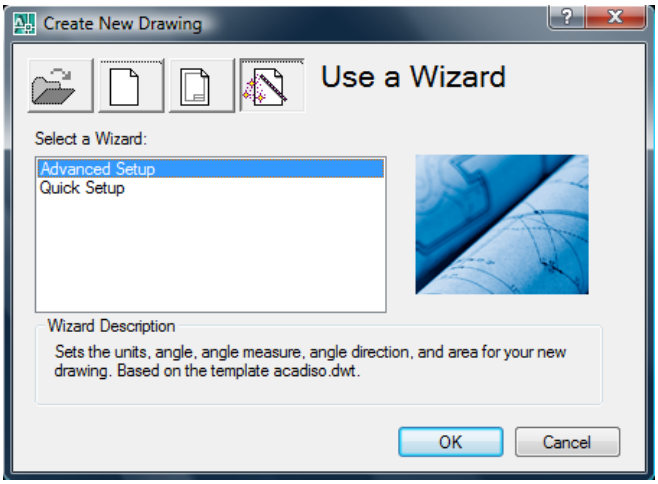
Allows you to choose a previously created template. You can choose one of the templates supplied with AutoCAD or create your own.

We will be creating a Template in exercise 6.03



Use a wizard

Allows you to start a new drawing using either the “Quick” or “Advanced” setup wizard. The wizard sets the units, angle, angle measurement, angle direction and area for your new drawing.



OPENING AutoCAD

For starting Auto CAD, double click the Auto CAD icon on the desk top or Auto CAD from start menu, if startup dialog box not shown in **GUI**, follow the follwing:-

Procedure:- right click on the screen

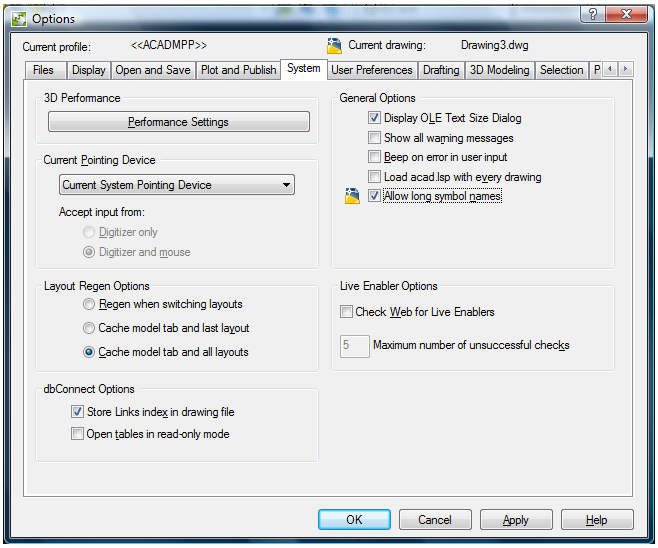
Select Option

Option dialogue box

Select system tab

Click on the Startup

select show startup dialogue box



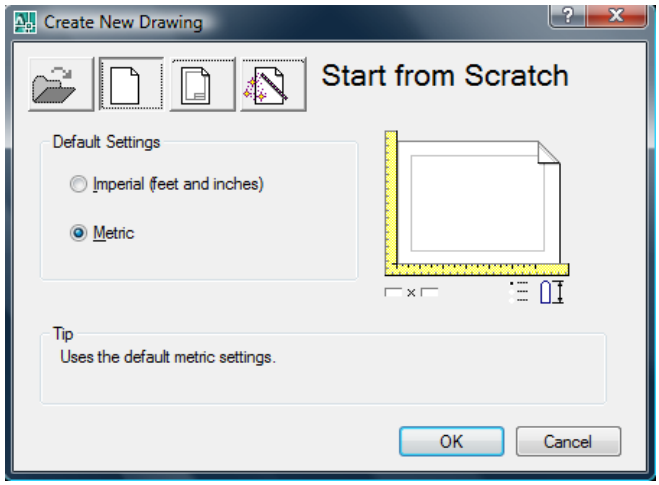
Startup dialogue box shown below. In the startup dialogue box, four options are available such as, open drawing, start from scratch, use a template and use a wizard.

1. Opening a drawing

2. Start from scratch

3. Use template

4. Use a wizard



1. Open a drawing:- to open an already saved drawings.

2. Starts an empty drawing using default imperial or metric settings. Auto CAD stores this setting in the MEASUREMENT system variable. You can change measurement system for a given drawing by using the MEASUREMENT system variable.

Imperial: Starts a new drawing based on the Imperial measurement system. The default drawing boundary (The drawing limits) is 12 x 9 inches.

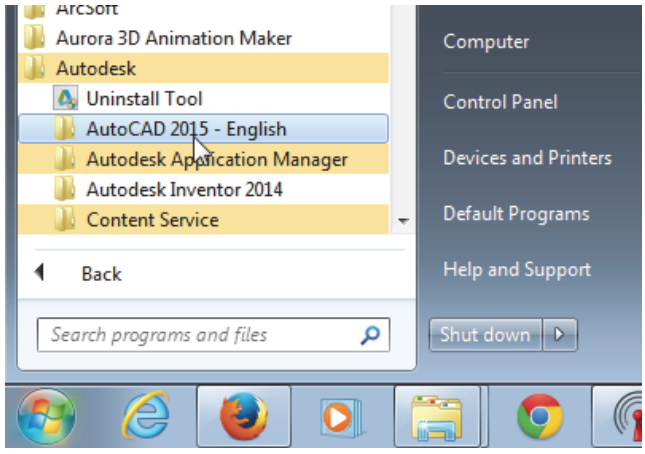
Metric: Starts new drawing based on the Metric measurement system. The default drawing boundary (the drawing limits) is 420 x 297 millimeters.

3. Use a template:- Starts a drawing based on a drawing template file.

4. Use a Wizard:- Sets up a drawing using a step-by-step guide. You can choose from two wizards: Quick set up and Advanced Set up.

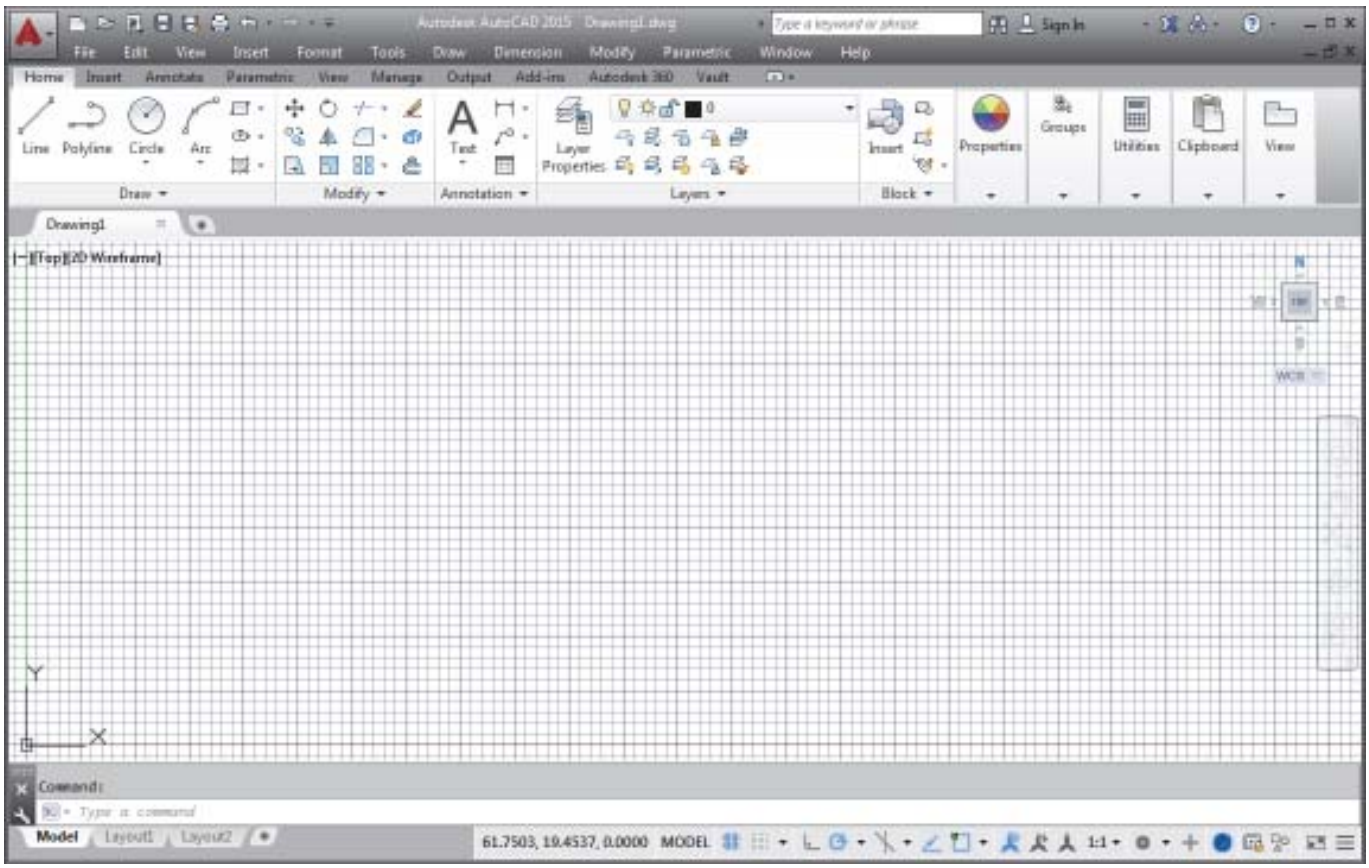
Starting Up AutoCAD

Select the AutoCAD Option on the program menu or select the **AutoCAD** icon on the Desktop.



Once the program is loaded into memory, the AutoCAD drawing screen will appear on the screen.

Note that AutoCAD automatically assigns generic name, Drawing X, as new drawings are created. In our example, AutoCAD opened the graphics window using the default system units and assigned the drawing name Drawing1.



Getting familiar with the autocad window

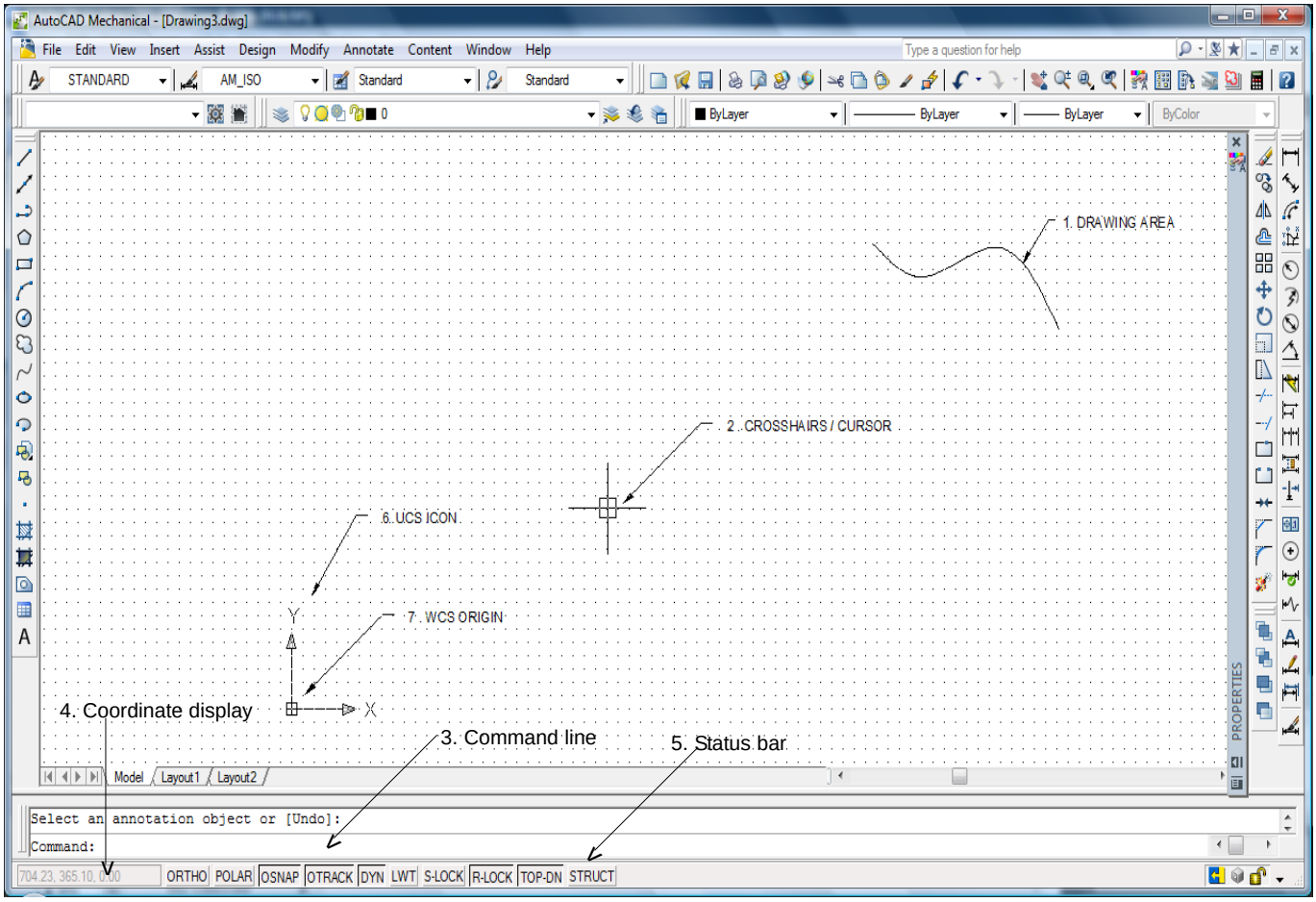
Objectives : At the end of this exercise, you shall be able to,

- **identify graphical user interface of (GUI) of AutoCAD.**
- **identify function keys.**
- **identify pull down menubar, dial box, tool bars.**

Getting familiar with the autocad window

Before you can start drawing you need to get familiar with the AutoCAD window. In the following lessons, I will be referring to all of the areas described below.

So it is important for you to understand each of them. But remember, this page will always be here for you.



Drawing area

Location: The large area in the center of the screen.

This is where you will draw. This area represents a piece of paper.

The color of this area can be changed using Tools/Option/ Display/ Color.

2. Crosshairs/ Cursor

Location: Can be anywhere inthe drawing Area.

The movement of the cursor is controlled by the movement of the pointing device such as a mouse. You will use the cursor to locate points, make selections and draw objects. The size can be changed using Tools/Options/ Display/Crosshair Size.

3. Command line

Location: The three lines at the bottom of the screen. This is where you enter commands and Autocad will prompt you to input information.

4. Coordinate display (F6)

Location: Lower left corner

In the Absolute mode (coords =1) displays the location of the crosshairs / cursor in reference to the origin. The first number represents the horizontal movement (X axis), the second number represents the vertical movement (Y axis) and the third number is the Z axis which is used for 3D.

In the Relative Polar mode (coords = 2) displays the distance and angle of the cursor from the last point entered.(Distance < Angle)

5. Status Bar

Location: Below the command line.

Display your current settings. These settings can be turned on the and off by clicking on the word (snap, grid, ortho, etc.)or by pressing the function keys, F1, F2 etc. See button description below.

[Snap] (F9)

Increment snap controls the movement of the cursor. If it is off, the cursor will move smoothly. If it is ON, the cursor will jump in an incremental movement.

The increment spacing can be changed at any time using Tools/Drafting Settings / Snap and Grid. The default spacing is 250.

[Grid] (F7)

The grid (dots) is merely a visual “drawing aid”. The default spacing is 1 unit.You may change the grid spacing at any time using Tools/Drafting Settings/ Snap and Grid.

[Ortho] (F8)

When Ortho is ON, cursor movement is restricted to horizontal or vertical. When Ortho is OFF, the cursor moves freely.

[Polar] (F10)

Polar tracking creates “Alignment paths” at specified angles.

[Osnap](F3)

Running object Snap. Specific object snaps can be set to stay active untill you turn them off.

[Otrack](F11)

Object Snap tracking

Creates Alignment paths at precise positions using objects snap locations.

[LWT]

Line weight. Displays the width assigned to each object.

MODEL

Switches your drawing between paperspace and modelspace.

6. UCS ICON (User Coordinate System)

Location: Lower left corner of the screen. The UCS icon indicates the location of the Origin. The UCS icon appearance can be changed using: **View/Display/Icon/ Properties**.

7. Origin

The location where the X, Y, and Z axes intersect. 0,0,0

(Don’t worry about this now. We will talk more in Lesson 9)

FUNCTION KEYS

F1	Help	Explanations of commands.
F2	Flipscreen	Toggles from Text Screen to Graphics Screen.
F3	Osnap	Toggles Osnap On and Off.
F4	Tablet	Toggles the tablet On and Off.
F5	Isoplane	Changes the Isoplane fron Top to Right to Left.
F6	Coordinate Display	Changes the display from ON/Off/
F7	Grid	Toggles the Grid On or Off.
F8	Ortho	Toggles Ortho On or Off.
F9	Snap	Toggles Increment Snap on or off.
F10	Polar	Toggles Polar Tracking On or Off.
F11	Otrack	Toggles Object Snap Tracking On and Off.

SPECIAL KEY FUNCTIONS

Escape key Cancels the current command, menu or Dialog box.

Enter key Ends a command, or will repeat the previous command if the command line is blank.

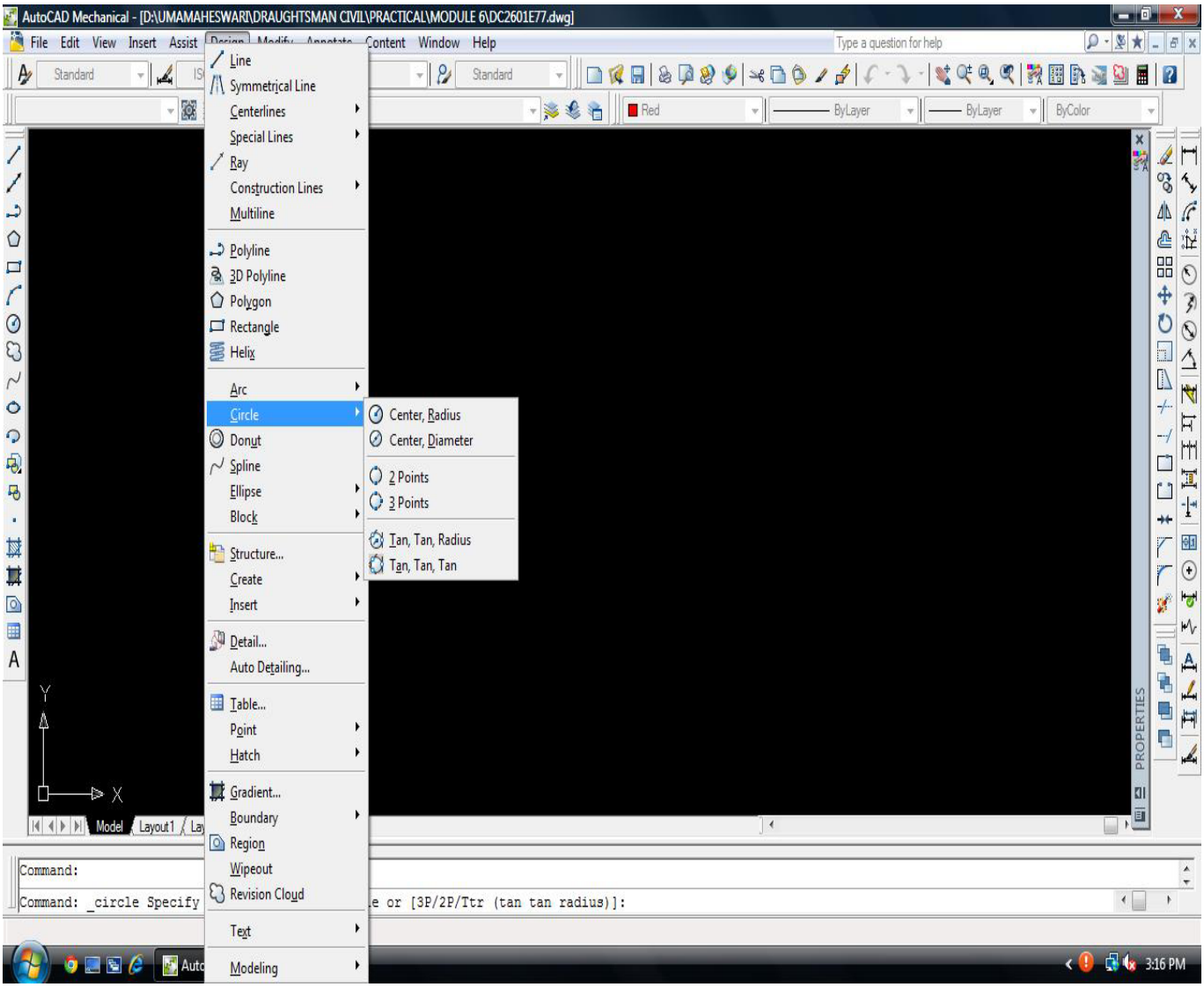
Space Bar Same as the Enter Key, except when entering text.

PULL- DOWN “MENU BAR”

(1) The pull-down “MENU BAR” is located at the top of the screen.

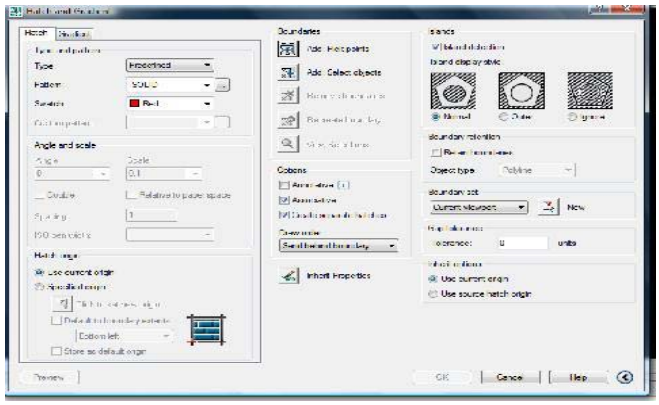
by selecting any of the words in the MENU BAR, a **(2) Pull - down menu** appears. If you select a word from the pull - down menu that has an **(3) Arrow** a **(4) Sub menu** if you select a word with **(5) Ellipse**... a dialog box will appear.

(Example: Draw/Boundary...)



DIALOG BOX

Many commands have **multiple options** and require you to make selections. These commands will display a dialog box. Dialog boxes, such as the **Hatch** dialog box shown here, make selecting and setting options easy.



Tool Bars

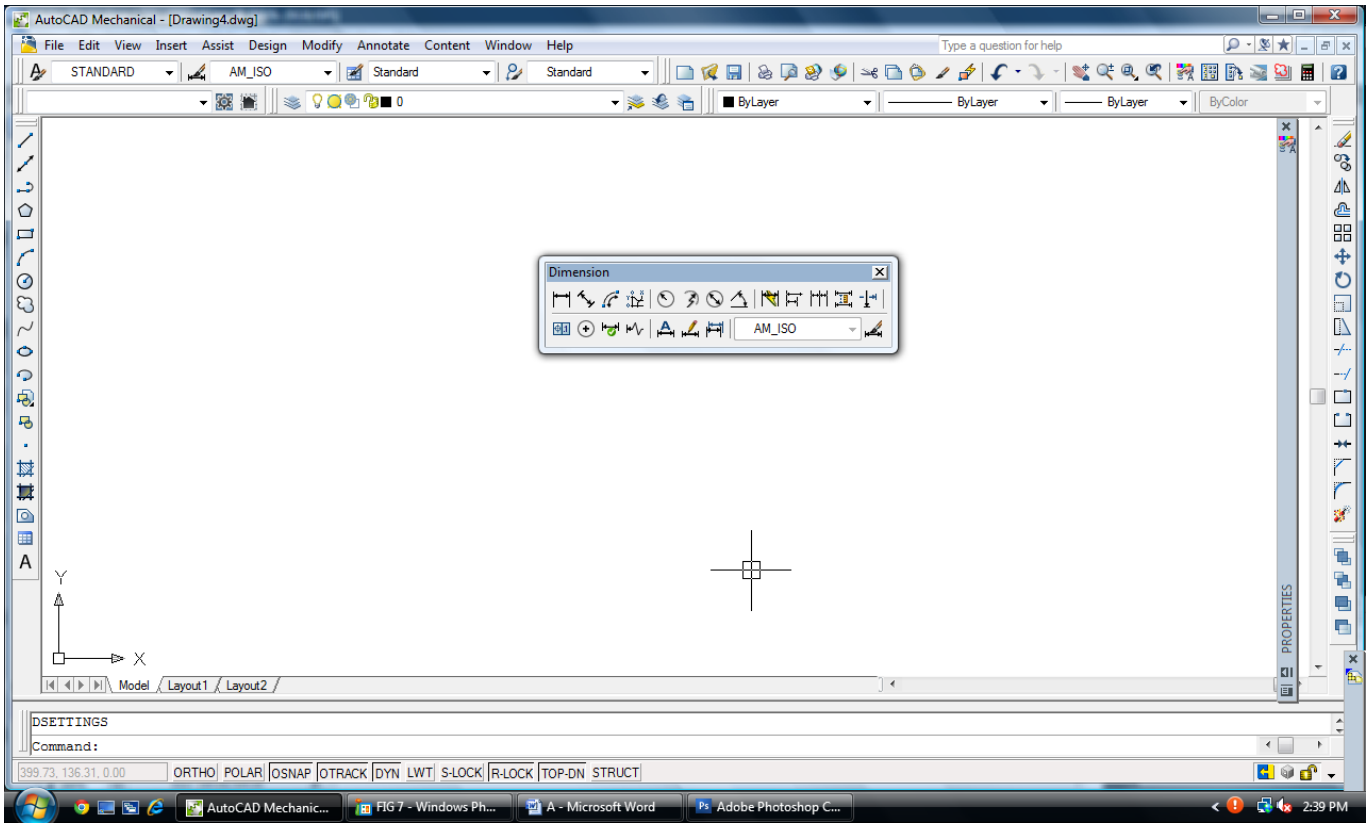
AutoCAD provides several toolbars to access frequently used commands.

The **Standard, Object Properties, Draw, and Modify** toolbars are displayed by default.

Toolbars contain **Icon Buttons**

These icon buttons can be selected to Draw or Edit objects and manage files.

If you place the pointer on any icon and wait a second, a **tool tip** will appear and a **Help Message** will appear at the bottom of the screen.



Basic commands -I

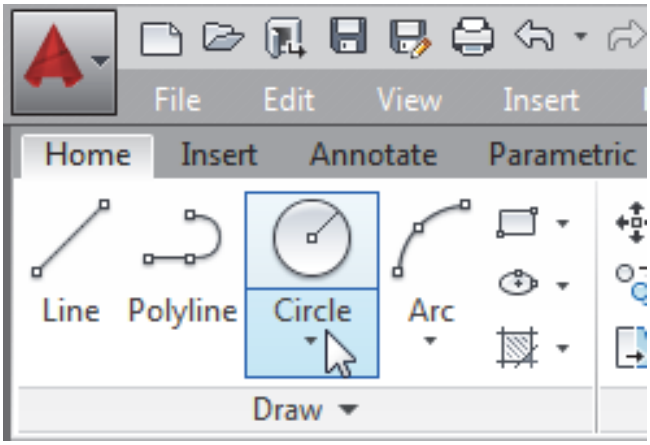
Objectives : At the end of this exercise, you shall be able to,

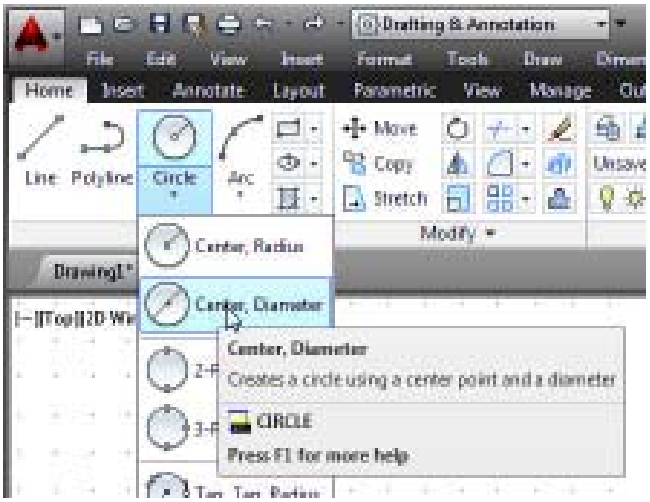
- **create Circle**
- **create Arcs**
- **creat polygon**

Creating Circles

The menus and toolbars is **AutoCAD 2013** are designed to allow the CAD operators to quickly activate the desired commands.

1. In the Draw toolbar, click on the little triangle below the circle icon. Note that the little triangle indicates additional options are available.





2. In the aws a circle based on two endpoints of the diameter.

   Notice the different options available under the circle submenu:

- **Center, Radius:** Draws a circle based on a center point and a radius.
- **Center, Diameter:** Draws a circle based on a center point and a diameter.
- **2 points:** Draws a circle based on two
- **3 Points:** Draws a circle based on three points on the circumference.
- **TTR - Tangent, Tangent, Radius:** Draws a circle with a specified radius tangent to two objects.
- **TTT - Tangent, Tangent, Tangent:** Draws a circle tangent to three objects.

Circle

AutoCAD provides the following ways of drawing circles.

1. Centre and radius

This is the classical method. The first point define the circle's center,

The second one radius

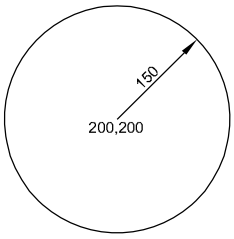
Example:

Command : Circle or C

3P / 2P / TTR /<Center point> : 200,200

Diameter / <Radius> : 150

Fig 1



PRACTICE ON CIRCLE COMMAND

SUN1533H1

2. Centre and diameter

After the circle's center has been defined the diameter can be given

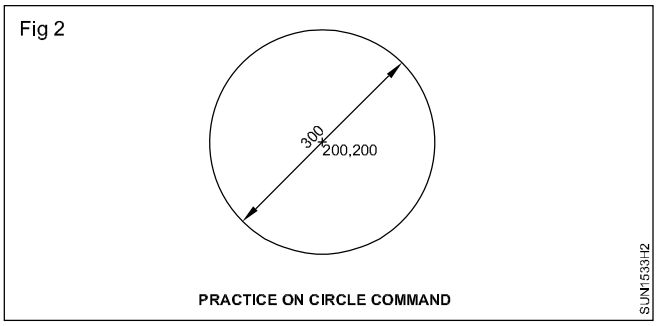
Example:

Command : Circle or C

3P/2P/TTR/<Center Point> : 200, 200

Diameter/<Radius> :D

Diameter :300



3 2 Points

With this option, the user can specify two points constituting the end points of the circles diameter.

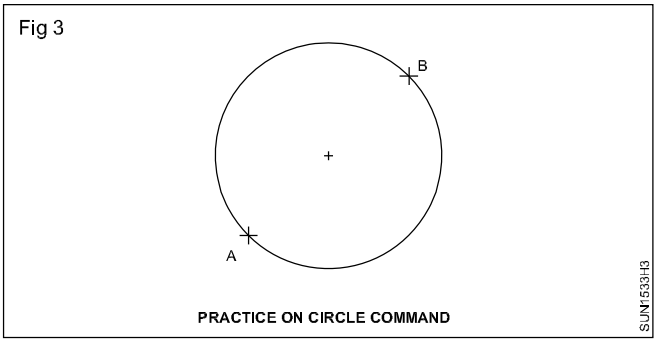
Example:

Command : Circle or C

3P/2P/TTT/<Center point> :2P

First point on Diameter :200,200

Second point on Diameter :400,400



4. 3 Points

With this option the user can specify two points constituting the end points of the circles diameter.

Example:

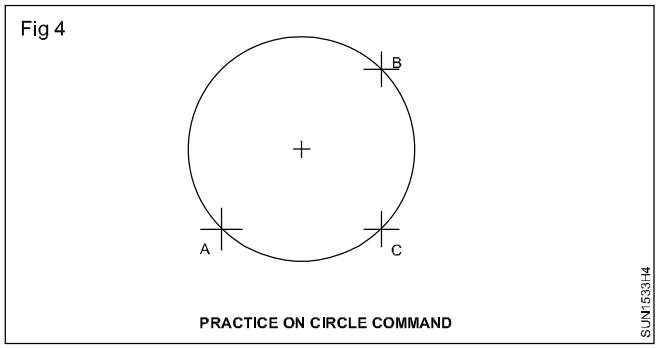
Command : Circle or C

3P/2P/TTR/<Center point> : 3P

First point on Diameter : 200,200

Second point on Diameter : 400,400

Third point on Diameter : 300,350



5. Tangent, Tangent and Radius

This option allows the user to define two tangential points and then the circle's radius. In order to invoke this option it should have two entities draw. The circle can be drawn between Tangentially to two lines, two circles, or two Arc's or combination of any two.

Example:

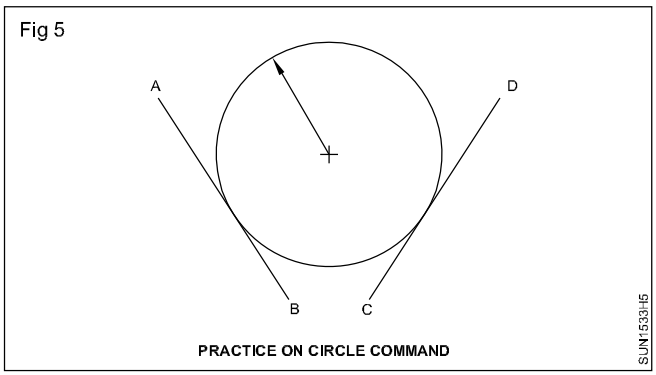
Command : Circle or C

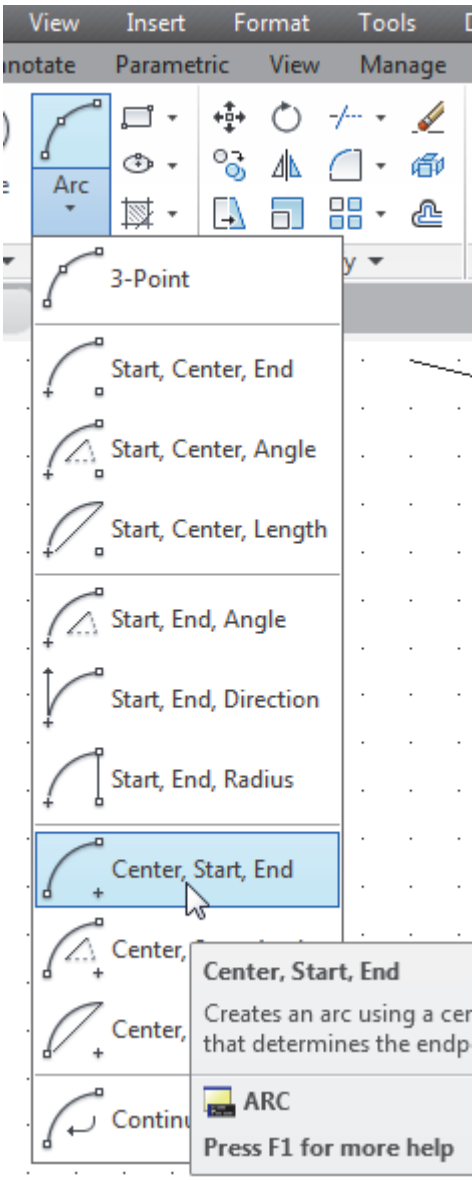
3P/2P/TTR/<Center point> : TTR

Enter Tangent Space : Pick by using mouse on the entity drawn already

Enter second Tangent Space: Pick by using mouse on the other entity drawn already

Radius : 100

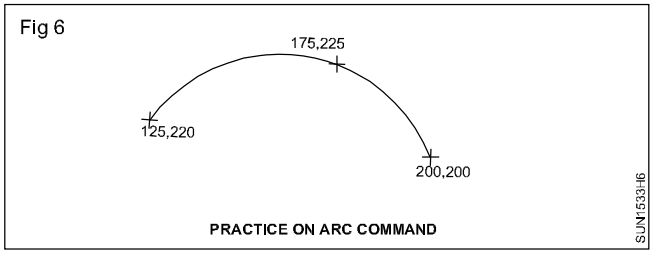




AutoCAD procides 11 different ways of drawing Arcs.

1. 3 Points

In this method three points define the Arc's Start point, Second point that the Arc passes through, and the Arc's End point.



2. Start point, centre, end point (S,C,E)

Center refers to the center point of the circle of while the arc is a part.

Example:

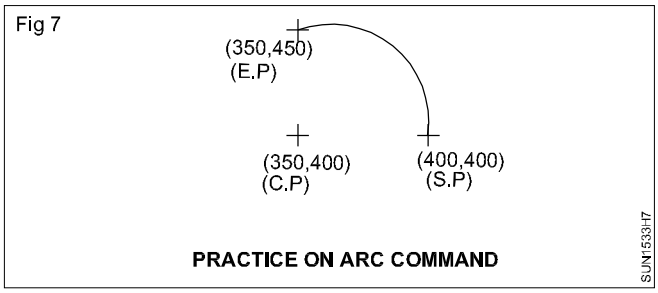
Command : Arc or A

Center/<Start point> : 400,400

Center/End<Second point> : C

Center point :350,400

Angle/Length of chord/<End point>: 50,450



3. Start point, centre, included angle (S,C,A)

In this method first specify the start point of the arc, then the center point or the arc, and then the include angle between the start point and the end point of the arc.

Example:

Command : Arc or A

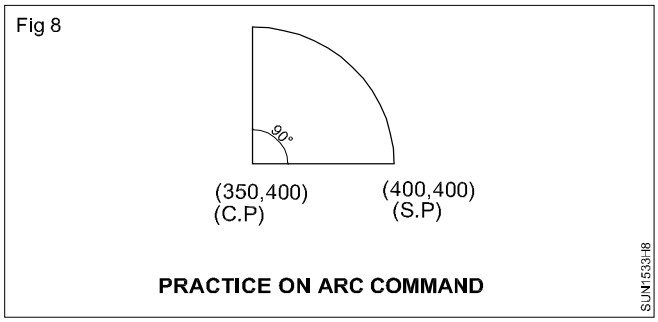
Center/<Start point> :400,400

Center/End<Second point> :C

Center point :350,400

Angle/Length of Chord/<End point>: A

Included Angle : 90



4. Start point. centre, length of chord (S,C,L)

In this method first specify the start point of the arc, then the center point of the arc and then the chord length.

Example:

Command : Arc or A

Center/<Start point> : 400,400

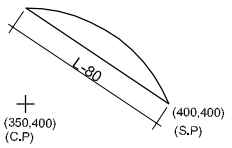
Center/End<Second point> : C

Center Point :350,400

Angle/Length of Chord/<End point>: L

Length of Chord : 80

Fig 9



PRACTICE ON ARC COMMAND

SUN1533-I9

5. Start point, end point, radius (S,E,R)

In this method first specify the start point of the arc, then the end point and finally the radius of the arc.

Example:

Command : Arc or A

Center/<Start point> : 400,400

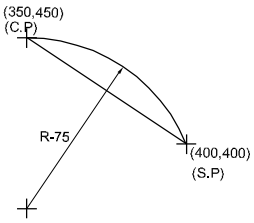
Center/End<Second point> : E

End point :350,450

Angle/Direction/Radius/<Center point>: R

Radius : 75

Fig 10



PRACTICE ON ARC COMMAND

SUN1533-IA

6. Start point, end point, included angle (S,E,A)

In this method first specify the start point of the arc, then the end point and finally the included angle of the arc.

Example:

Command : Arc or A

Cener/<Start Point> : 400,400

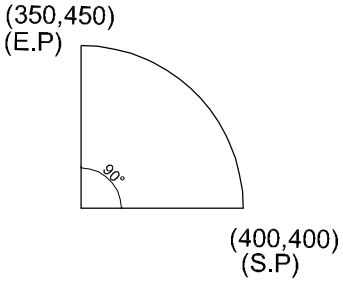
Center/End<Second point> : E

End point : 350,450

Angle/Direction/Radius/<Center poinmt> : A

Included angle : 90

Fig 11



PRACTICE ON ARC COMMAND

SUN1533-Ib

7. Start point, end point, starting direction (S,E,D)

In this method first specify the start point of the arc, then the end point and finally the starting direction of the arc from the start point.

Example:

Command : Arc or A

Center/<Start point> :400,400

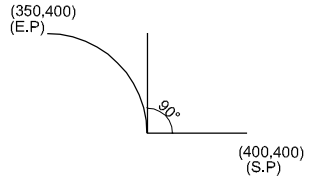
Center/End<Second point> : E

End point : 350,450

Angle/Direction/Radius/<Center point>: D

Direction from start point : 90

Fig 12



PRACTICE ON LINE COMMANDS

SUN1533-Ic

8. Start point, end point, centre point (S,E,C)

In this method first specify the start point of the arc, then the end point and finally the center point of the arc.

Example:

Command : Arc or A

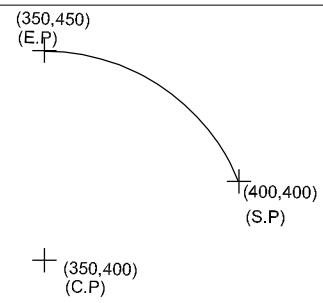
Center/<Start Point> :400,400

Cener/End<Second point> : E

End point : 250,450

Angle/Direction/Radius/<Center point>: 350,400

Fig 13



PRACTICE ON ARC COMMAND

SUN1533-ID

9. Centre point, start point, end point (C,S,E)

In this method first specify the center point of the arc, then the start point and finally the end point of the arc.

Example:

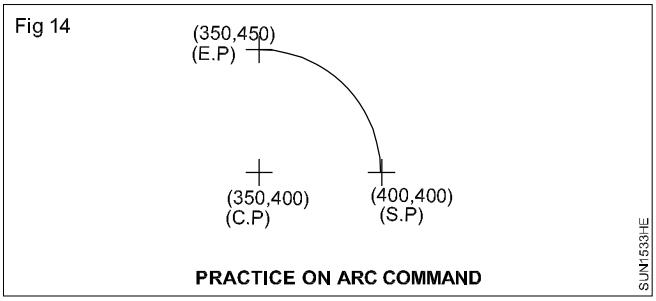
Command : Arc or A

Center/<Start point> : C

Center point : 350,400

Stat point : 400,400

Angle/Length of chord/<End point> : 350,450



10. Centre point, start point, length of the chord (C,S,L)

In this method first specify the center point of the arc, then the start point and finally the length of chord.

Example:

Command : Arc or A

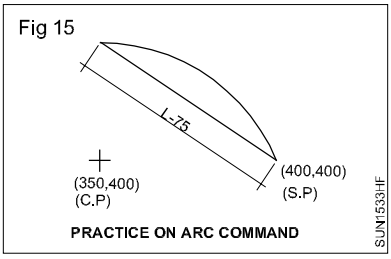
Center/<Start point> : C

Center point : 350,400

Stat point : 400,400

Angle/Length of chord/<End point>: L

Length of chord : 75



11. Centre point, start point, included angle (C,S,A)

In this method first specify the center point of the arc, then the start point and finally the included angle.

Example:

Command : Arc or A

Center/<Start point> : C

Center point : 350,400

Stat point : 400,400

Angle/Length of chord/<End point>: A

Included angle : 90

ELLIPSE

This command approximates an ellipse is to choose the default options:

1. Ellipse by axis and eccentricity

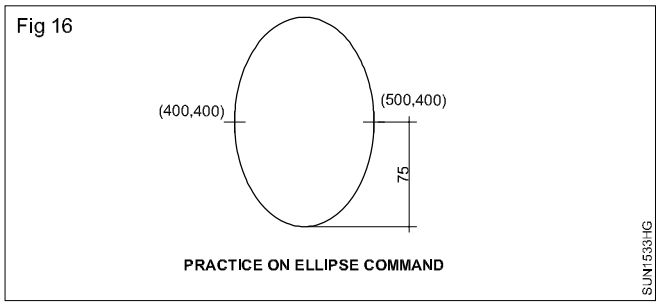
Example:

Command : Ellipse or EL

Axis end point of ellipse or (Arc/Center) : 400,400

Other end point of axis : 500,400

Distance to other axis or [Rotation] : 75



2. Ellipse by axis and rotation

Example:

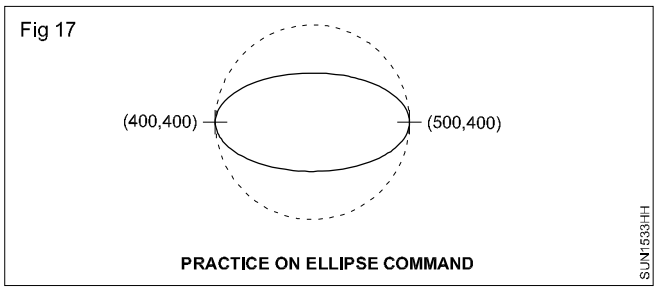
Command : Ellipse or EL

Axis end point of ellipse or (Arc/center):400,400

Other end point of axis : 500,400

Distance to other axis or [Rotation]: R

Rotation around major axis : 60



3. Ellipse by centre and two axes

Example:

Command : Ellipse or EL

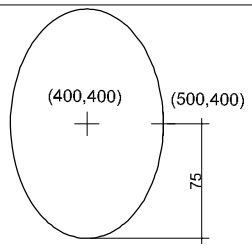
Axis end point of ellipse or (Arc/center):400,400

Center of ellipse : 400,400

Axis end point : 500,400

Distance to other axis or [Rotation]: 75

Fig 18



PRACTICE ON ELLIPSE COMMAND

SUN1533-II

4. Ellipse by centre, one axis, and rotation

Example:

Command : Ellipse or EL

Axis end point of ellipse or (Arc/center): C

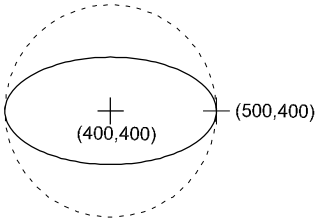
Center of ellipse : 400,400

Axis end point : 500,400

Distance to other axis or [Rotation]: R

Rotation around major axis : 60

Fig 19



PRACTICE ON ELLIPSE COMMAND

SUN1533-IJ

POLYGON

This command allows the user to draw regular 2D polygons.

1. Centre of polygon, inscribed circel, radius

Example:

Command : POL

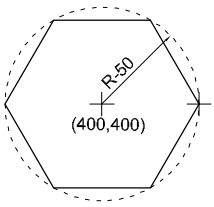
POLYGON Enter number of sides <default>: 6

Center of polygon or [Edge] : 400,400

[Inscribed in circle/Circumscribed about circle]<I>:I

Specify radius of circle : 50

Fig 20



PRACTICE ON POLYGON COMMAND

SUN1533-IK

2. Centre of polygon, circumscribed about circle radius of circle

Example:

Command : Polygon/POL

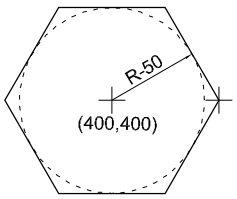
POLYGON Enter number of sides <default>: 6

Center of polygon or [Edge] : 400,400

[Inscribed in circle/Circumscribed about circle]<I>: C

Radius of circle : 50

Fig 21



PRACTICE ON POLYGON COMMAND

SUN1533-IL

3. EDGE OPTION

Example:

Command : Polygon/POL

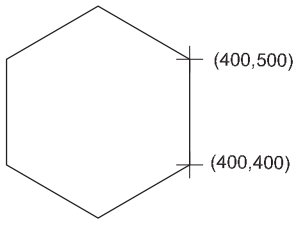
POLYGON Enter number of sides <default>: 6

Center of polygon or [Edge] : E

First end point of edge : 400,400

Second end point of edge : 400,500

Fig 22



PRACTICE ON POLYGON COMMAND

SUN1533-IM

DOUGHNUT (DONUT)

This command allows the user to draw filled circles and rings

Example of filled circle option:

Command : Donut

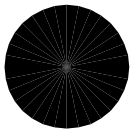
Inside diameter <default>: 0

Out side diameter <default>: 50

Center of doughnut : 100,100

Center of doughnut :

Fig 23



PRACTICE ON DOUGHNUT COMMAND

SUN1533HN

Example for rings:

Command : Donut

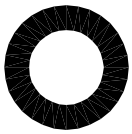
Inside diameter <default>: 30

Out side diameter <default>: 50

Center of doughnut : 100,100

Center of doughnut :

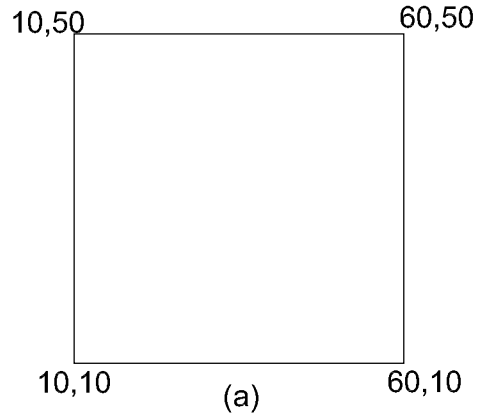
Fig 24



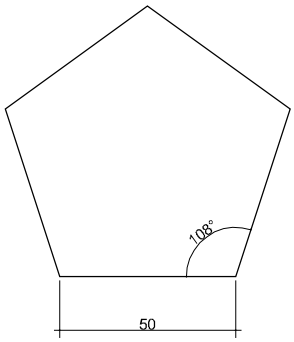
PRACTICE ON DOUGHNUT COMMAND

SUN1533HO

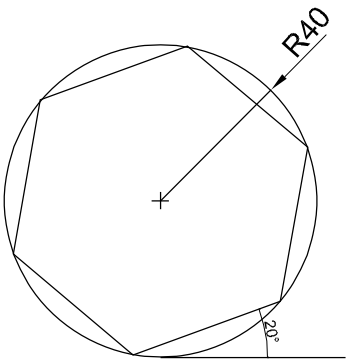
Fig 25



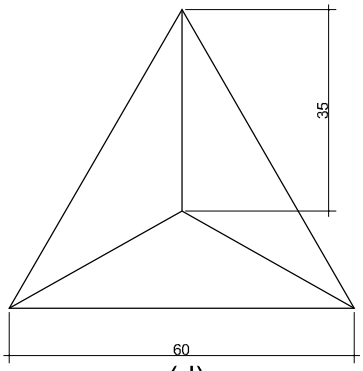
(a)



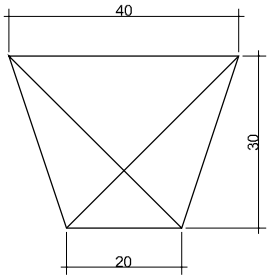
(b)



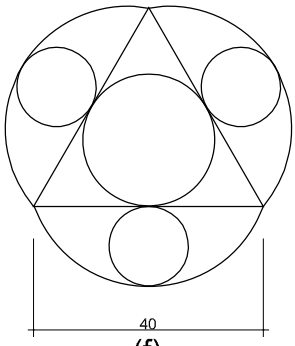
(C)



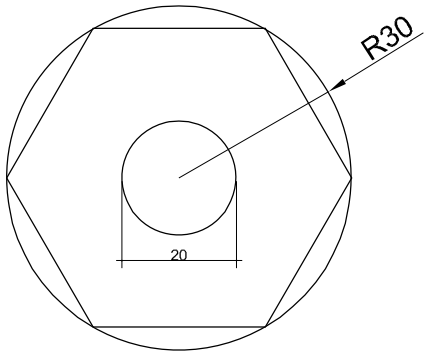
(d)



(e)



(f)



(g)

EXERCISE

SUN1533HP

Basic commands -II

Objectives : At the end of this exercise, you shall be able to,

- **erase, oops, move, copy, offset, rotate.**
- **scale, fillet, trim, champer, extend, break.**
- **join, mirror, array, strech, lengthen,explode.**

Modifying commands

Modifying commands are used for modifying the existing drawings. Thus it helps to prepare a final drawing incorporating the necessary changes and a lot of time is saved. Modifying commands are properties, erase, copy, mirror, offset, array,move,rotate, scale, trim, extend, explode etc.

1. Erase:

This command allows the user to specify entities permanently removed from the drawing. The selection can be made with any of the standard SELECT OBJECT method

Tool bar : Modify, Erase

Pull down : Modify, Erase

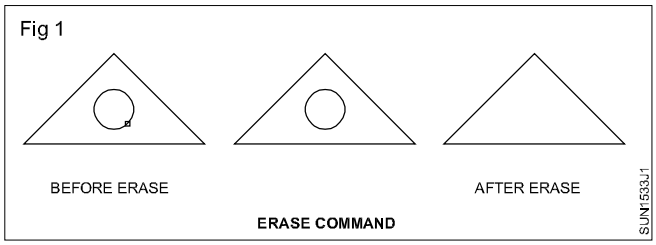
Command : Erase./ E

Example:

Command : Erase or E

Select objects : Select the objects using mouse

Select objects :



2. Oops

This command restore objects that have been unexpectedly erased by the previous ERASE command

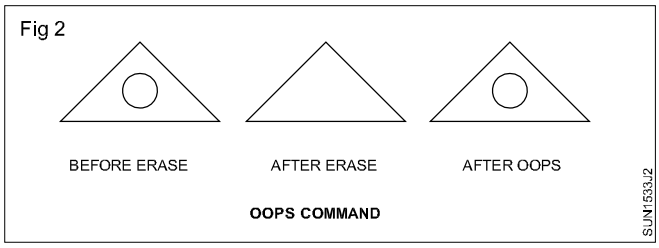
Example:

Command : Erase or E

Select objects : Select the objects using mouse

Select objects :

Command : Oops



3. Move

This command is used to move a single or a set of objects to a new location on a drawing.

Tool bar : Modify, Move

Pull down : Modify, Move

Command : Move / M

Example

Command : Move or M

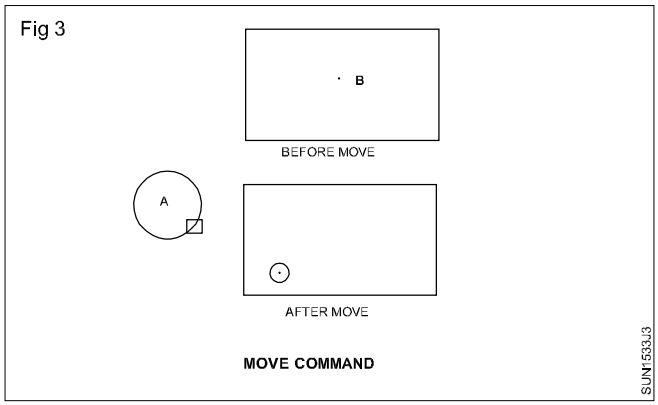
Select objects : Select circle

Select objects : One found

Select objects :

Base point or displacement : Click A as basepoint

Second point of displacement: Select B



. Copy

Tool bar : Modify, Copy

Pull down : Modify, Copy

Command : Copy

This command is used to copy the existing drawing to another place

Example:

Command : Copy or Co or CP

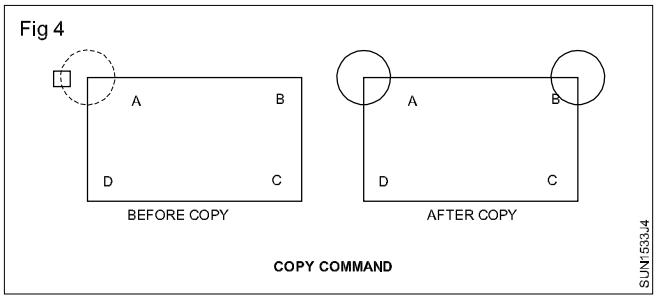
Select objects : Select object to Copy

Select objects : One found

Select objects :

Base point or displacement : Select a base point

Second point of displacement: Drag cursor at desired place and click mouse



5. Offset

Tool bar : Modify, Offset

Pull down: Modify, Offset

Command: Offset / O

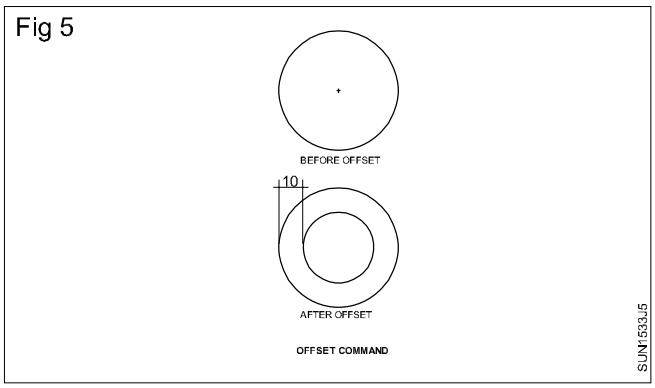
This command is used to draw parallel lines, concentric circle, arcs etc. When offset is used, it is necessary to specify the offset distance and side of offset.

Command : Offset or O

Offset distance or through <current> : 10

Select the object to offset: Select the circle

Side to offset : Specify the side for offsetting



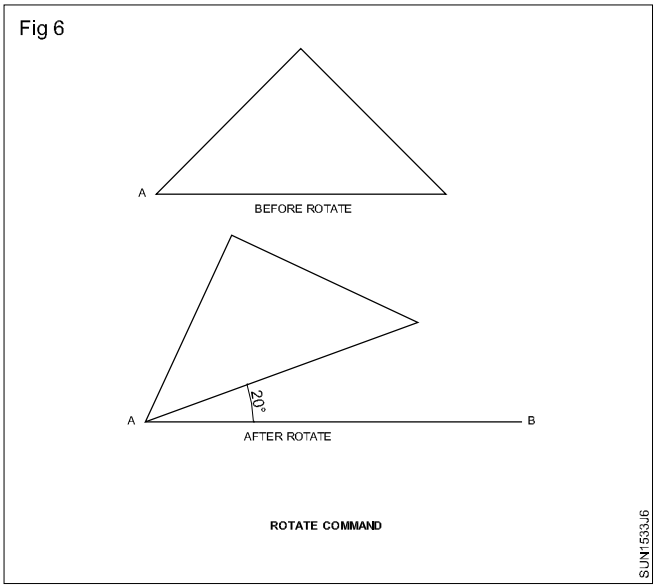
6. Rotate

This command is used to rotate an object or set of objects to a specified angle.

Tool bar : Modify, Rotate

Pull Down : Modify, Rotate

Command : Rotate / Ro



Example:

Command : Rotate / Ro

Select objects : Select the object by window

Select objects : Three found

Select objects :

Specify base point or displacement: Click A as basepoint

Specify rotation angle or [Copy / Reference] < default>: 20

7. Scale

This command is used to change the size of an object

Tool bar : Modify, Scale

Pull down : Modify, Scale

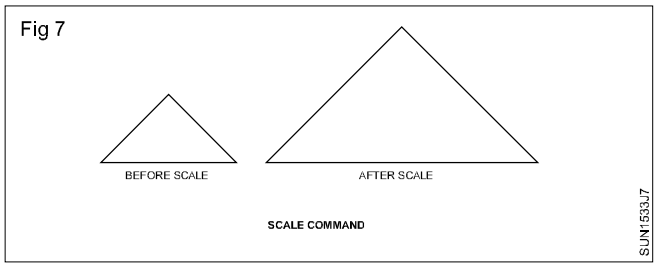
Command : Scale / SC

Example:

Command : Scale / SC

Select objects : Select the object by window

Fig 7



Select objects : Three found

Select objects :

Specify scale factor or [Copy/Reference]<Default>: 2

8. Fillet

This command is used to connect two parallel lines, arcs etc., smoothly by a curve of specified radius

Tool bar : Modify, Fillet

Pull down : Modify, Fillet

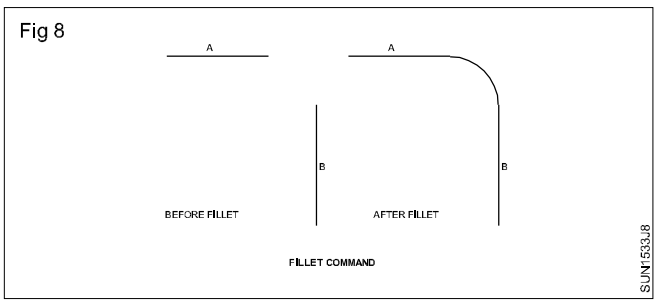
Command : Fillet or F

Example:

Command : Fillet or F

Current settings : TRIM, Radius = 0,0000

Fig 8



Select first object or [Undo/Polyline/Radius/Trim/Multiple]: R

Specify fillet radius<0.0000>

Select first object or [Undo/Polyline/Radius/Trim/Multiple]: Select A

Select second object or shift - selected to apply corner: Select B

9. Trim

This command is used to removed a part of a line, circle or arc based on a cutting edge.

Tool bar : Modify, Trim

Pull Down : Modify, Trim

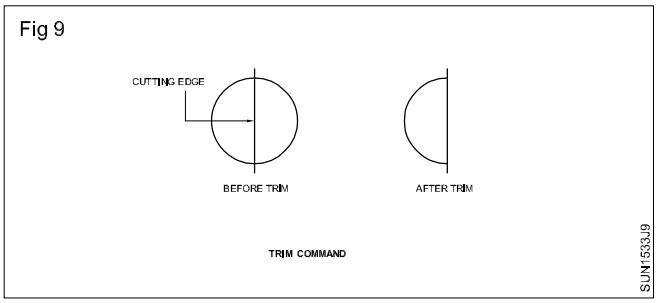
Command : Trim or TR

Example:

Command : TR TRIM

Select objects or <Select all>: Select cutting edge, 1 found

Fig 9



Select objects:

Select object to trim of shift - select to extend or

[Fence / Crossing / Project / Edge / eRase / Undo]: Select object to trim

Select object to trim or shift - select to extend or

[Fence / Crossing / Project / Edge/ eRase/ Undo]:

10. Chamfer

This command is used to join two non parallel lines with an intermediate line. It produces an inclined surface at the edge of two intersetting lines.

Tool bar : Modify, Chamfer

Pull down : Modify, Chamfer

Command : Chamfer or CHA

Example:

Command : CHAMFER OR CH

(TRIM mode) Current chamfer Dist1 <Default>, Dist2 <Default>

Select first line or [Undo Polyline/Distance/Angle/

Trim/mEthod/Multiple] : D

Specify first chamfer distance <0.5000>

Specify second chamfer distance <3.0000>

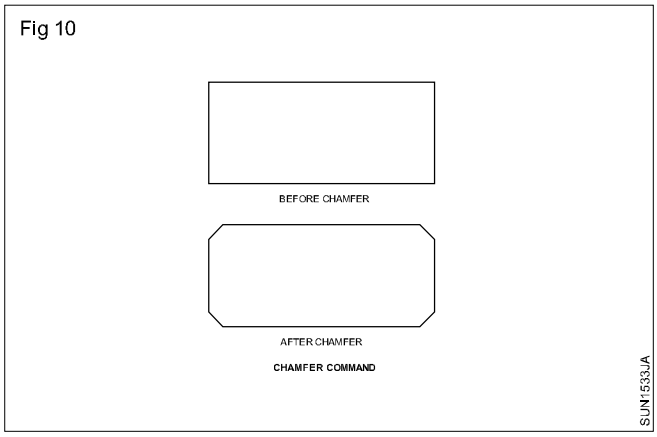
Select first line :

Select second line :

11. Extend

This command is used to extend the shorter lines to meet another object.

Fig 10



Tool bar : Modify, Extend

Pull down : Modify, Extend

Command : Extend or EX

Example:

Command : Extend or EX

Select boundary edges..

Select objects or <Select all>: Select A, 1 found

Select objects:

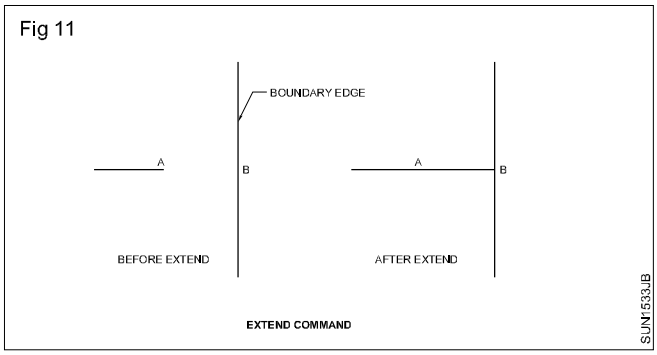
Select object to extend or shift - select to trim or [Fence/ Crossing/Project/Edge/Undo]:Select B

Select object to extend or shift - select to trim or [Fence/ Crossing/Project/Edge/Undo]:

12. Break

This command is used to erase a part of an object be-

Fig 11



tween two points.

Tool bar : Modify, Break

Pull Down : Modify, Break

Command : Break or BR

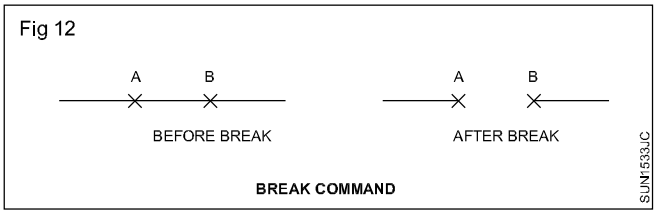
Example1 : To break a line

Command : Break or BR

Select objects : Select A

Specify second break point : Select B

Fig 12



13. Join

This command is used to join two lines.

Tool bar : Modify, Join

Pull down : Modify, Join

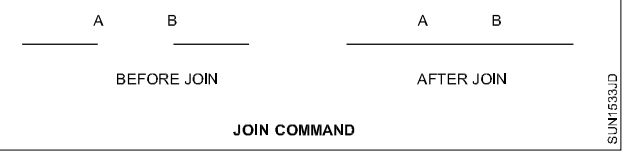
Command : Join or J

Example:

Command : Join or J: Select source object

Select lines to join to source: Select A and B

Fig 13



14. Mirror

Tool bar : Modify, Mirror

Pull down : Modify, Mirror

Command : Mirror or MI

This command is used to create a mirror image of the select objects. After selecting the objects the beginning point and end point of a mirror line is entered.

Example:

Command : Mirror

Select object : Select the object

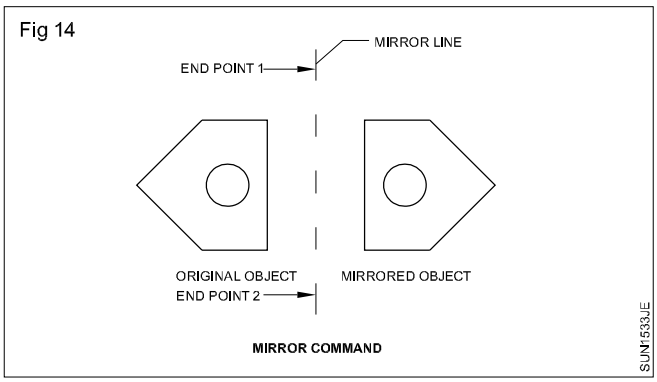
Select object :

First point of mirror line : Specify the first point

Second point : Specify the second point

Delete old object ? <N> : Enter Y for deletion, N for re-taining the previous object

Fig 14



15. Array

Tool bar : Modify, Array

Pull down : Modify, Array

Command : Array or AR

This command is used to make multiple copies of an object in rectangular or polr (circulr) patterns.

Example: 1

Command : Array

Select objects : Select circle of radius 5

Select objects :

Rectangular or polar Array (R/P) : R

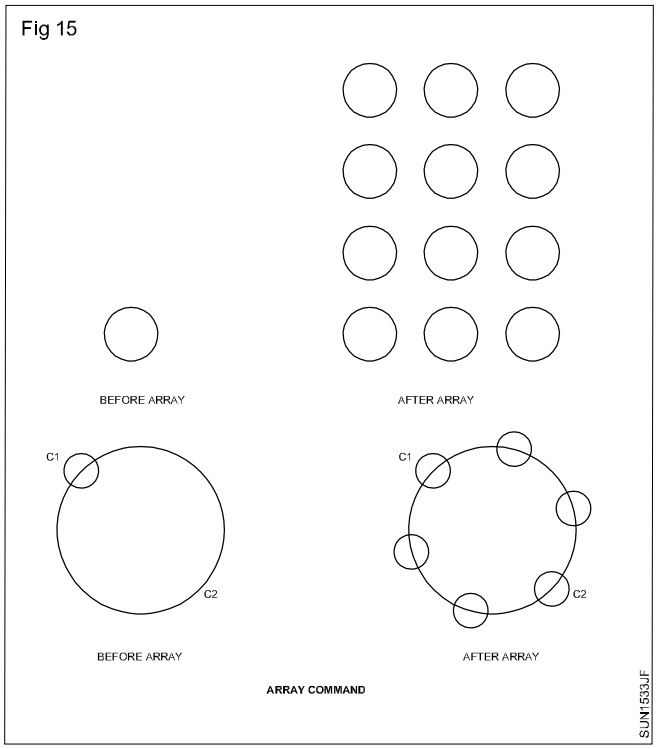
Number or Rows (----) <1> : 4

Number of columns (III) <1> : 3

Unit cell or distance between Rows (----) : 3

Distance between columns (III) : 3

Fig 15



Example: 2

Command : Array

Select objects : Select circle C1

Select objects :

Rectangular or polar Array (R/P) : P

Base /<Centre point of Array>: Select circle C2

Number or Items : 4

Angle to fill <360> : Press to acept 360°

Rotate objects as they are copied ? <Y>: Enter Y or N

16. Strech

Tool bar : Modify, Strech

Pull down : Modify, Strech

Command : Strech or S

This command is used to lengthen or shorten the line or objects

Example: 1

Command : STRETCH

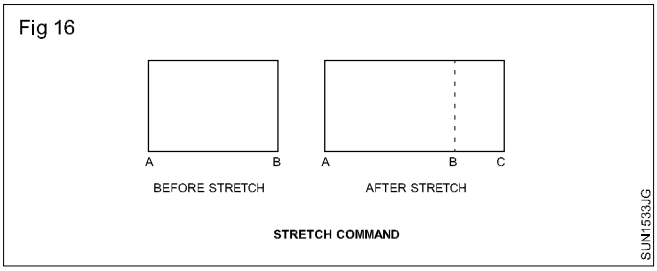
Select objects to stretch by crossing - window

Select objects: Select A and B by crossing - window

Select objects:

Specify base point or [Displacement] <Displacement>

Specify second point: Mouse click at C

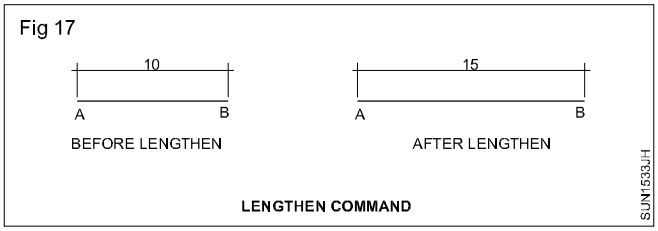


17. Lengthen

Tool bar : Modify, Lengthen

Pull down: Modify, Lengthen

Command: Lengthen or LEN



This command is used to lengthen or shorten a line.

Example : 1

Command : LEN or LENGTHEN

Select an object or [DElta/Percent/Total/Dynamic]: T

(Current length: 10)

Specify total length of [Angle] <1.0000)>:15

Select an object to change or [Undo]: Select line AB

Select an object to change or [Undo]:

18. Explode

Tool bar : Modify, Explode

Pull down : Modify, Explode

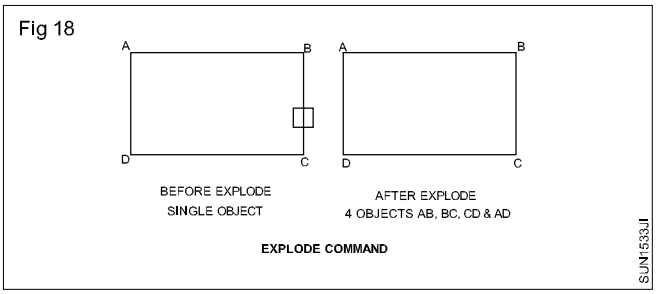
Command : Explode or X

This command will split the component objects such as blocks, polylines, regions etc. If you explode a ploy line the result will be ordinary lines or arcs.

Example:1

Command : EXPLODE or X

Select an object : Select the rectangle



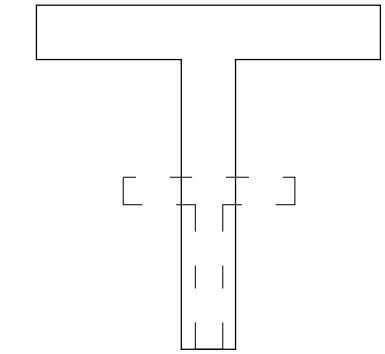
19. SCALE

Choose	Modify, Scale.
Click	the Scale icon.
Type	SCALE at the command prompt
	Command : SCALE
	Select objects: (Select Objects)
Pick	A pivot point to scale about base point : (point)
Type	A rotation angle <Scale factor> / Reference: (number)
or	
Pick	A scale factor< Scale Factor>/ Reference: (Point)
	Scale factor / Reference: (points)

Scale by specifying Length

You can show AutoCAD the reference length (by pointing to the two endpoints of a line to be scaled), and then specify the new length. You can specify the new length by pointing, or by dragging the object.

Fig 19



SCALE COMMAND

SUN:533JJ

1. Type R to define a reference length

   Scale factor / Reference: (R)

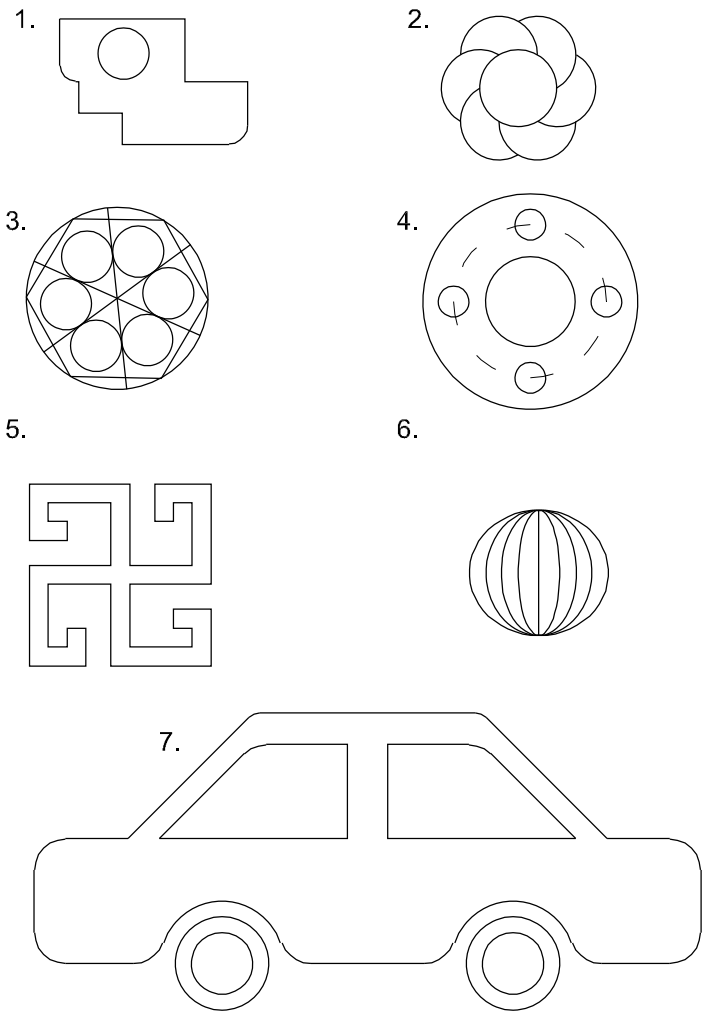
2. Choose A reference scale factor

   Reference length; (number or points)

3. Choose A new scale factor

   New length: (number of points)

Fig 20



EXERCISE

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