SURVEYOR

NSQF LEVEL - 4

1st Year

TRADE PRACTICAL

SECTOR : CONSTRUCTION

(As per revised syllabus July 2022 - 1200 Hrs)

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

Sector : Construction

Duration : 2 - Years

Trade : Surveyor- 1st Year - Trade Practical - NSQF Level - 4 (Revised 2022)

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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 Mentor Councils comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, an autonomous body under Ministry of Skill Development & Entrepreneurship is entrusted with developing producing and disseminating Instructional Media Packages (IMPs) required for ITIs and other related institutions.

The institute has now come up with instructional material to suit the revised curriculum for **Surveyor 1st Year Trade Practical NSQF Level - 4 (Revised 2022) in Construction Sector under Annual Pattern.** The NSQF Level - 4 (Revised 2022) 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 - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these 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

Addl.Secretary/Director General (Training)
Ministry of Skill Development & Entrepreneurship,
Government of India.

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 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 (NSQF) 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.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

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.

Chennai - 600 032 **EXECUTIVE DIRECTOR**

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 NSQF Level - 4 (Revised 2022)** under **Construction** Sector for ITIs.

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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. It consists of a series of practical exercises to be completed by the trainees during the 1st Year Course of **Surveyor under Construction Sector.** Trade supplemented and supported by instructions / informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 4 (Revised 2022) syllabus are covered. The manual is divided into Ten modules.

Module 1 - Safety

Module 2 - Basic Engineering Drawing

Module 3 - Chain Surveying

Module 4 - Compass surveying

Module 5 - Computer Aided Drafting

Module 6 - Plane Table Surveying

Module 7 - Theodolite

Module 8 - Levelling

Module 9 - Road Project Survey

Module 10 - Perform AutoCAD Drawing

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

While developing the practical manual, a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI looks forward to the suggestions from the experienced training faculty for improving the manual.

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **Surveyor** Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 4 (Revised 2022) syllabus on Trade Practical. Attempt has been made to relate the theoretical 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 on trade practical. The indications about the corresponding practical exercises are given in every sheet of this manual.

It will be preferable to teach/learn 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 for the purpose of self-learning and should be considered as supplementary to class room instruction.

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

Sl.No.	Learning Outcome	Exercise No.
1	Concept of drawing & sheet layout following safety precautions	1.1.01 - 1.2.09
2	Draw lettering & numbering applying drawing instruments	1.2.10 & 1.2.11
3	Draw plain geometrical figures, curves & conics	1.2.12
4	Construct plain scale, diagonal scale, comparative scale, vernier scale	1.2.13 & 1.2.14
5	Draw conventional signs & symbols used in surveying	1.2.15 & 1.2.16
6	Perform site survey using chain/ tape & prepare a site plan	1.3.17 - 1.3.25
7	Perform the site survey using prismatic compass	1.4.26 - 1.4.29
8	Perform AutoCAD drawing	1.5.30
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10	Perform theodolite survey	1.7.34 - 1.7.41
11	Perform traverse survey by Theodolite & prepare a site map	1.7.42 - 1.7.47
12	Determine of R.L & heights of different points by levelling instruments	1.8.48 - 1.8.58
13	Perform a road project survey	1.9.59 - 1.9.62
14	Perform AutoCAD drawing (single story building)	1.10.63 - 1.10.65

SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 56 Hrs.; Professional Knowledge 12 Hrs.	Concept of drawing & sheet layout following safety precautions.	1. 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 newcomers 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. (12 Hrs.)
Professional Skill 56 Hrs.; Professional Knowledge 18 Hrs.	Draw lettering & numbering applying drawing instruments.	10. Lettering & numbering (Single & double stroke) (30hrs.) 11. Types of lines and dimensioning. (26hrs.)	Details layout of lettering, lines & dimensioning system. (18Hrs.)
Professional Skill 28Hrs.; Professional Knowledge 06Hrs.	Draw plain geometrical figures, curves & conics	12. Construction of plain geometrical figures, curves & conics. (28 hrs.)	Introduction of surveying, types of surveying, use, application principal. (06 Hrs.)
Professional Skill 28Hrs.; Professional Knowledge 08Hrs.	Construct plain scale, diagonal scale, comparative scale, vernier scale.	13. Drawing of: - 14. Construction of scales - plain, diagonal, vernier. (28 hrs.)	Knowledge of different types of scales, determine of R.F & uses of scales. (8Hrs.)
Professional Skill 28Hrs.; Professional Knowledge 06 Hrs.	Draw conventional signs & symbols used in surveying.	15. Drawing of conventional signs & symbols (10hrs.) 16. Free hand sketch of liner measurement instruments (18 hrs.)	Use & application of conventional signs & symbols. (06 Hrs.)

Professional Skill 84 Hrs.; Professional Knowledge 18Hrs.	Perform site survey using chain/ tape & prepare a site plan.	17. Practice of folding & unfolding of chain. (5 hrs.) 18. Equipment and instrument used to perform surveying & testing of chain. (5 hrs.) 19. Ranging (direct/ indirect) & distance measure with chain/ tape. (10 hrs.) 20. Offset taking & entering field book. (6 hrs.) 21. Overcoming obstacles in chaining. (6 hrs.) 22. Chaining on sloping ground. (10 hrs.) 23. Conduct a chain survey of a small area with all details and plotting the map. (20hrs.) 24. Calculating the area of site. (6 hrs.) 25. Prepare a site plan by the help of chain / tape. (16hrs.)	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. (18hrs.)
Professional Skill 112 Hrs.; Professional Knowledge 24 Hrs.	Perform the site survey using prismatic compass	26. Temporary adjustment of prismatic compass. (10 hrs.) 27. Measure fore & back bearing of a line. (10 hrs.) 28. Measure true bearing of a line. (20 hrs.) 29. Prepare a closed & open traverse using prismatic compass measure the bearings, entry into field 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 & it setting up. Conversion of bearing web to R.B. Calculation of included angle from bearing local attraction, magnetic declination and true bearing, closing error. Adjustment of closing error, precaution in using prismatic compass. (24 hrs.)
Professional Skill 28 Hrs.; Professional Knowledge 06Hrs.	Perform Auto CAD drawing	30. Practice with AutoCAD using commands (28 hrs.)	Introduction to Auto CAD. Use AutoCAD command. (06 hrs.)
Professional Skill 84 Hrs.; Professional Knowledge 18Hrs.	Perform the site survey using the plane table.	31. Demonstration of instrument used for plane table surveying &their uses (alidade, U-fork, trough compass) Set up the plane table (24hrs.) • Centring • Levelling • Orientation 32. Practice the method of plane tabling (40hrs.) • Radiation	Plane table survey, principle, merits & demerits Instrument used in plane table survey setting up the plane table. (centering, levelling, orientation) Methods of plane table survey (radiation, intersection, resection, traversing) Error in plane table survey. (18hrs.)

		• Intersection • Resection • Traversing 33. Determination of height by telescopic alidade (20 hrs.)	
Professional Skill56 Hrs.; Professional Knowledge 18Hrs.	Perform Theodolite survey.	34. Practice to set up the Theodolite(05hrs.) 35. Reading the vernier& booking (hor./ ver.) Angle. (05hrs.) 36. Perform permanent adjustment of Theodolite(05hrs.) 37. Measurement of horizontal angle by various methods. (10hrs.) 38. Setting out the angles. (5hrs.) 39. Measurement of vertical angle, deflection angle (10 hrs.) 40. Prolongation of line by various methods. (8hrs.) 41. Determination of height of inaccessible object by Theodolite. (8hrs.)	Introduction to Theodolite. Types of Theodolite, parts of Theodolite, Terms used in Theodolite survey. Temporary adjustment of Theodolite, Angle measurement process. Reading of angles, field book entry of measured angles. Permanent adjustment of Theodolite. (18hrs.)
Professional Skill 84Hrs.; Professional Knowledge 24Hrs.	Perform traverse survey by Theodolite & prepare a site map.	42. Traversing (closed & open) using Theodolite & tape/chain (15 hrs.) 43. Measurement of horizontal angles & bearing of a line. (15 hrs.) 44. Computation of coordinates from the bearing, angle length. (15 hrs.) 45. Preparation of gales traverse table (15 hrs.) 46. Computation of area using co-ordinates (15 hrs.) 47. Determine omitted measurements (09 hrs.)	Traversing using theodolite (closed & open), traverse computation, determination of consecutive coordinates, independent co-ordinate, checking & balancing of traverse, preparation of gales traverse table, computation of area using co-ordinates, calculation of omitted measurement (24hrs.)
Professional Skill 84Hrs.; Professional Knowledge 18Hrs.	Determine of RL and heights of different points by levelling instruments.	48. Practice in setting up of dumpy level and performing temporary adjustments (10 hrs.) 49. Practice in staff reading(05hrs.) 50. Practice in simple levelling (10 hrs.) 51. Practice differential levelling (fly levelling) (10 hrs.) 52. Practice reciprocal levelling. (10hrs.) 53. Carryout levelling field book. (02hrs.) 54. Equate reduction of level (rise fall method, height of instrument method) comparison of method. (10hrs.)	Introduction to levelling. Types of levelling instrument. Technical terms used in levelling Temporary & permanent adjustment. Different types of levelling Entry of level book. (Reduced level calculation method) Curvature & refraction effect sensitivity of bubble tube. Common error and their elimination. Degree of accuracy. (18hrs.)

		55. Solve problems on reduction of level. (02hrs.) 56. Practice levelling with (auto / digital level) (10hrs.) 57. Practice profile levelling or longitudinal & cross section levelling, plotting the profile. (10 hrs.) 58. Check levelling (05hrs.)	
Professional Skill 56Hrs.; Professional Knowledge 12Hrs.	Perform a road project survey. shift	59. Road project reconnaissance. (5hrs.) 60. Preliminary survey. (10 hrs.) 61. Final location survey including preparation of route map. (21 hrs.) 62. Profile or longitudinal &cross-sectional levelling & plotting. (20hrs.)	Types of surveys for location of a road. Points to be considered during reconnaissance survey. Classification of roads and terms used in road engineering, alignment of roads relative importance of length of road, height of embankment depth of cutting & filling, road gradients super elevation etc. (12hrs.)
Professional Skill 56 Hrs.; Professional Knowledge 12Hrs.	Perform AutoCAD drawing (single story building)	63. Prepare traverse drawing using Auto cad. (10 hrs.) 64. Prepare a simple building (20 hrs.) 65. Drawing using Auto cad. (26 hrs.)	Use AutoCAD command for drawings. (18hrs.)

List of Instruments and equipment to be used in the trade

Objective: At the end of this exercise you shall be able to
- **list the instrument & equipment used in the trade.**

In addition to drawing equipment the following survey instruments.

1 Metallic tape / invar tape
2 Steel tape
3 Chain (Engineers) - 20m, 30m
4 Ranging rods
5 Arrows
6 Cross staff (Wood)
7 Cross staff (Metal)
8 Cross staff (French)
9 Optical square
10 Planimeter etc.....
11 Compass (Prismatic)
12 Plane Table with Accessories
13 Levelling Instrument & staff accessories
14 Theodolite Tachometry
15 Minor instruments
16 Digital Theodolite
17 Total station
18 Remote sensing
19 GPS
20 CAD ..... Etc.,

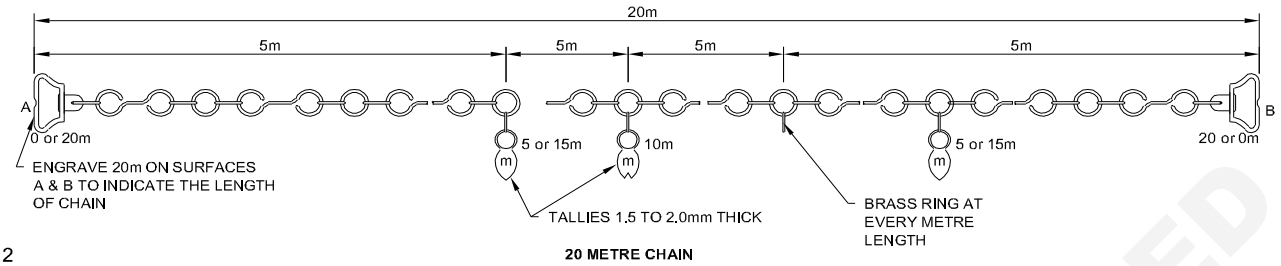
Tools and equipments used in the trade

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

- **demonstrate the chain survey instruments**
- **demonstrate plane table instruments**
- **demonstrate levelling instruments**

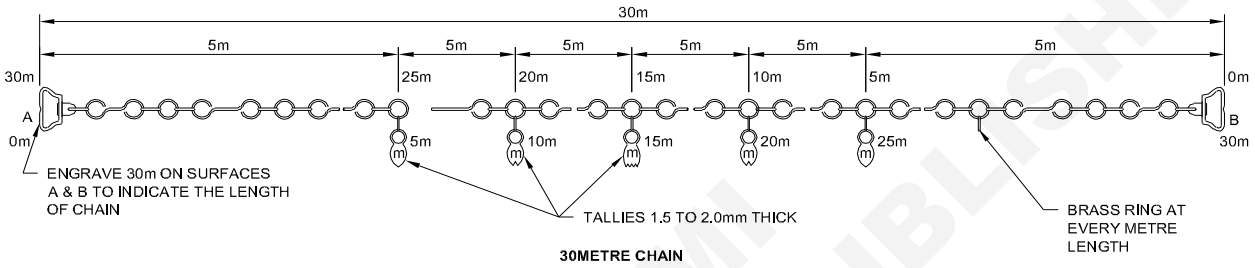
Instructor should demonstrate how to unfold the chain and flod the chain and state the safety precaution.

Fig 1



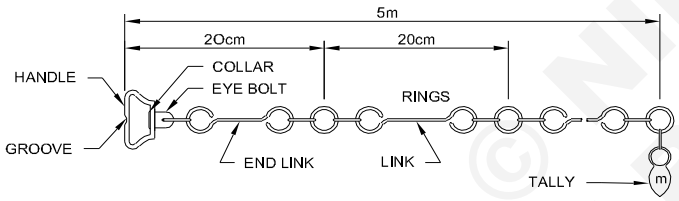
20 METRE CHAIN

Fig 2



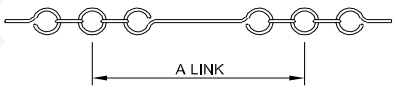
30METRE CHAIN

Fig 3



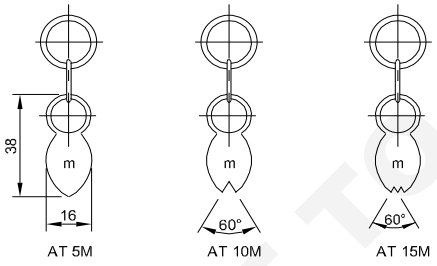
DETAILS OF A METRIC CHAIN

Fig 4



A LINK OF A CHAIN

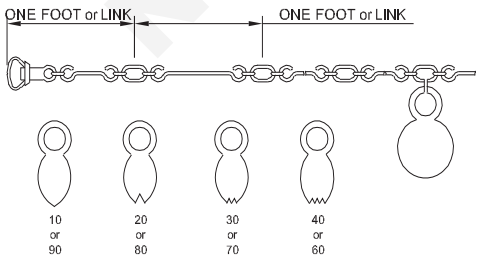
Fig 5



SHAPE OF TALLIES IN 30m METRIC CHAIN

SUN110111

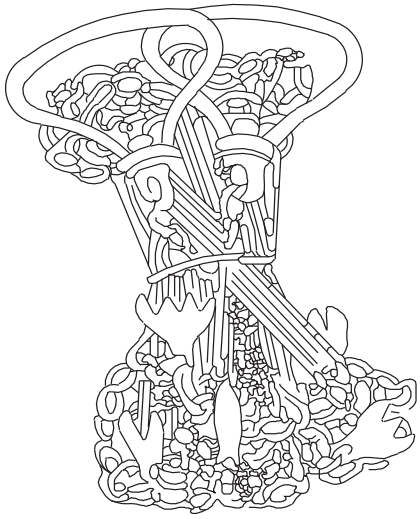
Fig 6



NON-METRIC CHAIN AS GUNTER'S or ENGINEER'S

SUN110116

Fig 7



FOLDING OF CHAIN

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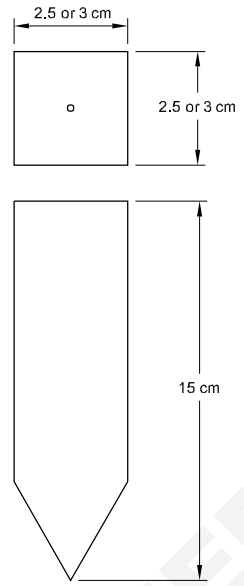
Fig 9



WOODEN PEG

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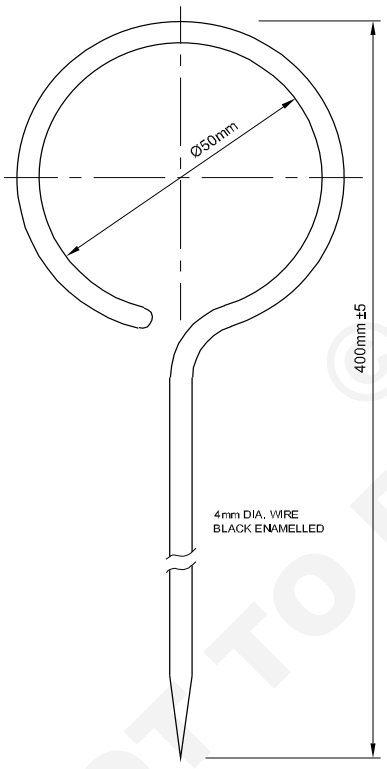
Fig 8



ARROW

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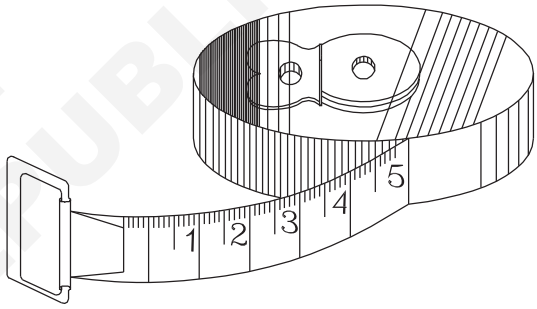
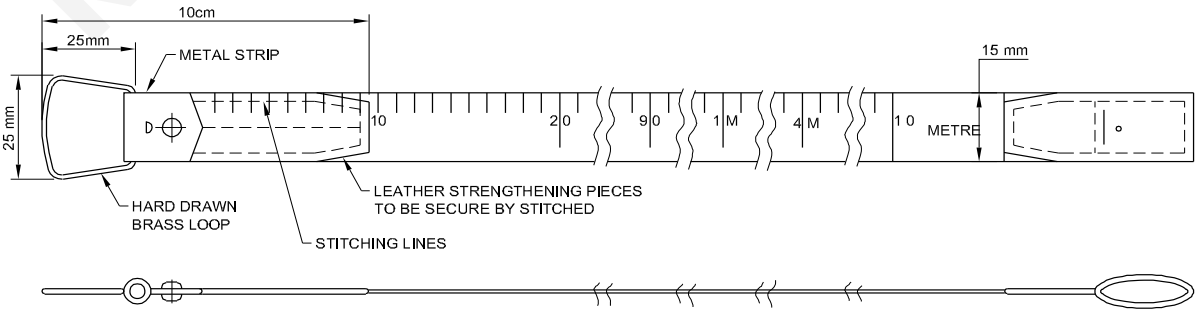
Fig 10



SUN11011A

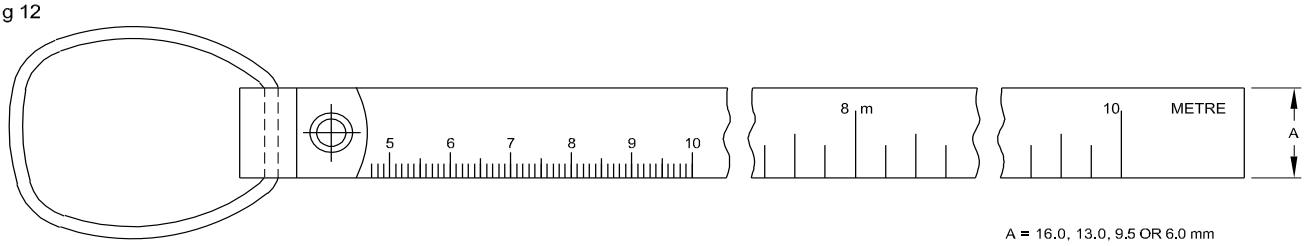
Fig 11



METALLIC TAPE

SUN11011B

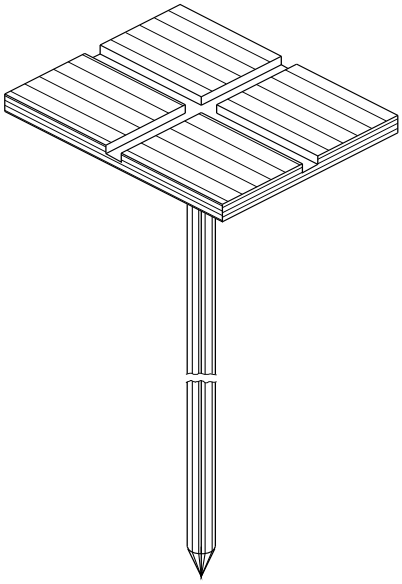
Fig 12



STEEL TAPE

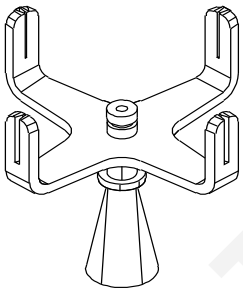
Note: Instructor should demonstrate the handling of different types of taps

Fig 13



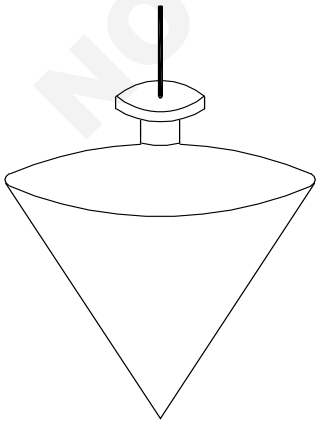
WOODEN CROSS STAFF

Fig 14



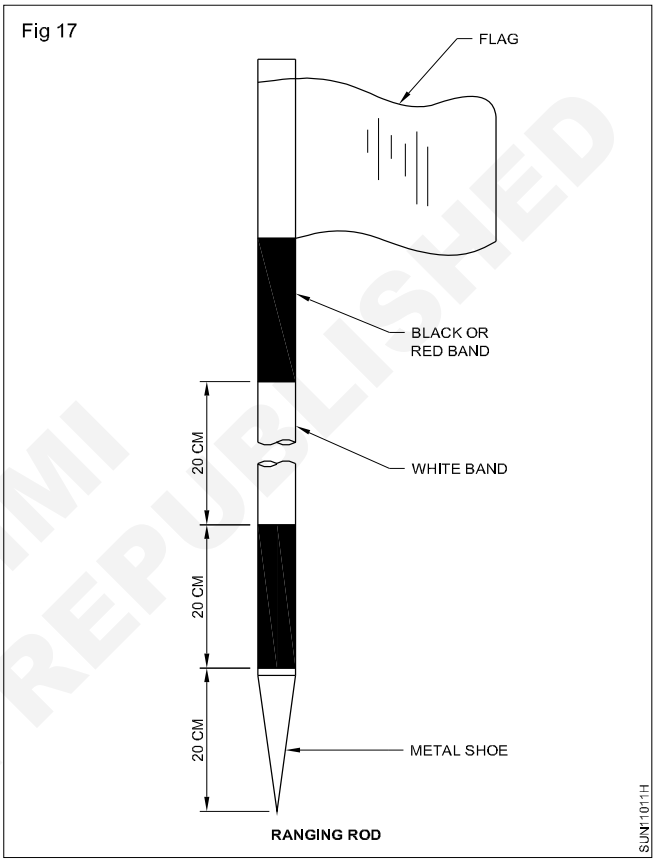
METAL ARM CROSS-STAFF

Fig 15



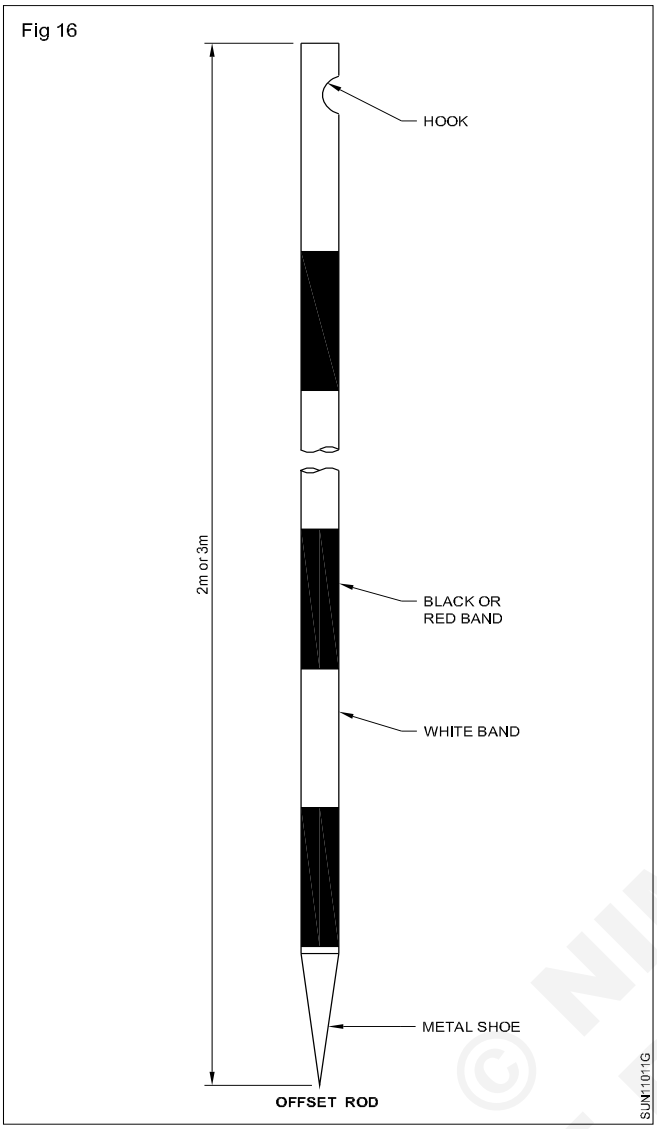
PLUMB BOB

Fig 17



RANGING ROD

Fig 16



Demonstrate

Plane Table Instrument

Fig 18

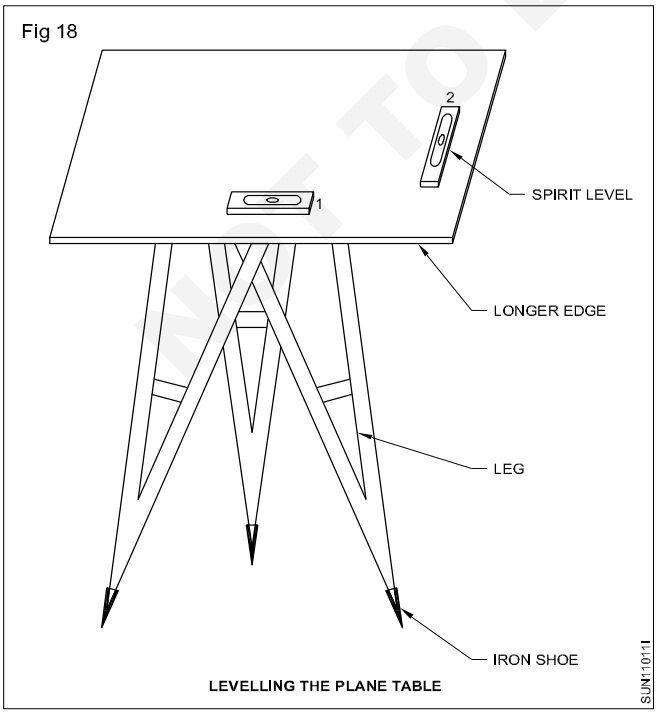
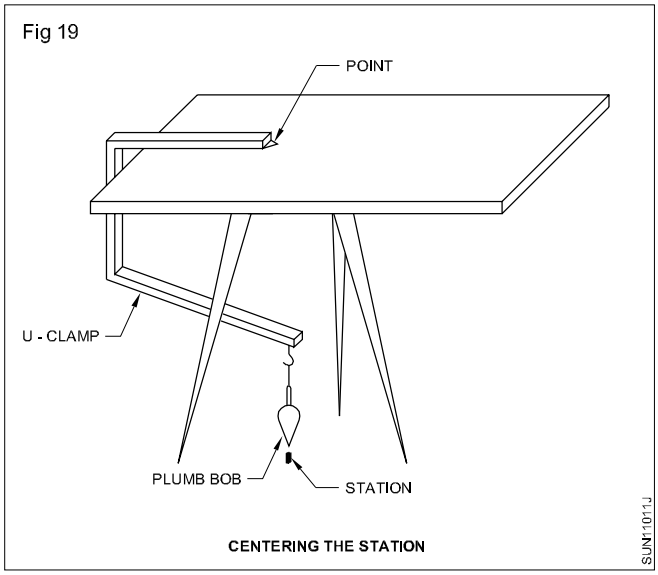


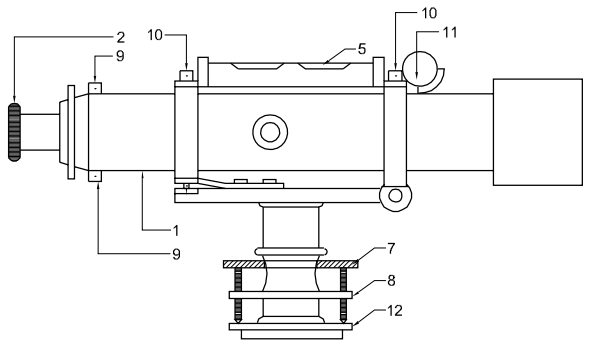
Fig 19



Demonstrate

Levelling Instrument

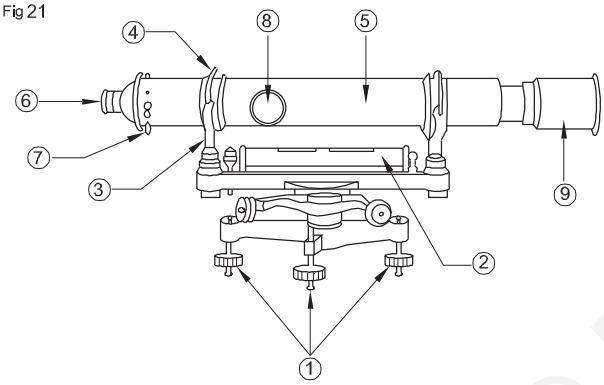
Fig 20



DUMPY LEVEL

SUN11011K

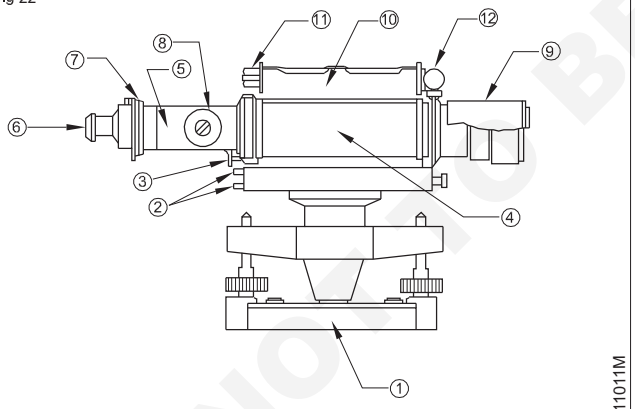
Fig 21



WYE (Y) LEVEL

SUN11011L

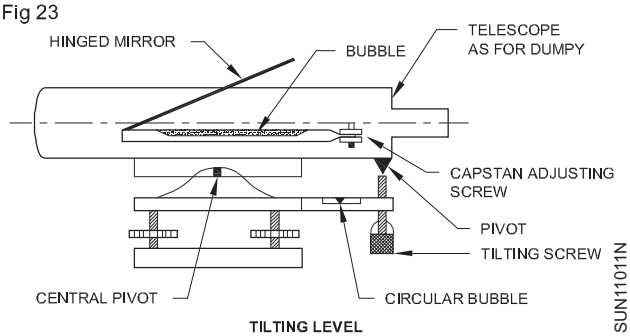
Fig 22



COOKE ' S REVERSIBLE LEVEL

DCN11011M

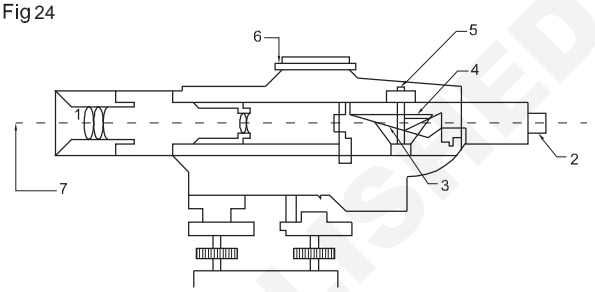
Fig 23



TILTING LEVEL

SUN11011N

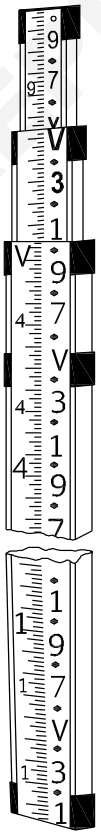
Fig 24



AUTO LEVEL

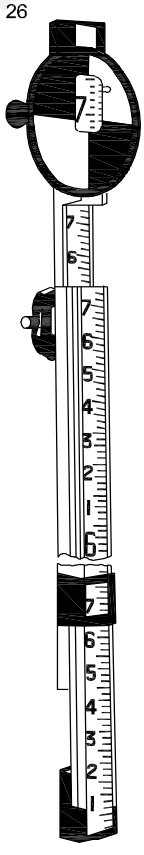
SUN11011O

Fig 25



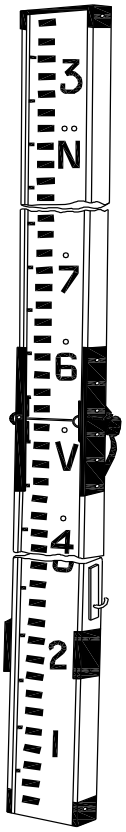
TELESCOPIC STAFF

Fig 26



TARGET STAFF

Fig 27



FOLDING STAFF

SUN11011P

Occupational safety and health

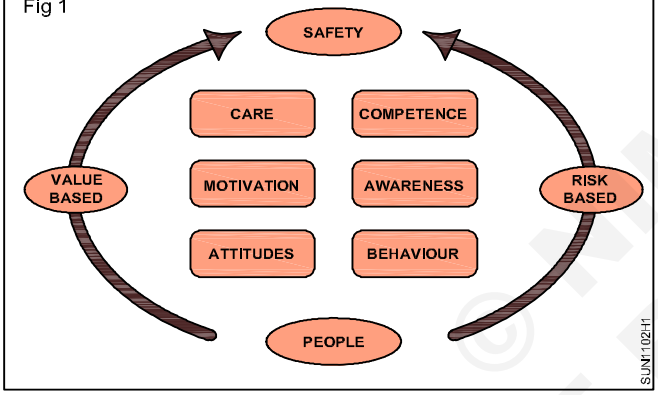
Objectives: At the end of this exercise you shall be able to

- **define occupational safety and health**
- **state the importance of safety and healthy 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 their 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 health 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 committee on occupational health (1995) main focus in occupational health is on three different objectives.

The maintenance and promotion of worker's 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 workspace 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 patterns 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 workspace 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 which the worker is exposed to harmful elements or physical dangers, such as heat or moving parts.

Introduction of safety equipments & uses

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**
- **practice safe methods of the fighting in case of electrical fire**

Requirements

Materials

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

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. (Figs 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.

Fig 1

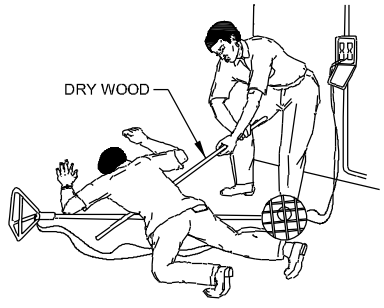
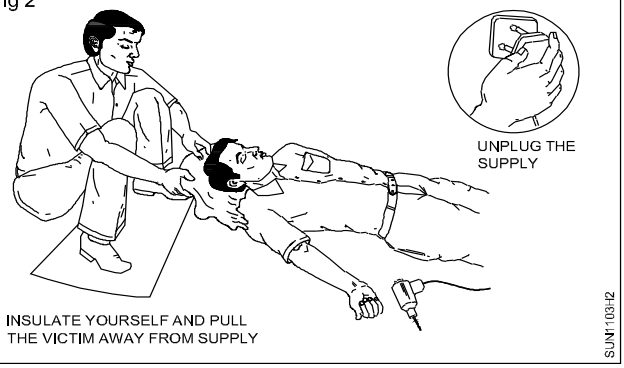


Fig 2



4 Keep the patient warm and at mental rest.

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)

Fig 3

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

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.

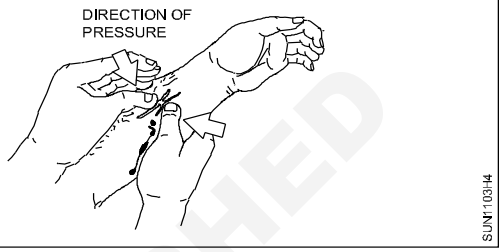
In case of severe bleeding

11 Lay the patient lie down and rest.

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

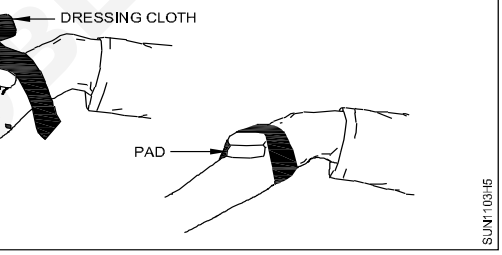
13 Apply pressure on the wound as long as necessary to stop the bleeding. (Fig 4)

Fig 4



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

Fig 5



If bleeding is severe apply more than one dressing.

14 Proceed to perform the right methods of artificial respiration.

— — — — — — — — —

TASK 3: **General procedure to be adopted in the event of electrical fire**

1 Raise an alarm. Follow the method written below for giving an alarm signals when fire breaks 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. (Bette switch off the sub - main)

3 If you are not involved in fighting the fire:
- Leave calmly using the emergency exit.
- Evacuate 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 attempt evacuate (Remove explosive material substances that can serve as a ready fuel for fire with the vicinity of the fire break)
- Fight out the fire with assistance to put it out, by naming the person responsible 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 small helps in the

Investigation of the cause of the fire. It helps to prevent the same kind of accident occurring 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.**

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

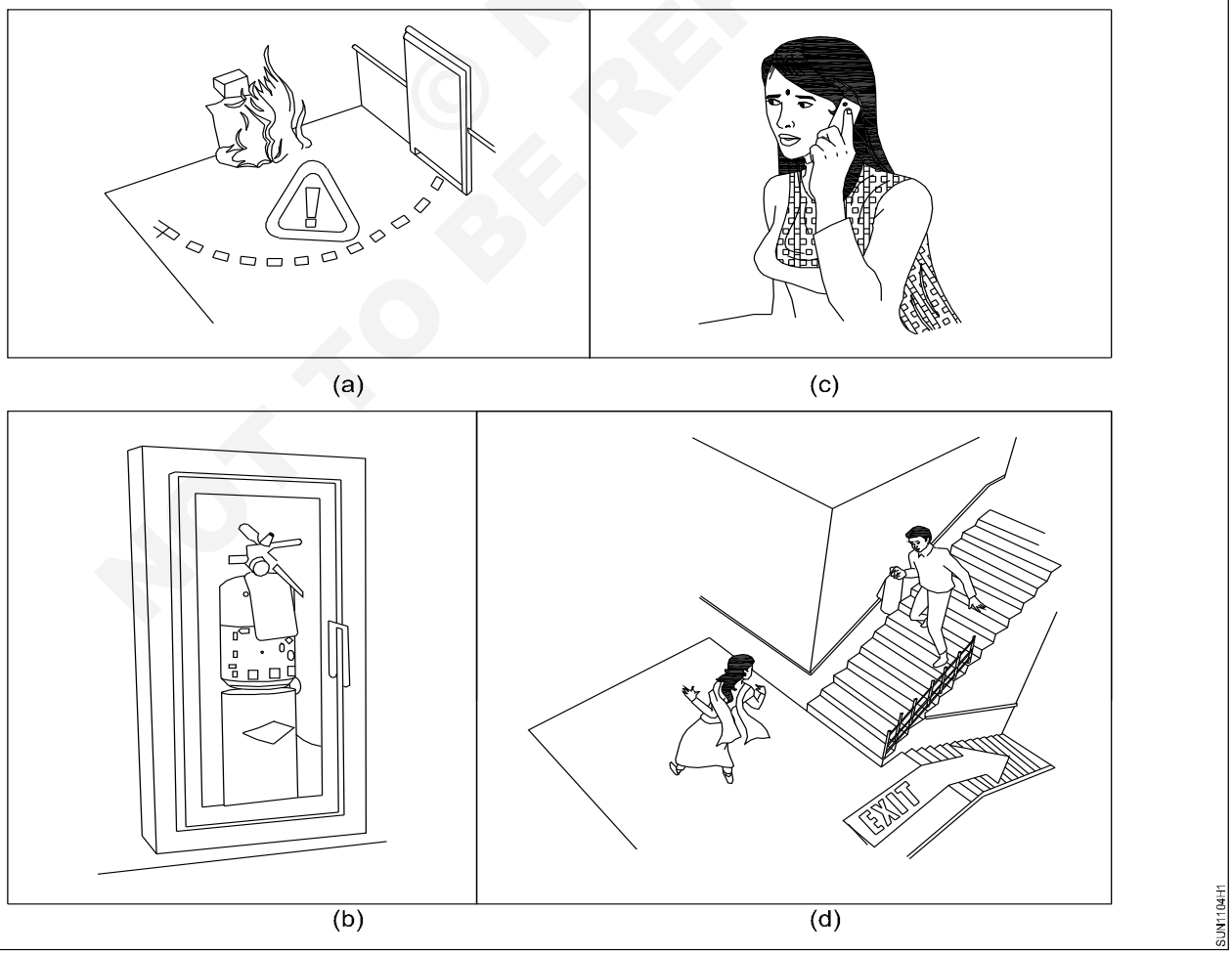
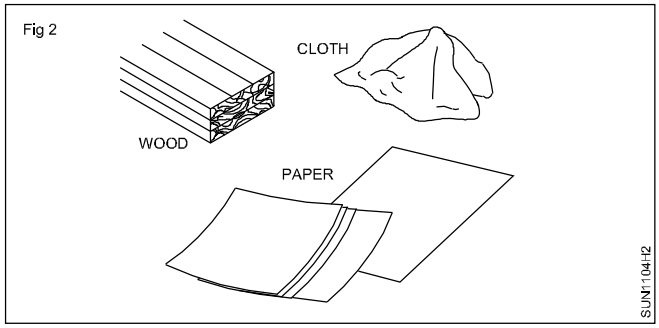
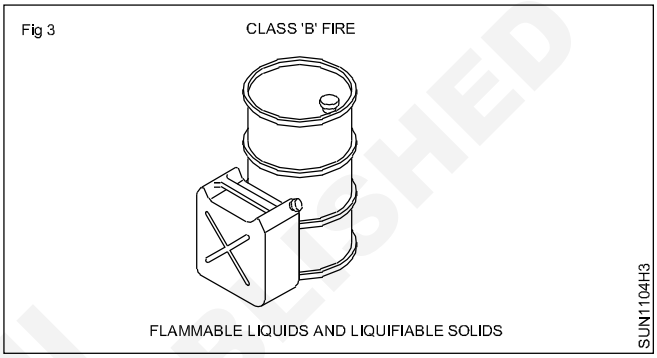
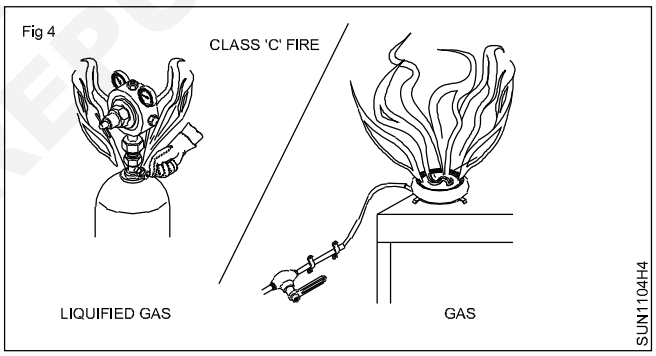
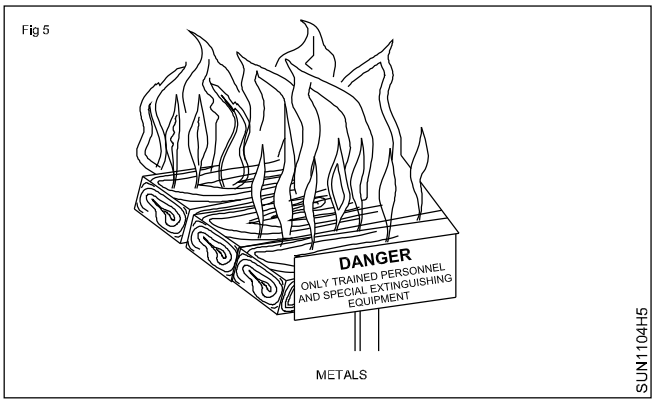


Table 1

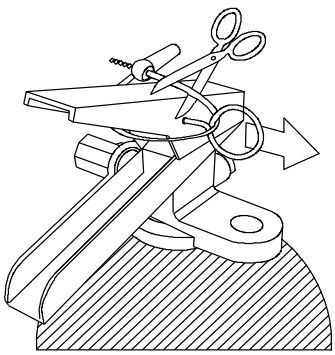
Class 'A': Wood, paper, cloth, solid material	
Class 'B': Oil based fire (grease, gasoline, oil) & liquefiable solids	
Class 'C': Gas and liquefied gases	
Class 'D': Metals and electrical equipment	

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)

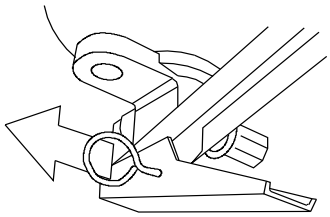
Fig 6



SUN1104-I6

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

Fig 7



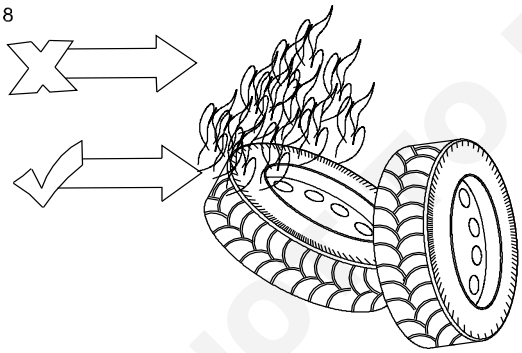
SUN1104-I7

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)

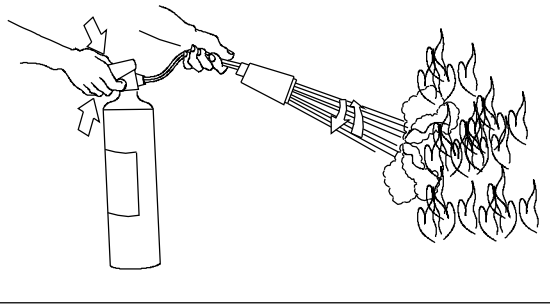
Fig 8



SUN1104-I8

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

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 yourself 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

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

- **prepare the victim for elementary first aid**
- **prepare the victim to receive artificial respiration**
- **disconnecting a person (mock victim) from a live supply (stimulated)**
- **resuscitate the victim by Nelson's are - Lift back pressure method, Schafer's method, mouth-to-mouth method and Mouse to nose method.**

Requirements

Equipment/Materials

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

PROCEDURE

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

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

SUN:104J1

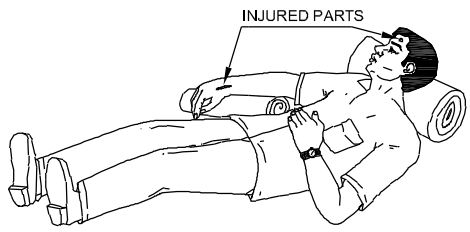
2 Remove any foreign materials or false teeth from his mouth and keep the victim's mouth open. (Fig 2)

Fig 2

SUN:104J2

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

Fig 3



SUN:104J3

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.

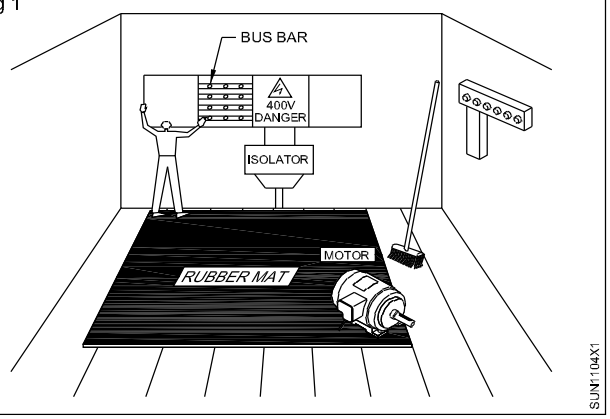
7 In the case of burn and injury in the back, follow Nelson's method.

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

— — — — — — — — —

TASK 3**: 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 4: **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.

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.

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.

Fig 2

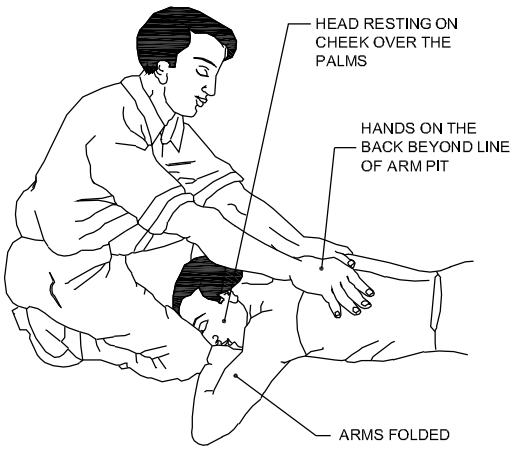


Fig 3

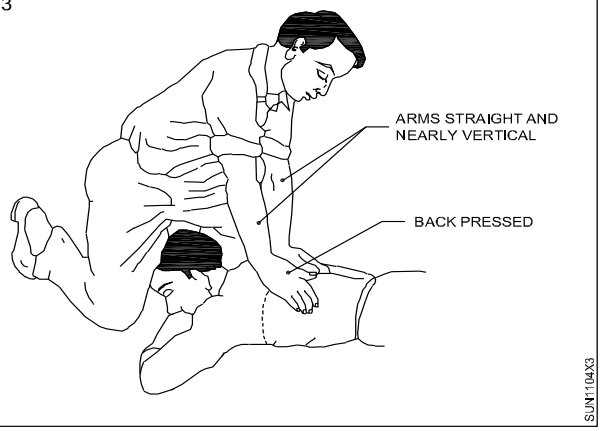


Fig 4

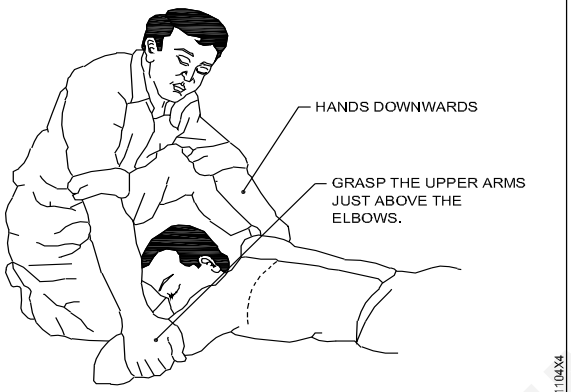
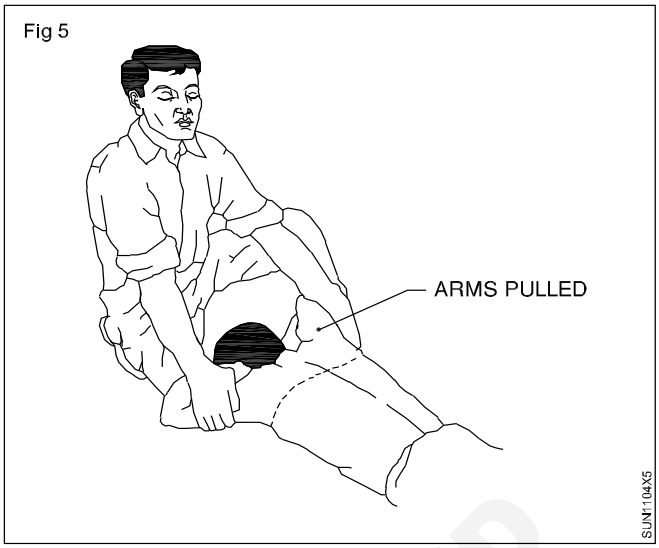


Fig 5



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.

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

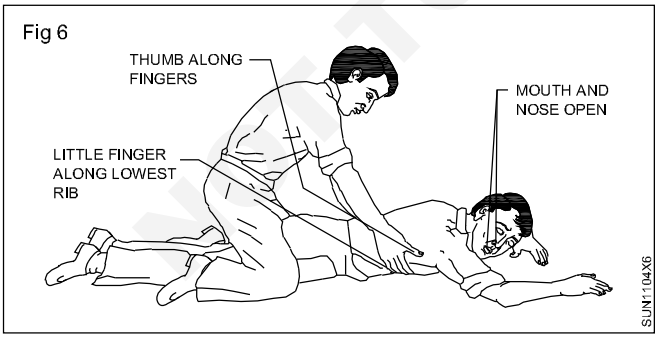
Do not give him any stimulant until he is fully conscious.

TASK 5: **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.

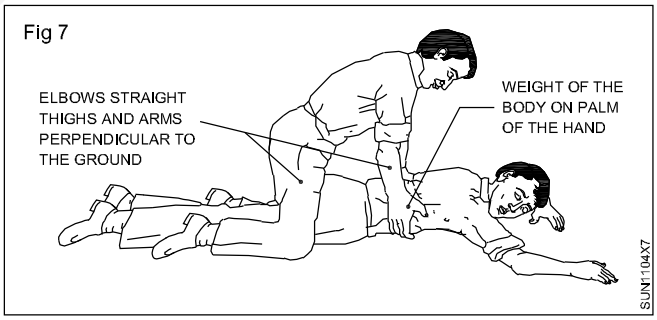
Fig 6



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

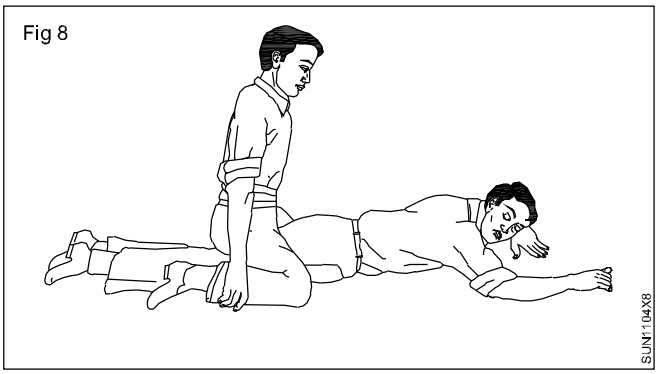
3 With the arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the lower ribs of the victim to force the air out of the victim's lungs as shown in Fig 7.

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.

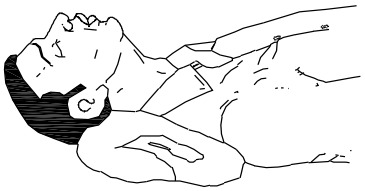
6 Continue artificial respiration till the victim begins to breathe naturally.

— — — — — — — — —

TASK 6: **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)

Fig 9



SUN1104X9

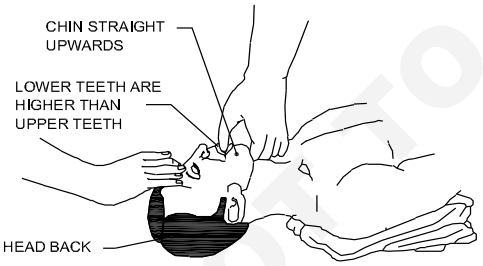
2 Tilt the victim's head back so that the chin points straight upward. (Fig 10)

Fig 10

SUN1104XA

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.

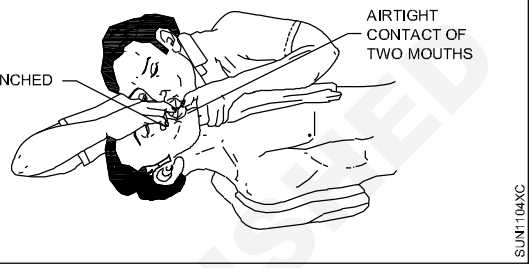
Fig 11



SUN1104XB

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



SUN1104XC

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 7: **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)

Fig 13

SUN1104XD

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.

— — — — — — — — —

TASK 8: **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.

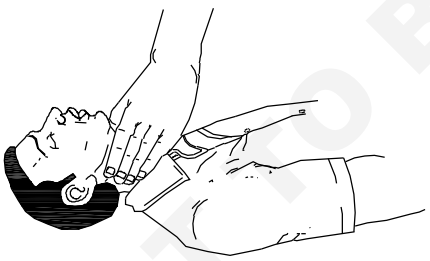
Cardiac arrest could be ascertained by the absence of the cardiac pulse in the neck (Fig 14), blue colour around lips and widely dilated pupil of the eyes.

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)

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 14

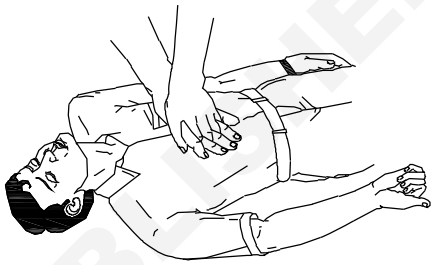


SUN1104XE

Fig 15

SUN1104XF

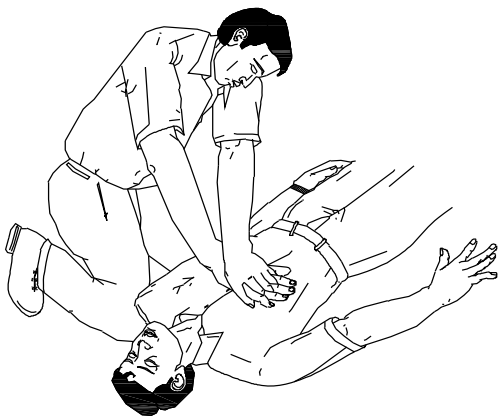
Fig 16



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)

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

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.

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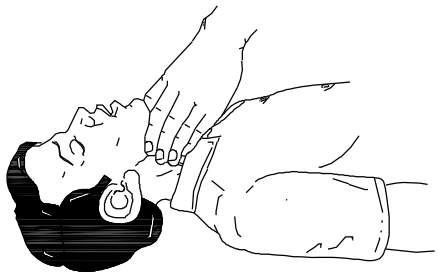
Fig 18



SUN1104XI

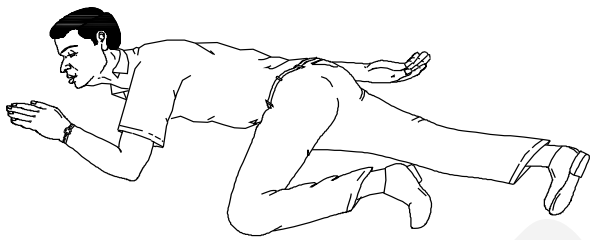
Fig 19

SUN1104XJ

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.

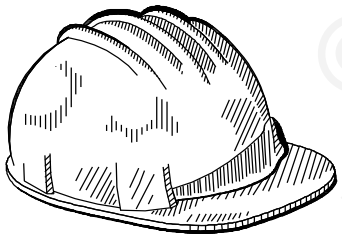
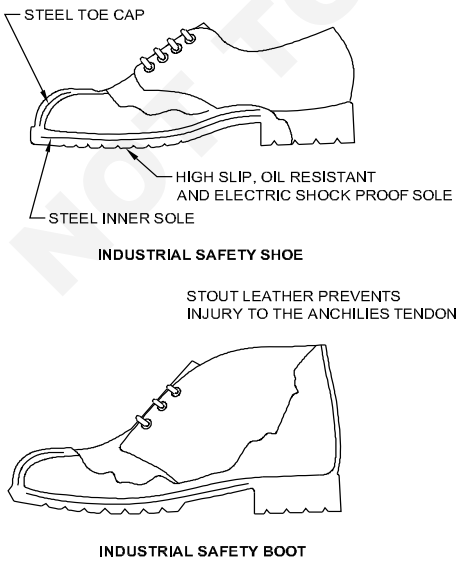
PROCEDURE

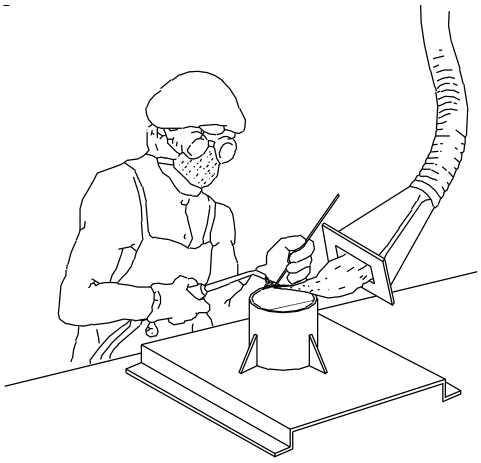
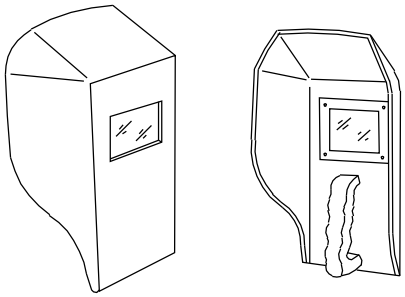
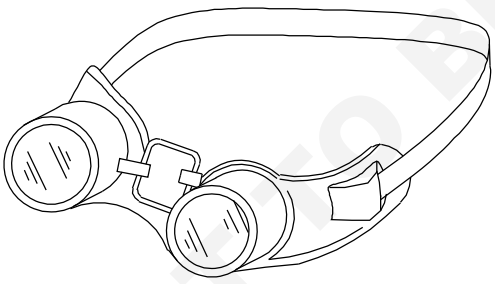
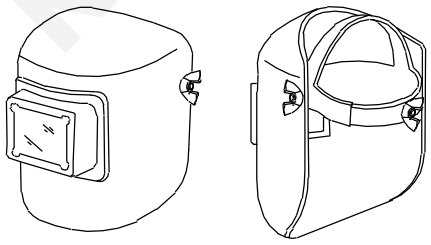
Instructor may arrange the available different types of PPEs in the table (or) provide the chart showing the PPEs. Explain the types of PPEs and their uses for corresponding hazards.

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				

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

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

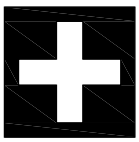
TASK 1 : **Identify the safety symbols and interpret their meaning and colour with shape**

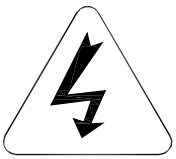
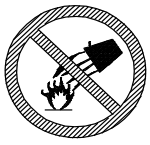
Instructor may provide various safety signs chart for basic categories and road safety with traffic signals. Then explain their categories meaning and colour. Ask the trainees to identify the sign and record in table 1.

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

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

S.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		

S.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			

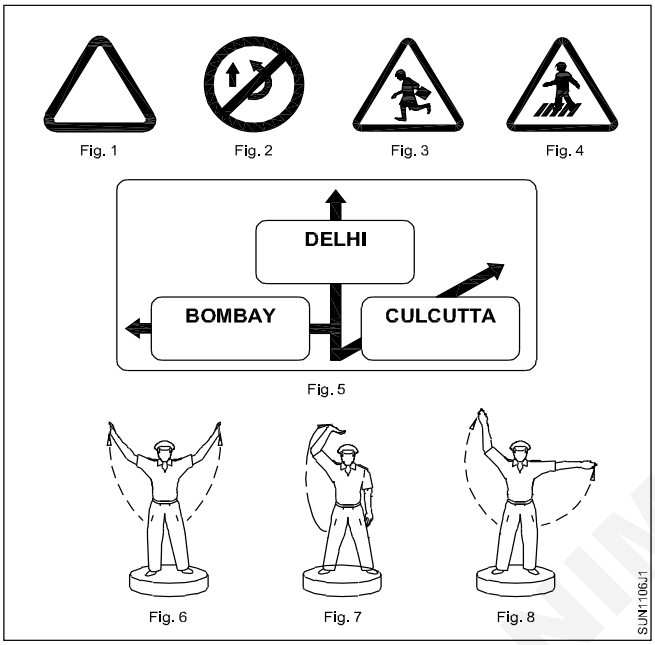
TASK 2: **Identify the road safety sign and traffic signals**

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

S.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.

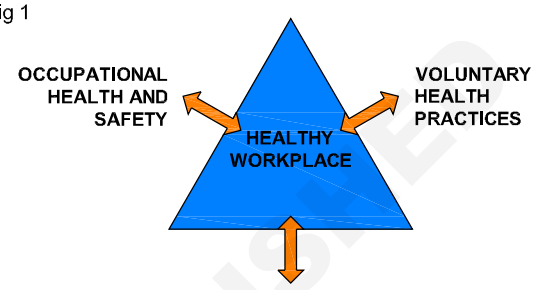
- Provide adequate control of the health and safety risks.
- Consult with employees on matters affecting their health and safety.
- Provide and maintain safe plant and equipment.
- Ensure safe handing and use of substances.
- Provide information, instruction, supervision and training so that employees 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.

- 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.

Fig 1



- 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 :

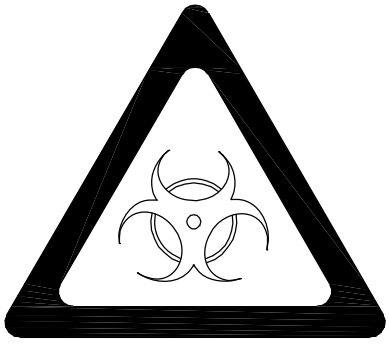
- **Ingestion**
- **Inhalation**
- **Absorption or**
- **Injection**

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)

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. Muscular Skeletal Disorders (MSDs) affect the muscles, nerves and tendons. Work related MSDs are one of the leading causes injury and illness.

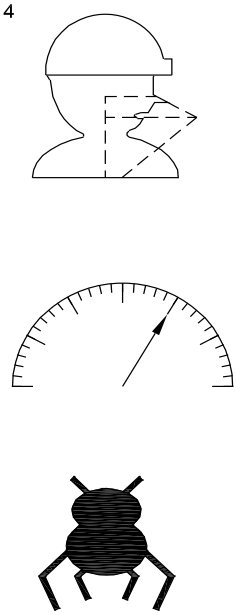
Fig 3



BIOLOGICAL HAZARD

SJN1106Y3

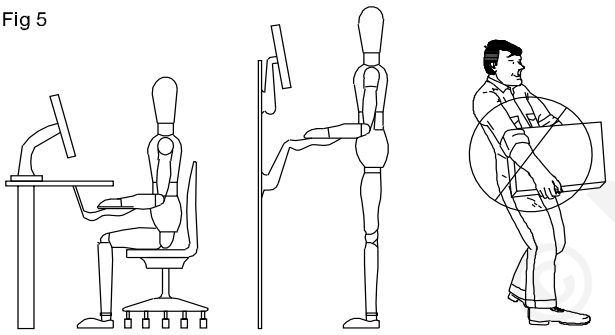
Fig 4



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

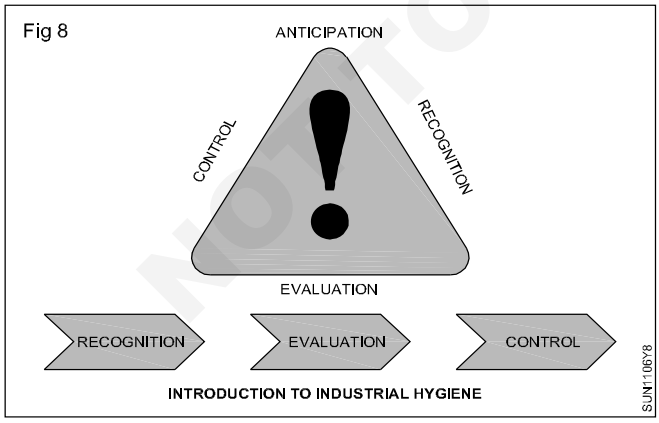
- Listening to the concerns of workers and supervisors.
- Gaining further understanding of jobs and tasks.
- Identifying existing and potential hazards.
- Determining underlying causes of hazards.
- Monitoring hazard controls (Personal protective equipment, engineering controls, policies, procedures)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

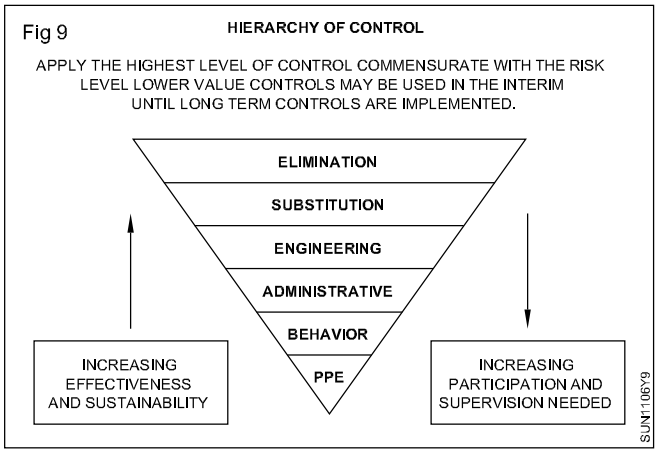
Occupational disease, illness incurred because of the conditions or environment of employment. Unlike with accidents, sometime usually elapses between exposure to the cause and development of symptoms. In some instances, symptoms may not become evident for many years and hence the relationship between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

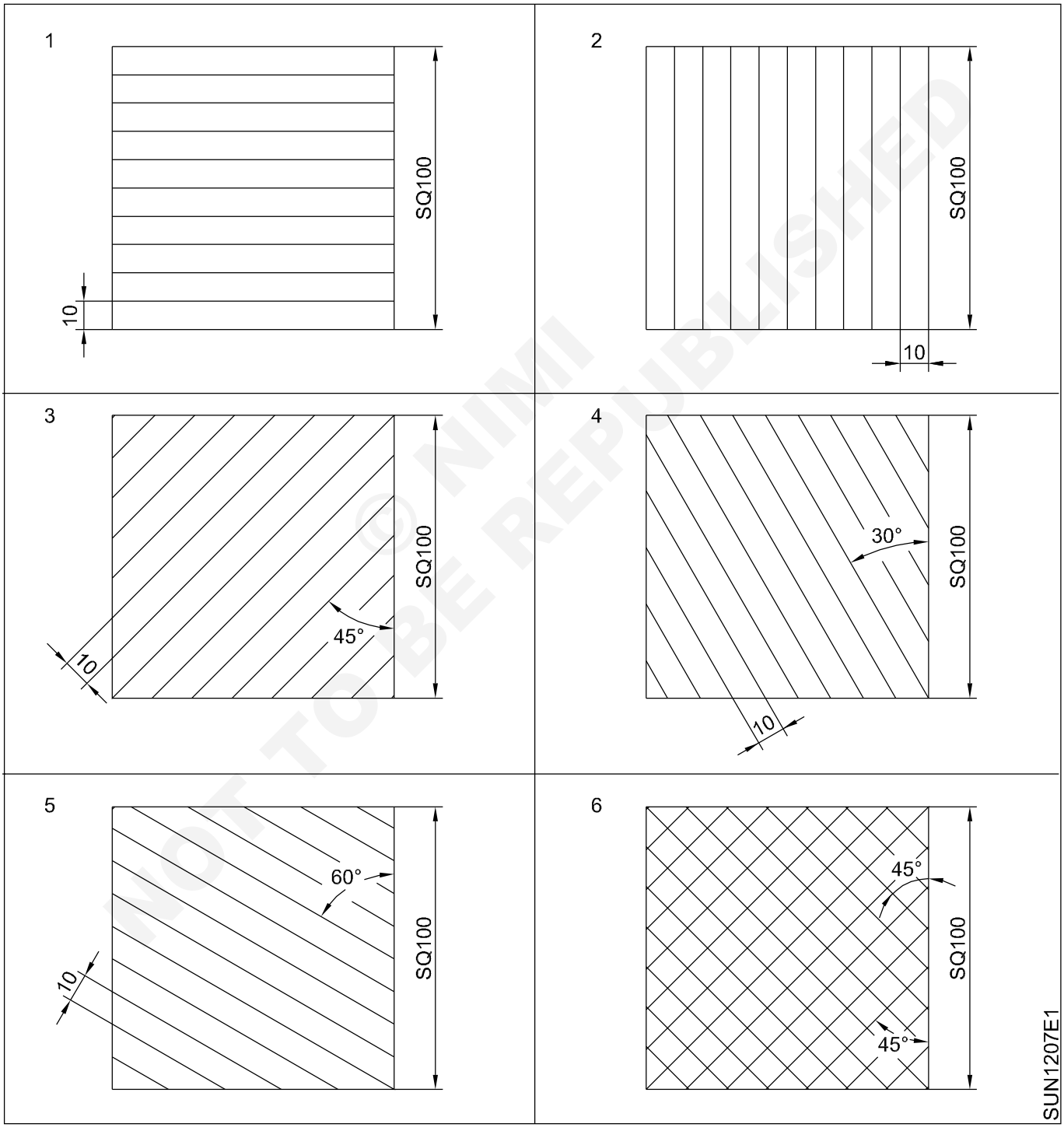
Class A fire extinguishers are designed to put out fires that have started from household items that are made out of materials that will quickly ignite. These materials include paper products and furniture made from wood. The Type A fire extinguisher contains water. The number on the canister represents 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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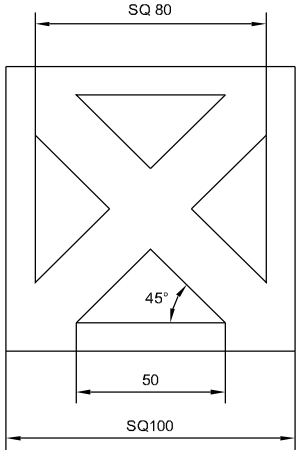

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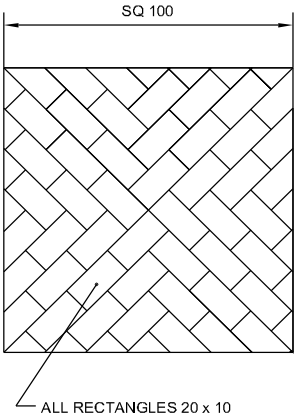

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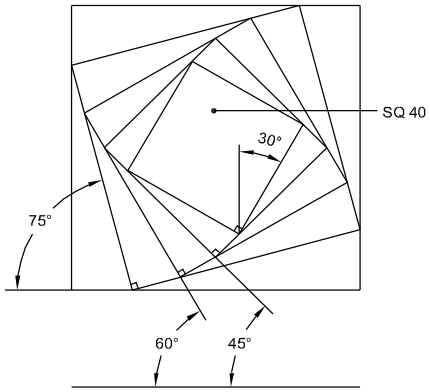

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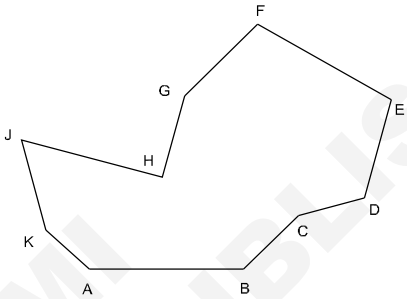
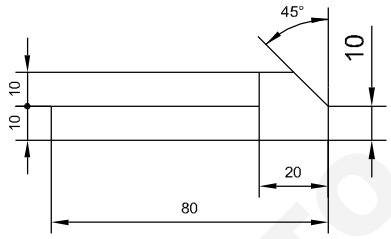


AB = 90	FG = 60	∠B = 135°	∠G = 150°
BC = 45	GH = 50	∠C = 150°	∠H = 75°
CD = 40	HJ = 85	∠D = 120°	∠J = 60°
DE = 60	JK = 55	∠E = 105°	∠K = ?°
EF = 90	KA = ?	∠F = 135°	∠A = ?°

11



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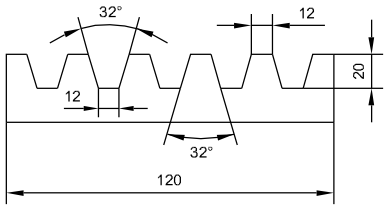

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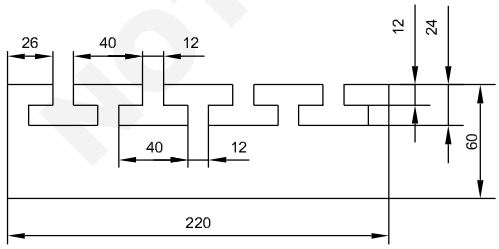

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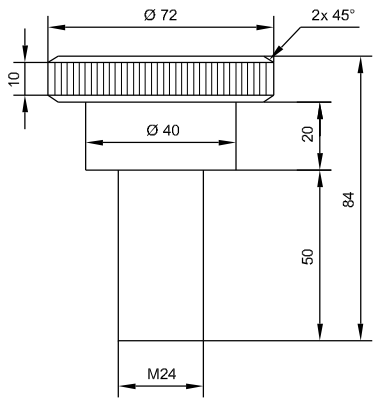


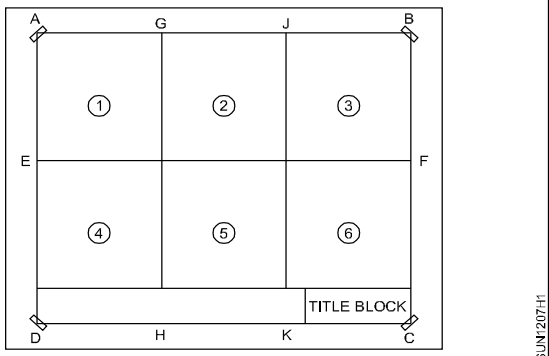
SUN1207E2

PROCEDURE

Exercise 1: Horizontal line

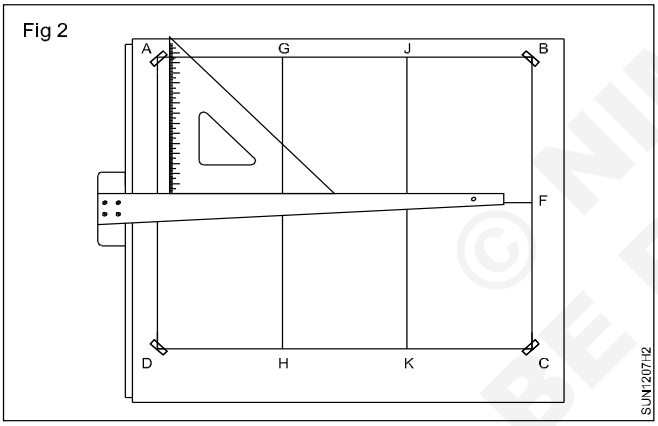
- Layout lines as shown in Fig 1 on an A2 drawing sheet.

Fig 1



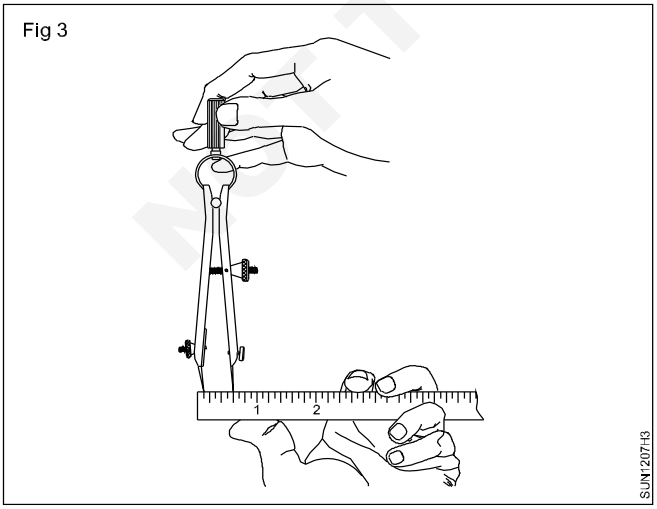
- Butt the 'T' square approximately 5 mm above the line EF.
- Draw a horizontal line 100 mm long left to right. (15 mm from AE)
- Draw a vertical line 100 mm long from the left end of the drawing paper as shown in Fig 2.

Fig 2



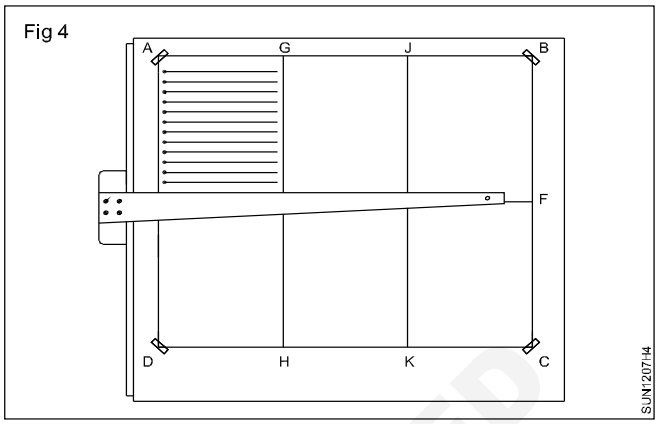
- Mark of points on the vertical line at 10 mm intervals using divider. (Fig 3)

Fig 3



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

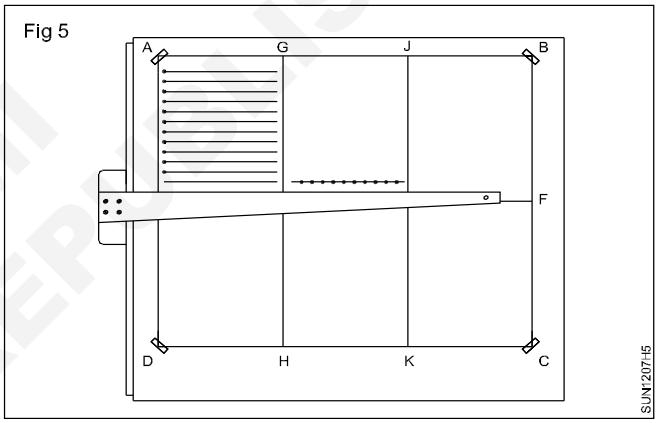
Fig 4



Exercise 2

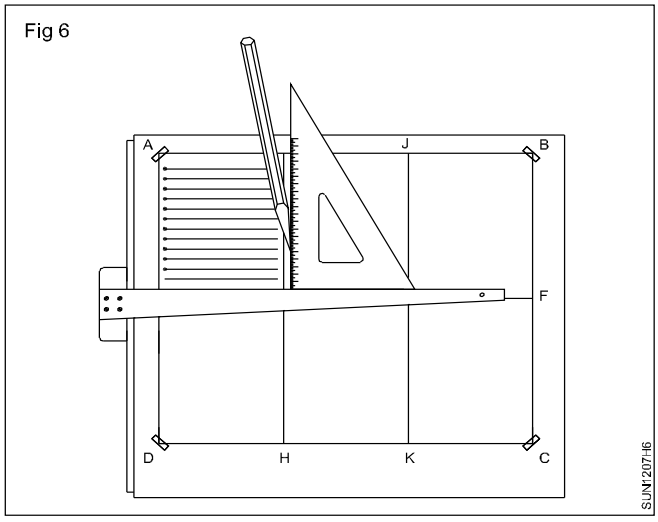
- Draw the thin horizontal line and mark 10 mm spaces as in Fig 5.

Fig 5



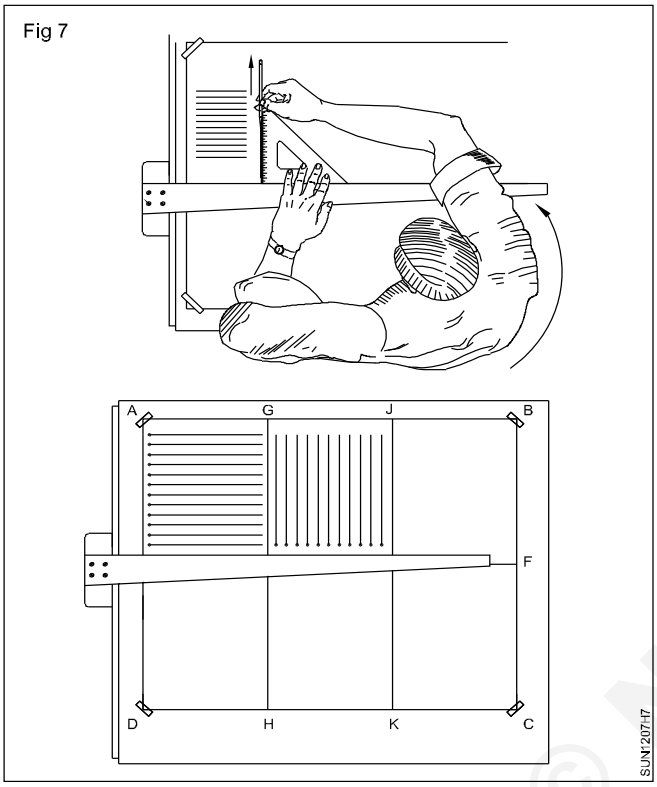
- Place the 30°/60° setsquare on the 'T' square in such a way that its vertical edge is towards the left side of the board, approximately 15 mm from the line GH. (Fig 6)

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)
- 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.

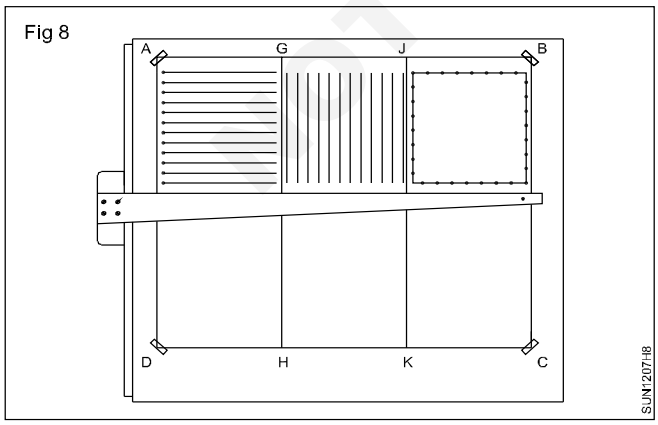
Fig 7



Exercise 3 to 6: Inclined lines

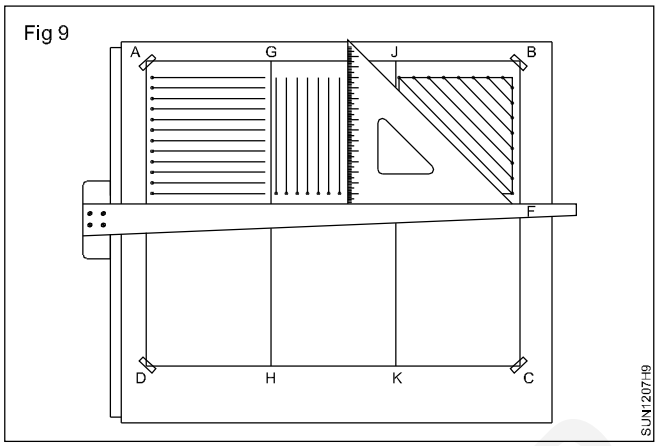
- For drawing 45° lines.
- Place the working edge of the 'T' square 15 mm above the line EF and draw horizontal lines in block (3) as shown.
- Draw vertical lines parallel to JK as shown in the block.
- Using divider, mark points from top corner at 10 mm intervals on horizontal and vertical line. (Fig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

Fig 8



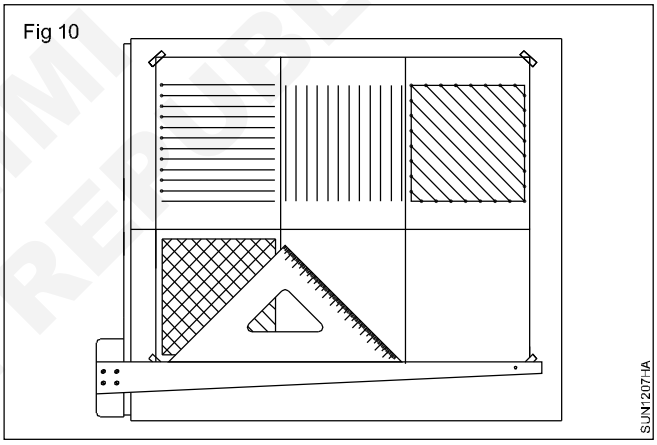
- Butt, slide and take the working edge of 'T' square to line EF.
- Place the 45° setsquare and draw the 45° inclined lines from the corner, top to downwards. (Fig 9)

Fig 9



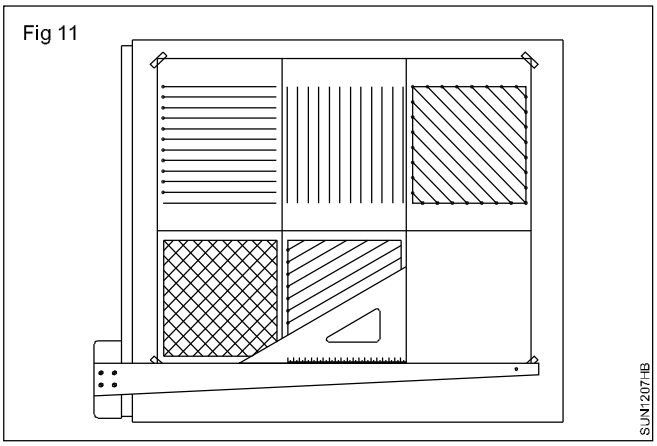
- Hold the blade of the 'T' square and setsquare intact while drawing lines.
- Following the same procedure complete block 4, 5 & 6.
- Draw 45° inclined line in the opposite direction in block 4. (Fig 10)

Fig 10



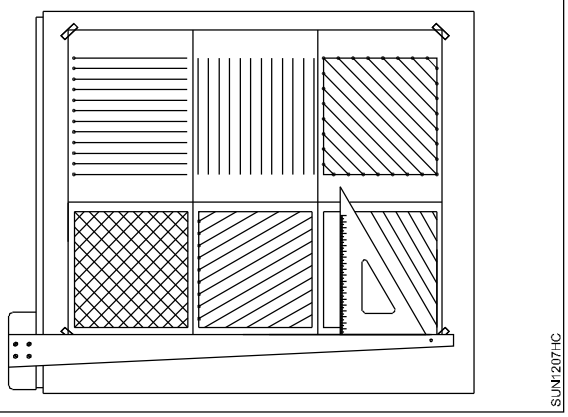
- 30° or/and 60° inclined lines can be drawn with the help of 30°/60° setsquare and 'T' square.
- Draw 30° inclined lines in block 5. (Fig 11)

Fig 11



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

Fig 12

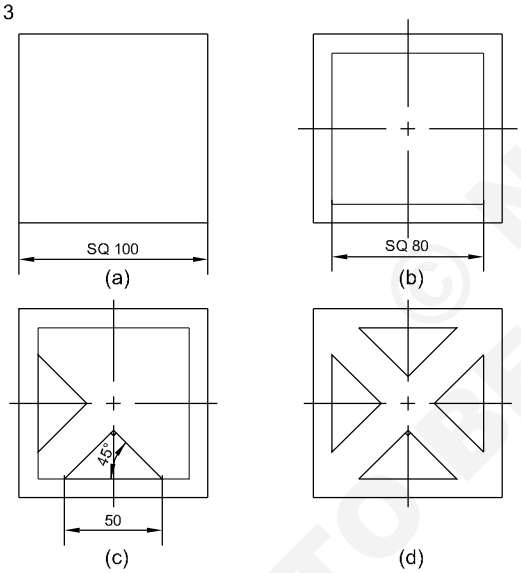


SUN1207HC

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 13

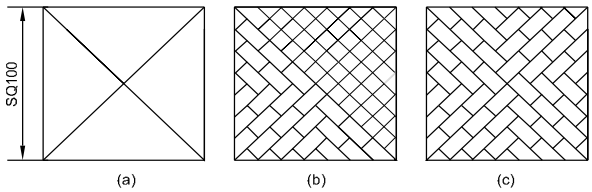


SUN1207HD

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

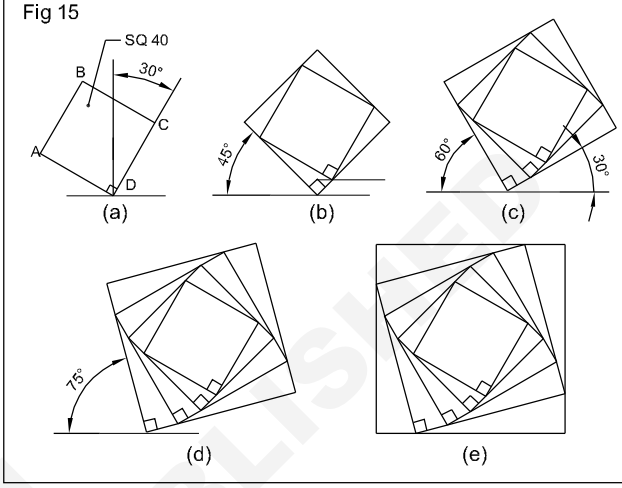


SUN1207HE

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)

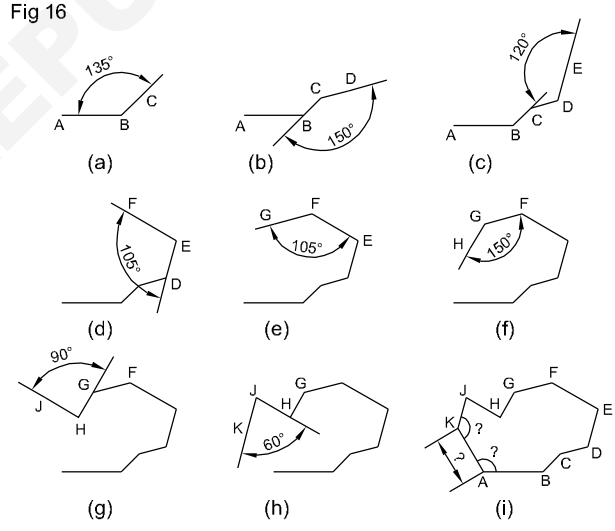
Fig 15



SUN1207HF

Exercise 10: Irregular pattern (Fig 16)

Fig 16



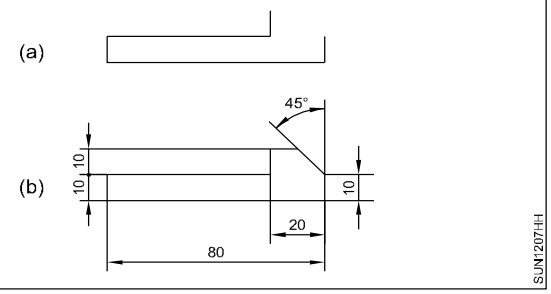
SUN1207HG

- 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 Fig16.
- Join the points KA and measure the length of KA.
- Measure the angles JKA and KAB.

Exercise 11

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

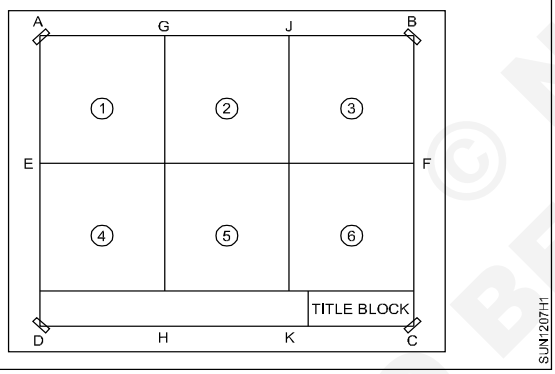
Fig 17



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 midpoint 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 angle 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)

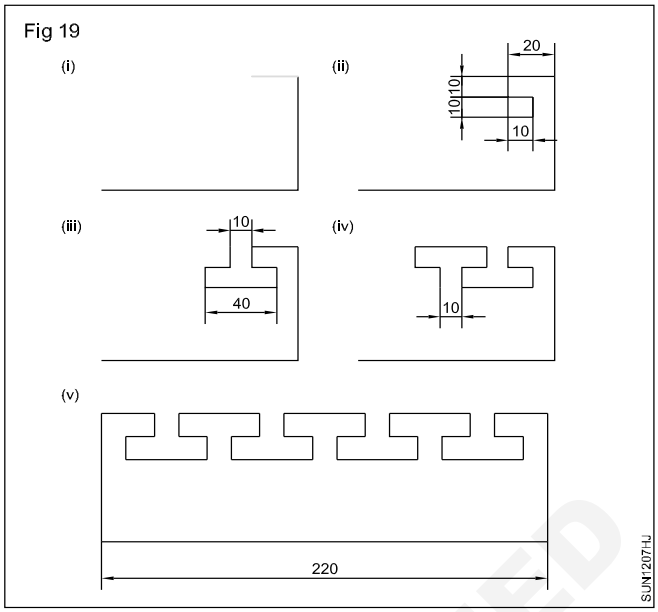
Fig 1



Exercise 13

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

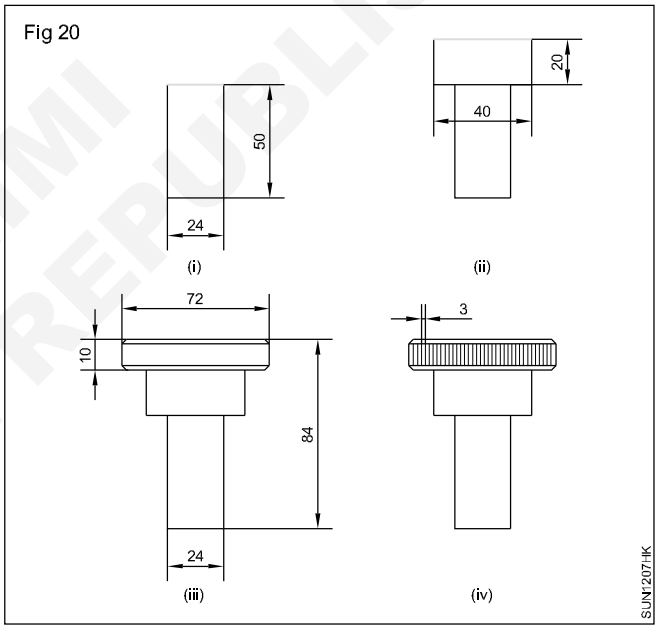
Fig 19



Exercise 14

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

Fig 20



Skill sequence

Drawing horizontal lines

Objective: This shall help you to
- **draw horizontal lines using 'T' square.**

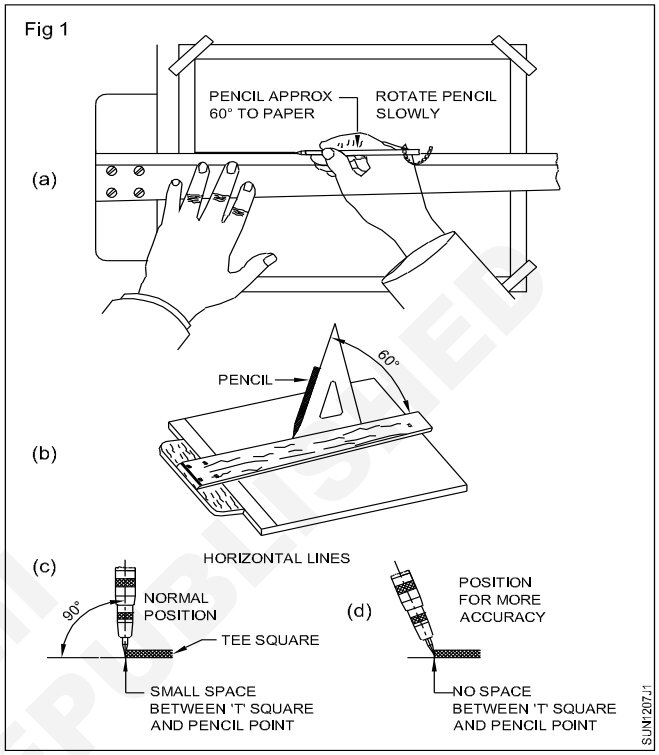
Press the head (stock) of the 'T' square firmly against the drawing board with left hand.

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



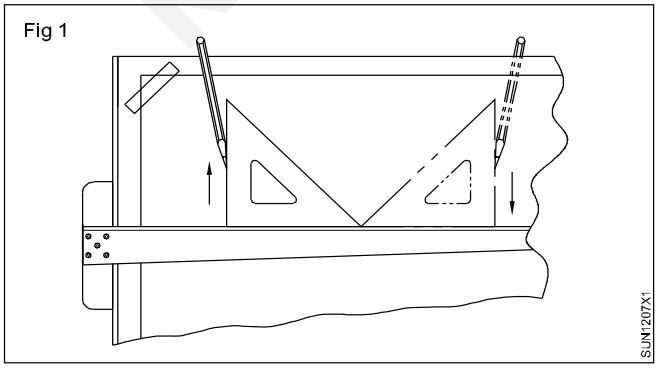
Drawing vertical and inclined lines 30°, 45° & 60°

Objectives: 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)

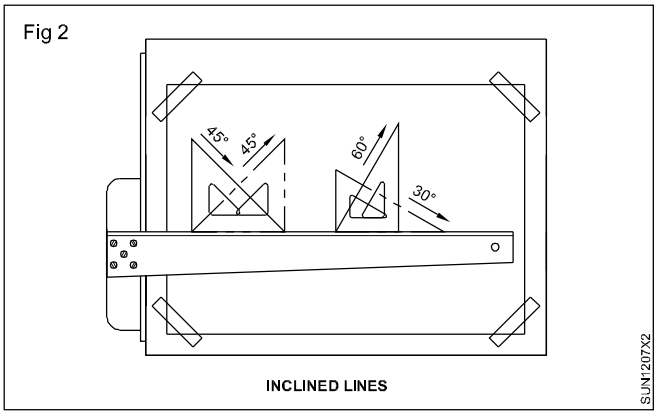
Fig 1



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°)

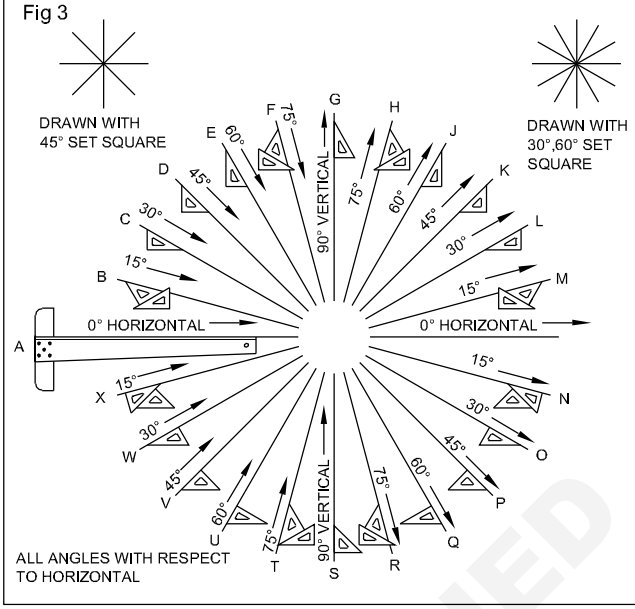
Fig 2



Inclined lines 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



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.

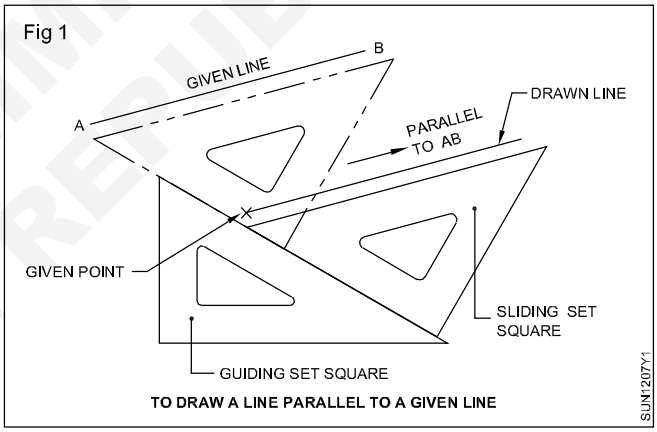
Place the other setsquare (guiding setsquare) with one of its edges butting the first square as shown in Fig 1.

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

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.

Method 2 (Fig 1b)

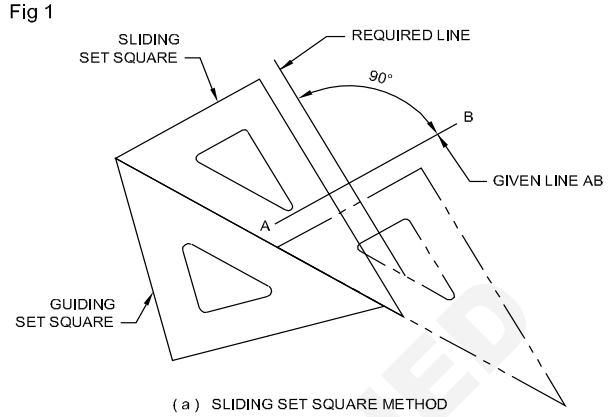
Place the hypotenuse of one setsquare to coincide with the given line.

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.

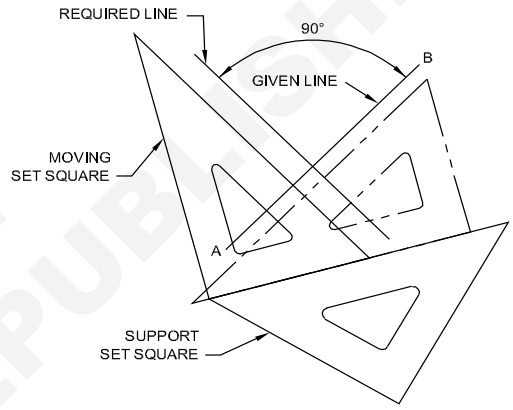
Holding the supporting setsquare firmly, revolve the moving setsquare and place it on the supporting setsquare such that the hypotenuse of the setsquare passes through the given point.

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

Fig 1



(a) SLIDING SET SQUARE METHOD



(b) REVOLVED SET SQUARE METHOD

TO DRAW A LINE PERPENDICULAR TO ANOTHER LINE

SUNT207Z1

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.

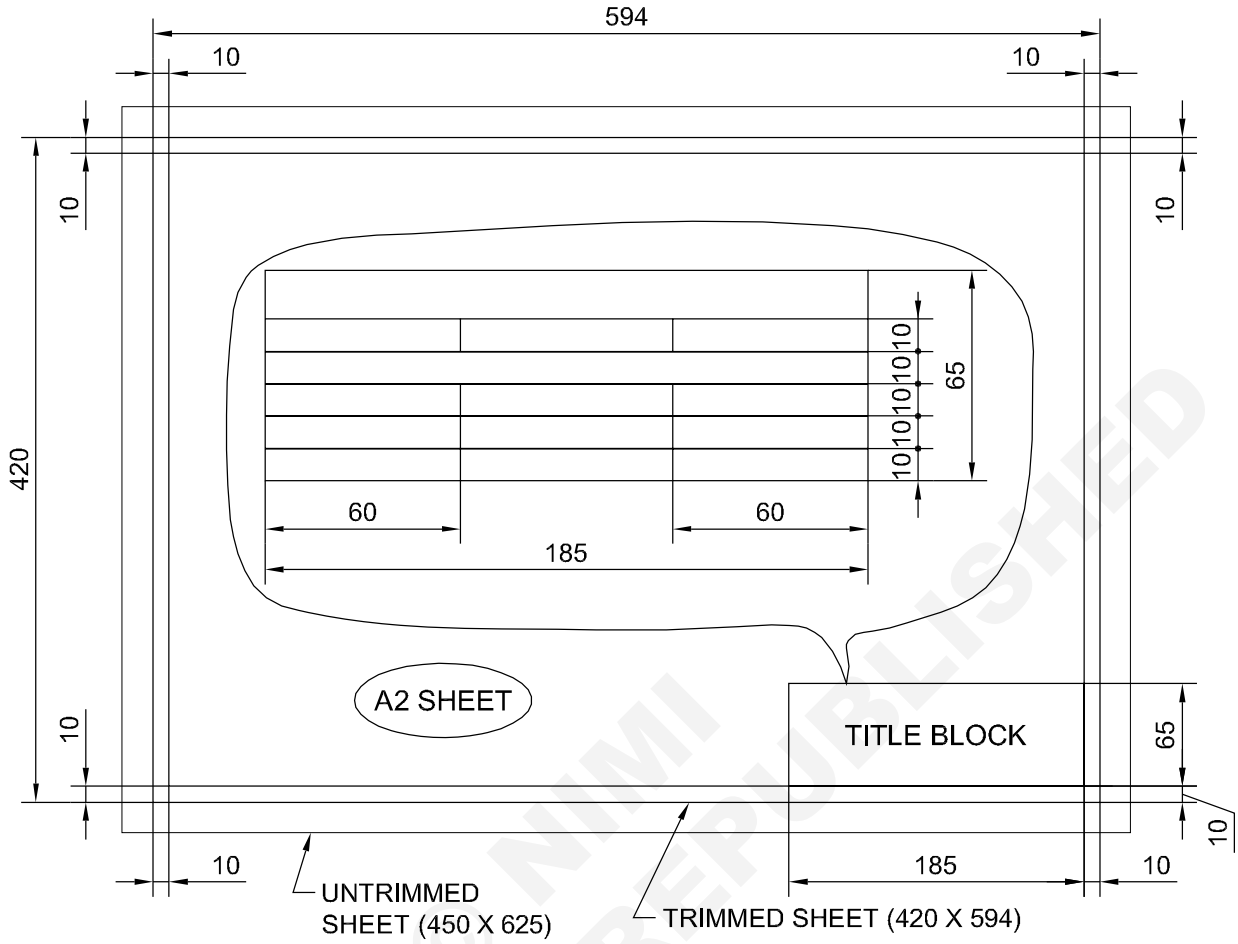
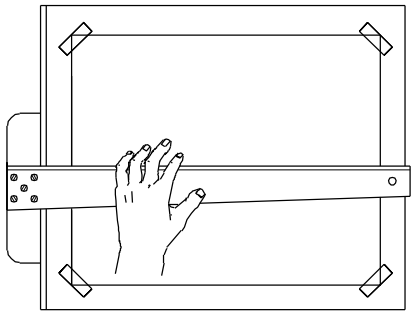


Fig 1



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

Layout of different size of drawing sheet and folding of sheets

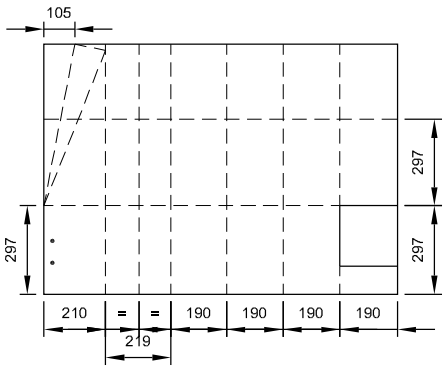
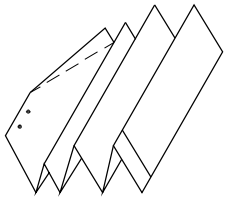
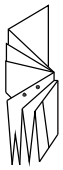
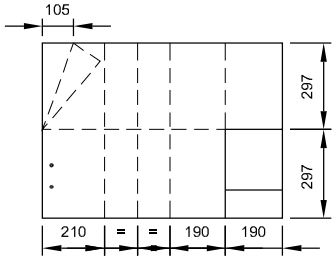
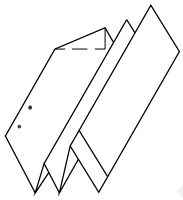
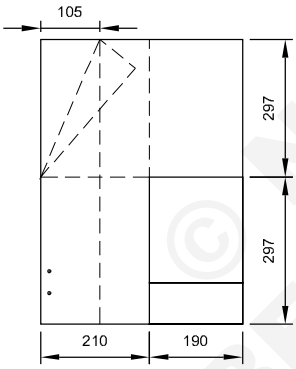
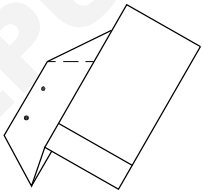
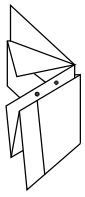
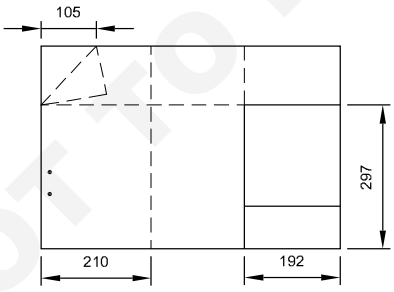
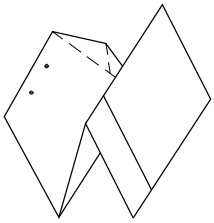
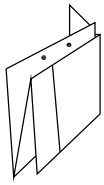
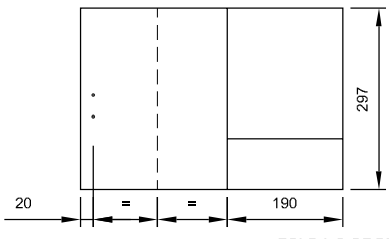
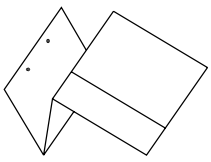
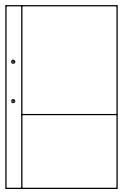
Objectives: At the end of this exercise you shall be able to
- **Fold the drawing sheet sequential as per marking for filling it.**
- **Fold the different size of drawing sheet.**

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 appears on the top of right hand bottom.

Practice for folding 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.

Fig 1

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 adjacent 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

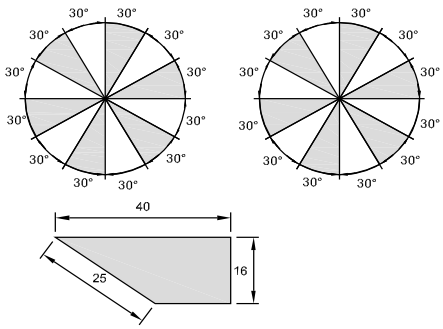
Objectives: At the end of this exercise you shall be able to

- **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.**

To show aligned system of dimensioning

- Draw the figures as shown in Fig 1.

Fig 1



ALIGNED SYSTEM

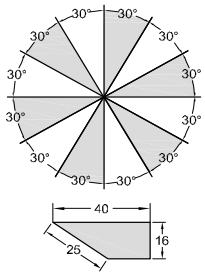
SUN1211H1

- 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 in Fig 2.

Fig 2



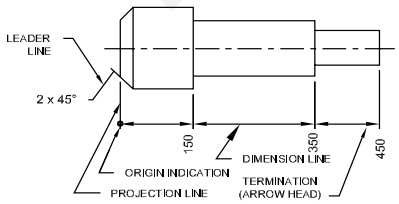
UNIDIRECTIONAL SYSTEM

SU20N1211H2

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

To show various notations used in dimensioning (Fig 3)

Fig 3

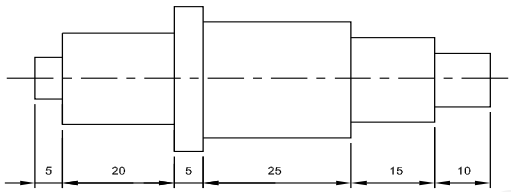


ELEMENTS OF DIMENSIONING

SUN1211H3

Arrangements of Dimensional Values

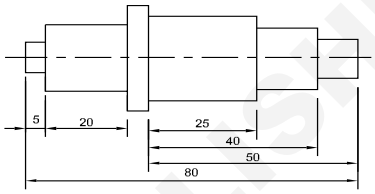
Fig 4



CHAIN DIMENSION

SUN1211H4

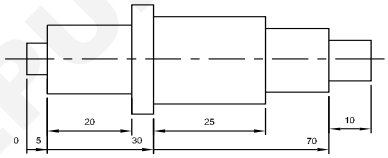
Fig 5



COMBINED DIMENSIONING (CHAIN AND PARALLEL)

SUN1211H5

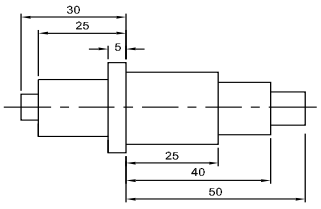
Fig 6



COMBINED DIMENSIONING (CHAIN AND SUPERIMPOSED RUNNING)

SUN1211H6

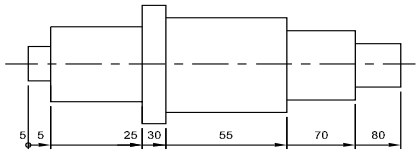
Fig 7



PARALLEL DIMENSIONING

SUN1211H7

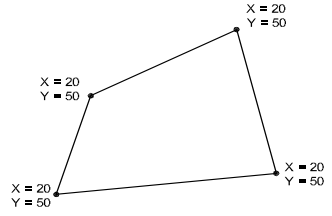
Fig 8



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 = 60 mm & 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 A BC 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, erect perpendicular.
- Mark C and D as AD=BC=45mm
- Join CD and complete the rectangle.

— — — — — — — — —

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

Sides = 75 mm and 40 mm, 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 intersecting at C.
- Join DC and BC, ABCD is the required rhombus.

— — — — — — — — —

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

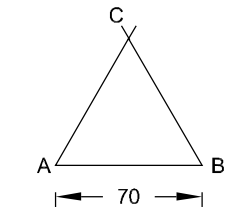
Parallel sides AB = 60mm, CD = 30mm, Distance between parallel sides = 40mm, Side DA = 45mm.

- 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, cutting the line at two places D and D^1
- From D or D^1 mark 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

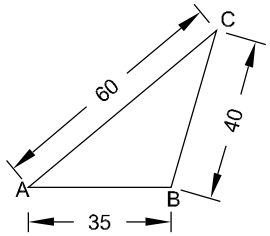
— — — — — — — — —

Fig 1



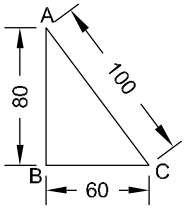
EQUILATERAL TRIANGLE

Fig .1A



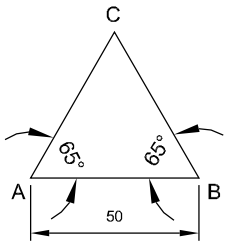
SCALENE TRIANGLE

Fig .1B



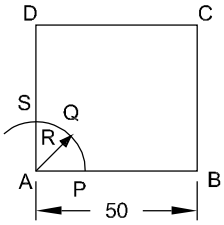
RIGHT ANGLED TRIANGLE

Fig .1C



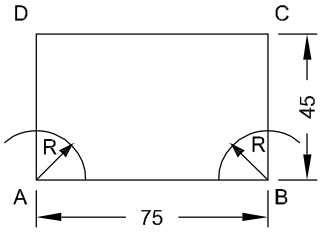
ISOSCELES TRIANGLE

Fig .1D



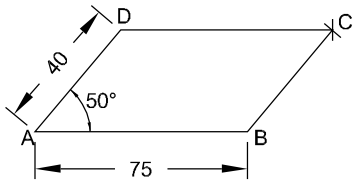
SQUARE

Fig .1E



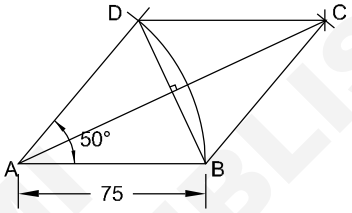
RECTANGLE

Fig .1F



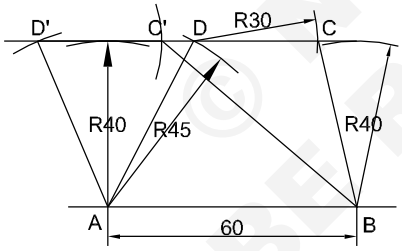
PARALLELOGRAM

Fig .1G



RHOMBUS

Fig .1H



TRAPEZIUM

Fig .1I

SUN1212H1

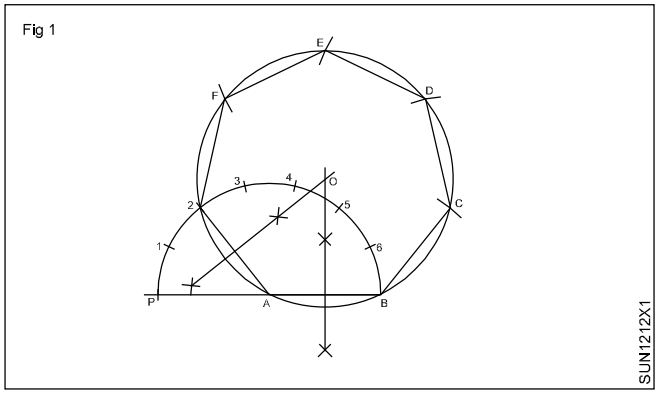
To construct polygons

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

PROCEDURE

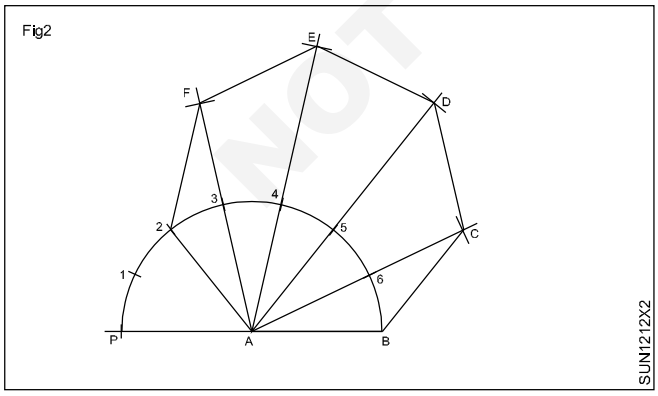
TASK 1: **Regular heptagon of side 30 mm**

Semi-circular method - Type A (Fig 1)



- 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.

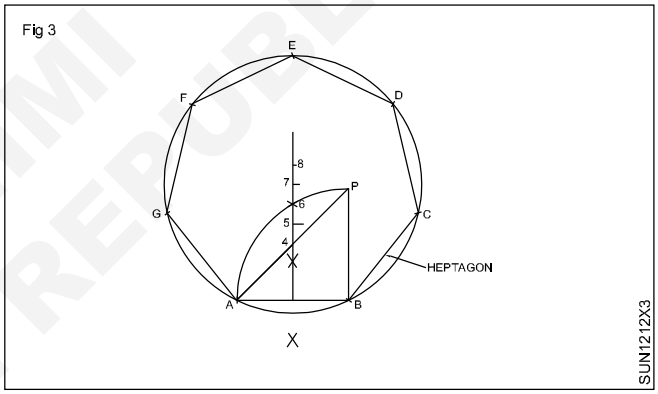
Semi-circle method - Type B (Fig 2)



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

- 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.

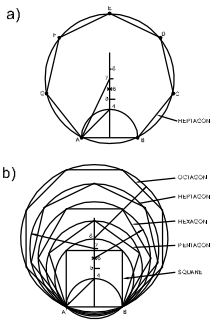
Perpendicular bisector method - Type A (Fig 3)



- 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 heptagon.

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

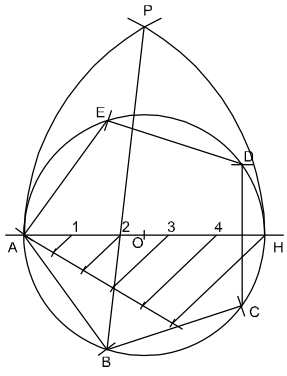
Fig 4



SUN1212X4

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

Fig 5

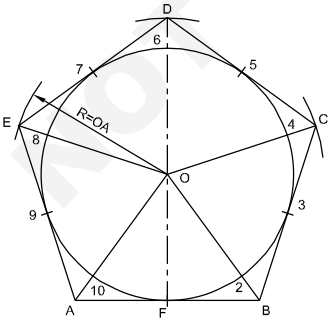


SUN1212X5

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

Fig 6

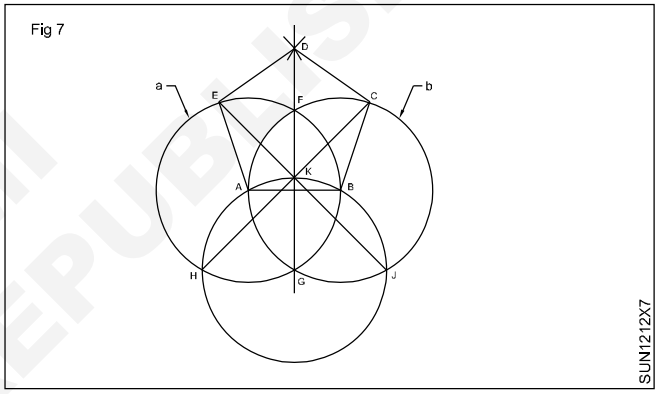


SUN1212X6

- 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.
- 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)

Fig 7



SUN1212X7

Pentagon of 38 mm side

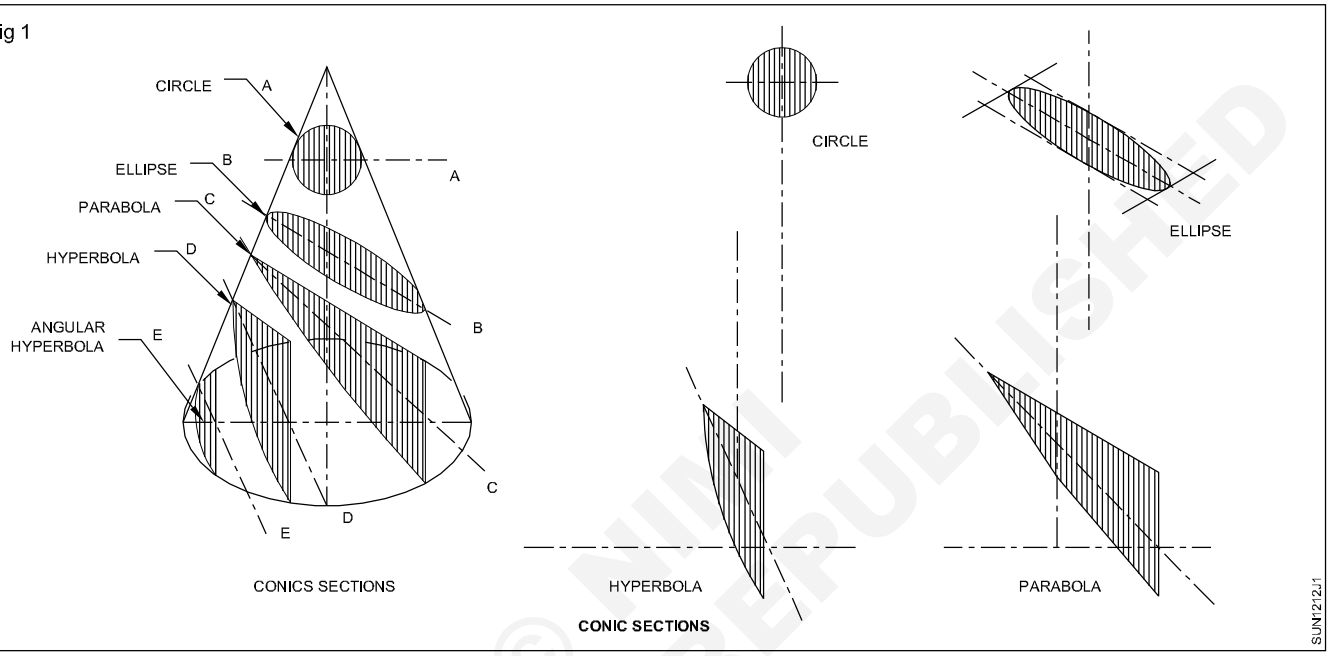
- Draw the line AB equal to side of polygon 38 mm.
- Draw two circles of radius equal and AB, with center A and B, cutting at two points F and G.
- Join G and F extend upwards.
- AB as radius, G as centre, draw a circle passing through A and B cutting both the circles at H and J, and also cutting the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

objective: 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.**

- 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

Objective: 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 concentric circles.
- Draw a number of radial lines through 'O' say 4 cutting 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 vetical 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.

— — — — — — — — —

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.

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Fig 1

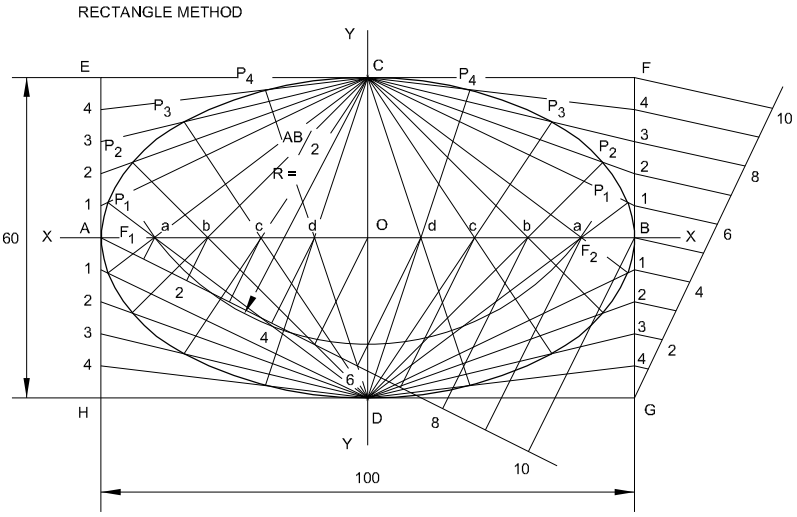


Fig 1A

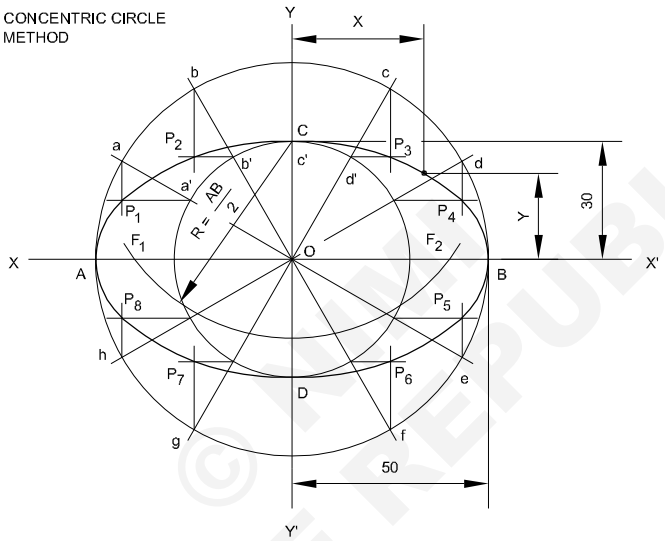


Fig 1B

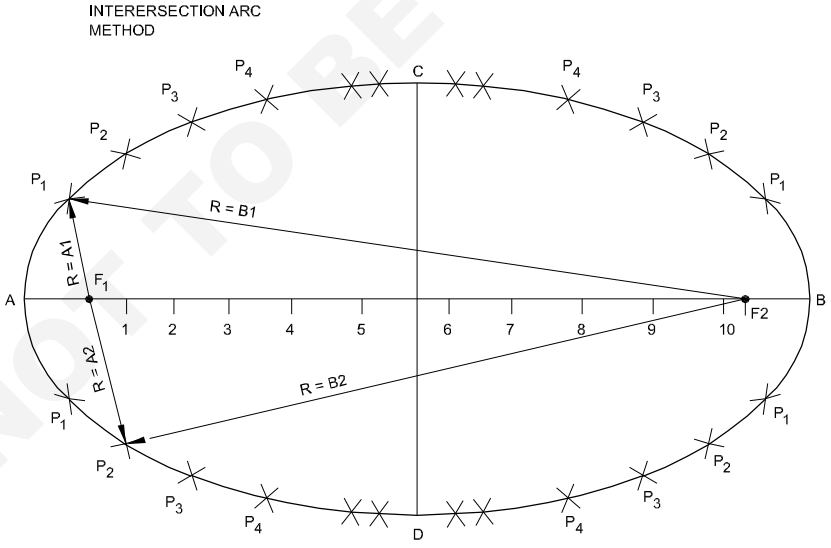


Fig 1C

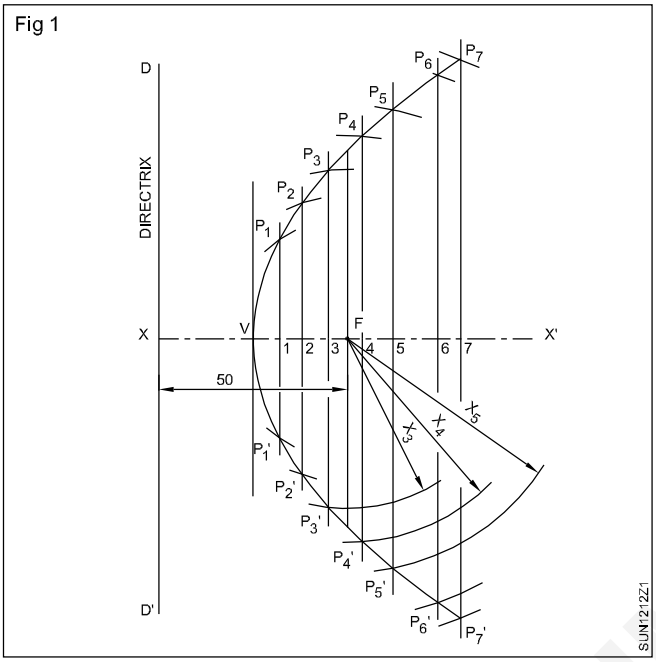
SUN1212Y1

Parabola and hyperbola

Objective: At the end of this exercise you shall be able to
- **construct parabolic curves using the various conditions given.**

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

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

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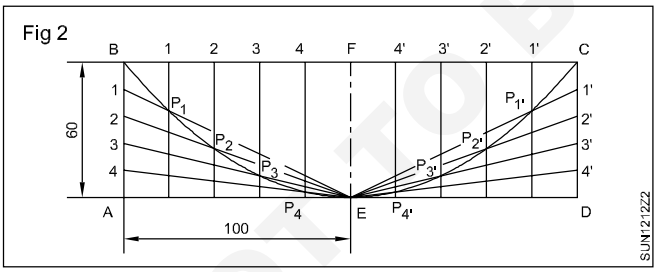
TASK 2: **Parabola, given the base and axis of a rectangle, base 200 mm axis 60 mm- Rectangle method (Fig 2)**

Fig 2



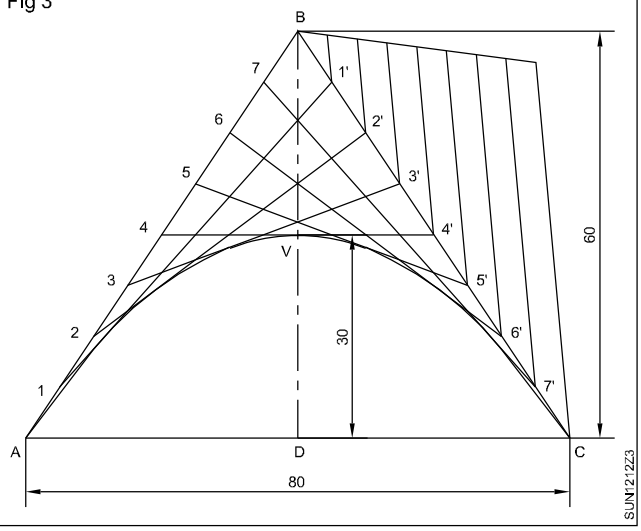
- Draw a rectangle ABCD of sides 200 mm & 60 mm.
- Mark centre points of AD and BC, as E and F, join EF.
- Divide AB & CD and into any number of equal parts say 5. Also divide AE and ED into the same number of equal parts and number them as shown.
- From point E on AD, draw lines to the divisions on 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.

— — — — — — — — —

TASK 2: **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 midpoint 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.

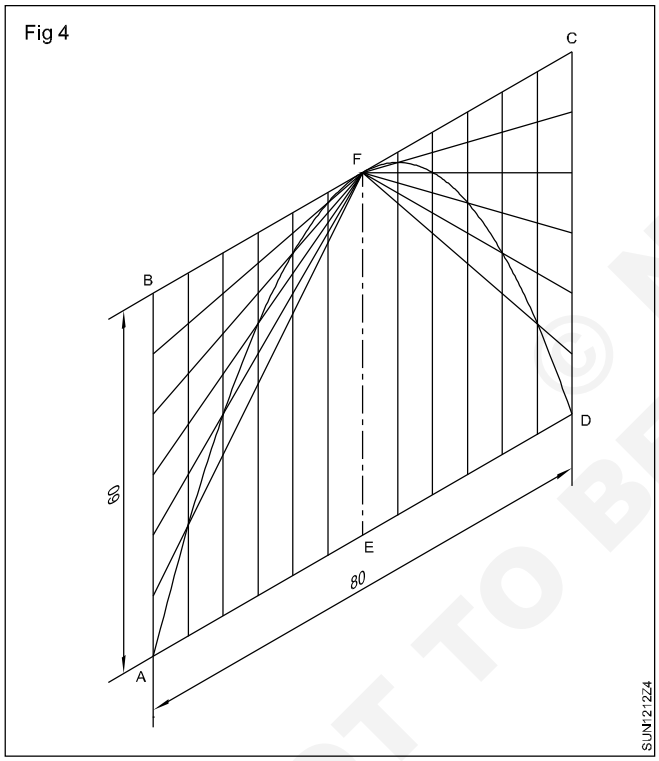
Fig 3



- 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.

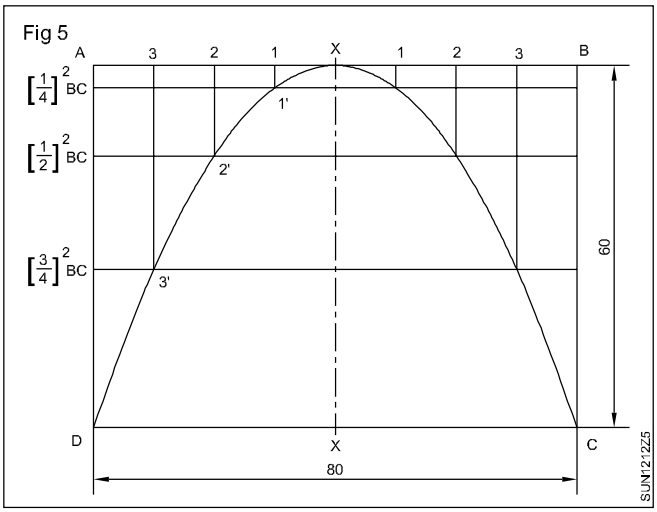
TASK 4: **Parabolic curve of sides 80 and 60 making 60°/120° - Parallelogram method (Fig 4)**

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.

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



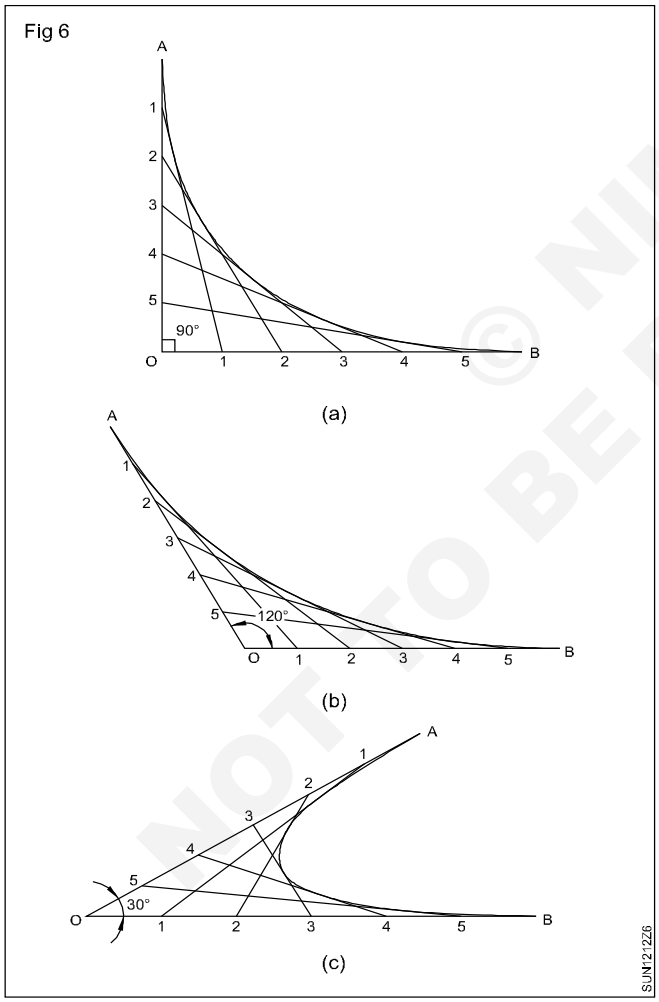
- Draw the rectangle ABCD and draw XX through the midpoint of AB and CD.
- Divide AX and XB into same number of equal parts say 4 and mark them as 1,2,3 as shown.
- From the points 1,2 & 3, draw parallels (offset) to XX.
- On these offsets mark off distances as below:

  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.

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.

To construct plain scale, comparative scale and diagonal scale

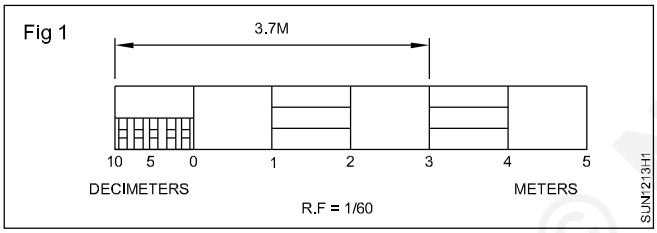
Objectives: At the end of this exercise you shall be able to
- **find out R.F of the scale**
- **calculate the length of scale on drawing**
- **construction of plain scales, comparative scales, diagonal scale**
- **mark the distance on the scale**
- **construct a scale of chords.**

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 measured.
- 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 division 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- divisions, 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-divisions 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.

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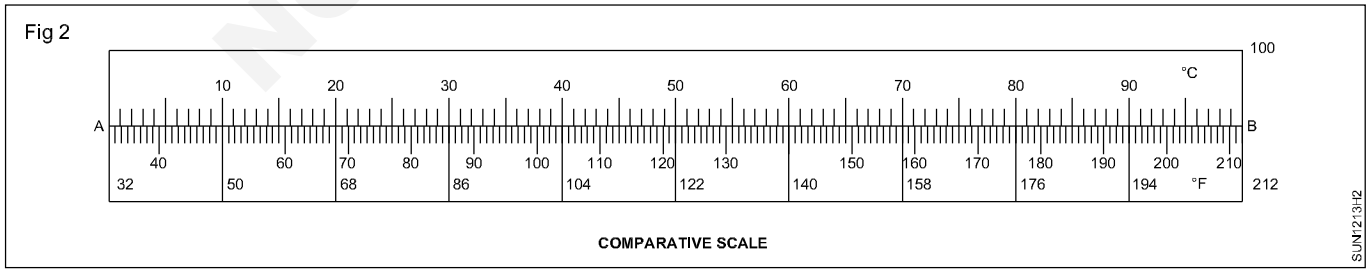
TASK 2: **Construct a comparative scale to convert Fahrenheit (°F) into Celsius °C and vice-versa (Fig 2)**

Fig 2



COMPARATIVE SCALE

- 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.

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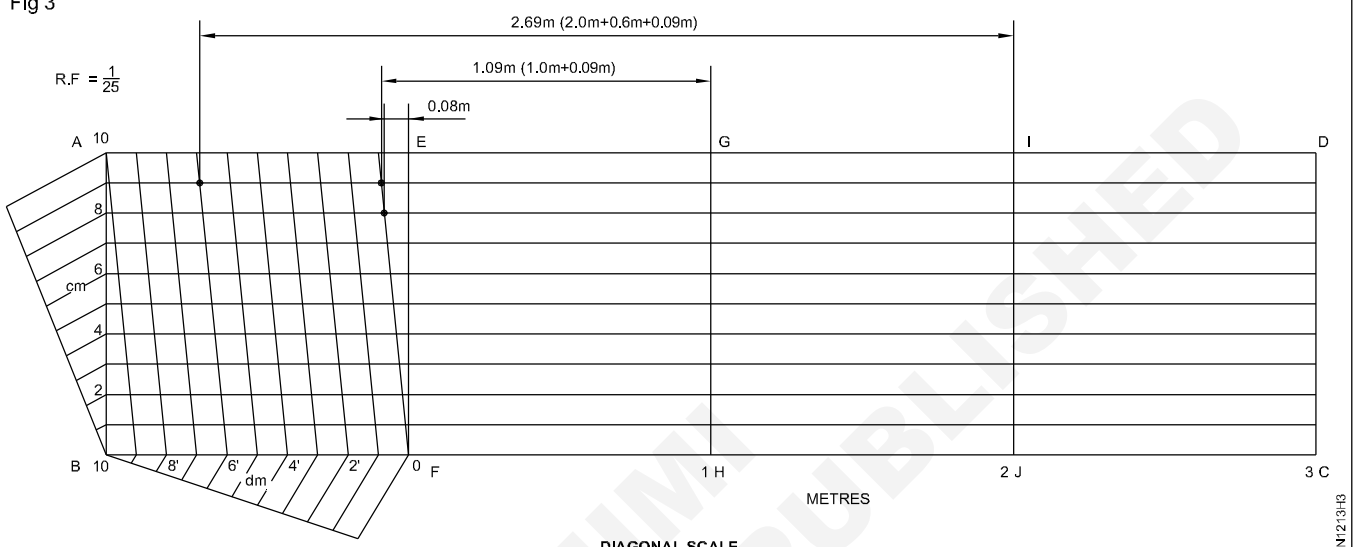
TASK 3: **Construct a diagonal scale for 4 m length and show the lengths 2.69 m, 1.09 m and 0.08 m. (RF = 1/25) (Fig 3)**

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.

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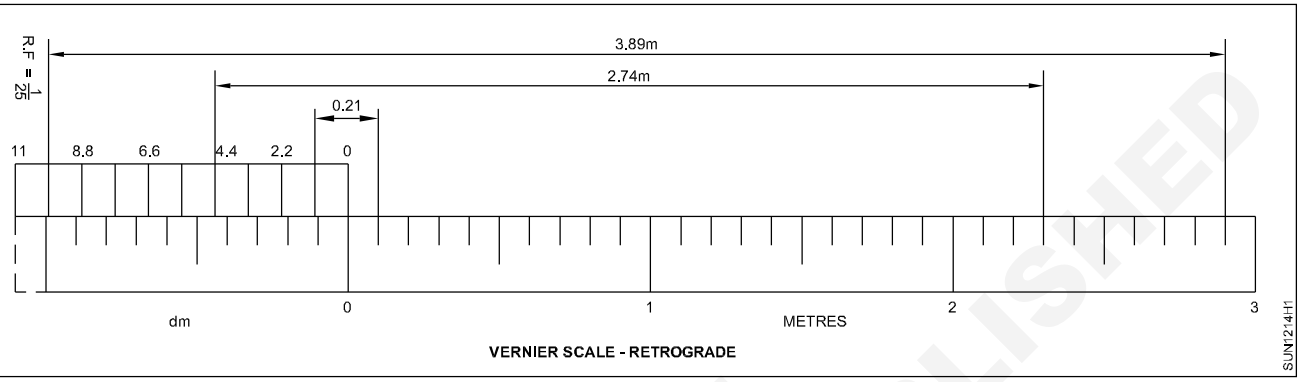
To construct vernier scale

Objective: At the end of this exercise you shall be able to
- **construction of vernier scale.**

PROCEDURE

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

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.

— — — — — — — — —

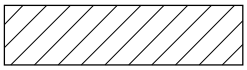
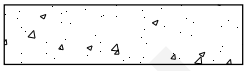
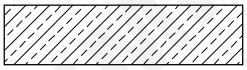
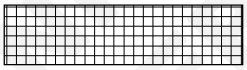
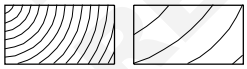
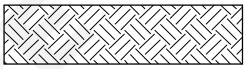
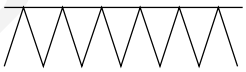
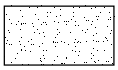
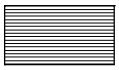
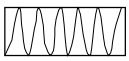
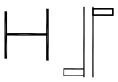
Symbols for Materials and survey

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

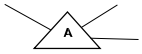
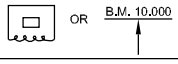
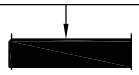
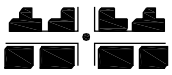
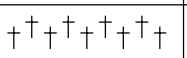
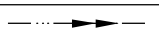
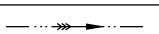
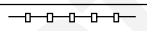
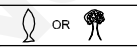
TASK 1: **Draw the symbols for various materials as shown in figure**

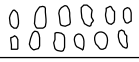
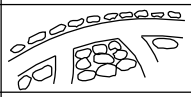
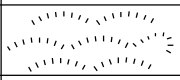
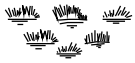
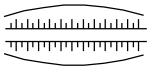
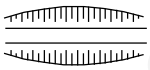
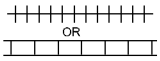
Fig 1

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

Survey symbols

SL. NO.	OBJECT	CONVENTIONAL SIGN	COLOUR
1.	CHAIN LINE		CRIMSON LAKE
2.	TRIANGULATION STATION		CRIMSON LAKE
3.	TRAVERSE STATION		CRIMSON LAKE
4.	BENCH MARK		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		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		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		BLACK
48.	DEMARCATED PROPERTY BOUNDARY		
49.	UNDEMARCATED PROPERTY BOUNDARY		
50.	CULVERT		
51.	ELECTRIC LINE		

SUN1218E2

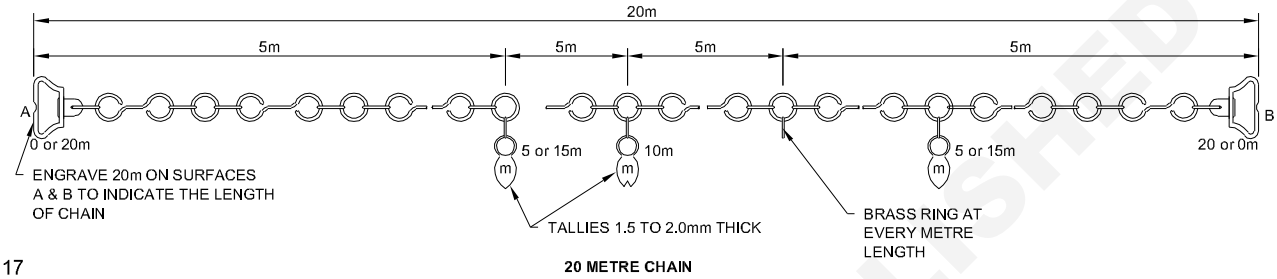
Free hand sketching of instruments

Objectives: At the end of this exercise you shall be able to
- **sketch the linear measurement of metric chain and tape**
- **sketch the survey tools.**

PROCEDURE

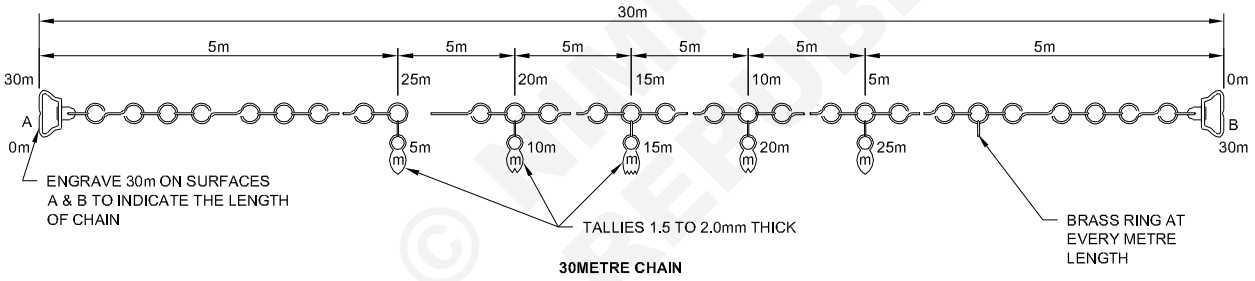
TASK 1: **Sketch the given instruments figures as shown in freehand**.

Fig 16



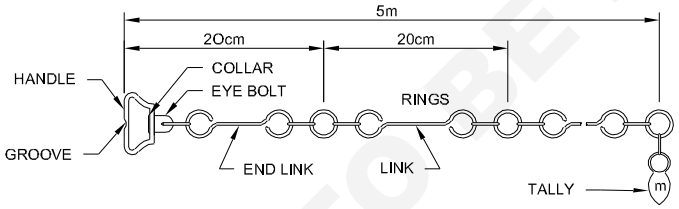
20 METRE CHAIN

Fig 17



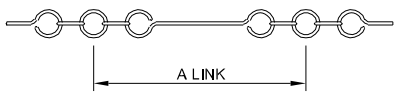
30METRE CHAIN

Fig 18



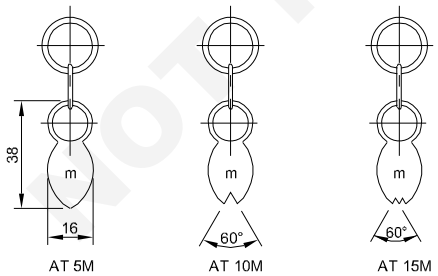
DETAILS OF A METRIC CHAIN

Fig 19



A LINK OF A CHAIN

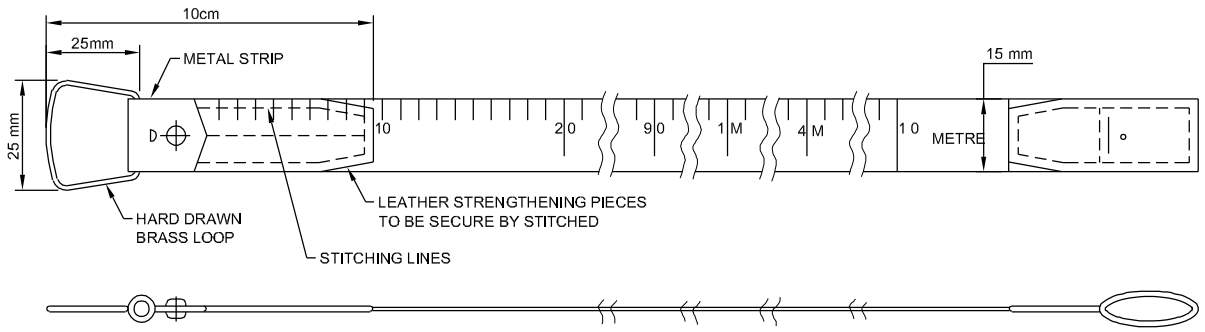
Fig 20



SHAPE OF TALLIES IN 30m METRIC CHAIN

SUN1219HG

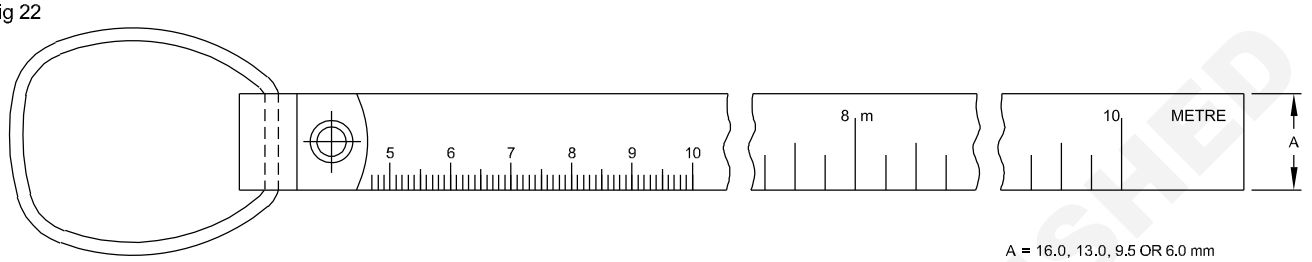
Fig 21



METALLIC TAPE

SUN1219IH

Fig 22

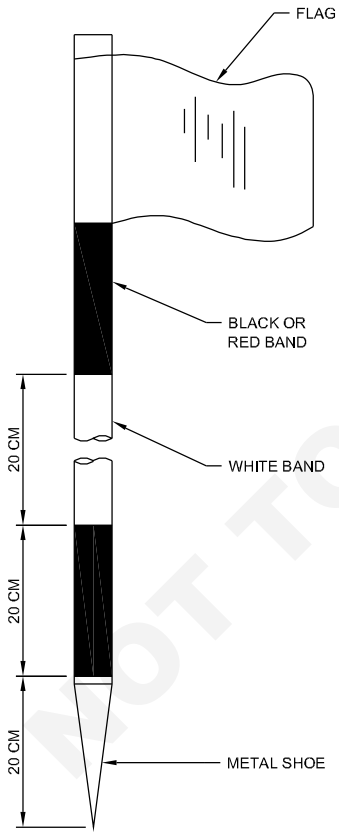


A = 16.0, 13.0, 9.5 OR 6.0 mm

STEEL TAPE

SUN1219II

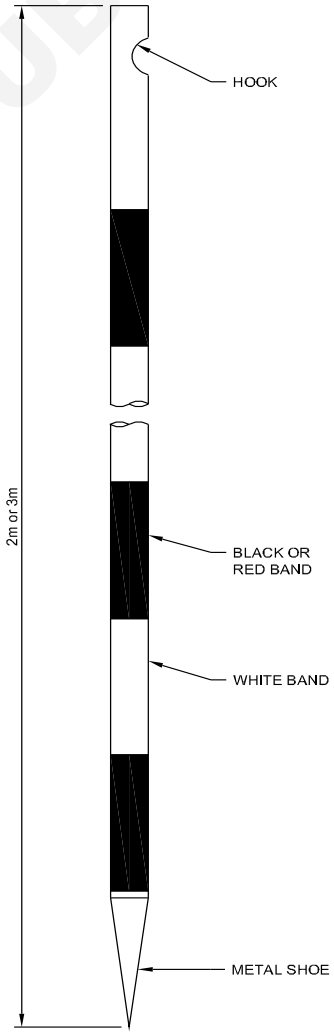
Fig 23



RANGING ROD

SUN1219IJ

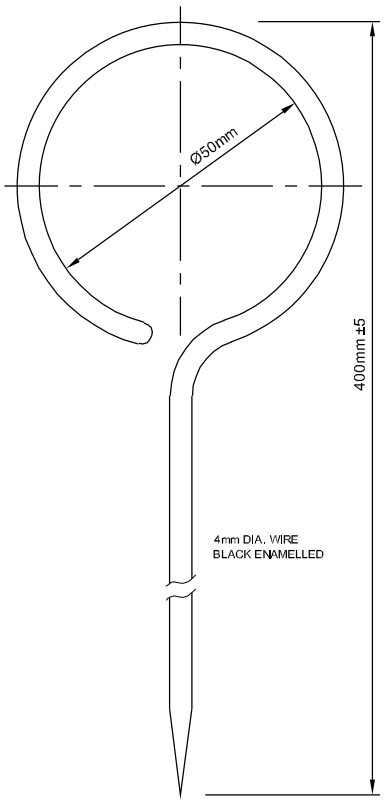
Fig 24



OFFSET ROD

SUN1219IK

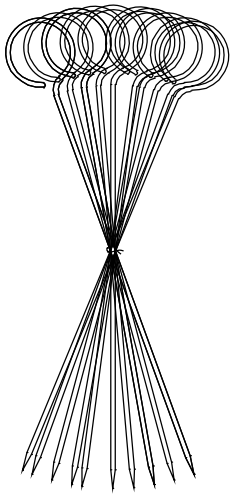
Fig 25



ARROW

SUN219HL

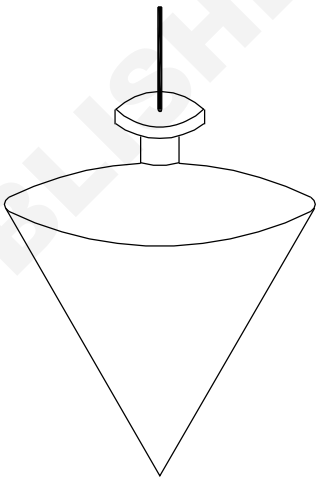
Fig 26



ARROWS

SUN219HM

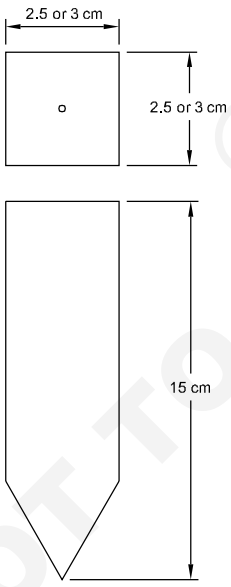
Fig 28



PLUMB BOB

SUN219HO

Fig 27



WOODEN PEG

SUN219HN

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

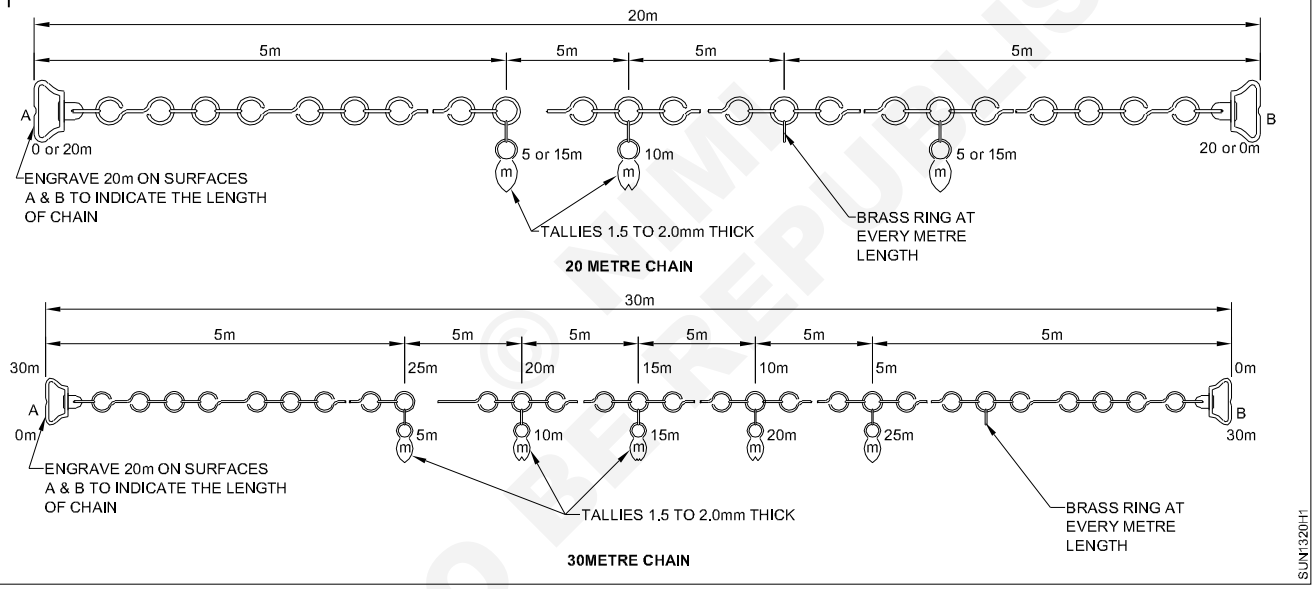
Tools/Equipments/Instruments

- 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**

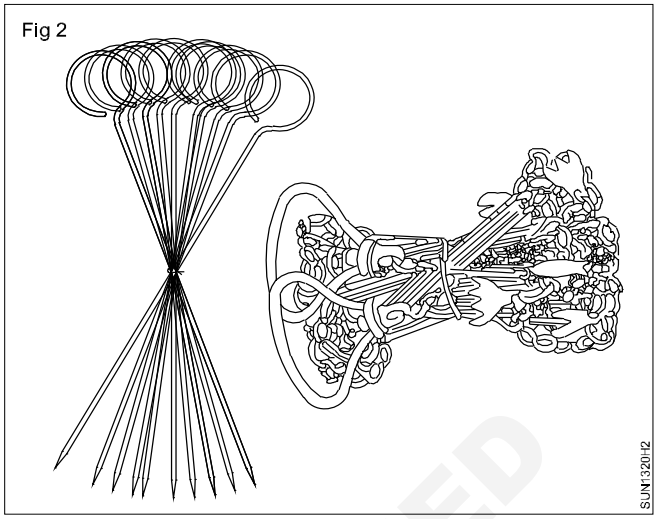
1 Leader to take the middle of the chain with his left hand, after completing the work.

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)

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

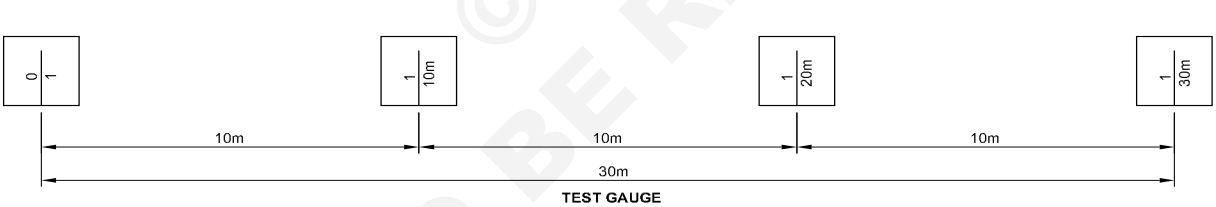
1 Mark the standard distance of 30m/20m on a nearest verandah floor or Railway platform or copings of walls etc. with a standard chain or a steel tape which should kept in the surveyor's office for the sole purpose.

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

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

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

Fig 1



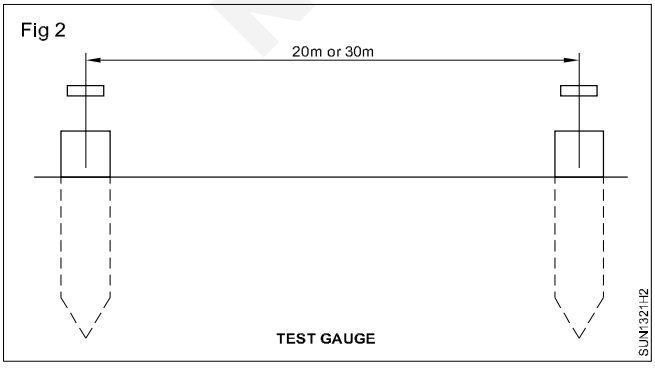
Method 2

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.

Fig 2

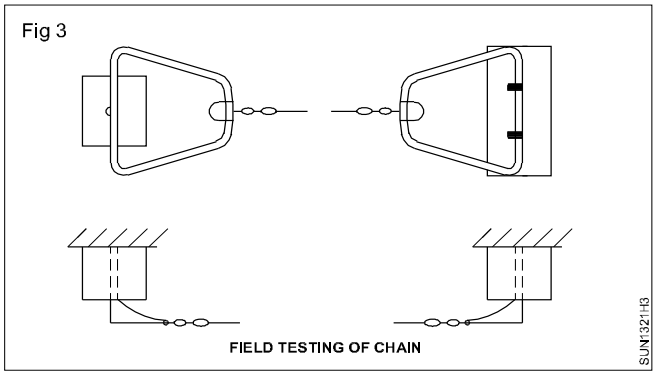


8 Drive a third peg in the middle of above two markings by standard chain/steel tape.

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

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

Fig 3

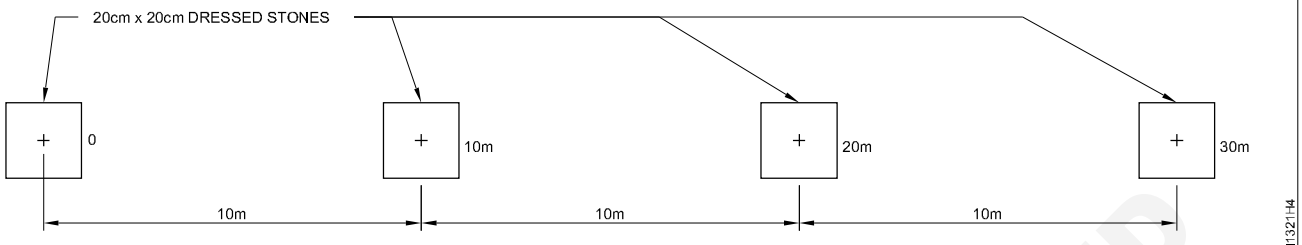


It is preferable to establish a permanent test gauge by using dressed stones about 20cm square instead of pegs. (Fig 4)

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

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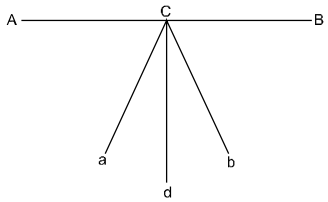
TASK 2: **Test on Optical square**

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

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' midway between 'a' and 'b' fix ranging rod at 'd'

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

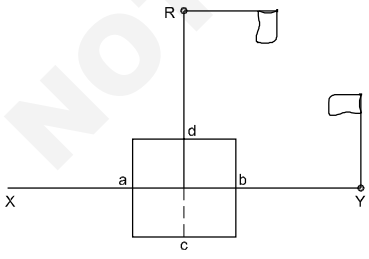
7 Repeat the above process till it corrects.

— — — — — — — — —

TASK 3: **Test on cross staff**

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

Fig 6



TESTING A CROSS-STAFF

2 Hold the ranging rods at X and Y

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.

— — — — — — — — —

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

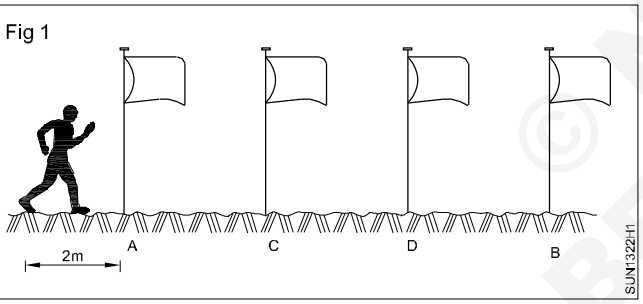
- Metric chain 20m/30m - 1 No.
- Ranging rods 2/3m-3cm Ø - 3 Nos.(min.)
- Arrow 40cm long-4mm Ø - 10 Nos.
- Measuring tape steel 30m - 1 No.

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.

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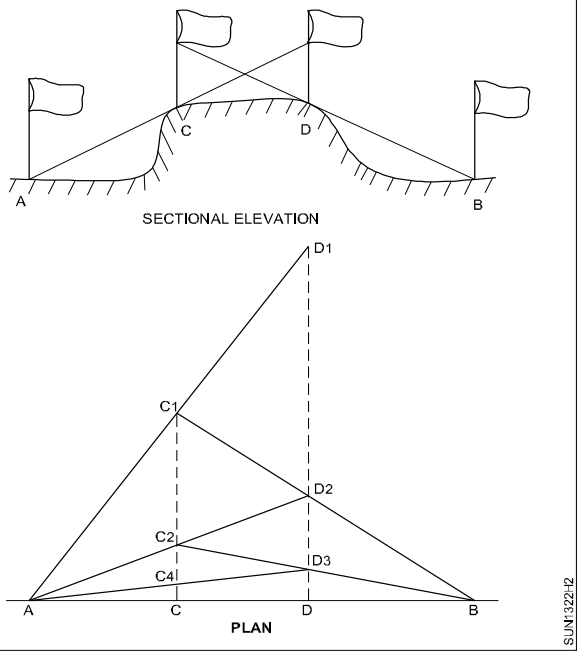
TASK 3: **Indirect ranging or reciprocal ranging (Fig 2)**

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 movements 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.

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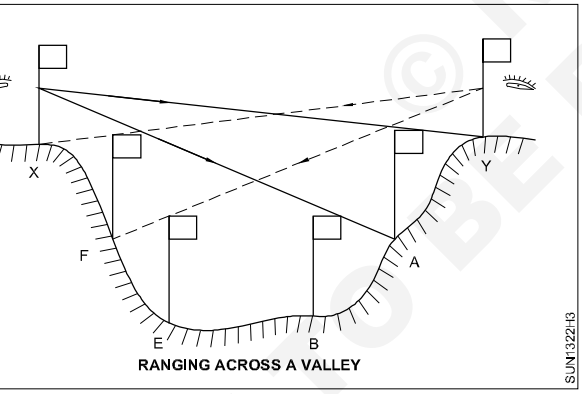
TASK 4: **Ranging across a valley (Fig 3)**

Fig 3



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

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 until 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

— — — — — — — — —

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.

2 Form a random line AB1 from A.

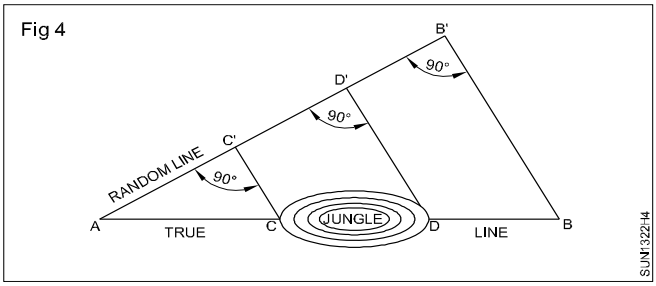
3 Select B1 such that the line BB1 should be perpendicular to AB1.

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.



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

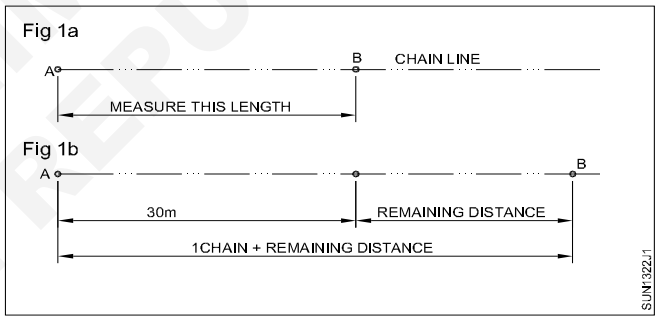
TASK 1: **Measure the distance between two given points within 30m/20m by using 30m/20m chain.**

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 in line 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

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	0 Nos.
• Cross staff	1 No.
• Ranging rod	2 Nos.
• Offset rod	2 Nos.
• Steel tape (30m)	1 No.

Materials

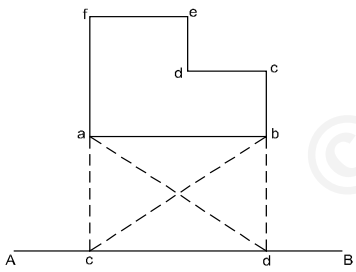
• Field book	1 No.
• Pencil	1 No.
• Eraser	1 No.

PROCEDURE

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

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

Fig 1



ca, db ARE THE PERPENDICULAR OFFSETS.
USING CROSS STAFF

SUNT323H1

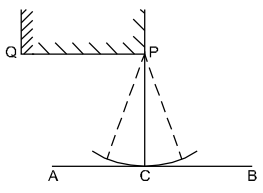
1 Run a chain line AB approximately parallel to the side of building a, b on ground.

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'.

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

Fig 2



BY SWINGING ARC METHOD

SUNT323H2

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

5 The leader holds 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.

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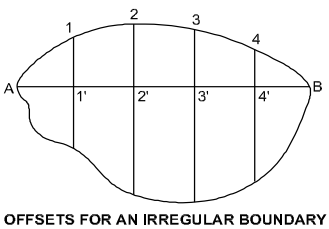
TASK 2: **Take perpendicular offsets to a given Irregular fields (Fig 3)**

Fig 3



OFFSETS FOR AN IRREGULAR BOUNDARY

SUNT323H3

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

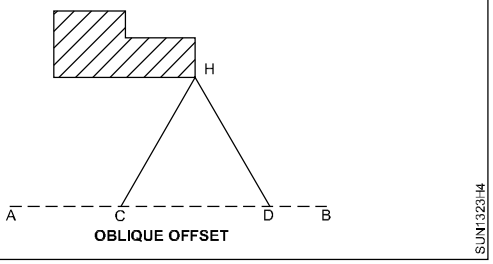
2 Take offsets on both sides at suitable intervals and at such points where the direction suddenly changes.

3 Note the chain age and measure the offset.

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

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

Fig 4



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

2 At a convenient full chain age 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 chain ages and offsets in the field book.

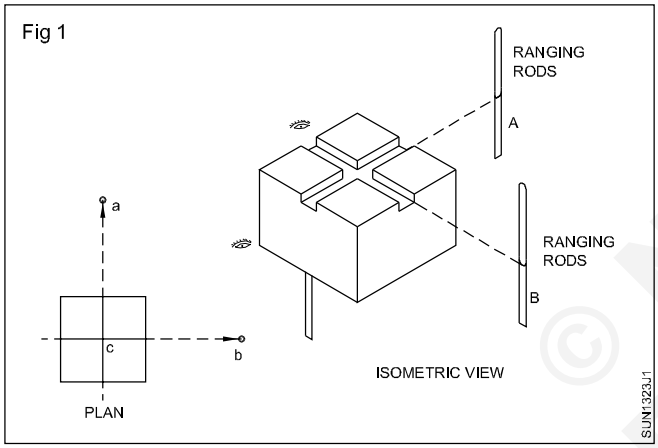
Skill Sequence

Finding the foot of the perpendicular offset

Objective: 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)

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 chain line 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 simultaneously. (Fig 1)

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

Note the chain age and measure the offset.

6 Record the chain age 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'.

Finding the foot of the perpendicular offset (Optical Square)

Objective: At the end of this exercise you shall be able 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 triage of the ranging rod at the object 'a' appeared in the silvered position 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 chain age and measure the offset.

9 Record the above chain age 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 - 1 No.
- Arrow 40cm long-4mm thick - 10 Nos.

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 chain line 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)

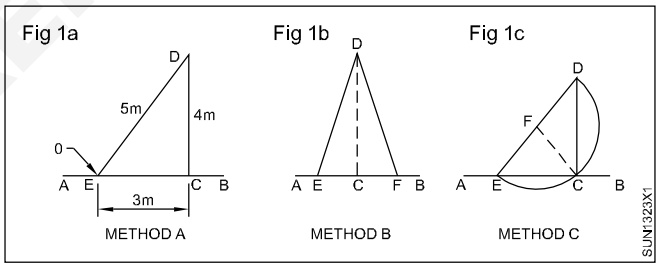
15 Mark E where the semicircle cuts the chain line AB

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.



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TASK 2: **To drop a perpendicular offset to a chain line 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 chain line in F.

5 Bisect EF at C.

6 CD will be perpendicular to AB.

Method B (Fig 2b)

7 Stretch and run a chain line AB.

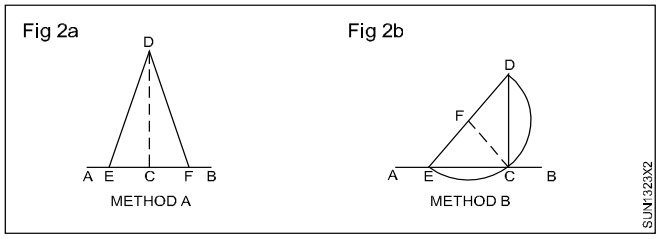
8 Select any point E on the chain line

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 chain line in C.

22 CD will be perpendicular to the chain line AB.



Marking an arc on ground

Objective: At the end of this exercise you shall be able to
- **make an arc of 5m on ground.**

1 Hold zero end of tape at E with the Helper. (Fig 1)

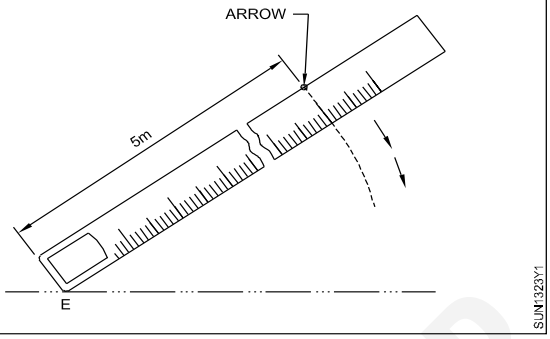
2 Stretch the tape for more than 5m in the direction in which the arc is to be made.

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



Practice on overcoming obstacles in chaining

Objectives: At the end of this exercise you shall be able to
- **run the chain line even vision is obstruct**
- **overcome obstacles in chaining**
- **measure the distance even chaining is obstructed**
- **measure the obstructed distance even both chaining and ranging obstructed.**

Requirements

Tools/Equipments/Instruments

- Chain 30m - 1 No.
- Ranging rods 2/3m-3cmØ - 4 Nos.
- Tape 30m - 1 No.
- Cross staff - 1 No.
- Arrows - 40cm long - 10 Nos.

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)

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 in line with DA.

7 Thus the intermediate positions C and D are established in line with AB. (Fig 1b step 4 and 5)

Fig 1a

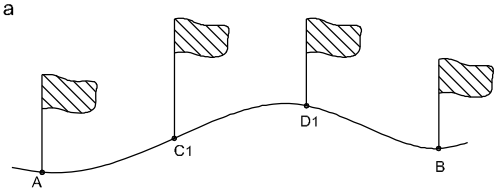
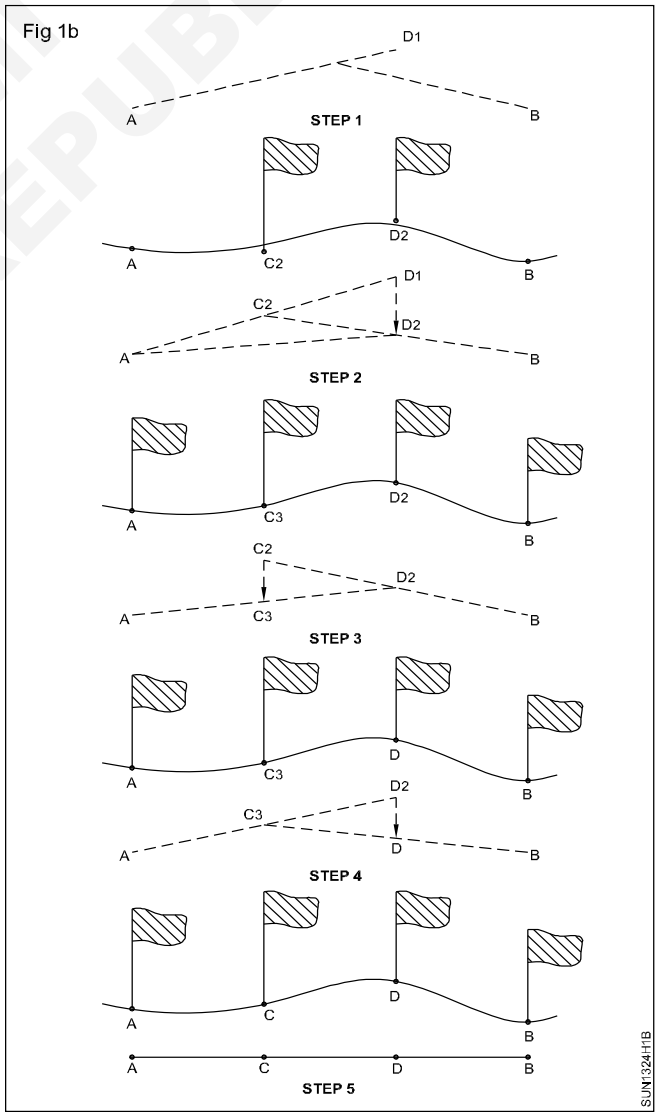


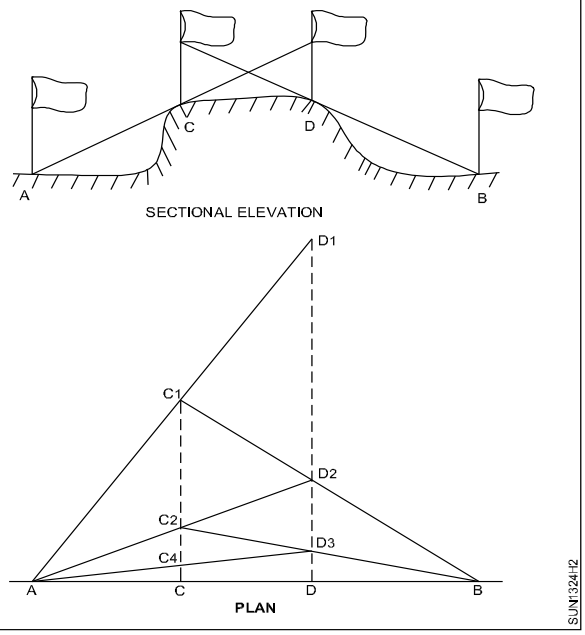
Fig 1b



8 Run the chain through C and D to B. (Fig 2)

9 The same procedure can be adopted for valley portion also. (Fig 3)

Fig 2



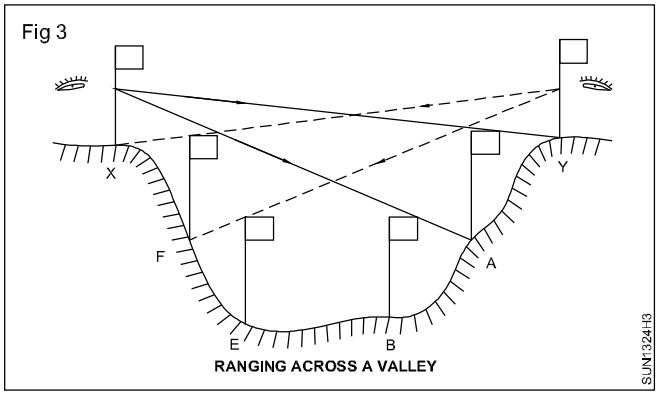
Case (ii) Both ends may not be visible from any intermediate point such as in the case of Jungle.

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

11 Form a random line AB1 from A.

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

Fig 3



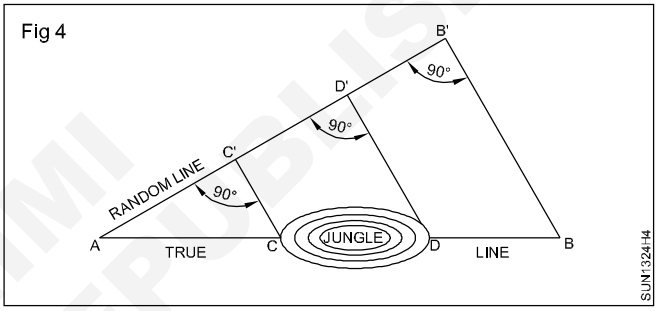
13 Measure the length of AB1 and BB1.

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 Fig 4.

Fig 4

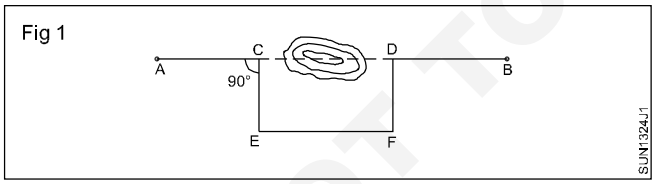


TASK 2: **Measure the distance even chaining is obstructed**

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.

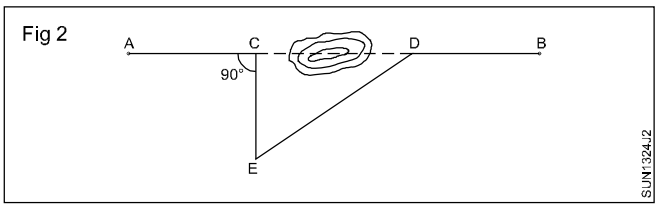
3 Erect a perpendicular to a convenient distance from station 'C' and denote it as 'E'.

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 perpendicular to a convenient distance from station 'C' and denote as E.

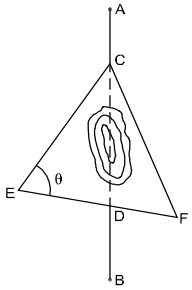
9 Measure the distance CE and DE.

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 ⌊CEF as θ

In Triangle CEF

$CF^2 = CE^2 + EF^2 - 2CE.EF.\cos\theta$

$2CE.EF.\cos\theta = CE^2 + EF^2 - CF^2$

$$\cos\theta = \frac{CE^2 + EF^2 - CF^2}{2\,CE.EF} \quad \text{-----> (1)}$$

In Triangle CED

$CD^2 = CE^2 + ED^2 - 2CE.ED.\cos\theta$

$2CE.ED.\cos\theta = CE^2 + ED^2 - CD^2$

$$\cos\theta = \frac{CE^2 + ED^2 - CD^2}{2\,CE.ED} \quad \text{-----> (2)}$$

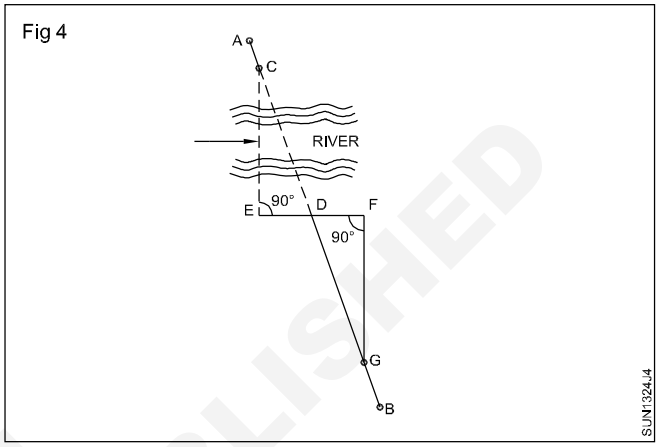
Equating 1 and 2

$$\frac{CE^2 + EF^2 - CF^2}{2CE.EF} = \frac{CE^2 + ED^2 - CD^2}{2CE.ED} \quad \text{-----> (3)}$$

substituting the field measurements in 3 we get the distance of CD.

Case (ii) When the obstacle cannot be chained around (Fig 4)

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., ⌊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 chain line AB such that FG perpendicular to the FD.

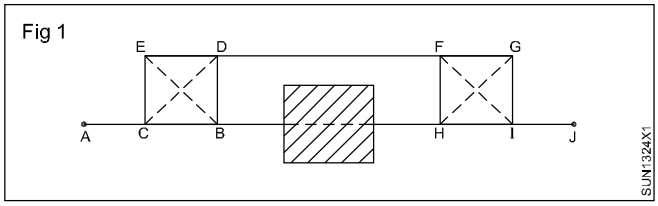
22 Measure the distance DG, then DG will be equal to the obstructed distance of CD.

— — — — — — — — —

TASK 3: **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 perpendicular 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.

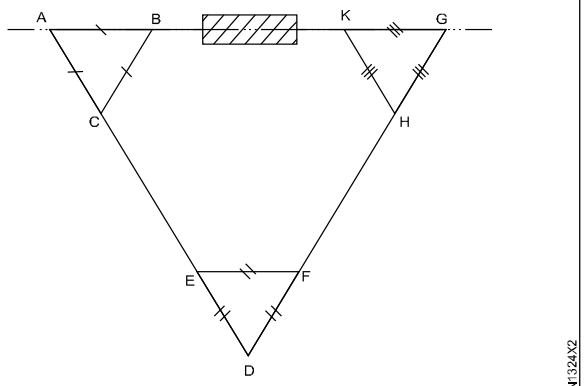
2 With AB as base construct an equilateral triangle ABC by swinging equal arcs with a tape.

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.

Fig 2



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.

Practice on Ranging and chaining in sloping ground

Objective: 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. - 1 No. each
- Arrows - 10 Nos.

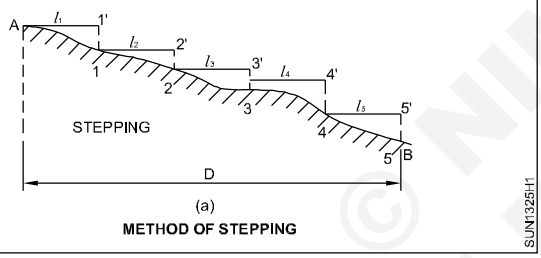
PROCEDURE

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



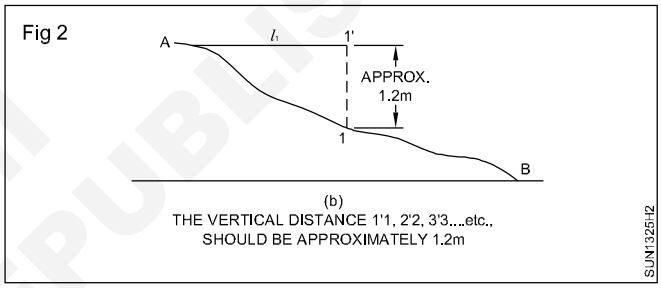
3 Hold the zero end of the steel tape at A on the ground by follower.

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



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 = $l_1 + l_2 + l_3 + l_4 + l_5$

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 and plotting on the map.**

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.

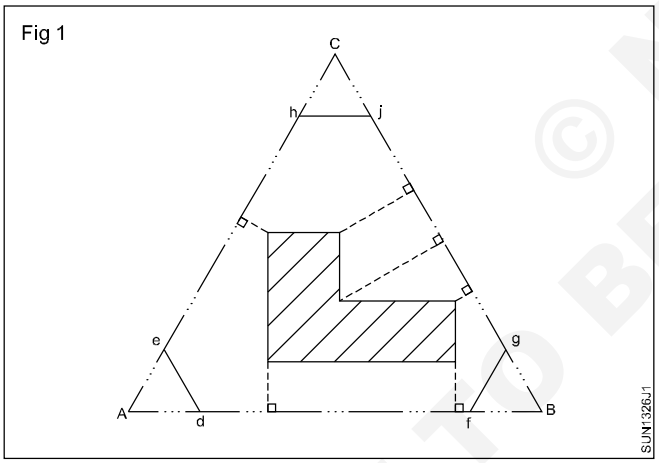
Materials

- 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 chain ages and offsets of the corners of the building and enter in the field book.

6 Mark a point 'd' & 'f' on the chain line 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 chain line 'BC' and 'e' and 'h' on the chainline 'CA' and fix arrows.

9 Measure check lines distances 'de','fg' and 'hj' and enter in the field book.

Office work

10 Draw the chain line '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 check line points 'd' and 'f' on the chain line 'AB'.

16 Similarly mark the check line points g, j and 'h','e' on the check line BC and CA respectively.

17 Measure the check line distances 'de' , 'hj' and 'gf' in the drawing.

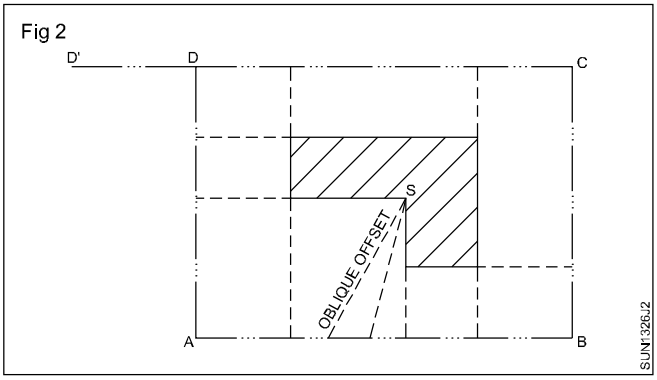
18 Check the measured distances with field measurements for accurancy of the frame work.

19 Plot the chain ages and offsets to all chain lines 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)

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 chain ages and measure the offsets.

6 Enter the chain ages and offsets in the field book.

7 Locate the interior corner (s) of the building by taking oblique offsets from any two fixed round chain ages.

8 Locate the station 'c' by sighting station 'A' using the cross staff at B.

9 Run the chain line 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 chain line from C to D and locate the details along CD

15 Similarly, Run the chain line from D to A, and locate the details along DA.

Office work

16 Draw a chain line '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 chain ages on the correspond chain lines.

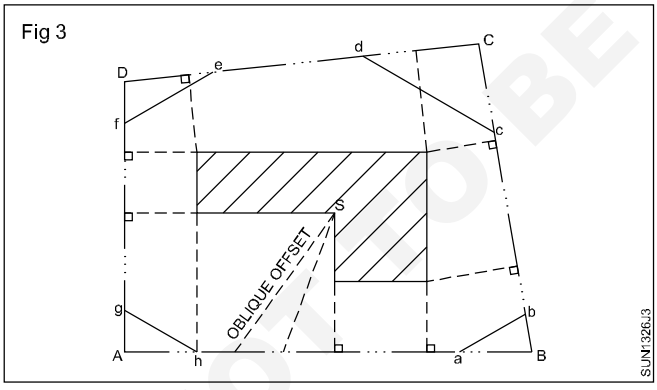
20 Draw the offsets from the correspond chain lines

21 Connect all the offset points to get the actual outlines of the buildings

— — — — — — — — — —

TASK 3 : **Chain survey around a given small building by traversing using chain angle method.** (Fig 3)

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 chain ages.

5 Measure the offsets and enter in the field book.

6 Fix a check line point 'a' on the chain line 'AB' where more than 3m from station B and fix an arrow.

7 According to the ground conditions run the chain line from B to C at any angle using chain angle method.

8 Take chain ages and offsets on the chain line BC.

9 Fix a chain line 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 check line point 'b' where the above two arcs intersect each other.

18 Join Bb and prolong it up to station C.

19 Mark the chain ages and offsets on the chain line BC.

20 Follow the above procedure for remaining chain lines CD and DA.

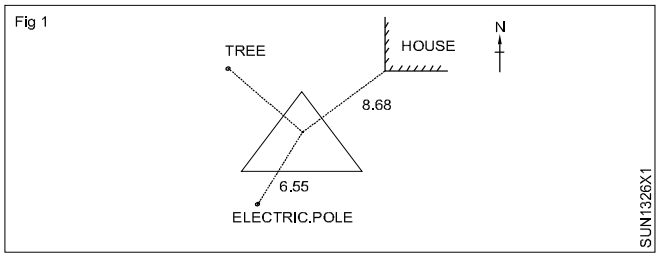
Skill Sequence

Preparing reference sketch to stations

Objective: 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 permanent 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

Objective: At the end of this exercise you shall be able 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 chain age 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.

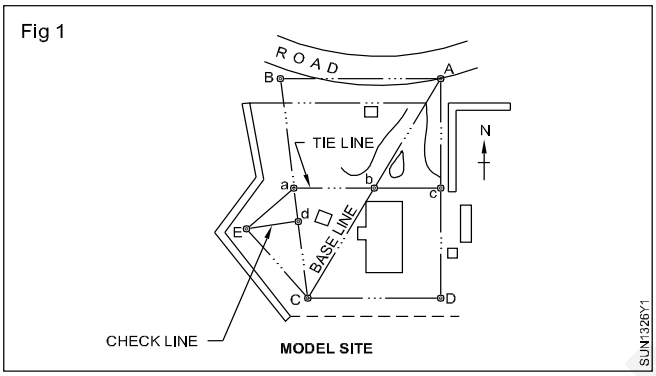
Materials

- Drawing sheet A3 - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale -1 set.
- Cello tape - 1 No.
- Field note - 1 No.

PROCEDURE

TASK 1: **Prepare key plan of the site (Fig 1)**

Fig 1



Field work

1 Make reconnaissance survey, prepare a rough sketches of the given site in the field book.

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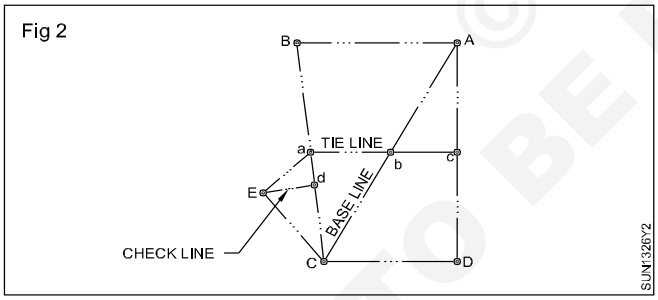
TASK 2: **Select and fix stations, base lines, check lines and tie lines (Fig 2)**

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.

— — — — — — — — —

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 chain ages 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

Objective: 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.

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 chain ages, and offsets on both sides of the chain lines 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.

12 Draw all the boundary lines with Indian ink.

13 Give colouring according to the symbol.

Use the conventional signs for the various types of objects

Fig 1

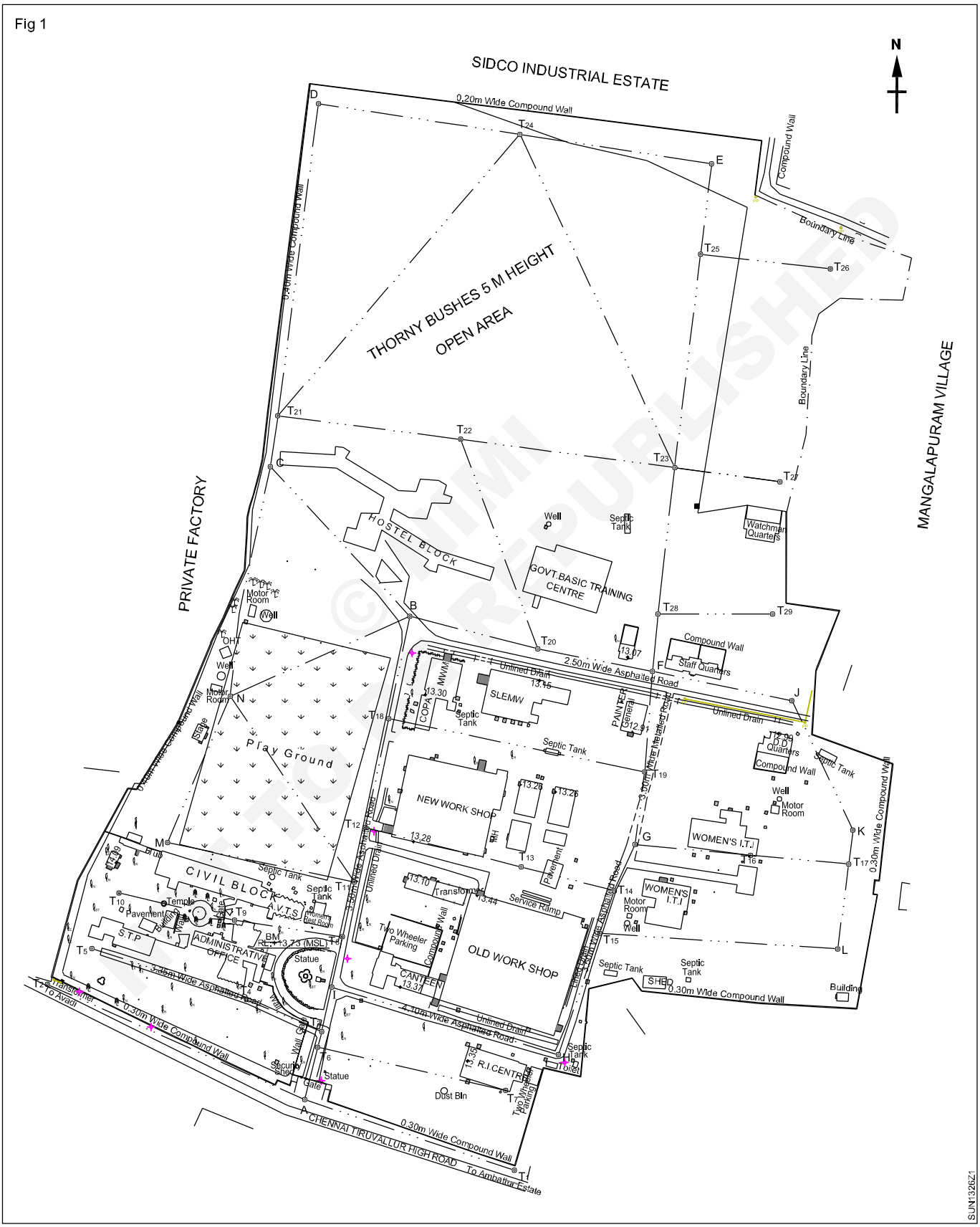
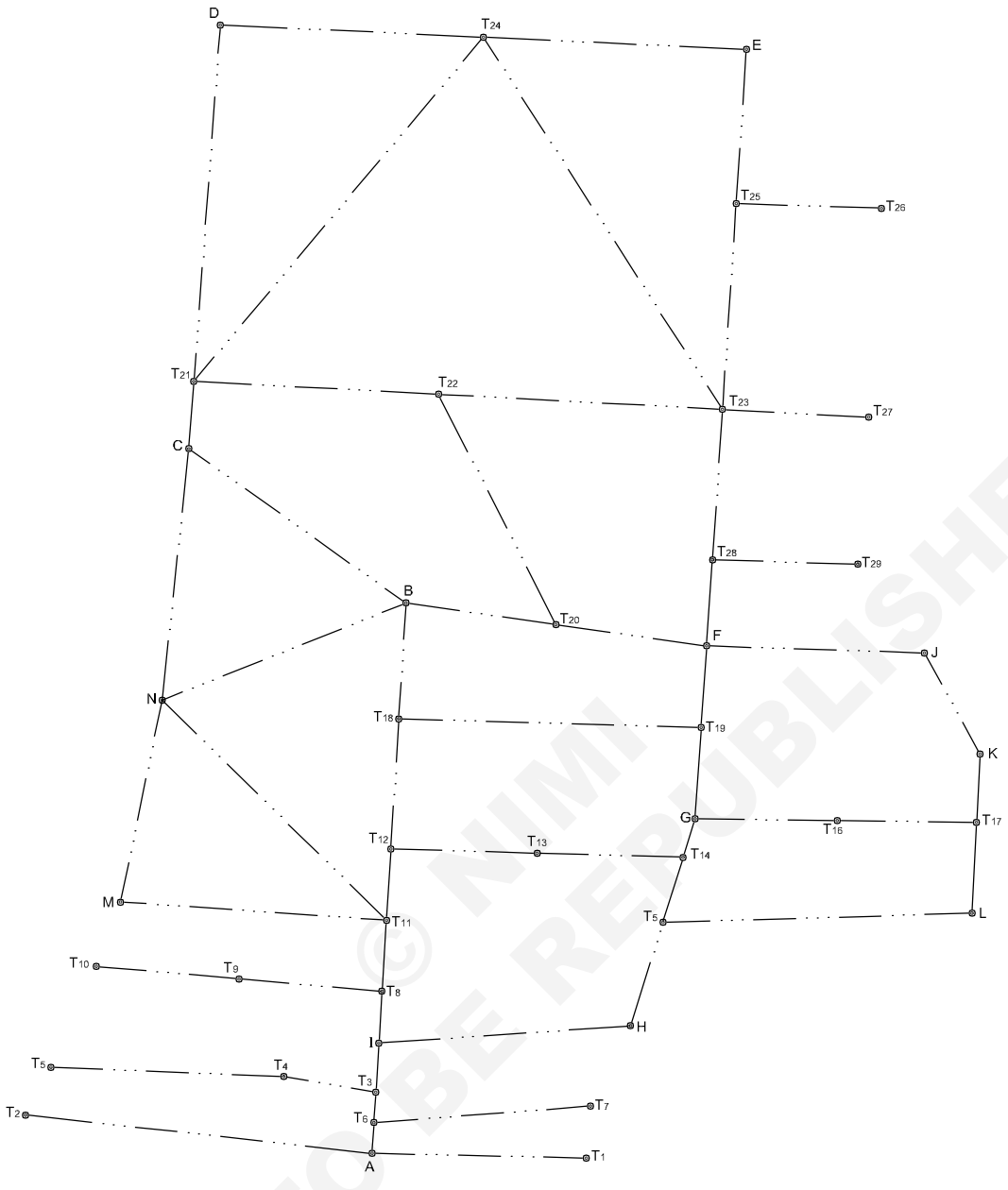


Fig 2



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

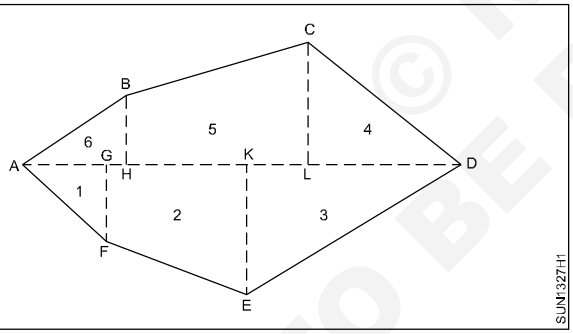
PROCEDURE

TASK 1: **Calculate the area of the polygonal shaped land**

Field work

1 Mark the given points ABCDE & F on the ground. (Given by the Instructor) (Fig 1)

Fig 1



2 Select the longest distance between any two points say AD as the base line.

3 Run the chain line along AD.

4 Locate the perpendicular offset FG.

5 Note the chain age 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 chain ages at H,K and L and measure offset BH, EK and CL and enter in the field book.

Office work

8 Draw the base line AD to a suitable scale on the drawing sheet.

9 Mark the chain ages 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 anti clockwise 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 initial 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.**

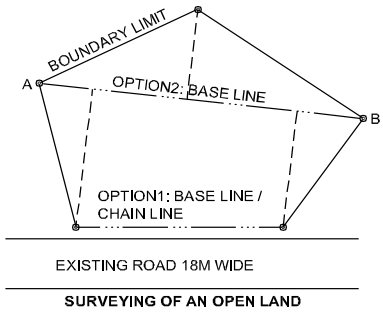
PROCEDURE

TASK 1: **Prepare detailed survey for layout plan**

1 Fix a baseline following boundary line or diagonal to the boundary corners (Fig 1).

2 Same baseline/chain line to be retained or permanently marked for laying of layout plots.

Fig 1



3 Locate all boundary corners and existing or access roads, natural and manmade 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.

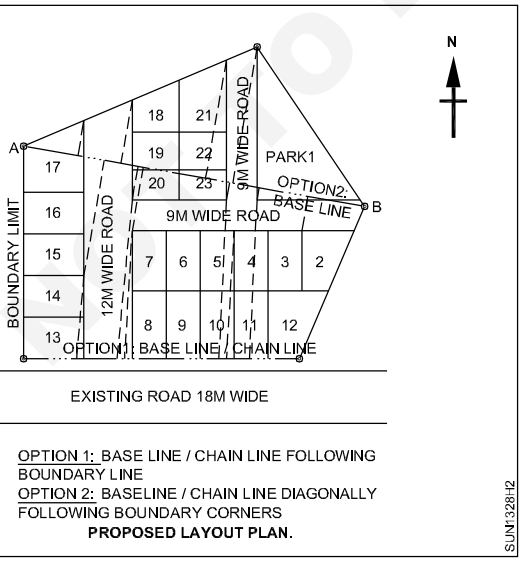
7 To mark the layout at the ground take right angle offsets with reference to baseline/chain line.

— — — — — — — —

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

Objective: 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)

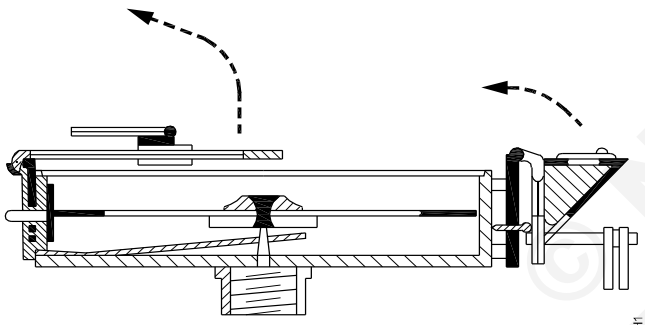


FIGURE SHOWING POSITION 1

SUN1429H1

Fig 1(b)

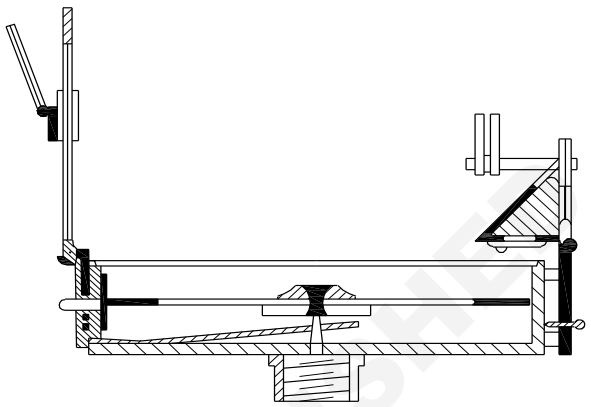


FIGURE SHOWING POSITION 2

SUN1429H2

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

Objective: This shall help you to
- **level the instrument**

1 Adjust the compass 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: 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

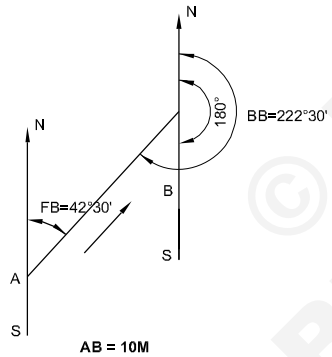
- Field book - 1 No.
- Ink pen - 1 No.

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)

Fig 1



The stations A and B should be selected free from local attraction.

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.

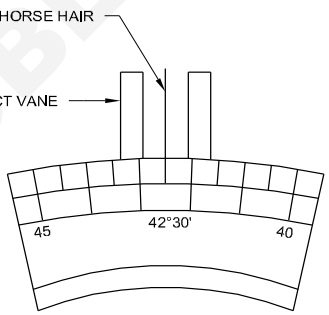
5 Fix a ranging rod at the station ‘B’.

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° 30’) at which the hair line produced appears to cut the image of the graduated ring (Fig 1(a)).

8 Thus the required for bearing of line AB is 42° 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

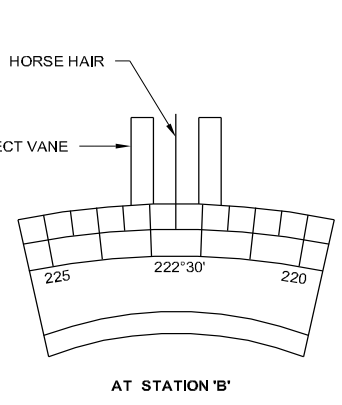
9 Shift the instrument and setup at station ‘B’.

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° 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°

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

Objective: At the end of this exercise you shall be able to
- **observe the bearings.**

1 Fix a ranging rod where the bearing is to be found.

2 After centering levelling and focusing the prism, turn the compass box until the ranging rod is bisected by the hair when looked through the slit in the prism.

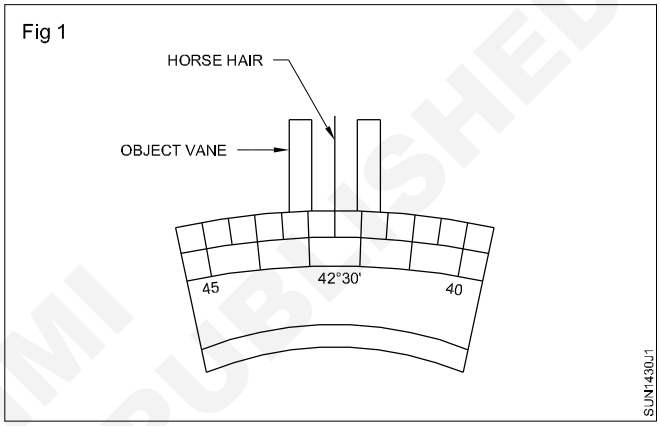
3 Allow the magnetic needle comes to rest.

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

Objective: At the end of this exercise you shall be able 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.

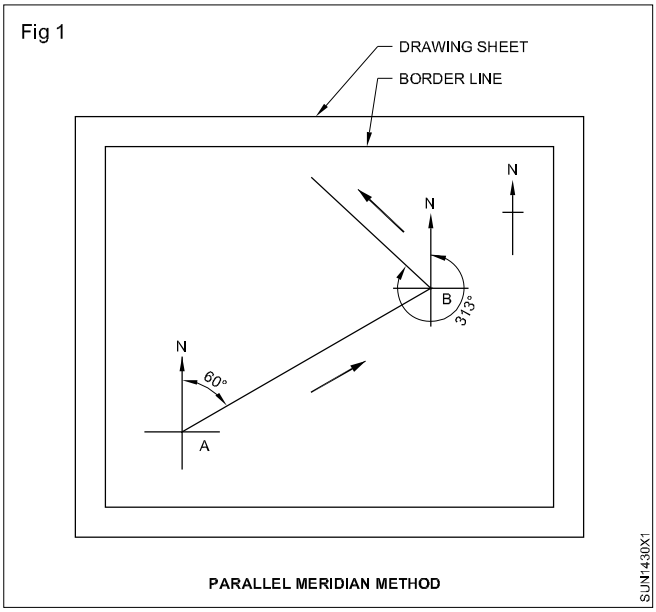
6 Draw border line and indicate the North direction on the right hand top corner of the sheet.

Method 1 - 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'

Fig 1



PARALLEL MERIDIAN METHOD

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’.

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’.

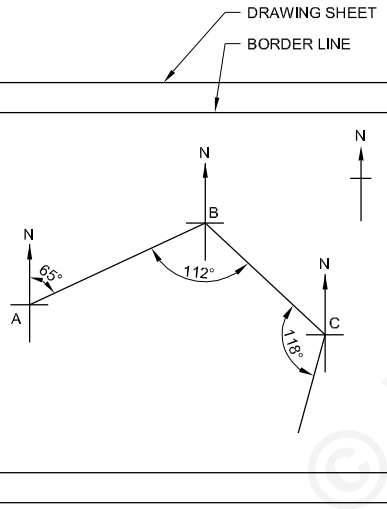
14 Denote the station as ‘B’

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 2 - Included Angle Method (Fig 2)

Fig 2



INCLUDED ANGLE METHOD

SUN1430X2

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.

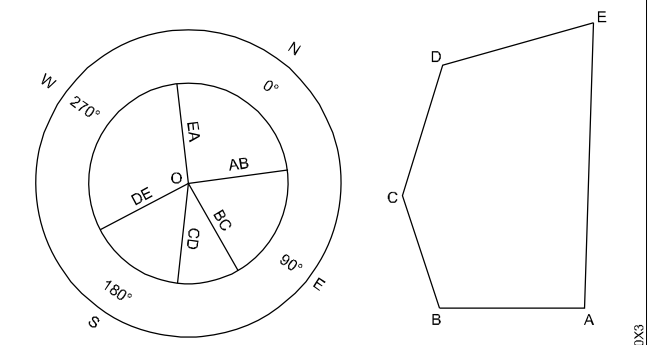
5 Prolong the line through the point from B.

6 Mark the ‘C’ on the line to the same scale.

7 Continue the above process till all stations are plotted.

Method 3 - Central Meridian (or) Paper Protractor method (Fig 3)

Fig 3



CENTRAL MERIDIAN METHOD

SUN1430X3

1 Select a point ‘0’ in the centre of the drawing sheet.

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 convenient 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

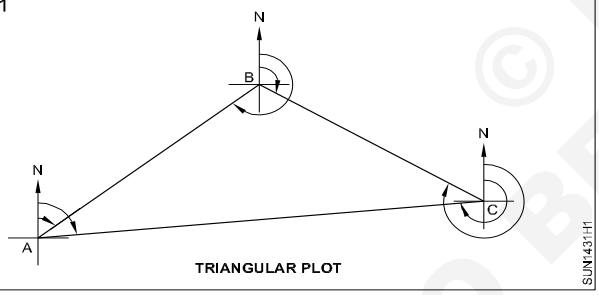
- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape
- Set of scale - 1 set

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' and note 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°.

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)

2 Measure the horizontal distance of AB, BC, CD etc. and note them as mentioned in the previous method against each line.

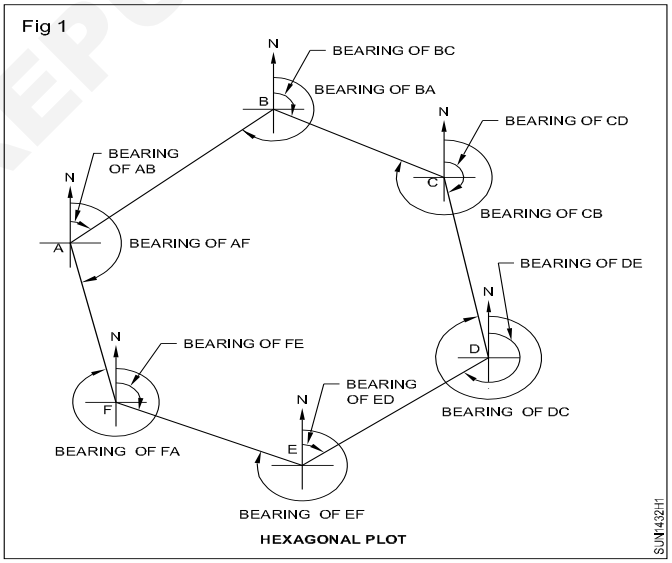
3 Set up the compass on first station 'A' and level it.

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.

Fig 1



— — — — — — — — —

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 theoretical 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.

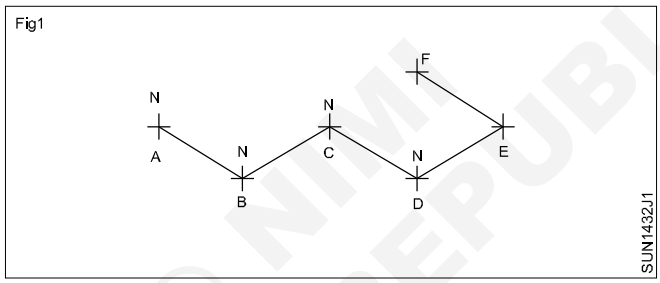
Materials

- 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 proceeding the survey taking bearings check for bearing with back bearing.

7 The F.B & B.B are tallied/otherwise 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

Objective: 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

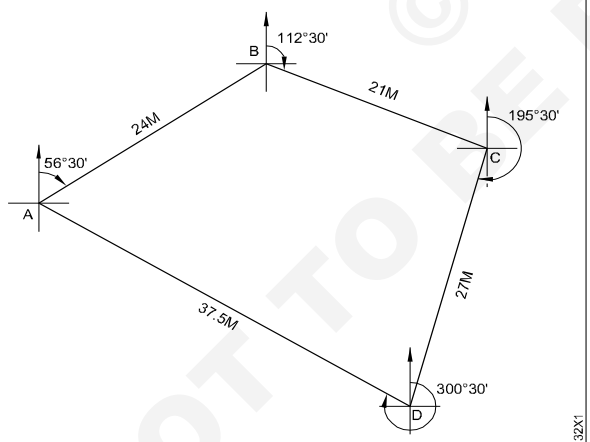
TASK 1: **Set out the rectilinear field as a per the given readings**

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 ± 4) 90°.

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°30'.

If the observed back bearing of AB is not same as the given bearing the occurred 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° 30'	236° 30'
BC	21.00	112° 30'	292° 30'
CD	27.00	195° 30'	15° 30'
DA	37.50	300° 30'	120° 30'

Understanding computer

Objectives: At the end of this exercise you shall be able to
- **identify basic computer terms**
- **start auto CAD four ways.**

STARTING AutoCAD

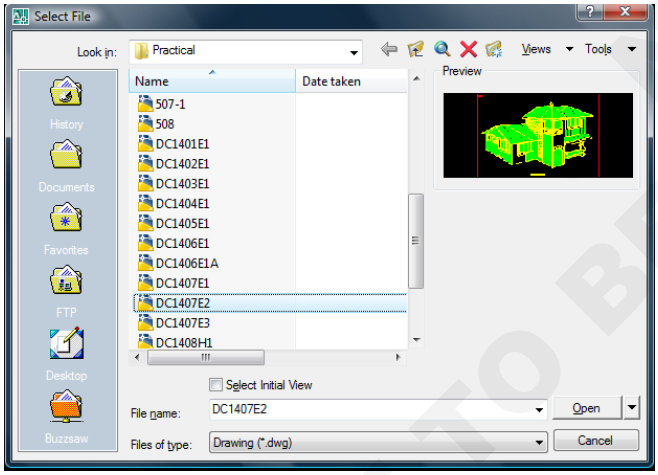
To Start AutoCAD, select the START button/PROGRAMS/ AutoCAD.

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

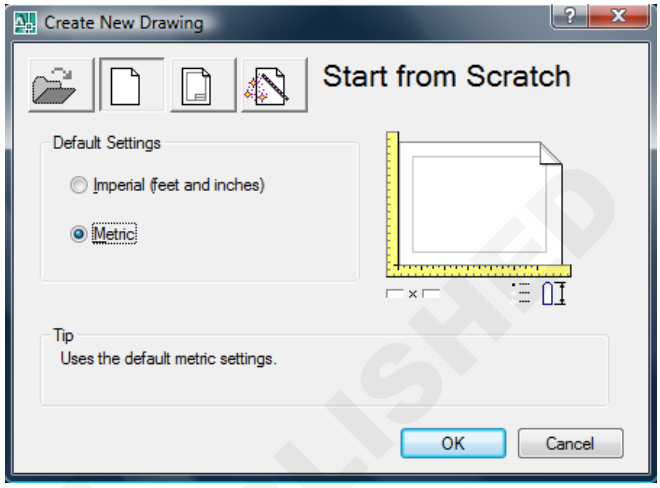
Allows you to begin a new drawing from scratch. Starting from scratch means all settings are preset by AutoCAD.

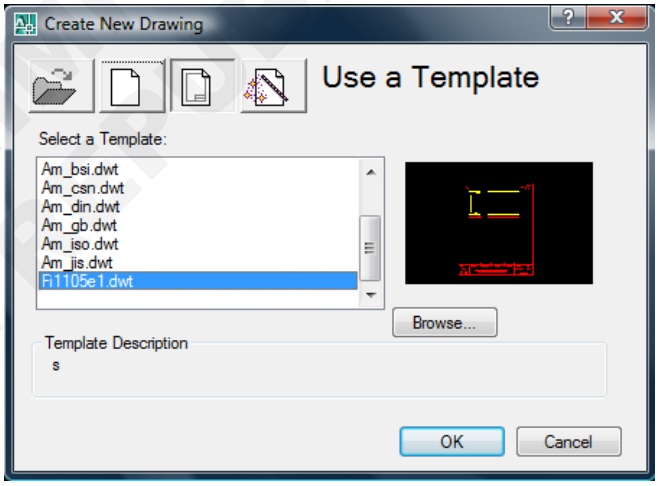
You must select the measurement system on which to base your new drawing; Imperial or Metric.

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

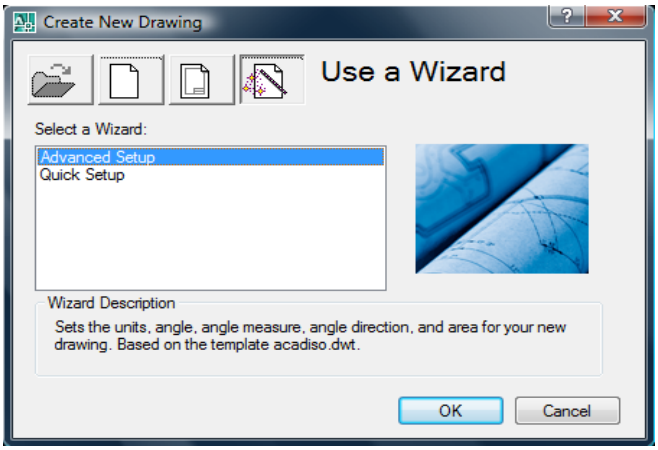
Click on the Startup

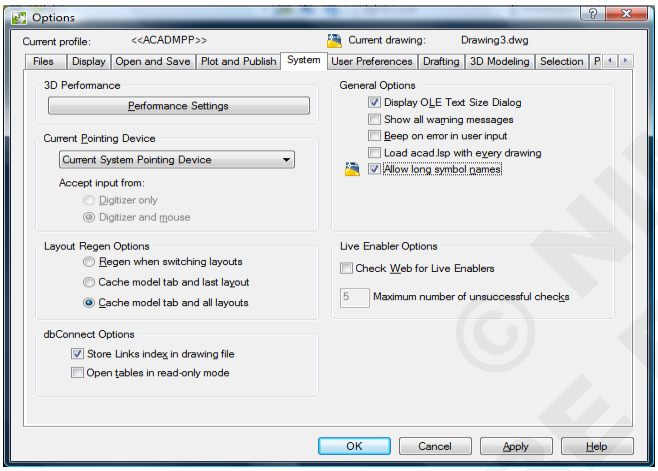
select show startup dialogue box

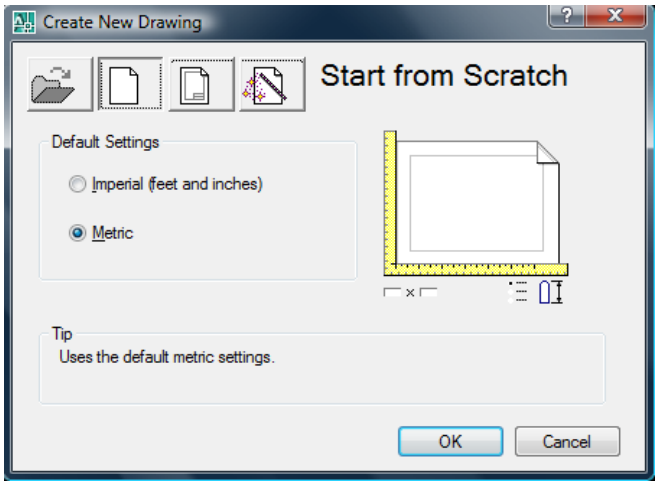
Startup dialogue box shown below. In the startup dialogue box, four options are available such as, open drawing, start from scratch, use a template and use a wizard.

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.

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 menu bar, 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.

1 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.

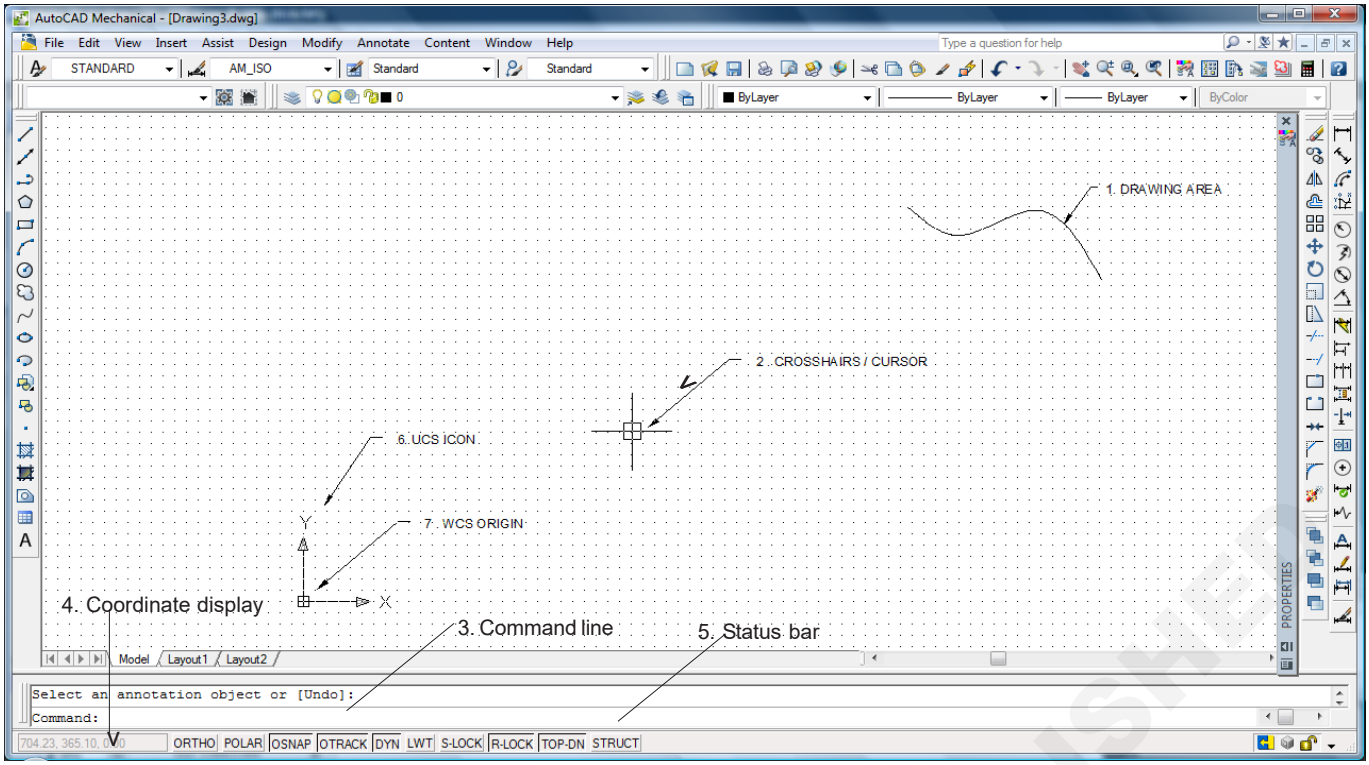
2 Crosshairs/ Cursor

Location: Can be anywhere in the 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 until 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 paper space and model space.

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	Flip screen	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 from 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.

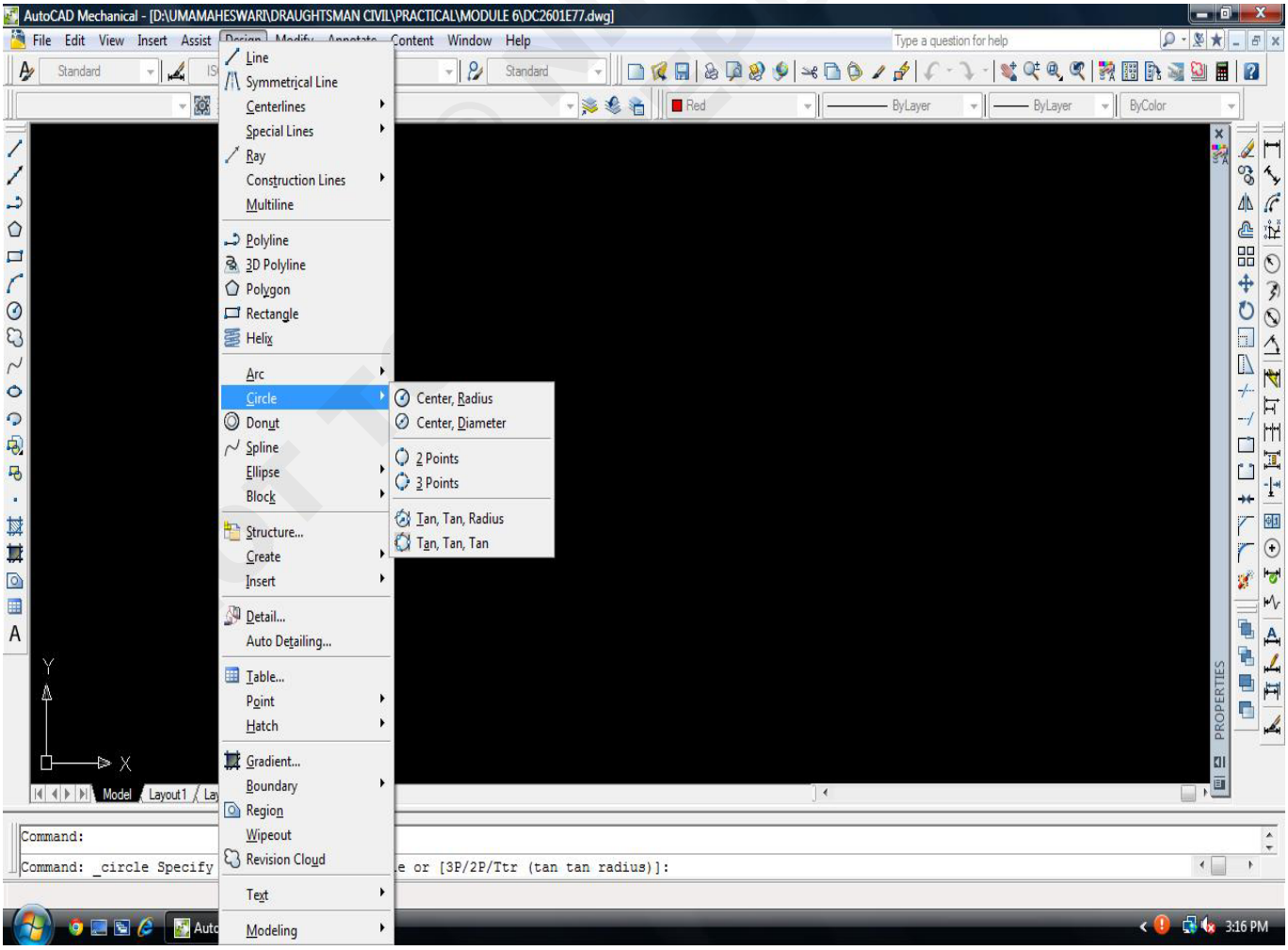
PULL- DOWN "MENU BAR"

(1) The pull-down "MENU BAR" is located at the top of the screen.

File Edit View Insert Format Tools Draw Dimension Modify Express Window Help

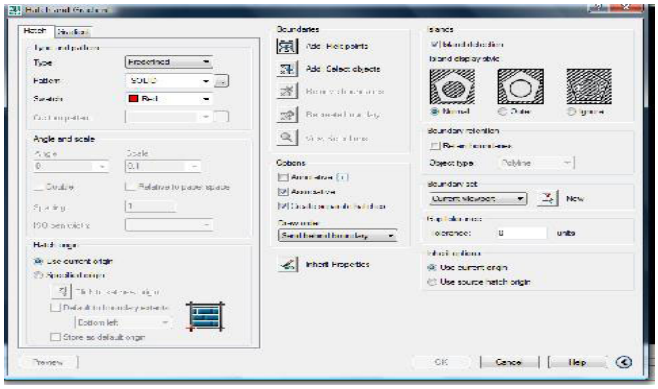
by selecting any of the words in the MENU BAR, a **(2) Pull - down menu** appears. If you select a word from the pull - down menu that has an **(3) Arrow** a **(4) Sub menu** if you select a word with **(5) Ellipse**... a dialog box will appear.

(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

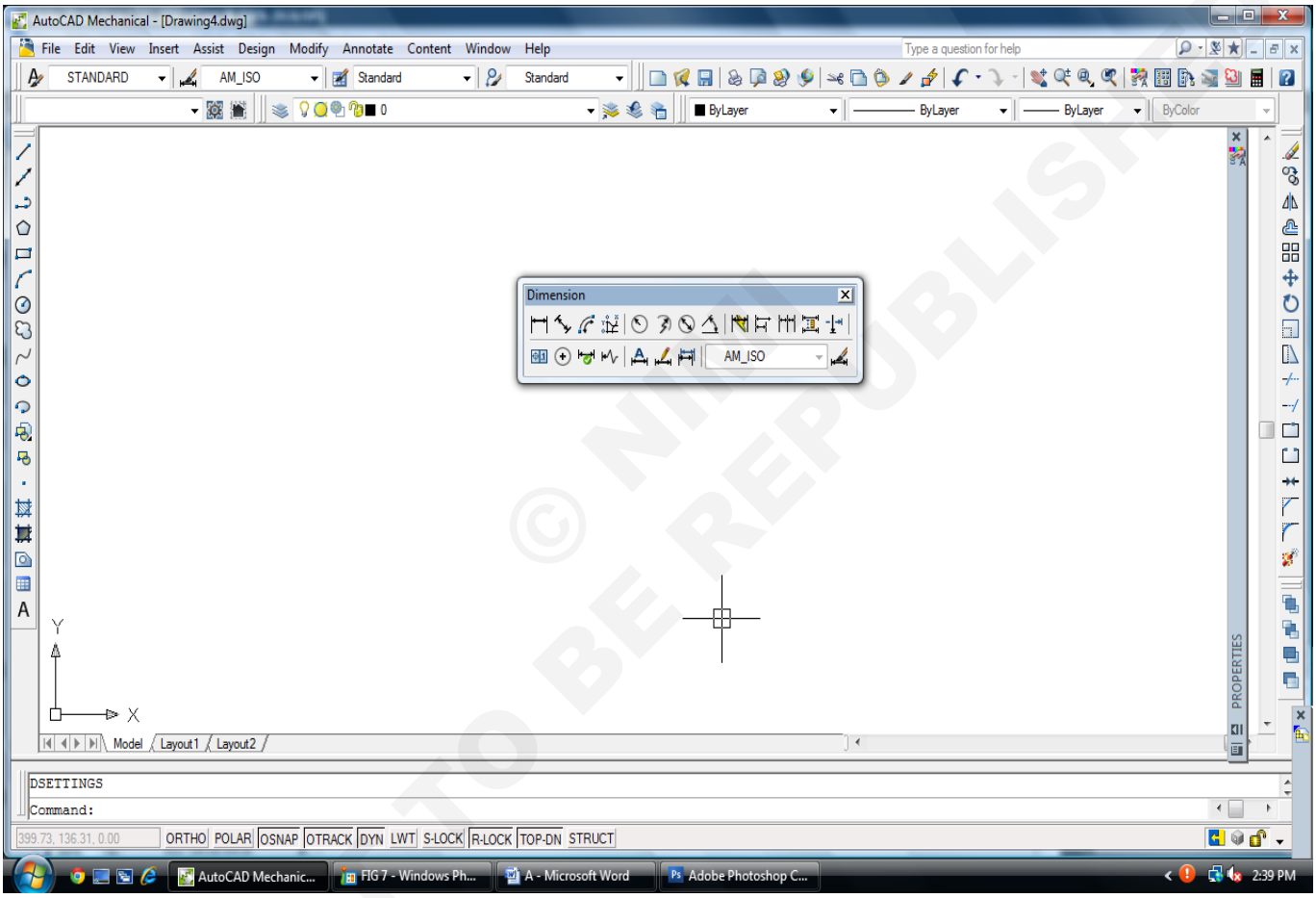
AutoCAD provides several toolbars to access frequently used commands.

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**
- **create Polygon**

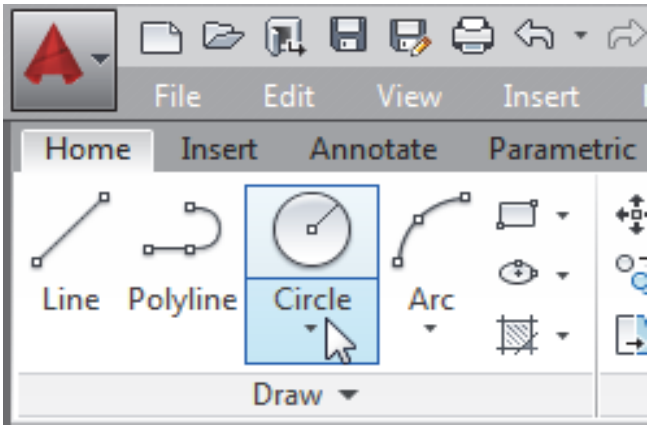
Creating Circles: The menus and toolbars is **AutoCAD 2013** are designed to allow the CAD operators to quickly activate the desired commands.

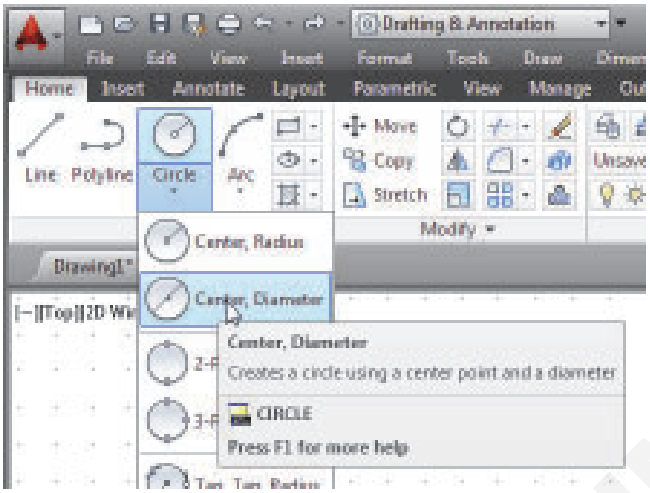
1 In the Draw toolbar, click on the little triangle below the circle icon. Note that the little triangle indicates additional options are available.

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

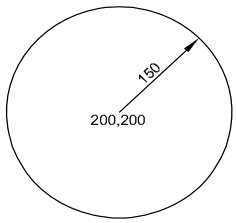
2 Centre and diameter

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

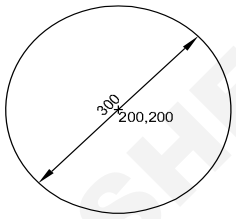
Fig 1



PRACTICE ON CIRCLE COMMAND

SUN1533H1

Fig 2



PRACTICE ON CIRCLE COMMAND

SUN1533H2

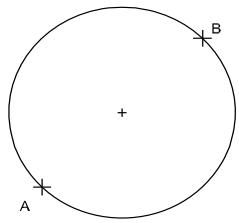
3 2 Points

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

Fig 3



PRACTICE ON CIRCLE COMMAND

SUN1533H3

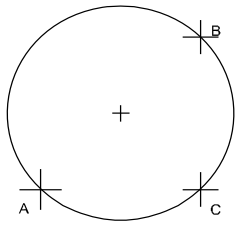
4 3 Points

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

Fig 4



PRACTICE ON CIRCLE COMMAND

SUN1533H4

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

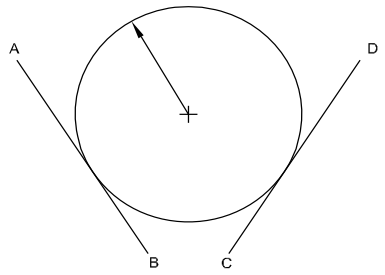
3P/2P/TTR/<Center point> : TTR

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

Fig 5



PRACTICE ON CIRCLE COMMAND

SUN1533H5

AutoCAD proceedes 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

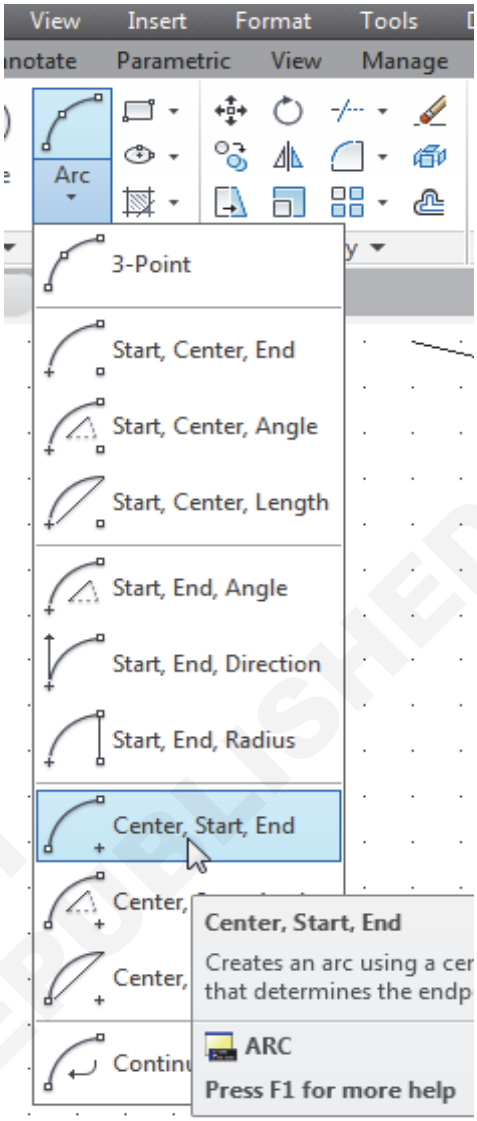
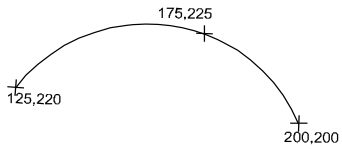


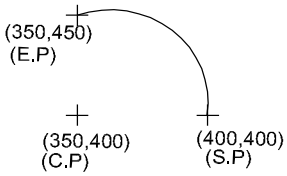
Fig 6



PRACTICE ON ARC COMMAND

SUN1533H6

Fig 7



PRACTICE ON ARC COMMAND

SUN1533H7

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 they include angle between the start point and the end point of the arc.

Example:

Command : Arc or A

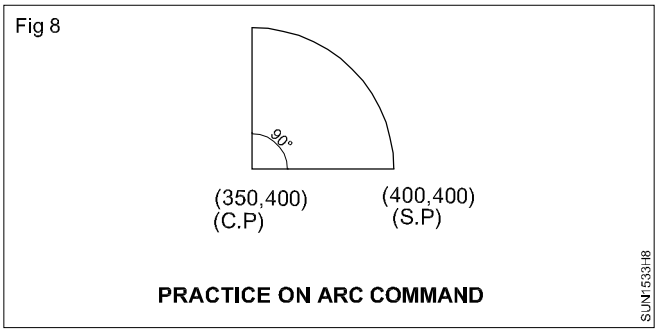
Center/<Start point> : 400,400

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

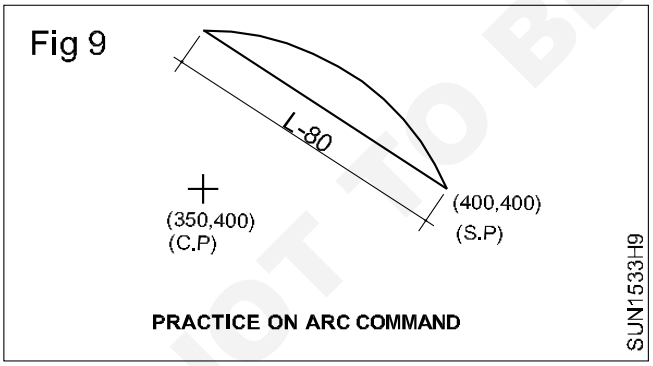
Center/<Start point> : 400,400

Center/End<Second point> : C

Center Point :350,400

Angle/Length of Chord/<End point>: L

Length of Chord : 80



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

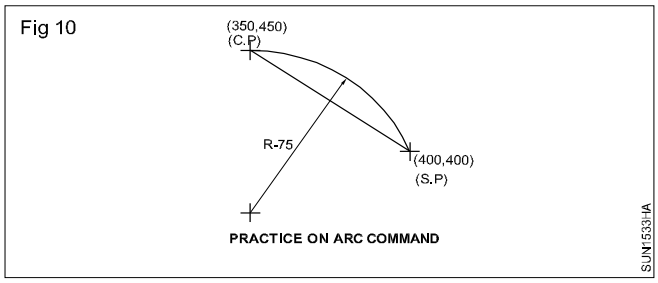
Center/<Start point> : 400,400

Center/End<Second point> : E

End point :350,450

Angle/Direction/Radius/<Center point>: R

Radius : 75



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

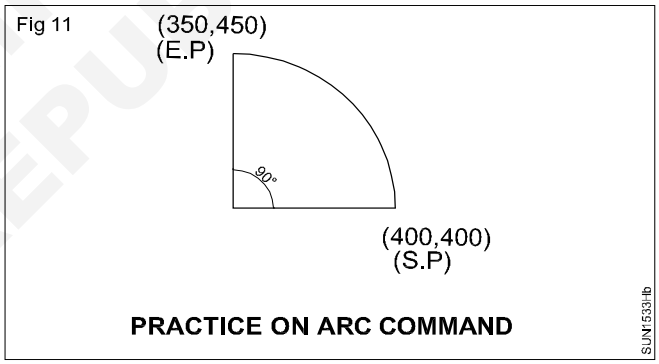
Cener/<Start Point> : 400,400

Center/End<Second point> : E

End point : 350,450

Angle/Direction/Radius/<Center poinmt> A

Included angle : 90



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

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:

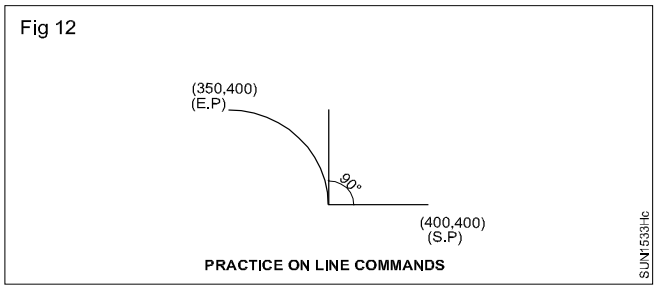
Command : Arc or A

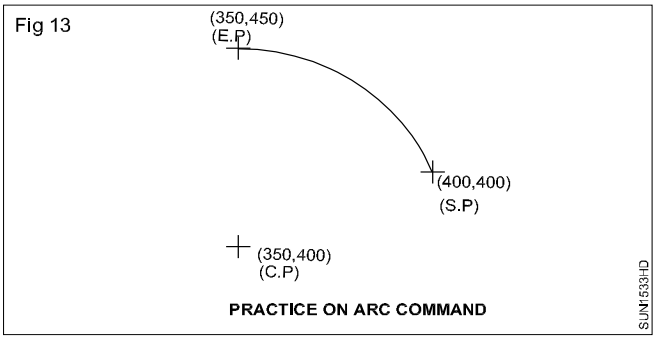
Center/<Start Point> : 400,400

Center/End<Second point> : E

End point : 250,450

Angle/Direction/Radius/<Center point>: 350,400





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:

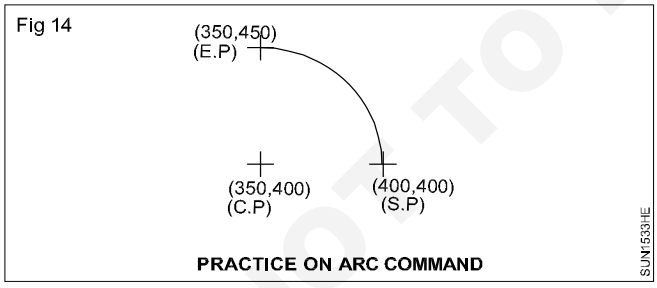
Command : Arc or A

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

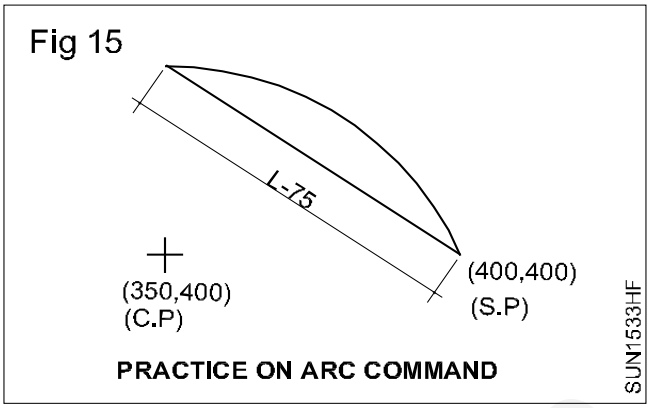
Center/<Start point> : C

Center point : 350,400

Start 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

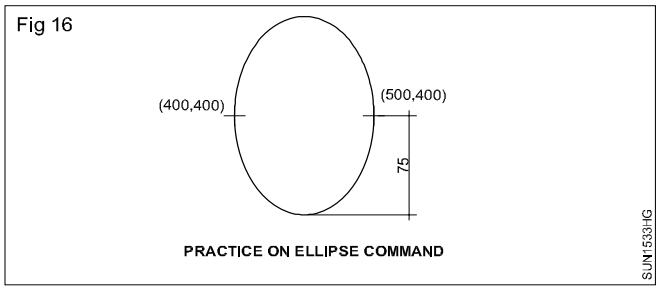
Example:

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

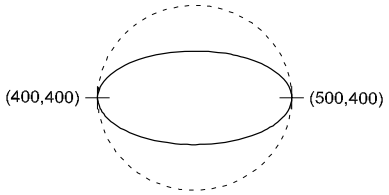
Axis end point of ellipse or (Arc/center): 400,400

Other end point of axis : 500,400

Distance to other axis or [Rotation] : R

Rotation around major axis : 60

Fig 17



PRACTICE ON ELLIPSE COMMAND

SUN1533HH

3 Ellipse by centre and two axes

Example:

Command : Ellipse or EL

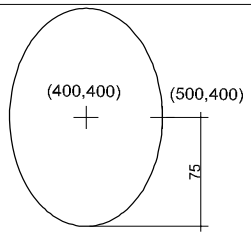
Axis end point of ellipse or (Arc/center): 400,400

Center of ellipse : 400,400

Axis end point : 500,400

Distance to other axis or [Rotation]: 75

Fig 18



PRACTICE ON ELLIPSE COMMAND

SUN1533HI

4 Ellipse by centre, one axis, and rotation

Example:

Command : Ellipse or EL

Axis end point of ellipse or (Arc/center): C

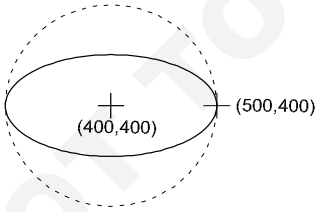
Center of ellipse : 400,400

Axis end point : 500,400

Distance to other axis or [Rotation]: R

Rotation around major axis : 60

Fig 19



PRACTICE ON ELLIPSE COMMAND

SUN1533HJ

POLYGON

This command allows the user to draw regular 2D polygons.

1 Centre of polygon, inscribed circle, radius

Example:

Command : POL

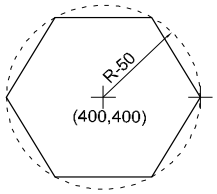
POLYGON Enter number of sides <default>: 6

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

SUN1533HK

2 Centre of polygon, circumscribed about circle radius of circle

Example:

Command : Polygon/POL

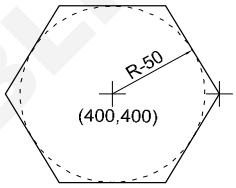
POLYGON Enter number of sides <default>: 6

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

SUN1533HL

3. EDGE OPTION

Example:

Command : Polygon/POL

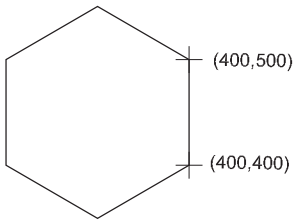
POLYGON Enter number of sides <default>: 6

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

SUN1533HM

DOUGHNUT (DONUT)

This command allows the user to draw filled circles and rings

Example of filled circle option:

Command : Donut

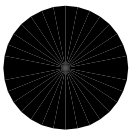
Inside diameter <default>: 0

Outside diameter <default>: 50

Center of doughnut : 100,100

Center of doughnut :

Fig 23



PRACTICE ON DOUGHNUT COMMAND

SUN1533HN

Example for rings

Command : Donut

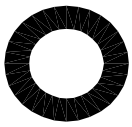
Inside diameter <default>: 30

Outside diameter <default>: 50

Center of doughnut : 100,100

Center of doughnut :

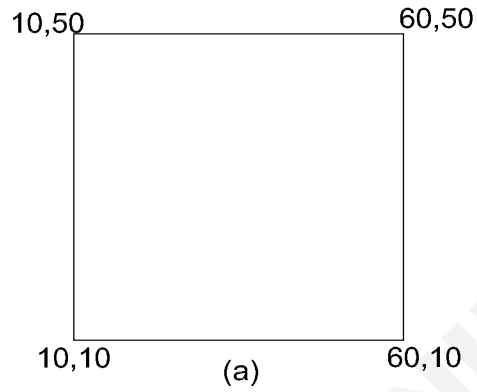
Fig 24

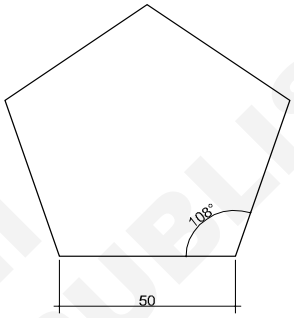


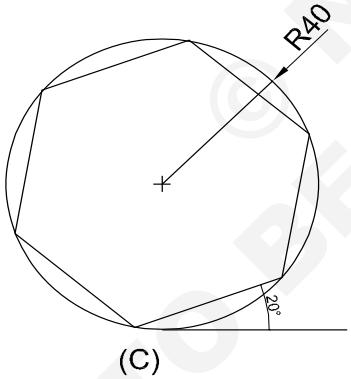
PRACTICE ON DOUGHNUT COMMAND

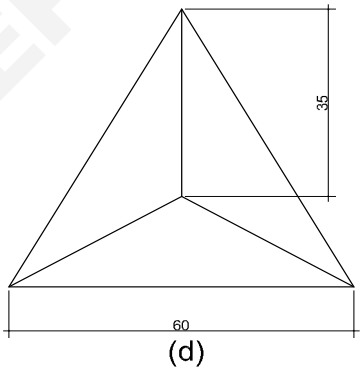
SUN1533HO

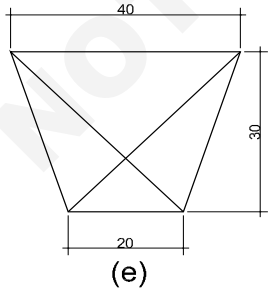
Fig 25

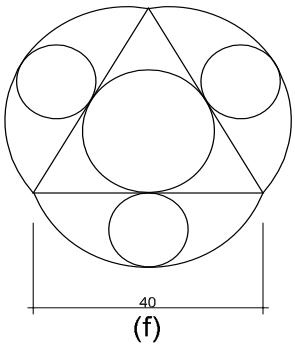


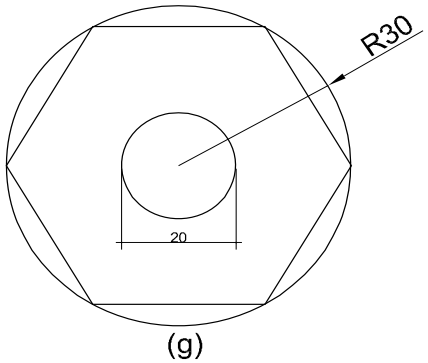












EXERCISE

SUN1533HP

Basic commands - II

Objectives: At the end of this exercise you shall be able to
- **familiarize with the commands**
- **erase, oops, move, copy, offset, rotate**
- **erase, oops, move, copy, offset, rotate**
- **scale, fillet, trim, chamfer, extend, break**
- **join, mirror, array, stretch, 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

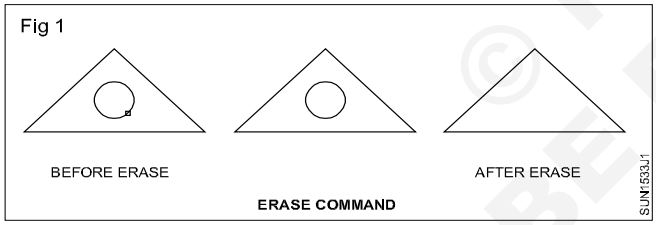
Command : Erase./ E

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

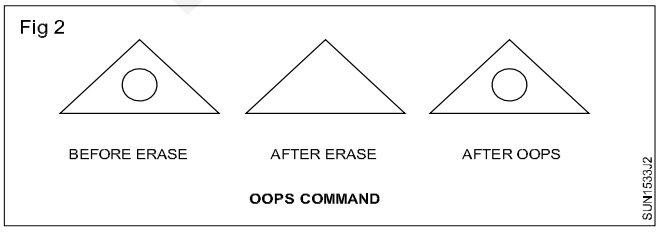
Example

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

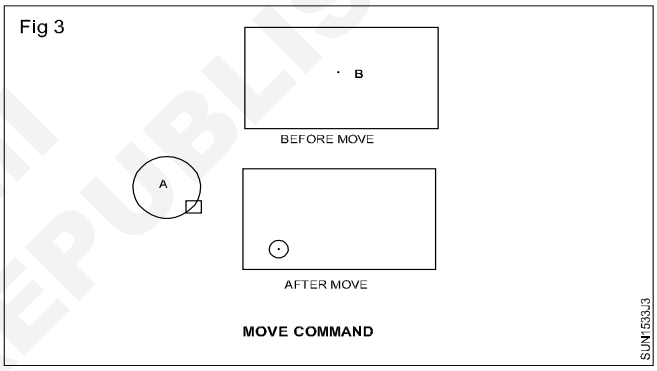
Select objects : Select circle

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

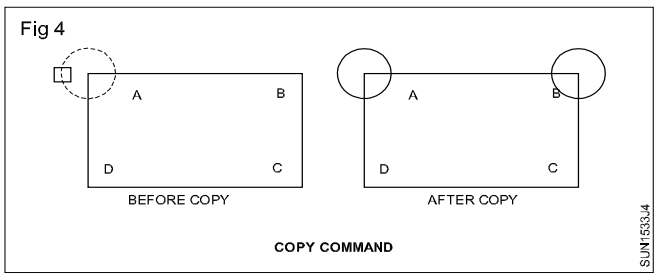
Select objects : Select object to Copy

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.

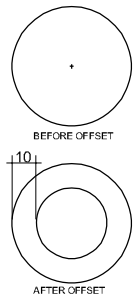
Command : Offset or O

Offset distance or through <current> : 10

Select the object to offset: Select the circle

Side to offset : Specify the side for offsetting

Fig 5



OFFSET COMMAND

SUN1533J5

6 Rotate

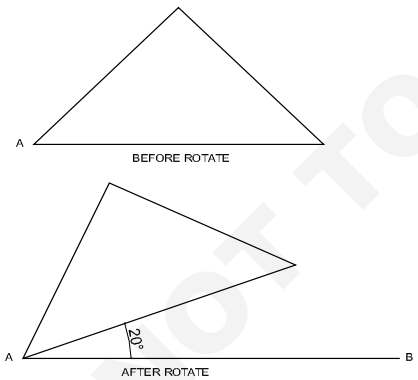
This command is used to rotate an object or set of objects to a specified angle.

Tool bar : Modify, Rotate

Pull Down : Modify, Rotate

Command : Rotate / Ro

Fig 6



ROTATE COMMAND

SUN1533J6

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

Select objects : Three found

Select objects :

Specify scale factor or [Copy/Reference]<Default>: 2

Fig 7

SCALE COMMAND

SUN1533J7

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

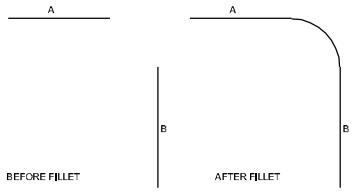
Command : Fillet or F

Example

Command : Fillet or F

Current settings : TRIM, Radius = 0,0000

Fig 8



FILLET COMMAND

SUN1533J8

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

Select objects:

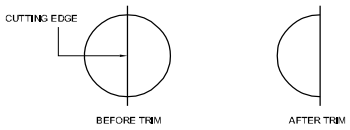
Select object to trim of shift - select to extend or

[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]:

Fig 9



TRIM COMMAND

SUN1533J9

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.

Tool bar : Modify, Extend

Pull down : Modify, Extend

Command : Extend or EX

Example

Command : Extend or EX

Select boundary edges..

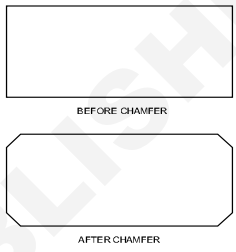
Select objects or <Select all>: Select A, 1 found

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]:

Fig 10

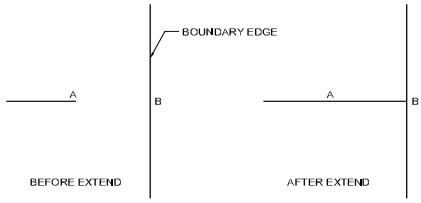


CHAMFER COMMAND

SUN1533JA

12 Break

Fig 11



EXTEND COMMAND

SUN1533JB

This command is used to erase a part of an object between two points.

Tool bar : Modify, Break

Pull Down : Modify, Break

Command : Break or BR

Example 1: To break a line

Command : Break or BR

Select objects : Select A

Specify second break point : Select B

Fig 12

BREAK COMMAND

SUN1533JC

13 Join

This command is used to join two lines.

Tool bar : Modify, Join

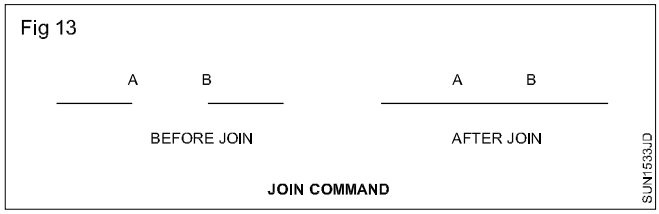
Pull down : Modify, Join

Command : Join or J

Example

Command : Join or J: Select source object

Select lines to join to source: Select A and B



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

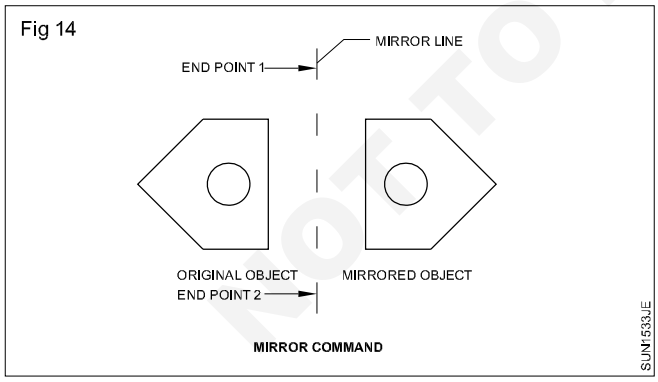
Select object : Select the object

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 retaining the previous object



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 polar (circular) patterns.

Example: 1

Command : Array

Select objects : Select circle of radius 5

Select objects :

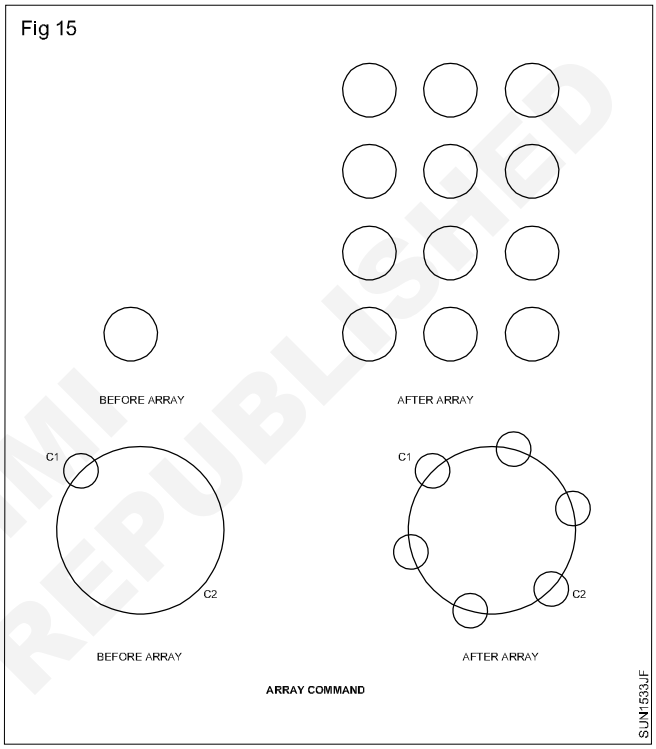
Rectangular or polar Array (R/P) : R

Number or Rows (----) <1> : 4

Number of columns (III) <1> : 3

Unit cell or distance between Rows (----) : 3

Distance between columns (III) : 3



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 accept 360°

Rotate objects as they are copied ? <Y>: Enter Y or N

16 Strech

Tool bar : Modify, Stretch

Pull down : Modify, Stretch

Command : Stretch 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

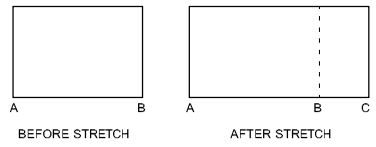
Select objects: Select A and B by crossing - window

Select objects:

Specify base point or [Displacement] <Displacement>

Specify second point: Mouse click at C

Fig 16



STRETCH COMMAND

SUN1533JG

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]:

Fig 17

LENGTHEN COMMAND

SUN1533JH

18 Explode

Tool bar : Modify, Explode

Pull down : Modify, Explode

Command : Explode or X

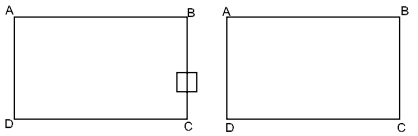
This command will split the component objects such as blocks, polylines, regions etc. If you explode a polyline the result will be ordinary lines or arcs.

Example:1

Command : EXPLODE or X

Select an object : Select the rectangle

Fig 18



EXPLODE COMMAND

SUN1533JI

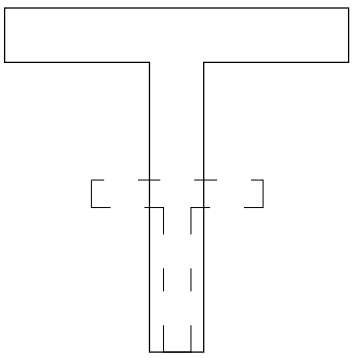
19. SCALE

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

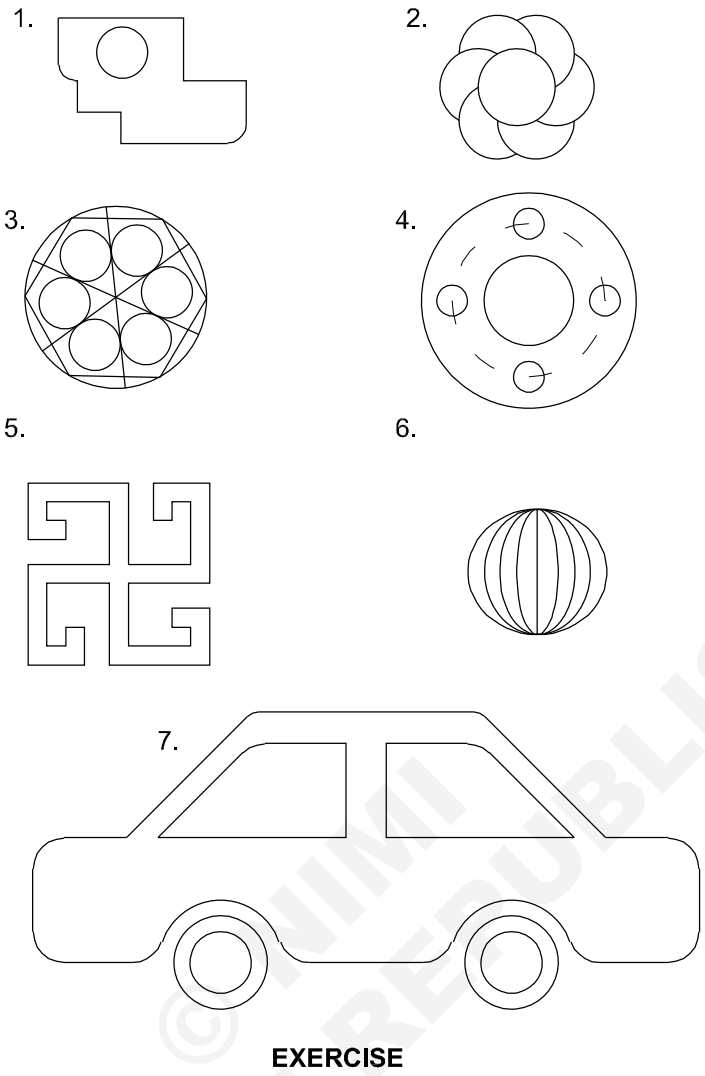


SCALE COMMAND

SUN1533JJ

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

SUN1533JK

Demonstration of instrument used for plane table surveying & their uses (alidade, U fork, trough compass) Set up the plane table

Objective: At the end of this exercise you shall be able to
- **orientation of plane table.**

Requirements

Tools / Instruments

- Plane table with Tripod - 1 No.
- Alidade - 1 No.
- Spirit level - 1 No.
- Trough compass - 1 No.
- Plumbing fork with plumb bob - 1 No.
- Measuring tape 30m - 1 No.
- Arrows - 10 Nos.
- Peg 15cm long - 6 Nos.
- Ranging Rod 2/3m long - 2 Nos.

Materials

- Set of scale - 1 Set
- Pencil, HB - 1 No.
- Eraser - 1 No.
- Drawing sheet A3 - 1 No.
- Cello tape - 1 No.

PROCEDURE

TASK 1: **Orienting the plane table with a magnetic compass**

1 Select a station A and setup the table over the station and mark it as ‘a’ in the drawing sheet.

2 Place the trough compass on the right hand top corner of drawing sheet at the first station.

3 Draw a line along the longer edge of the Trough compass when the needle shows north direction exactly.

4 Select and fix a ranging rod at the next station ‘B’.

5 Keep the alidade touching the first station point on the drawing sheet.

6 Sight the next station through the alidade and draw a ray.

7 Measure the distance ‘AB’ on the ground and mark it on the sheet as ‘ab’ to a convenient scale. Fig. 1a.

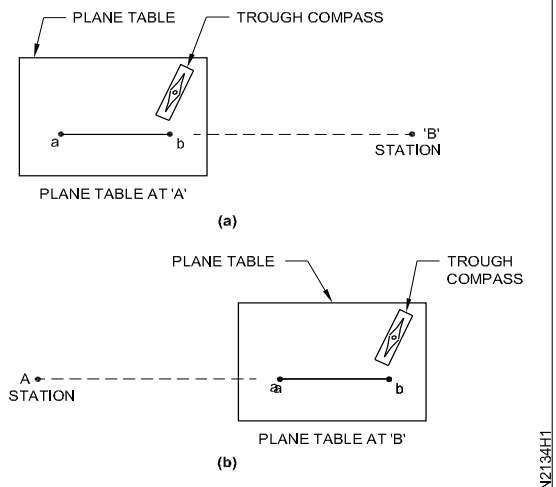
8 Shift the plane table to the station ‘B’ after taking all the details from the first station.

9 Level and centre the plane table at the station ‘B’ with plumbing fork with plumb bob.

10 Place the compass along the north line already marked on the sheet.

11 Unclamp and turn the table until the needle show exactly in north direction. (Fig 1b)

Fig 1



ORIENTATION WITH MAGNETIC COMPASS

12 Clamp the board in this oriented position of the table.

This method of orientation is not an accurate if any of the stations are affected by local attraction.

TASK 2: **Orienting the plane table by back sighting**

1 Follow the first eight steps as in the previous skill (Orientating the plane table with a magnetic compass)

2 Level and centre the plane table at the station 'B', with plumbing fork with plumb bob. (Fig 2a)

3 Place the alidade along the ray 'ba' already drawn from the previous station to sight 'A'.

Rotate the table until the line of sight bisects the ranging rod at the previous station 'A'.

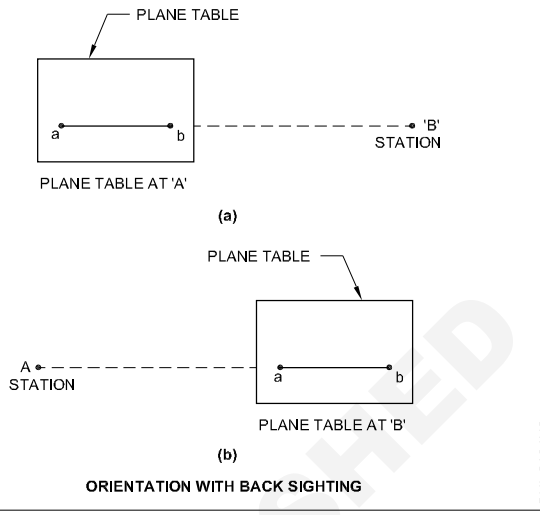
This method of orientation will be accurate even all stations, are affected by Local attraction.

4 Now check the centering of the plane table over station 'B' with plotted position 'b' and correct it by bodily shifting the table.

5 Again keep the alidade along 'ba' and sight 'A' and rotate the table until it bisects 'A'.

6 Repeat the above two process simultaneously until to get the exact orientation. Fig 2b.

Fig 2



ORIENTATION WITH BACK SIGHTING

Skill Sequence

Levelling the plane table

Objective: This shall help you to
- **level the plane table.**

1 Spread the legs of the tripod in firm position approximately over the station.

2 Place the plane table over the tripod and tighten the clamp.

3 Adjust the legs of the tripod to bring the table to a convenient height of the surveyor.

4 Bring the longer edge of the table parallel to any two legs by rotating it about its vertical axis.

5 Place the spirit level on the table parallel to the longer edge of the table as in position 1 of Fig 1.

6 Bring the bubble of the spirit level to its centre by moving the third leg to its left or right.

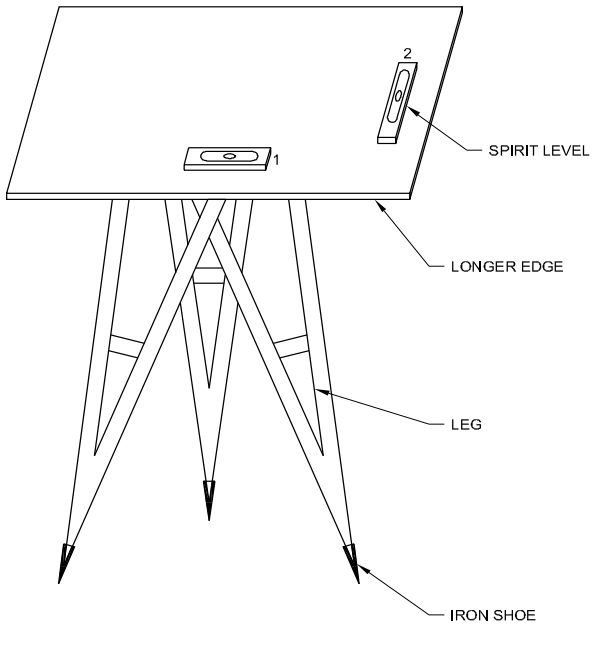
7 Place the spirit level on the table perpendicular to its previous position as in position 2 of Fig 1.

8 Bring the bubble of the spirit level to its centre by moving the third leg to forward or backward.

9 Check the bubble of the spirit level remains central in all positions.

10 Repeat the above process until the bubble of the spirit level remains central in all positions.

Fig 1



LEVELLING THE PLANE TABLE

Centering the plane table

Objective: At the end of this exercise you shall be able to
- **center the plane table over a station.**

1 Clamp the board, after completing the levelling, centering should be done.

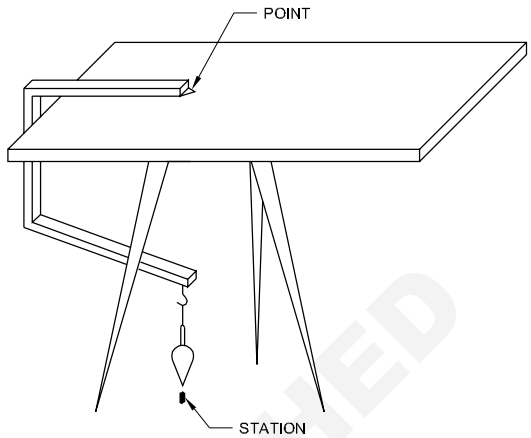
2 Select a point on the drawing sheet for the station occupied by the plane table by observing such that all the objects should be covered within the drawing sheet. (Fig 1)

3 Fix a pin on the point.

4 Place the pointed end of the plumbing fork (or) 'U' frame touching the pin on the paper.

5 Shift the table bodily until the plumb - bob hangs exactly over the centre of the station peg.

Fig 1



CENTERING THE STATION

SUN2134X1

Practice the method of plane tabling by radiation method

Objective: At the end of this exercise you shall be able to
- **locate and reproduce the ground boundary points on the sheet.**

Requirements

Tools / Instruments

• Plane table with Tripod	- 1 No.
• Alidade	- 1 No.
• Spirit level	- 1 No.
• Trough compass	- 1 No.
• Plumbing fork with plumb bob	- 1 No.
• Measuring tape 30m	- 1 No.
• Arrows	-10 Nos.
• Peg 15cm long	- 6 Nos.
• Ranging Rod 2/3m long	- 2 Nos.

Materials

• Set of scale	- 1 Set
• Pencil, HB	- 1 No.
• Eraser	- 1 No.
• Drawing sheet A3	- 1 No.
• Cello tape	

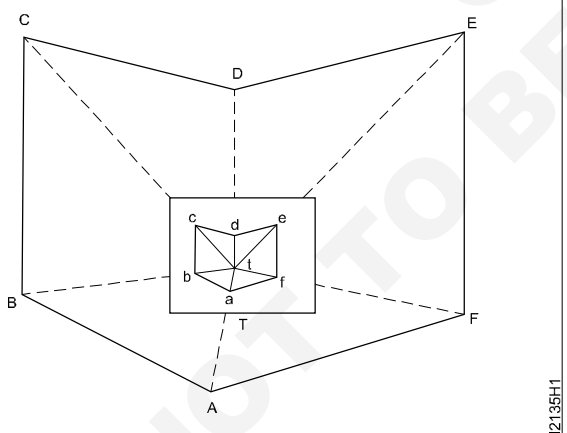
PROCEDURE

TASK 1: **locate and reproduce the ground boundary points on the sheet**

1 Select the given boundary points A,B,C,D,E and F on the ground and drive pegs.

2 Select the point T so that all points A,B,C,D,E and F are visible from station T.

Fig 1



3 Set up the plane table over the station T.

4 Clamp the board after centering and levelling the plane table.

5 Fix the given drawing sheet over the plane table.

6 Select a point 't' on the drawing sheet exactly over the ground station T with the help of plumbing fork and plumb bob.

7 Mark the magnetic north on the right hand top corner with the help of trough compass.

8 Fix a pin on drawing sheet at 't'.

9 Pivot the alidade on 't' sight the points A,B,C,D,E and F and draw rays along the fiducial edge of the alidade, and denote a,b,c,d,e and f to their respective rays with a pencil.

10 Measure the ground distances TA,TB,TC,TD,TE and TF by tape.

11 Plot the distances to a convenient scale along the respective rays, thus getting a, b, c, d, e and f.

12 Join the points a,b,c,d,e and f on the sheet to give the outline of the Boundary. (Fig 1)

Care must be taken to see that the alidade is touching the point 't' while the sights are being taken

Check:

The field work can be checked by measuring the distances AB,BC,CD etc., and comparing them with their plotted lengths of ab,bc,cd,dc,ef and fa.

Practice on locating boundaries with interior details by radiation method

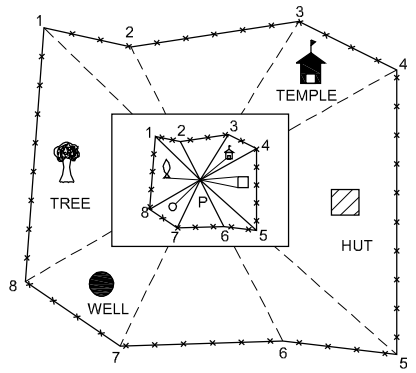
Objective: At the end of this exercise you shall be able to
- **survey and locate the boundaries and details of land by Radiation method.**

PROCEDURE

TASK 1: **Survey and locate the boundaries and details of land by radiation method.**

1 Select 1,2,3,4,5,6,7 & 8 be the boundary points to be surveyed with some objects of an area as shown in Fig 1.

Fig 1



RADIATION METHOD

SUN2135J1

2 Let tree, temple, Hut & well be some objects situated within the boundary as shown in Fig 1.

3 Select a station point 'p' which is visible from all the boundary points and the objects with in the boundary.

4 Set up the table over 'p' and mark 'p' on the drawing sheet and centre it.

5 Locate all the boundary points with suitable scale by the Radiation method on the drawing sheet with alidade.

With the same instrument position locate the objects such as tree, temple, hut, well etc. With the use of alidade.

With the same scale mark and draw the conventional symbols for the different details.

Practice the method of plane tabling by intersection method

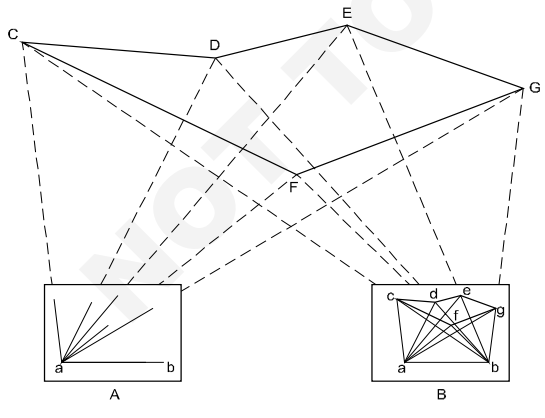
Objective: At the end of this exercise you shall be able to
- **survey and locate the boundaries by intersection method.**

PROCEDURE

TASK 1: **Survey and locate the boundaries by intersection method**

1 Select 5 boundary points C,D,E,F & G on the ground and drive pegs. (Fig 1)

Fig 1



INTERSECTION

SUN2135X1

2 Select two base stations A, B on the ground so that all boundary points are visible from the stations.

3 Set up the table at A and level it.

4 Clamp the board after centering and levelling the plane table over station A.

5 Transfer the ground station 'A' as 'a' in the drawing sheet.

6 Keep the alidade touching 'a' sight ranging rod at the point c and draw a ray with pencil.

7 Similarly sight and draw the other rays from 'a' to other points D,E,F and G.

8 Sight the station B draw a ray and measure the distance scale it and mark as 'b'

The line joining the base stations 'A' and 'B' known as base line should be visible to all points and be a round figure say 5 or 10m

9 Shift the plane table over station B and level, centre and orient it.

10 Keep the alidade touching 'b' sight the previous point 'C' and draw the ray to intersect corresponding ray at 'c'.

11 Similarly sight and intersect all other points D,E,F and G to corresponding rays at d,e,f and g.

12 join the intersection of all these points c,d,e,f and g are the required boundary line.

Practice the method of plane tabling by traversing method (Closed Traverse)

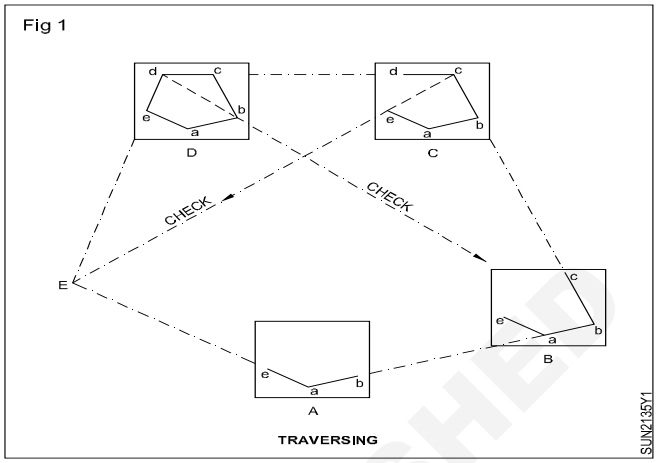
Objective: At the end of this exercise you shall be able to
- **survey, locate and check the boundaries by traversing method (closed traverse)**

PROCEDURE

TASK 1: **Survey, locate and check the boundaries by the traverse method (closed traverse)**

1 Select the running survey stations A,B,C,D,E to cover the whole area to be surveyed. (Fig 1)
2 Setup the table with drawing sheet over the station A level and centre it and mark as 'a'
3 With the help of a trough compass mark the magnetic north line on the right top corner of the drawing sheet.
4 Keep the alidade touching 'a' sight the station B and draw a ray and scale it with ground distance AB and mark as 'b'.
5 Similarly sight the station E and draw a ray measure 'AE' and mark as 'e'.
6 Shift the table to 'B' centre it level and orient it with station A.
7 Keep alidade touching 'b' sight the station C and draw a ray, scale it with ground distance BC and mark as c.
8 Similarly, sight, measure and mark the other points up to D.
9 Also sight measure and mark the check lines CE and DB when the table is at 'C' and 'D'.
10 When the table is at D, sight the station E, measure and draw the ray 'de'.

Fig 1



This should be the exact point of ground station E, which is already draw from A as back ray.

11 Check if 'de' coincides with point E, already plotted point 'e' there is no closing error.
12 If not, join 'de' and find the closing error.

Prctice the resection Method of Plane Table Survey

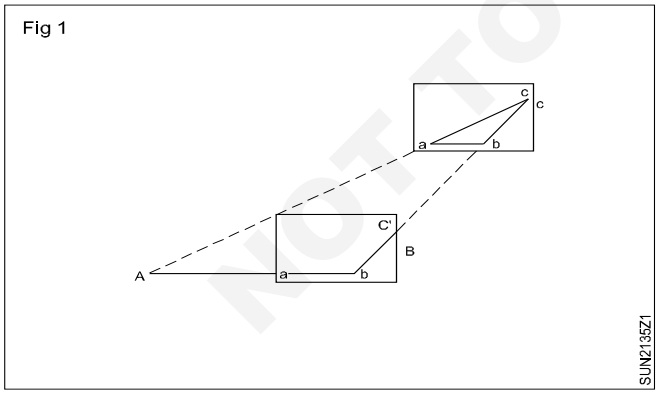
Objective: At the end of this exercise you shall be able to
- **survey, locate and check the boundaries by the resection method of plane table survey.**

PROCEDURE

TASK 1: **Survey, locate and check the boundaries by the resection method of plane table survey.**

- It is used for locating the station points only. (Fig 1)

Fig 1



- The main feature of resection is that the point plotted on the sheet is the station occupied by the plane table.
- After stations are fixed the details are taken by radiation or intersection, or sometimes both.
- Select a base line AB on the ground.
- Measure the distance accurately and then plot 'ab' in a convenient position.
- Set up and level the table at 'B' so that 'b' lies vertically above B and orient the table by placing the alidade along 'ab' and turning the table till 'A' is bisected and then clamp it.
- With the alidade touching 'b' sight the station 'C' which is to be plotted by resection and draw a ray.
- Estimate the distance BC by judgement only and move the point 'C' and along a ray to represent the approximate position of 'C'.
- Shift the table and set it up with c, on the ground point 'C'.
- Orient the table by taking back sight on 'B' and clamp it.
- With the alidade pivoted on 'a' sight the station 'A' and draw a ray.
- The point of intersection of this ray and that previously drawn from 'b' gives the required point 'c'. (i.e.) true position of 'c'.
- If necessary, locate the other station in the above manner. It is also known as back ray method.

Determination of height by telescopic alidade

Objective: At the end of this exercise you shall be able to
- **find the height of building using Telescopic Alidade**

Requirements

Tools / Instruments

• Plane table with Tripod	- 1 No.
• Telescopic alidade	- 1 No.
• Spirit level	- 1 No.
• Trough compass	- 1 No.
• Plumbing fork with plumb bob	- 1 No.
• Measuring tape 30m	- 1 No.

Materials

• Set of scale	- 1 Set
• Pencil	- 1 No.
• Eraser	- 1 No.
• Drawing sheet A3	- 1 No.
• Cello tape	- 1 No.

PROCEDURE

TASK 1: **Determine the height of building by Telescopic Alidade.**

- Select a point 'p' at a convenient distance from the building
- Set up and level the plane table by
- Levelling the plane table
- Centering the plane table
- Orientating the plane table
- Fix the drawing sheet carefully on plane table without any dislocation of plane of table.
- Transfer the ground point 'p' to the sheet by using 'U' fork & plumb bob.
- Place the Telescopic alidade on the table & level the telescope to the horizontal, gently use the telescope and tight or loose the nut.
- From the station point 'p' to the foot of the building range through telescope alidade and take the reading and find the R.L of the point (Fig 1)
- Measure the distance form point 'p' to the foot of the building
- Where the R.L.reading taken
- Note down the distance in metre
- Then slowly tilt the telescope of alidade by loose the telescope nut to the apex point of the building.
- Note down the angle of telescope elevation.
- Then calculate the height of building as follows.

Where,

Z = Horizontal distance form building to plane table.

X = Height of plane table

Y = Height of building from plane table level.

H = Total height of building

ø = Angle of elevation from plane table station

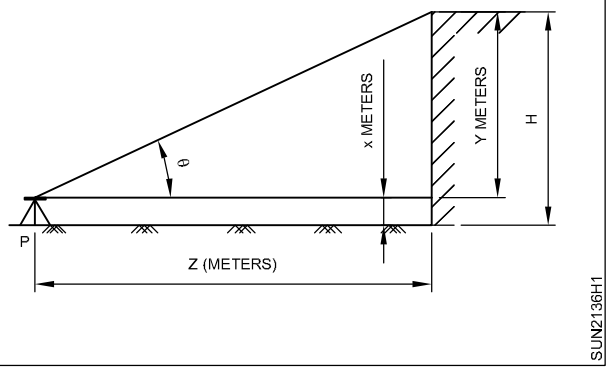
(x+y) = Height of the building (H)

Y = Z (tan ø)

X+Y = (Height of building)

H = x+z tan ø

Fig 1



Practice to setup of theodolite

Objectives: At the end of this exercise you shall be able to
- **unplace and place theodolite from and to the theodolite box respectively**
- **how to fix and remove theodolite to and from the tripod respectively.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob
- Peg
- Hammer

Materials

- White paper - 1 No.

PROCEDURE

1 Set two legs of the tripod firmly into the ground.

2 Adjust the third leg in circumferential direction so that the top of tripod becomes approximately horizontal

3 Open the instrument box and not, how the instrument is placed in the box.

4 Take out the instrument from the box. Hold it with right hand.

5 Turning the trivet in clockwise direction, screw the instrument firmly on the tripod.

8 Show and explain parts of the theodolite.

9 Remove the theodolite from the tripod by turning the trivet in anticlockwise direction.

10 Loosen all screws.

11 Place the theodolite in the box safely (vertical circle on left hand side. One of the foot screw facing the surveyor) and close the box.

Temporary adjustments of theodolite

Objectives: At the end of this exercise you shall be able to
- **set up the theodolite**
- **level up the theodolite**
- **eliminate parallax.**

TASK 1: **Fixing the instrument**

Fixing the instrument

1 Fix the theodolite over the tripod head.

2 Suspend a plumb bob from the hook attached to the vertical axis of the theodolite (clearance between plumb bob and station mark should be 1 cm to 2 cm).

Centering

1 One of the legs of the tripod is moved radially to bring the plumb bob exactly over the station.

2 The leg is pushed into the ground.

(If the instrument station has a shifting head, the instrument is roughly centered over the station mark and then by releasing the clamping nut and shifting the head, the plumb bob can be brought exactly over the station mark).

TASK 2: **Levelling up the theodolite**

1 Bring the plate level tube parallel to the line joining any two foot screws.

2 Bring the bubble to the centre of its run by moving these two foot screws either inwards or outwards.

3 Turn the telescope through 90° so that the bubble tube lies over the third screw.

4 Turn this screw inward or outward and bring the bubble of the plate level tube to the centre of its run.

5 Turn the telescope to its original position by rotating through 90° and check the bubble. Repeat the steps 2 to 4 till bubble is central in both the positions of the bubble tube.

(Rotate the instrument through 180°. Check the bubble tube. If permanent adjustment is correct bubble will remain in the centre).

— — — — — — — —

TASK 3: **Elimination of parallax**

Focusing the eyepiece

1 Remove the lid of the telescope.

2 Hold a white paper in front of the telescope (or direct the telescope to sky) and move eye piece inward or outward till the crosshairs are seen distinct and sharp.

Focusing the object glass

1 Direct the telescope towards the object.

2 The focusing screw is turned until the object appear clear and sharp.

— — — — — — — —

Reading the vernier and booking

Objectives: At the end of this exercise you shall be able to
- **prepare a table for booking the readings**
- **read the main scale reading (M.S.R) and vernier scale reading (V.S.R)**
- **book the readings.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Peg - 4 Nos
- Hammer - 1 No.

Materials

- White paper - 1 No.

1 Set up theodolite and do the temporary adjustments. (Exercise No. 1.7.34)

6 Clamp the plates using lower clamp screw.

7 Swing the telescope in clockwise direction to sight the station.

8 Tighten the upper clamp. Bisect the station accurately using upper tangent screw.

9 Determine value of main scale reading (in degrees and minutes) passed by the vernier zero (index) on the scale A.

10 Vernier reading (minutes and seconds) is obtained by locating the reading at which vernier line coincides with the main scale line.

11 Book the readings in column A of the table.

12 Similarly observe the reading on the scale B and book the readings in respective columns.

13 Find the average of A and B scale readings which is the desired reading.

14 Loosen all the clamps and cover the objective. Unscrew theodolite from tripod.

15 Gently place theodolite inside the box so that it fits properly.

Perform permanent adjustment of Theodolite - 1 (Plate level test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the plate level test**
- **adjust the instrument.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Measuring tape - 1 No.

Materials

- White paper - 1 No.

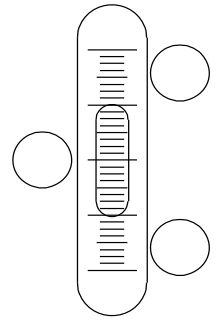
1 Fix the instrument at station O.

2 Set up the instrument over the station O with telescope in normal condition (vertical circle left of the observe and bubble is up)

3 Perform all the temporary adjustments.

4 Bring the plate bubble parallel to any two foot screws and make the bubble to the centre of its run. (Fig 1)

Fig 1

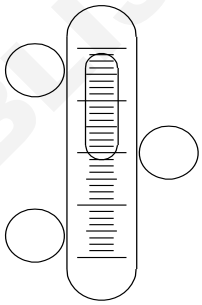


BUBBLE AFTER TEMPORARY ADJUSTMENT

SUN2239H1

5 Revolve the bubble in the horizontal plane so that the end S are reversed. (Fig 2)

Fig 2



BUBBLE AFTER REVERSING

SUN2239H2

6 If the bubble is out of the centre, count the number of graduations on the bubble tube.

Adjustment

7 Correct half the error by means of pair of levelling screws and the remaining correction is made by means of capstan headed screw provided at the end of the level tube.

Perform permanent adjustment of Theodolite -2 (Cross hair ring test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the cross hair ring test**
- **adjust the instrument.**

1 Fix the instrument at station O.

2 Set up the instrument over the station O with telescope in normal condition (vertical circle left of the observer and bubble is up)

3 Perform all the temporary adjustments.

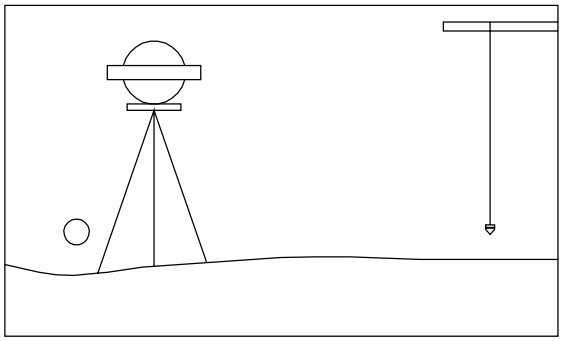
4 Hang a plumb bob at a reasonable distance from the instrument.

5 Direct the telescope to bisect the string of the plumb bob. (Fig 1)

6 Rotate the telescope in the vertical plane. (Fig 2)

7 If the relative motion of the string is not along the vertical cross hair, the instrument needs adjustment.

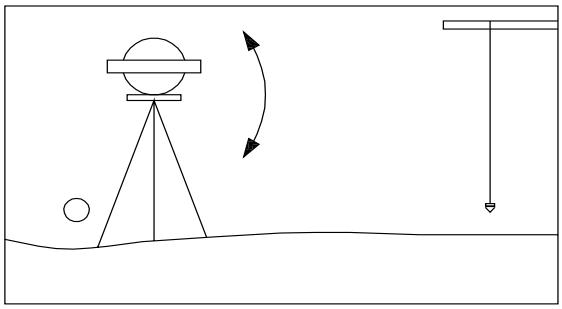
Fig 1



TELESCOPE DIRECTED TO BISECT THE STRING

SUN2239J1

Fig 2



ROTATING TELESCOPE IN THE VERTICAL PLANE

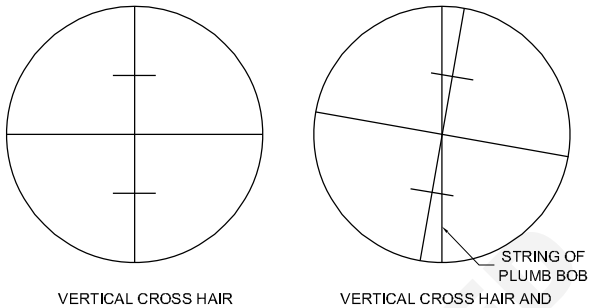
SUN2239J2

Adjustment

8 Loosen all four capstan screws on the cross - hair ring. Rotate the ring carefully so that the image of the string and the vertical cross hair coincide. (Fig 3)

9 The screws are then tightened.

Fig 3



CROSS-HAIR RING TEST

SUN2239J3

Perform permanent adjustment of Theodolite - 3 (Collimation)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the collimation test**
- **adjust the instrument.**

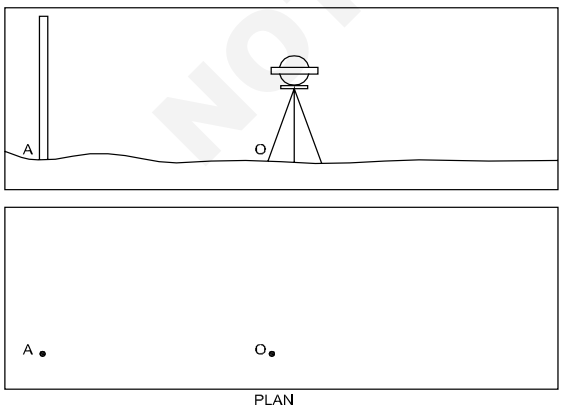
1 Fix the instrument at station O.

2 Set up the instrument over the station O with telescope in normal condition in midway of an open field (should have an unobstructed view of 200m).

3 Perform all the temporary adjustments.

4 Sight a point, A. (Fig 1)

Fig 1

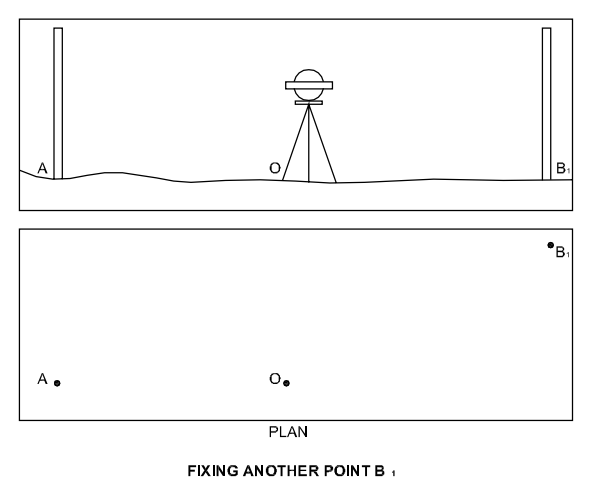


SIGHT A POINT A

SUN2239X1

5 Transit the telescope and fix another point, B_1 (Fig 2)

Fig 2



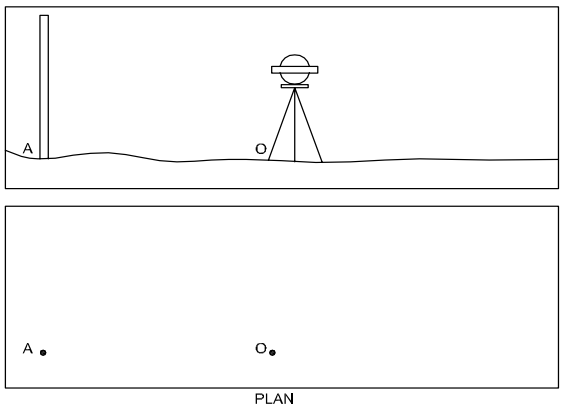
FIXING ANOTHER POINT B 1

SUN2239X2

6 Change face of the instrument and again bisect the first point, A. (Fig 3)

7 Transit the telescope. If the line of sight passes through the already fixed point, then the line of sight is perpendicular to the horizontal axis.

Fig 3



BISECTING AFTER CHANGING FACE

SUN2239X3

8 If not fix the new point, B_2. (Fig 4)

9 Measure the distance between the points B_1 and B_2.

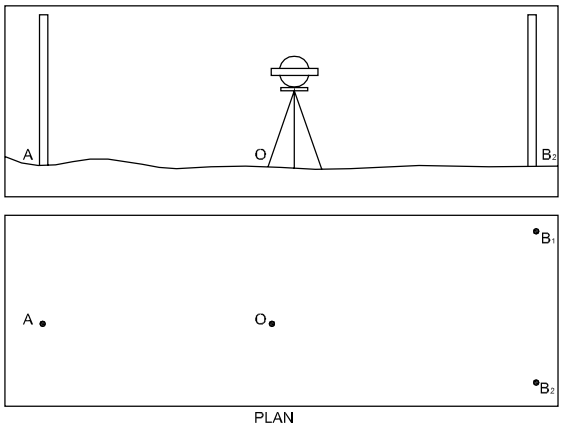
10 Measure a quarter of the distance from the last point, i.e., B_2.

Adjustment

11 Adjust the vertical hair by means of two opposite capstan headed screws so that the line of sight passes through the quarter distance.

12 Repeat the test till line of sight passes through the same point in both face observations. (Fig 5)

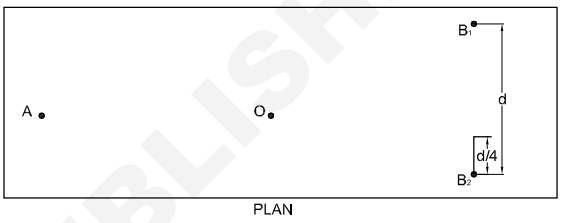
Fig 4



FIXING NEW POINT B_2

SUN2239X4

Fig 5



COLLIMATION TEST

SUN2239X5

Perform permanent adjustment of Theodolite - 4 (Spire test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the spire test**
- **adjust the instrument.**

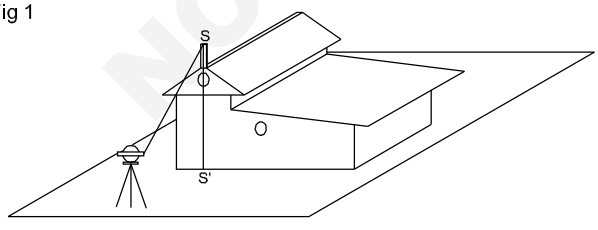
1 Fix up the instrument near to any tall object, at an instrument station O.

2 Set up the instrument over the station O with telescope in normal condition.

3 Perform all the temporary adjustments.

4 Sight a well-defined point, S. (Fig 1)

Fig 1



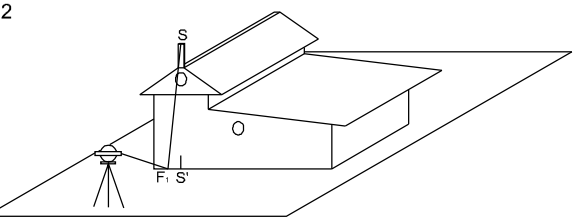
SIGHTING A WELL DEFINED POINT, S

SUN2239Y1

5 Lower the telescope and find a point on the ground, S. (Fig 2)

6 Change face of the instrument and again sight S. (Fig 3)

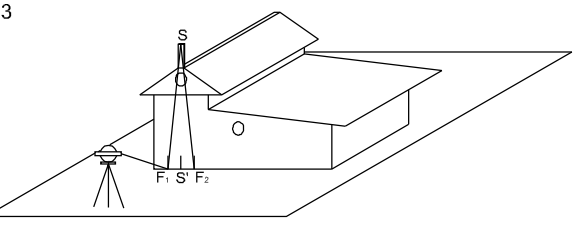
Fig 2



FINDING A POINT, S'

SUN2239Y2

Fig 3



S' IS SIGHTED AGAIN

SUN2239Y3

7 Lower the telescope.

8 If S' is sighted, then the telescope is in adjustment. If not, instrument needs adjustment.

Adjustment

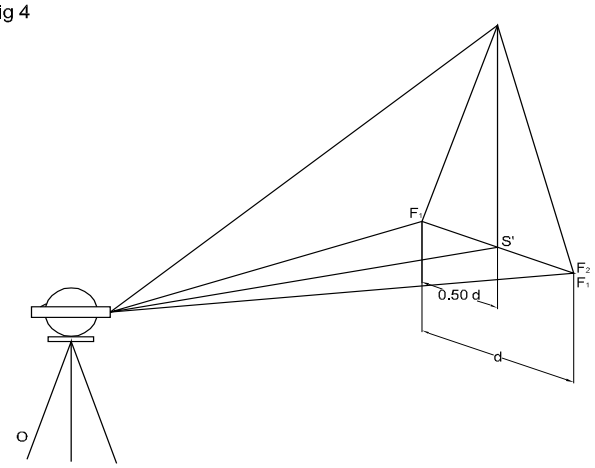
9 Distance between foot distance is measured and mark half the midway between the distance, S'.

10 Centre point is bisected and rise the telescope to sight the point, S. (Fig 4)

11 One end of the horizontal axis is moved with the adjusting screw until the line of sight bisects the point, S.

12 Repeat the test and check the adjustment.

Fig 4



SPIRE TEST

SUN2239Y4

Perform permanent adjustment of Theodolite- 5 (Vertical circle index test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the vertical circle index test**
- **adjust the instrument.**

1 Fix up the instrument near to any tall object, at an instrument station O.

2. Set up the instrument over the station O with telescope in normal condition.

3. Perform all the temporary adjustments.

4 Set the vertical vernier to zero.

5 A staff is held vertical at about 60 m from the instrument and the reading is taken by face left observation. (Fig 1)

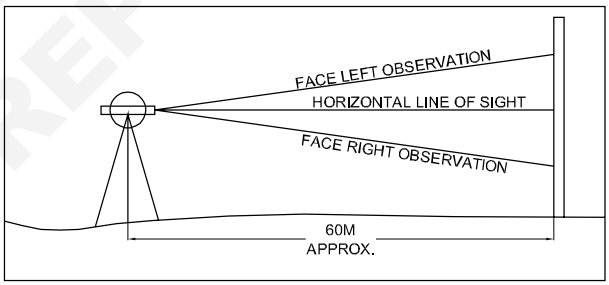
6 Then the face is changed and the staff is read again. If there is an error, the face readings will be different.

Adjustment

7 The telescope is set to read the mean of the two staff readings.

8 Then the vertical circle should be brought back to read zero using the clip screws.

Fig 1



VERTICAL CIRCLE INDEX TEST

SUN2239Z1

Perform permanent adjustment of Theodolite - 6 (Vertical arc test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the vertical arc test**
- **adjust the instrument.**

1 Fix up the instrument near to any tall object, at an instrument station O.

2 Set up the instrument over the station O with telescope in normal condition.

3 Perform all the temporary adjustments.

4 Centre the altitude bubble on the telescope

5 The zero of the vernier of the vertical circle should coincide with the zero on the main scale of the vertical circle. If it doesn't coincide, it needs adjustment.

Adjustment

6 The capstan head screws are loosened and the vernier is moved till the zero coincides with that of the main scale.

Measurement of horizontal angle by various methods (Ordinary method)

Objective: At the end of this exercise you shall be able to
- **measure the horizontal angle between two given points.**

Requirements

Tools / Instruments

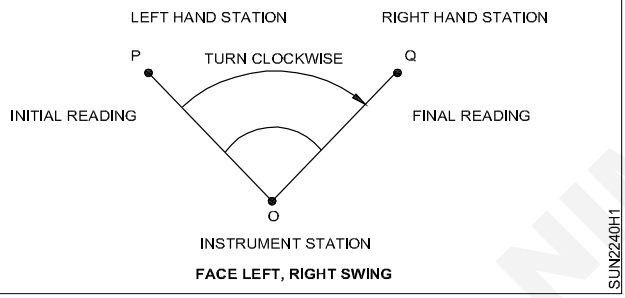
- Theodolite with tripod - 1 No.
- Pegs - 5 Nos.
- Ranging rods - 4 Nos.
- Hammer - 1 No.

Materials

- White paper - 1 No.

1 Erect two stations, P and Q by driving pegs on the field and erect ranging rods vertically behind the pegs. (Fig 1)

Fig 1



2 Fix an instrument station O.

3 Set up the instrument over the station O with telescope in normal condition (vertical circle left of the observer and bubble is up) (Fig 1)

4 Perform all the temporary adjustments.

5 Release both upper and lower clamps.

6 Turn the upper plate until the index of vernier of 'A' nearly coincides with the zero of the main scale. Lock the upper clamp.

7 Turn the upper tangent (slow motion) screw to make the two zeros exactly coincident. (After setting 00° 00'00" on 'A' scale, check the reading on the 'B' of main scale, which should read 180° 00'00" if there is no instrumental error).

8 Direct the telescope to sight the ranging rod at the left hand station (P) and bisect the station. (Approximate bisection of the station is done by sighting over the telescope through a pin- and - hole arrangement provided over the top of the telescope).

9 Lock the lower clamp.

10 Bisect the station P exactly by using the tangent screw. (For exact bisection - bring the station mark exactly at the intersection of horizontal and vertical hairs of the station, vertical circle clamp and its tangent have to be use)

11 Once more check both the vernier A and B and ensure readings remain unchanged.

12 Enter readings in the respective columns of table. (A scale reading is entered fully while only minutes and seconds of B scale are entered).

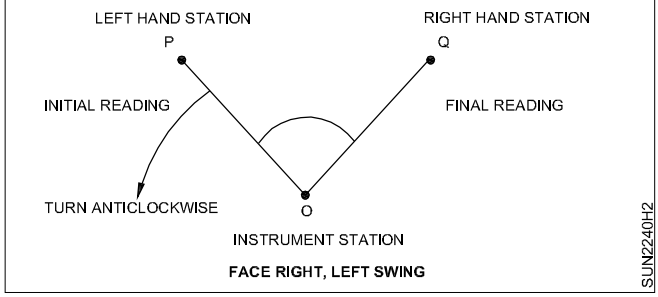
13 Release the upper clamp and swing the telescope to bisect the station 'Q'.

14 Lock the upper clamp and get exact bisection using upper tangent screw.

15 Read and enter readings in the respective columns of the table 1.

16 Change face of the instrument by transiting and swinging. (Fig 2)

Fig 2



17 Follow steps 5 to 15.

18 Angle POQ is the average of angles obtained from both face observations.

19 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Table 1 - Entering the readings

Instrument	Sight To	Face left Right Swing											Face Right Left Swing											Average Horizontal Angle			Rough Sketch
		A			B		Mean			Horizontal angle			A			B		Mean			Horizontal angle						
		0	'	"	'	"	0	'	"	0	'	"	0	'	"	'	"	0	'	"	0	'	"	0	'	"	

Measurement of horizontal angle by various method (Repetition method)

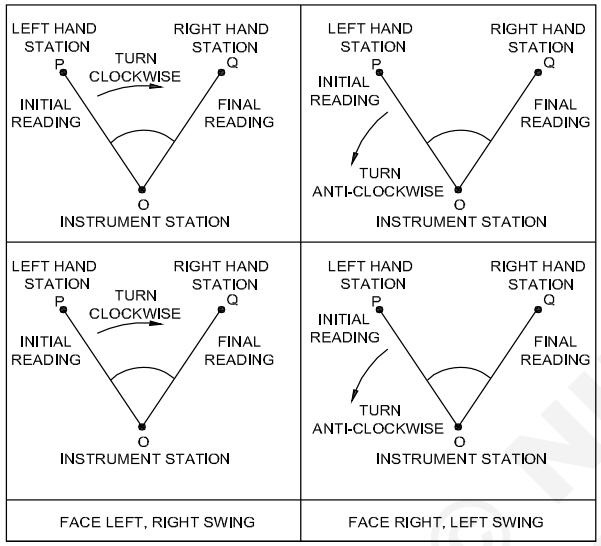
Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine horizontal angle by repetition method.**

1 Follow the steps 1 to 15 of the exercise 1.7.37 (measurement of horizontal angle)

2 Unlock the lower clamp and swing the telescope in clockwise direction to bisect the station 'P'. (Fig 1)

3 Lock the lower clamp. Exact bisection of 'P' is done using lower tangent screw.

Fig 1



MEASURING HORIZONTAL ANGLE BY REPETITION METHOD

SUN2240J1

4 Once more read the scales and check whether the readings remain unchanged.

5 Release the upper clamp and swing the telescope to bisect the station 'Q'.

6 Lock the upper clamp. Exact bisection of 'Q' is done using upper tangent screw.

7 Follow the steps for required number of times, say three times and find out the value of angle POQ. (The average observed reading sighting 'Q' after last repetition divided by the number of repetitions is the angle POQ for the respective face observation)

8 Change face of the instrument.

9 Release both upper and lower clamps.

10 Set zero of the vernier coincides with zero of the main scale A.

11 Direct the telescope to sight the left hand station, say 'P' and bisect it.

12 Once more check both the vernier's 'A' and 'B' and ensure readings remain unchanged.

13 Enter readings in the respective columns of table.

14 Release the upper clamp and swing the telescope in anticlockwise direction to bisect the right hand station 'Q'.

15 Read and enter readings in the respective columns of the table 2.

16 Follow steps 5 to 7.

17 Angle POQ is the average of angles obtained from both face observations.

18 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Measurement of horizontal angle by various method (Reiteration method)

Objectives: At the end of this exercise you shall be able to
- **adopt reiteration method**
- **observe and tabulate readings**
- **applying corrections for included angles**
- **determine horizontal angles POQ, QOR, ROS and SOP by reiteration method.**

1 Erect four stations P, Q R and S by driving pegs on the field and erect ranging rods vertically behind the pegs. (Fig 1)

2 Fix an instrument station 'O' so as to get complete sight of the stations.

3 Follow steps 3 to 15 of exercise 2.2.40 measurement of horizontal angle.

4 Release the upper clamp and swing the telescope to bisect the station 'Q'.

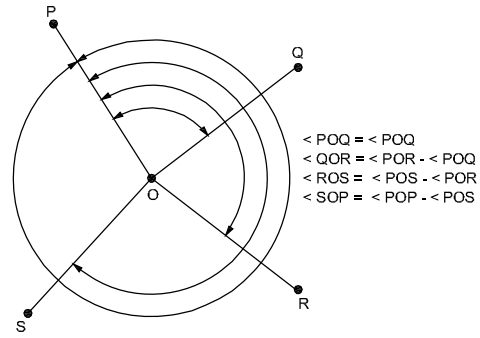
5 Lock the upper clamp and get exact bisection using upper tangent screw.

6 Read and enter readings in the respective columns of the table.

Table 2 - Horizontal angle by repetition method

Instru-ment	Sight To	Face left **Right Swing**										Face Right Left Swing															Average Horizontal Angle			Rough Sketch
		A			B		Mean			No of Repetitions	Horizontal Angle			A			B		Mean			No of Repetitions	Horizontal Angle						
		0	'	"	'	"	0	'	"		0	'	"	0	'	"	'	"	0	'	"		0	'	"	0	'	"	

Fig 1



HORIZON STATION INITIAL READING USUALLY 00°00'00"
CLOSING THE HORIZON SHOULD BE INITAL READING

SUN2240X1

MEASURING HORIZONTAL ANGLE BY REITERATION METHOD

7 Release the upper clamp and swing the telescope to bisect the station 'Q'.

8 Lock the upper clamp and get exact bisection using upper tangent screw.

9 Read and enter readings in the bisection using upper tangent screw.

10 Similarly bisect stations 'R' and 'S' using upper clamp screws and its tangent and enter readings in the respective columns.

11 Finally close the horizon (sight the station P) and observe the reading.

12 Change face of the instrument and follow steps 5 to 15 of exercise 2.2.40 Measurement of horizontal angle.

13 Follow above steps 4 to 11

14 Determine average horizontal angles POQ, QOR, ROS and SOP. (Apply corrections, if closing error exists).

15 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Setting out an angle (Ordinary method)

Objectives: At the end of this exercise you shall be able to
- **set given angle in theodolite**
- **operate theodolite**
- **set out the given angle POQ on the field.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Ranging rods - 2 No.
- Pegs - 3 Nos.
- Hammer - 1 No.

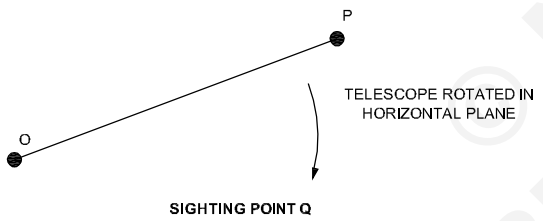
Materials

- White paper - 1 No.

1 Erect a station, P by driving pegs on the field and erect ranging rods vertically behind the pegs.

2 Fix an instrument station O. (Fig 1)

Fig 1



3 Set up the instrument over the station O with telescope in normal condition

4 Perform all the temporary adjustments.

5 Release both upper and lower clamps.

6 Turn the upper plate until the index of vernier of 'A' exactly coincides with the zero of the main scale.

7 Direct the telescope to sight the ranging rod at the left hand station (P) and bisect the station.

8 Lock the lower clamp.

9 Bisect the station P exactly by using the tangent screw.

10 Once more check both the vernier A and B and ensure readings remain unchanged.

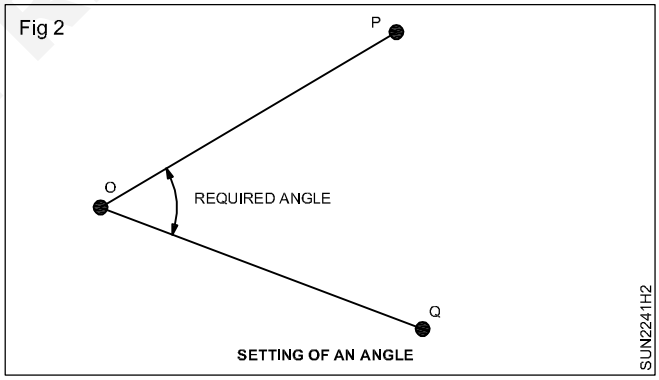
11 Loosen the upper clamp.

12 Turn the telescope in the clockwise direction to set the horizontal angles as per given value. Lock the upper clamp.

13 Exact setting of the angular value is done using upper tangent screw.

14 Direct the surveyor man with ranging rod along the line of sight and fix the point, Q on the ground along the line of sight. (Fig 2)

Fig 2



15 Check the angular value and the point, Q sighted.

16 Drive a peg on the ground.

17 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Measurement of vertical angle (Angle of elevation)

Objectives: At the end of this exercise you shall be able to
- **operate the instrument**
- **tabulate the readings**
- **measure a vertical angle.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Ranging rod - 2 Nos.
- Pegs - 5 Nos.
- Hammer - 1 Nos.

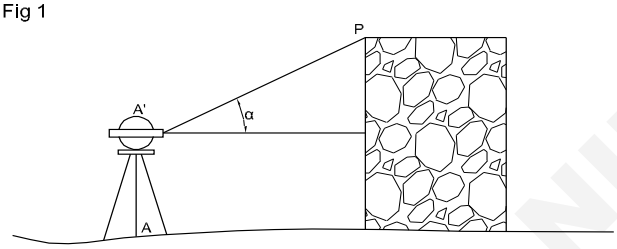
Materials

- White paper - 1 No.

1 Erect a station A by driving peg on an open and fair ground.

2 Set up the instrument at A. (Fig 1)

Fig 1



SUN2242H1

MEASURING VERTICAL ANGLE (FACE LEFT)

3 Perform all the temporary adjustments.

4 Level the instrument with respect to altitude bubble level (steps for keeping the plate bubble parallel are followed. But instead of bringing plate level parallel and perpendicular, bring altitude bubble).

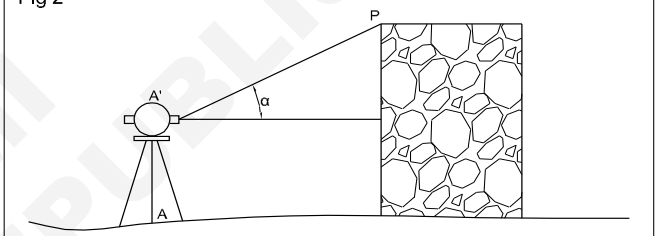
5 Direct the telescope upwards to sight 'P'.

6 Lock horizontal movement of plates.

7 Tighten vertical clamp screw.

8 Bisect 'P' exactly using tangent screws. (Fig 2)

Fig 2



SU2313E2

MEASURING VERTICAL ANGLE (FACE RIGHT)

9 Measure vertical angle, $+\alpha$ from C scale and D scale.

10 Record the readings with sign.

11 Mean reading is the vertical angle.

12 Change face of the instrument and measure vertical angle following appropriate above steps.

13 Average of both face readings is the angle of elevation ($+\alpha$) to 'p' from 'A'.

Measurement of vertical angle (Angle of depression)

Objectives: At the end of this exercise you shall be able to
- **operate the instrument**
- **tabulate the readings**
- **measure a vertical angle of depression**

1 Erect a station by driving peg on an open and fair ground.

2 Set up the instrument at A. (Fig 1)

3 Perform all the temporary adjustments.

4 Level the instrument with respect to altitude bubble level (steps for keeping the plate bubble parallel is followed. But instead of bringing plate level parallel and perpendicular, bring altitude bubble).

5 Direct horizontal downwards to sight 'Q'.

6 Lock horizontal movement of plates.

7 Tighten vertical clamp screw.

8 Bisect 'Q' exactly using tangent screws. (Fig 2)

9 Measure vertical angle, $-\alpha$ from C scale and D scale.

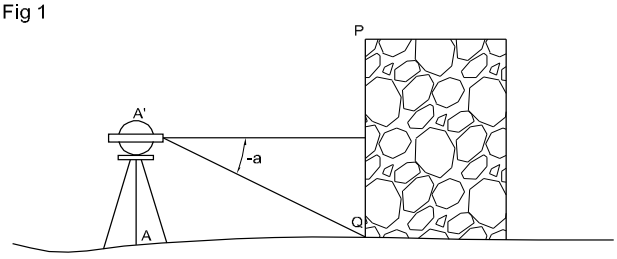
10 Record the readings with sign (-ve sign). (Table 1)

11 Mean reading is the vertical angle.

Table1 - Entering readings to measure vertical angle (Angle of elevation/Angle of depression)

Instrument	Sight to	Face Left											Face Right											Average vertical angle			Rough sketch
		C			D		Mean			Vertical angle			C			D		Mean			Vertical Angle						
		0	'	"	'	"	0	'	"	0	'	"	0	'	"	'	"	0	'	"	0	'	"	0	'	"	

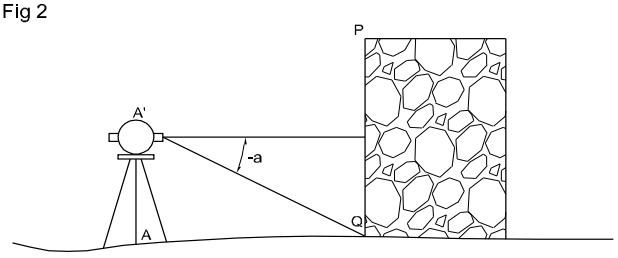
Fig 1



MEASURING VERTICAL ANGLE OF DEPRESSION - FACE LEFT

SUN2242J1

Fig 2



MEASURING VERTICAL ANGLE OF DEPRESSION - FACE RIGHT

SUN2242J2

12 Change face of the instrument and measure vertical angle following appropriate above steps.

13 Average of both face readings is the angle of depression ($-\alpha$) to 'Q' from 'A'.

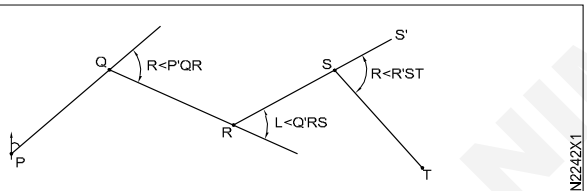
Measurement of deflection angle

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

- **operating theodolite**
- **observe and tabulate readings**
- **measure the deflection angles PQR, QRS and RST.**

1 Erect five stations P, Q, R, S and T by driving pegs on the field and erect ranging rods vertically behind the pegs P and R. (Figs 1 & 2)

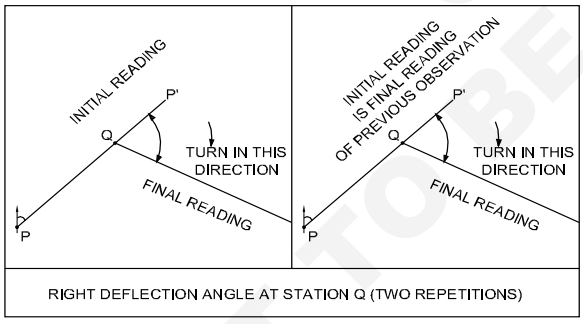
Fig 1



MEASUREMENT OF DEFLECTION ANGLE

SUN2242X1

Fig 2



MEASUREMENT OF DEFLECTION ANGLE

SUN2242X2

2 Fix the instrument at the station Q.

3 Set up the instrument over the station Q with telescope in normal condition (vertical circle left of the observer and bubble is up).

4 Follow the steps 4 to 12 of exercise 2.2.40 measurement of horizontal angle.

5 Transit the telescope. Ensure scale readings still remain unchanged.

6 Unclamp the upper plate, swing the telescope to sight station R.

7 Lock the upper clamp and get exact bisection using upper tangent screw.

8 Read and enter readings indicating direction of swing in the respective column of the table 1.

9 Loosen the lower clamp and sight P.

10 Lock the lower clamp. Bisect P accurately with lower tangent screw.

11 Follow above steps 5 to 8.

12 Average value is the value of the deflection angle.

13 Measure the length, PQ.

14 Shift the instrument and set up the instrument over the station R. Erect ranging rods vertically behind the pegs Q and S.

15 Follow above steps 4 and 5.

16 Unclamp the upper plate, swing the telescope clockwise to sight station S.

17 Follow above steps 7 and 8.

18 Loosen the lower clamp and sight Q.

19 Lock the lower clamp. Bisect Q accurately with lower tangent screw.

20 Transit the telescope. Ensure scale readings still remain unchanged.

21 Unclamp the upper plate, swing the telescope to sight station S.

22 Follow above steps 7 and 8.

23 Average value is the value of the deflection angle.

24 Measure the length, QR.

25 Similarly take readings from station S and measure the sides.

26 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Prolongation of line by various methods (Method - I)

Objectives: At the end of this exercise you shall be able to
- **set out a line AB**
- **prolong the line AB**
- **erect two points C and D on prolonged line.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Ranging rods - 2 Nos.
- Pegs - 5 Nos.
- Hammer - 1 No.

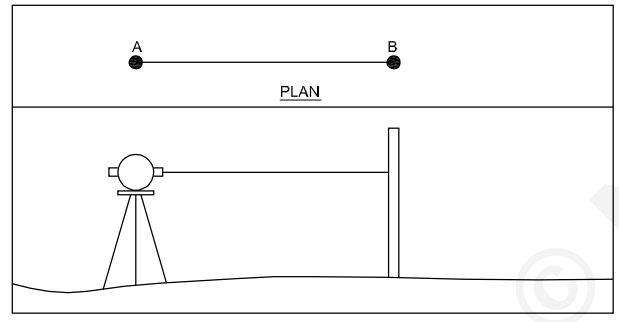
Materials

- White paper - 1 No.

1 Set a line AB and erect pegs at the ends of this line.

2 Set up the instrument over the station A. (Fig 1)

Fig 1



PROLONGING A STRAIGHT LINE - METHOD - I

SUN2243H1

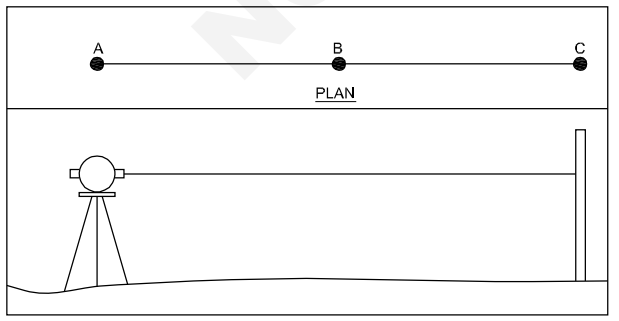
3 Perform all the temporary adjustments

4 Bisect station B accurately with tangent screws after fixing horizontal motion (clamp plates).

5 Move the telescope in vertical plane and looking through the pin and hole arrangement, direct the surveyor, with ranging rod, in line.

6 Exactly bisect the ranging rod and fix the point, C by driving peg. (Figs 2 & 3)

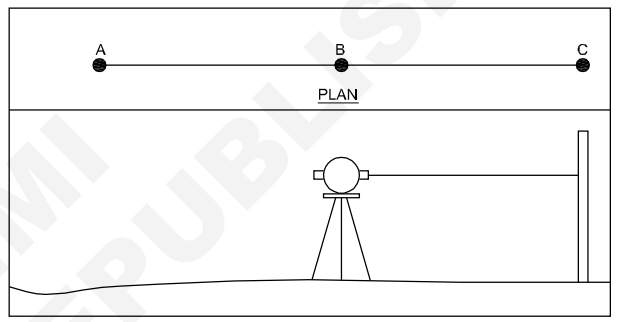
Fig 2



POINT C IS ERECTED ON THE PROLONGED LINE

SUN2243H2

Fig 3



PROLONGING A LINE - METHOD I

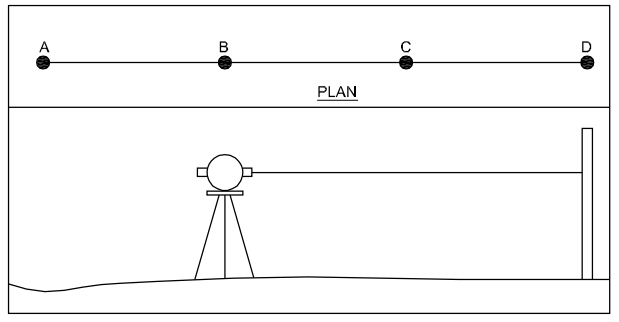
SUN2243H3

7 Move the instrument to B

8 Similarly fix another point D. (Fig 4)

9 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Fig 4



LINE PROLONGED TO POINT D

SUN2243H4

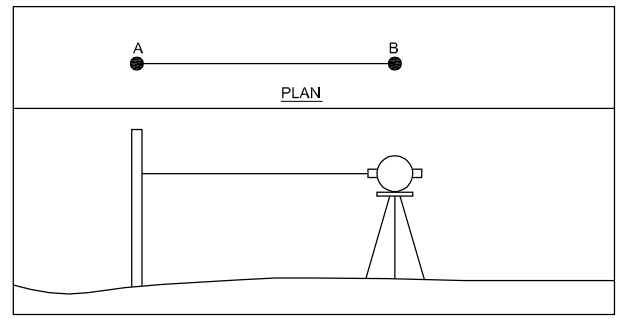
Prolongation of line by various methods (Method - II)

Objectives: At the end of this exercise you shall be able to
- **set out a line AB**
- **prolong the line AB minimizing error**
- **erect two points C and D on prolonged line.**

1 Fix a line AB and erect pegs at the ends of this line.

2 Set up the instrument over the station B. (Fig 1)

Fig 1



PROLONGING A LINE - METHOD - II

SUN2243J1

3 Perform all the temporary adjustments.

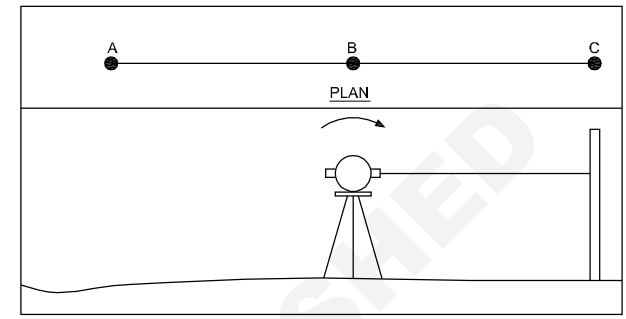
4 Bisect station A accurately with tangent screws after fixing horizontal motion.

5 Transit the telescope and looking through the pin and hole arrangement direct the surveyor, with ranging rod, in line.

6 Point C is located on the ground by driving peg.

7 Move the instrument to C. (Fig 2)

Fig 2



PROLONGING A LINE - METHOD II

SUN2243J2

8 Similarly fix another point D.

9 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

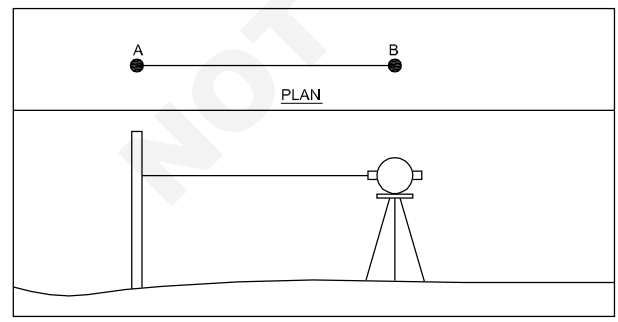
Prolongation of line by various methods (Method - III) (Double sighting)

Objectives: At the end of this exercise you shall be able to
- **prolong the line AB using defective instrument**
- **eliminate error due to permanent adjustment defects**
- **erect two points C and D on prolonged line.**

1 Fix a line AB and erect pegs at the ends of this line.

2 set up the instrument over the station B (Fig 1)

Fig 1



DOUBLE SIGHTING

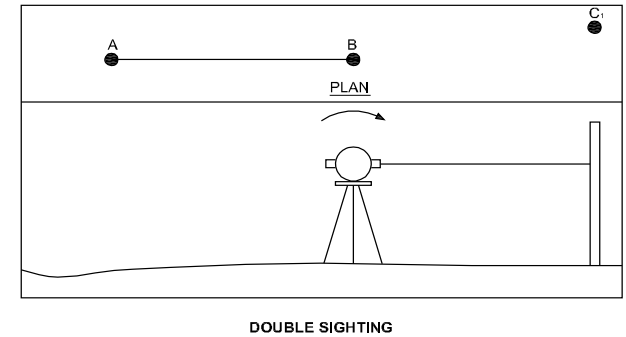
SUN2243X1

3 Perform all the temporary adjustments.

4 Bisect station A accurately with tangent screws after arresting horizontal motion.

5 Transit the telescope and locate the point, say C1. (Fig 2)

Fig 2

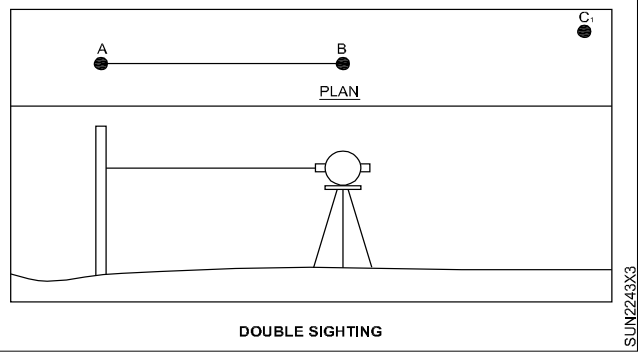


DOUBLE SIGHTING

SUN2243X2

6 Change the face and follow above steps 4. (Fig 3)

Fig 3



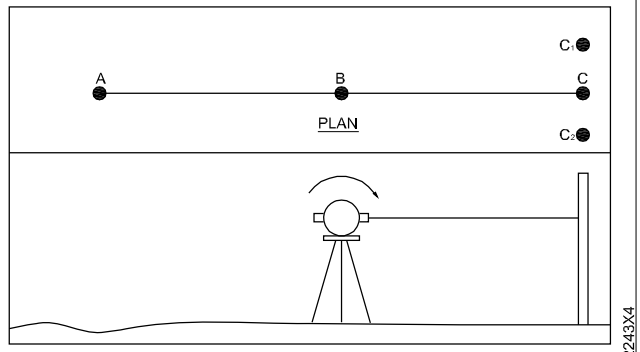
DOUBLE SIGHTING

7 Transit the telescope and locate a point, say C2. (Fig 4)

8 Measure C1 C2, Find middle of C1 C2, which is the required point C, line with AB.

9 Move the instrument to C.

Fig 4



DOUBLE SIGHTING

10 Similarly following above steps fix another point D.

11 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

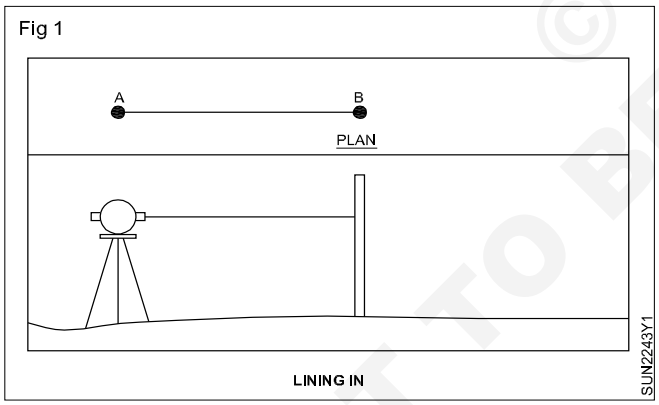
Ranging when ends intervisible (Lining in)

Objectives: At the end of this exercise you shall be able to
- **set out a line AB**
- **operate the instrument**
- **establish two intermediate points C and D in the line.**

1 Set a line AB of reasonable length on the ground and erect pegs at the ends of this line.

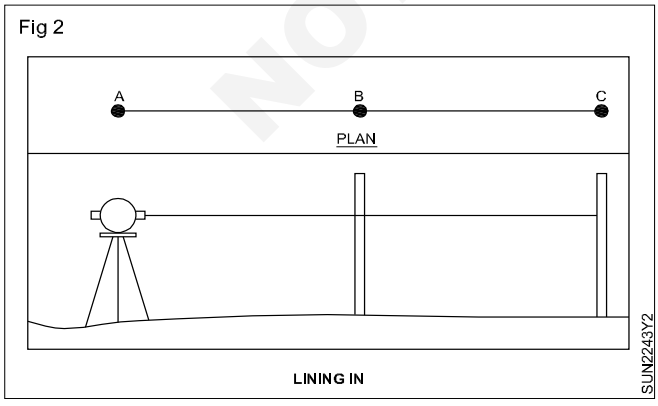
2 Set up the instrument over the station A. (Figs 1 & 2)

Fig 1



LINING IN

Fig 2



LINING IN

3 Perform all the temporary adjustments.

4 Bisect station B accurately with tangent screws after fixing horizontal motion (clamp plates)

5 Move the telescope in vertical plane and looking through the pin and hole arrangement direct the surveyor, with ranging rod, between pegs A and B in the line.

6 Exactly bisect the ranging rod and fix the point, C by driving peg.

7 Without changing the setup of the instrument, follow the above step 5 and fix another point D.

8 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Determination of height of an inaccessible object by theodolite (Single plane method)

Objectives: At the end of this exercise you shall be able to
- **operate the instrument**
- **deduce the readings**
- **find the reduced level of the point 'Y' at the top of the building.**

Requirements

Tools / Instruments

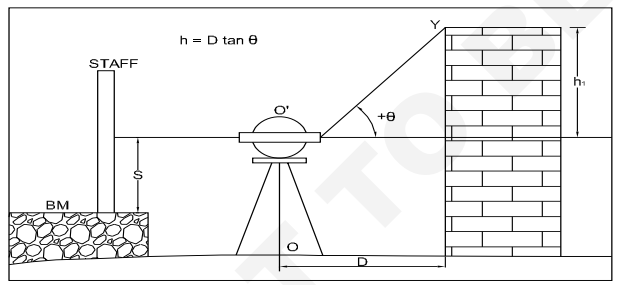
- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Levelling staff - 1 No.
- Measuring tape - 1 No.
- Pegs - 2 Nos.
- Hammer - 1 No.

Materials

- White paper - 1 No.

1 Select an instrument station, 'O' on a fairly open ground at a reasonable distance from the base of 'Y'.
2 Set up the instrument at 'O'
3 Perform all the temporary adjustments.
4 Set the vertical vernier 0-0.
5 Direct the telescope to the staff vertically held at the given BM (Check altitude bubble).
6 Clamp both plates. Exactly bisect the staff.
7 Observe the staff reading (S) and enter it in the table.
8 Loosen the lower clamp 'turn the telescope towards 'Y'

Fig 1

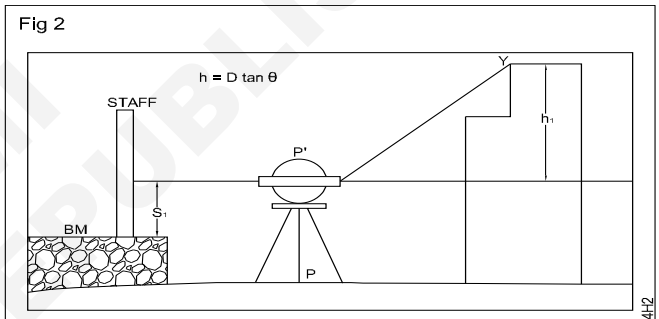


TRIGNOMETRIC LEVELLING

SUN2244H1

9 Lock lower clamp, tighten the vertical circle clamping screw. (Fig 1)
10 Plunge the telescope and locate a point 'P' on the ground by erecting a peg.
11 Measure and record the distance between the station 'O' and P (d).
12 Set up the instrument at station 'P'.
13 Follow steps 3 to 6 of exercise
14 Observe the staff reading (S2) and enter it in the table.
15 Deduce reduced level of 'Y' from the HIs of instrument stations 'O' and 'P'. (Figs 2 to 3 ,4)

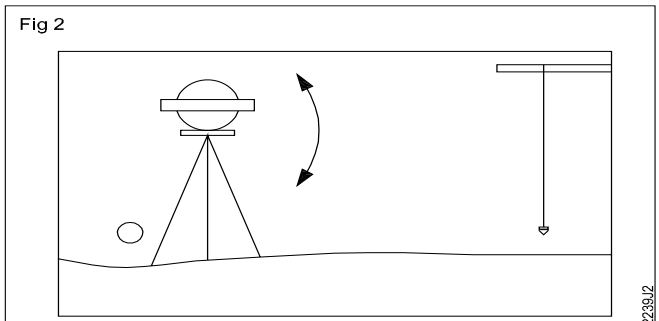
Fig 2



SINGLE PLANE METHOD

SUN2244H2

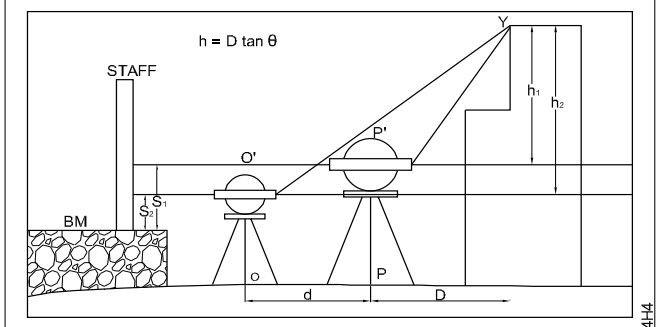
Fig 2



ROTATING TELESCOPE IN THE VERTICAL PLANE

SUN2239J2

Fig 4



SINGLE PLANE METHOD

SUN2244H4

Traversing (closed & open) using Theodolite & tape/chain (Open traverse different angle)

Objectives: At the end of this exercise you shall be able to
- **erect the stations for the traverse**
- **measure the deflection angles**
- **plot the traverse to a suitable scale.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Ranging rods - 2 Nos
- Pegs - 5 Nos
- Hammer - 1 No.
- Measuring tape - 1 No.

Materials

- White paper - 1 No.
- Nails - 1 No.
- Paint - 1 No.
- Brush - 1 No.
- A2 sheet - 1 No.

1 Reconnaissance the area to be surveyed.

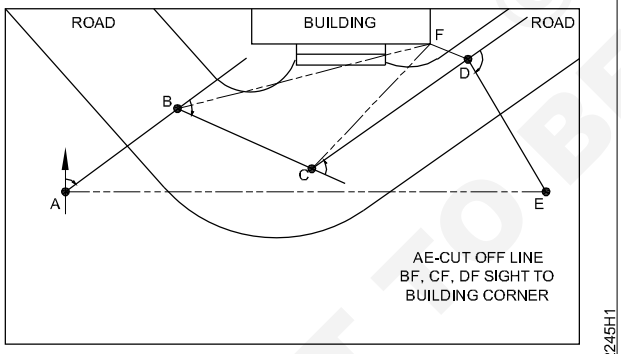
2 Select stations as per field conditions.

3 Mark the stations.

4 Take at least three permanent reference points of the stations.

5 Set up the instrument at the starting station, say 'A'. (Fig 1)

Fig 1



OPEN TRAVERSE (DEFLECTION ANGLE)

6 Perform all the temporary adjustments.

7 Measure the magnetic meridian of the line AB using theodolite if it is fitted with magnetic compass (otherwise use prismatic compass).

8 Shift and set up the instrument at station 'B'.

9 Set the vernier scale A, 0-0.

10 Perform all the temporary adjustments.

11 Loosen the lower clamp; direct the telescope towards station A.

12 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

13 Transit the telescope.

14 Loosen upper clamp; telescope is turned clockwise or anticlockwise to sight the forward station 'C'.

15 Observe the horizontal angle and record the angle indicating the deflection direction. (If the deflection angle is to the right, the reading itself is the measured angle, if the deflection angle is to the left, the difference between 360° and the observed angle gives the actual value).

16 Loosen the plates.

17 Change the face of the instrument.

18 Follow the above steps 9 to 14.

19 Measure the horizontal distance AB using measuring tape.

20 Shift the instrument to next station 'C'.

21 Set the vernier scale A, 0-0.

22 Set up the instrument at 'C' and perform all the temporary adjustments.

23 Loosen the lower clamp; direct the telescope towards station 'B'.

24 Proceed, following above steps to finish off the traverse.

25 Cut off lines and bearings of a prominent object from several are also note down for checking the traverse. Details can also locate by any method.

26 Plot the traverse to a suitable scale.

Open traverse (Direct angles or angles to the right)

Objectives: At the end of this exercise you shall be able to
- **measure the direct angles of the traverse**
- **check the traverse**
- **plot the open traverse ABCDEF.**

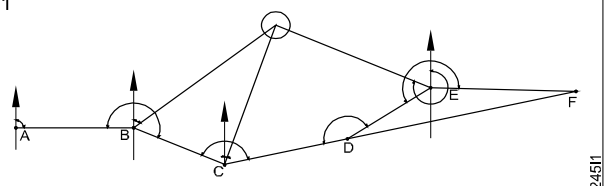
1 Reconnaissance the area to be surveyed.

2 Select stations as per field conditions.

3 Mark the stations.

4 Take atleast three permanent reference points of the stations. (Fig 1)

Fig 1



OPEN TRAVERSE (ANGLES TO THE RIGHT)

SUN2245I1

5 Set up the instrument at the starting station, say 'A'.

6 Perform all the temporary adjustments.

7 Measure the magnetic meridian of the line AB using theodolite, if it is fitted with magnetic compass (otherwise use prismatic compass) .

8 Shift and set up the instrument at station 'B'.

9 Set the vernier scale A, 0-0.

10 Perform all the temporary adjustments.

11 Loosen the lower clamp; direct the telescope towards station A.

12 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

13 Loosen upper clamp; telescope is turned clockwise to sight the forward station 'C'.

14 Observe the horizontal angle and record the angle.

15 Following appropriate above steps observe a face right reading.

16 Set up the instrument at forward station 'C'.

17 Follow steps 9 to 15.

18 Similarly proceed further and finish off the traverse.

19 Cut off lines and bearings of a prominent object from several stations are also note down for checking the traverse. Details can also locate by any method.

20 Plot the traverse to a suitable scale.

Closed traverse (Deflection angle)

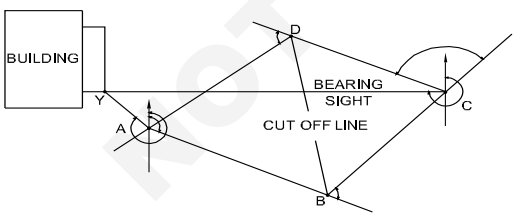
Objectives: At the end of this exercise you shall be able to
- **observe the deflection angles of the traverse**
- **check the deflection angles**
- **plot the closed traverse.**

1 Erect four stations, say A, B, C and D (Running clockwise) , on an open and fair ground by driving pegs.

2 Take at least three permanent reference points of the stations.

3 Set up the instrument at the station 'B'. (Fig 1)

Fig 1



CLOSED TRAVERSING (DEFLECTION ANGLE)

SUN2245J1

4 Set the vernier scale A, 0-0.

5 Perform all the temporary adjustments.

6 Loose the lower clamp; direct the telescope towards station A.

7 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

8 Transit the telescope.

9 Loosen upper clamp; telescope is turned clockwise to sight the forward station 'C'.

10 Observe the horizontal angle and record the angle indicating the deflection direction (Right deflection) .

11 Loosen the plates.

12 Change the face of the instrument.

13 Follow the above steps 4 to 11.

14 Measure the horizontal distance AB using measuring tape.

15 Shift the instrument to next station 'C'.

16 Set up the instrument at 'C' and perform all the temporary adjustments.

17 Follow appropriate steps to complete the loop traverse. (Cut off lines BD and magnetic bearings from stations C and A to any nearest prominent object should record)

18 Check the algebraic sum of the deflections angles.

19 Apply correction at each angle if found error is reasonable or permissible.

20 Plot the traverse to a suitable scale.

Closed traverse (Interior angles)

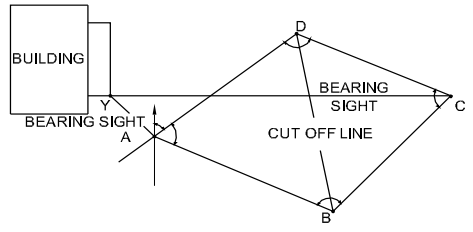
Objectives: At the end of this exercise you shall be able to
- **measure the interior angles of the traverse**
- **check the traverse**
- **compare the results.**

1 Precisely relocate stations A, B, C and D established in the exercise 2.2.45 closed traverse (deflection angle).

2 Check the sides of the established frame work.

3 Set up the instrument at the station 'A'. (Fig 1)

Fig 1



CLOSED TRAVERSE (INTERIOR ANGLES)

4 Set the vernier scale A, 0-0.

5 Perform all the temporary adjustments.

6 Measure the magnetic meridian of the line AB using theodolite if it is fitted with magnetic compass (otherwise use prismatic compass).

7 Loosen the lower clamp; direct the telescope towards station 'D'.

8 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

9 Loosen upper clamp; telescope is turned clockwise to sight the forward station 'B'.

10 Observe the horizontal angle.

11 Loosen the plates.

12 Following appropriate above steps observe a face right reading.

13 Shift the instrument to next stations and observe the horizontal angles.

14 Shift the instrument of next station 'C'.

15 Set up the instrument at 'C' and perform all the temporary adjustments.

16 Loosen the lower clamp; direct the telescope towards station 'B'.

17 Loosen upper clamp; telescope is turned clockwise to sight the forward station 'D'.

18 Follow appropriate above steps to complete the loop traverse.

19 Plot the traverse to a suitable scale.

20 Compare the results of the two methods. (Compare this exercise with the exercise closed traverse (deflection angle)

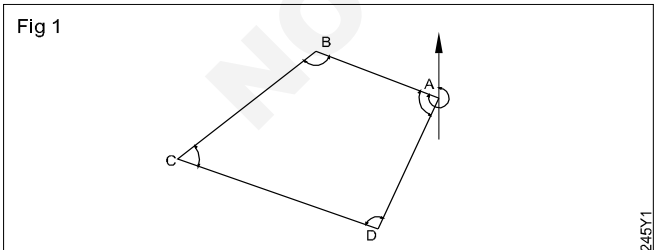
Closed traverse (Included angles)

Objectives: At the end of this exercise you shall be able to
- **measure the included angles**
- **balance the traverse**
- **plot closed traverse using coordinates.**

1 Follow steps 1 to 7 of the Exercise open traverse (deflection angle).

2 Shift and set up the instrument at station 'A'. (Fig 1)

Fig 1



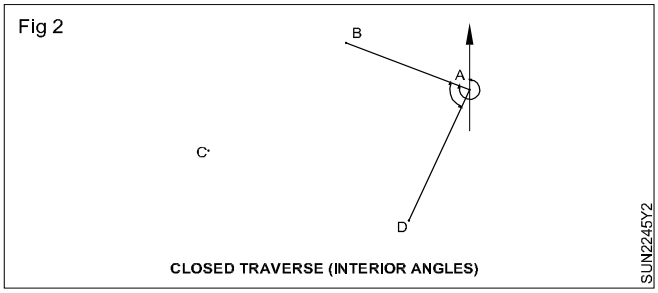
CLOSED TRAVERSE (INTERIOR ANGLES)

3 Set the vernier scale A, 0-0.

4 perform all the temporary adjustments.

5 Loosen the lower clamp; direct the telescope towards the last back sight station D. (Fig 2)

Fig 2

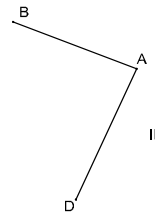


CLOSED TRAVERSE (INTERIOR ANGLES)

6 Tighten lower clamp; telescope is turned to sight the forward station 'C'.

7 Loosen upper clamp; telescope is turned to sight the forward station 'C'. (Fig 3)

Fig 3



CLOSED TRAVERSE (INTERIOR ANGLES)

SUN2245Y3

8 Tighten upper clamp. Bisect 'C' exactly and observe the horizontal angle.

9 Following appropriate above steps observe a face right reading.

10 Measure horizontal angles by both face observations at each station.

11 Measure the length of the side.

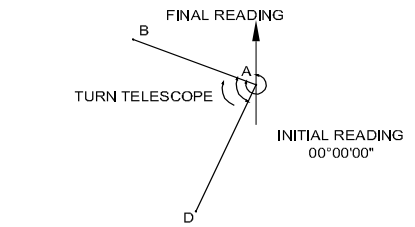
12 Proceed thus to finish off the traverse. (Figs 4 to 6)

13 Balance the traverse if error exists.

14 Plot the traverse using coordinates.

15 Balance the traverse graphically if traverse failed to close while plotting. (Traverse can be plotted by included angles and balance it graphically for comparison of balancing methods).

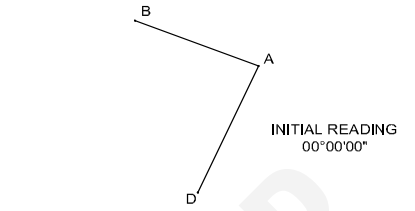
Fig 4



CLOSED TRAVERSE (INTERIOR ANGLES)

SUN2245Y4

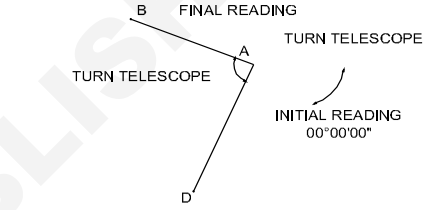
Fig 5



CLOSED TRAVERSE (INTERIOR ANGLES)

SUN2245Y5

Fig 6



CLOSED TRAVERSE (INTERIOR ANGLES)

SUN2245Y6

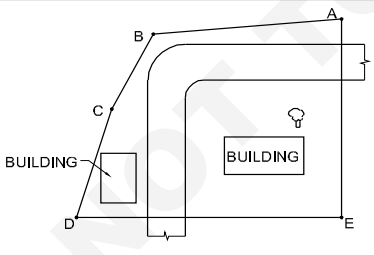
Balancing closed traverse

Objectives: At the end of this exercise you shall be able to
- **measure the included angles**
- **balance the traverse**
- **plot closed traverse using coordinates**
- **find the area by coordinates method.**

1 Follow steps 1 to 7 of the exercise open traverse (deflection angle)

2 Shift and set up the instrument at station 'A'. (Fig 1)

Fig 1



BALANCING CLOSED TRAVERSE

SUN2245Z1

3 Set the vernier scale A, 0-0.

4 Perform all the temporary adjustments.

5 Loosen the lower clamp; direct the telescope towards the last back sight station.

6 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

7 Loosen upper clamp; telescope is turned to sight the forward station 'C'.

8 Tighten upper clamp. Bisect 'C' exactly and observe the horizontal angle.

9 Following appropriate above steps observer a face right reading.

10 Measure horizontal angles by both face observations at each station.

11 Measure the length of the side.

12 Proceed thus to finish off the traverse.

13 Details can also be located by any methods (Details can be located by offsetting, angles or bearings from a point. Separately record the detailing if necessary).

14 Compute the traverse.

15 Balance the traverse if error exists.

16 Plot the traverse using coordinates.

17 Balance the traverse graphically if traverse failed to close while plotting.

18 Find the area of the traverse by coordinates method.

Measurement of horizontal angle and bearing of line

Objective: At the end of this exercise you shall be able to
- **find the bearing of a line AB**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Trough compass - 1 No.
- Plumb bob - 1 No.

Materials

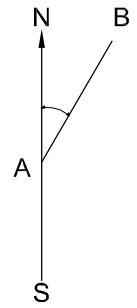
- White paper - 1 No.

PROCEDURE

Find the bearing of a line AB

1 Set up the instrument over A and level it accurately. (Fig 1)

Fig 1



SUN2246H1

2 Set the vernier A to the zero of the horizontal circle

3 Release the magnetic needle and loosen the lower clamp.

4 Rotate the Instrument in the horizontal plane until the magnetic needle comes the normal position

5 The zero of the small scale in the trough compass

6 Tighten lower clamp and use its tangent screw for the exact coincidence

7 The line of sight is parallel to magnetic meridian and the vernier A reads zero

8 Loose the upper clamp, turn the telescope and sight the object B

9 Bisect B by using the upper tangent screw

10 Read both vernier's on horizontal circle

11 The mean of the two vernier readings gives the magnetic bearing of the line AB.

Computation of Co-ordinate from the bearing angle and length

Objectives: At the end of this exercise you shall be able to
- **what are the rules used to solve the problem**
- **method of solving**

Rules for solving (Fig 1)

l = length of line: θ is its reduced bearing

1) Latitude = L cos θ

departure = l sin θ

2) $\tan\theta = \frac{\text{departure}}{\text{Latitude}}$

3) (**a)** $\mathbf{l} = \sqrt{(\text{latitude})^2 + (\text{departure})^2}$

(b) l = latitude x sec θ

(c) l = departure x cosec θ

Example: The co-ordinates of two points A and B are as given

Find the length and bearing of AB

Point	co ordinates	
	Northing	Easting
A	500.25	640.75
B	840.78	315.60

Solution:

l = length of AB

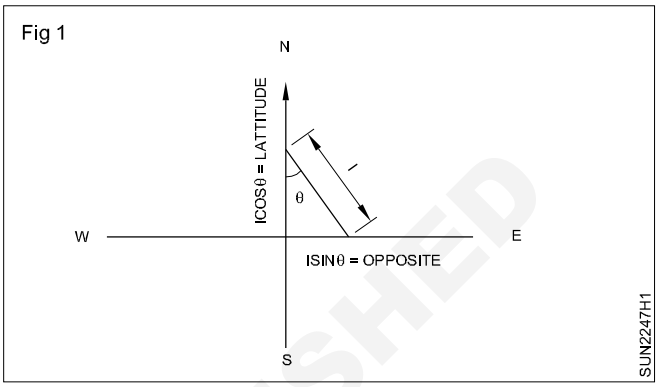
ø = reduced bearing of AB

Latitude of AB = The difference between the north co - ordinates of AB.

= 840.78 -500.25

= 340.53

Fig 1



Departure of AB = The difference between the east co - ordinates of AB.

= 315.60 - 640.75

= - 325.15

$\tan\theta = \frac{\text{departure}}{\text{latitude}} = \frac{325.15}{340.53} = 0.9548$

θ = 43° 41’

The latitude is positive (+) and the departure is negative (-) the line AB lies in the IV th quadrant (NW)

Reduced bearing of AB = N 43° 41’ W

In whole circle bearing of AB = 360° - 43° 41’ = 316° 19’

Length of line AB = $\sqrt{(L)^2 + (D)^2}$

$= \sqrt{(340.53)^2 + (325.15)^2}$

= 470.83 m

check: length of AB = latitude of AB x Sec θ

= 340.53 x sec 43° 41’

= 470.88 m

Preparation of gales traverse table

Objective: At the end of this exercise you shall be able to
- **preparation of gales traverse table**

PROCEDURE

1 Add up all the included angles.

2 Check the sum of the corrected angles equal to right angle.

3 Calculate the bearing of the first line equal to its observed bearing.

4 Correct the W.C bearing in to R.B and determine the quadrants.

5 From the known length, calculate R.B of the line and find out their latitudes and departures.

6 Add up all northing southing.

7 Find out the difference between the two sums.

8 Similarly determine the difference between the sum of all eastings and sum of all westings.

9 The sum of the latitudes and departure equal to sum of the southing the sum of the northing. Similary, the sum of eastings equal to the sum of the westing.

10 Find the independent co-ordinates of the line from the consecutive co-ordinates. They are all positive .The whole traverse may lie in the first quadrant (NE).

GALE'S TRAVERSE TABLE

1	2	3	4	5	6	7	8	9	10	11				12				13				Independent Co-Ordinates		Remarks
										Consecutive Co-Ordinates				Corrections				Corrected Consecutive Co-Ordinates						
										Lat			Dep												
Inst Station	Angles	Correction	Corrected angles	WCB	RB	Quadrant	Line	Length	Point	Northing (+)	Southing (-)	Easting (+)	Westing (-)	Northing	Southing	Easting	Westing	Northing	Southing	Easting	Westing	Northing	Easting	
D																								
E																								
F																								
G																								
H																								

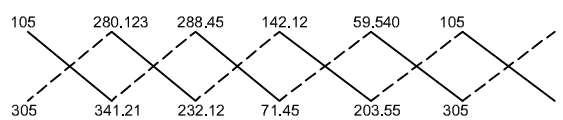
Closing Error = $= \sqrt{(\sum l)^2 + (\sum D)^2}$ Reduced bearing (ø) of the closing error = $\tan^{-1}\frac{\sum D}{\sum L}$

Computation of area using co-ordinates (Gales traverse)

Objectives: At the end of this exercise you shall be able to
- **calculate the closing error of traverse**
- **find the relative closing error**
- **find the area of field**

Calculation of Area (Fig 1)

Fig 1



Area = 1/2 { (105 x 341.21) - (280.123 x 305) +

+ [(280 .123 x 232.12) - (341.21 x 288.45)] +

+ [(288.45 x 71.45) - (232.12 x 142.12)] +

+[(142.12 x 203.55) - (71.45 x 59.540)] +

+[(59.540 x 305) - (203.55 x105)]

= 1/2 [49610 +32056 +12334 +24650 +3213)

= 60331.5 m^2

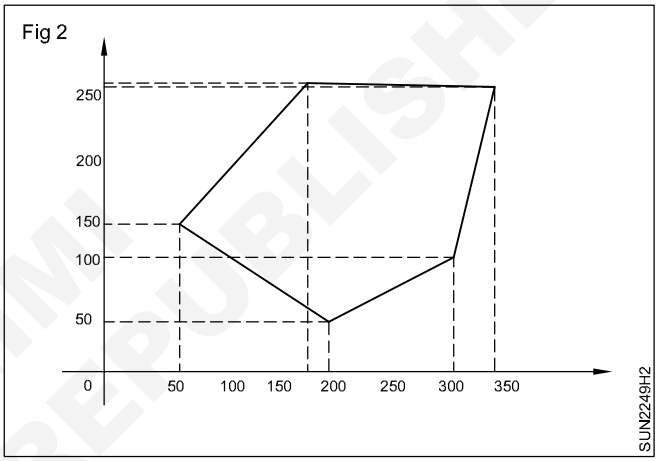
Relative closing Error: (Fig 2)

Closing error = $\sqrt{(-0.71)^2 + (+0.71)^2}$

Relative closing error = $\frac{\text{Closing Error}}{\text{Perimeter}} = \frac{\text{Cl Error}}{815.20}$

$= \frac{106.5}{815.2} = 0.12\text{m}$

Fig 2



GALE'S TRAVERSE TABLE

15	Remarks	Angels are measured with repetition method with face left & face right (3 times)	Both vernier are read	The traverse was run Anti-Clockwise			
14	Independent Co-Ordinates	Easting (+)	305.00	341.210	232.120	71.450	203.55	305.00
		Northing (+)	105.00	280.123	288.45	142.12	59.540	105.00
13	Corrected Consecutive Co-Ordinates	Westing (-)	-	152.019	151.139	-	-	303.942
		Easting (+)	414.88			158.380	104.674	303.942
		Southing (-)	-	-	133.731	86.24	-	219.971
		Northing (+)	170.357	0.330	-	-	49.284	219.971
12	Correction	Westing (-)	-	0.019	0.038	-	-	-0.057
		Easting (+)	0.008	-	-	0.032	0.017	+0.057
		Southing (-)	-	-	0.065	0.090	-	(-)0.155
		Northing (+)	0.087	0.015	-	-	0.054	+0.156
11	Consecutive Ordinators Dep	Northing (-)	-	152.0	151.177	-	-	-303.177 DEP+.710
		Easting (+)	41.480	-	-	158.350	104.057	+303.887
	Consecutive Ordinators Lat	Southing (-)	-	-	134.59	85.935	-	-220.525
		Northing (+)	170°.270	0.315	-	-	49.230	+219.815 Lat.-710
10		Point	D	E	F	G	H	D
9		Length in 'M'	175	150.10	198.70	179.00	112.40	815.20
8		Line	DE	EF	FG	GH	HD	
7		Quadrant	NE	NW	SW	SE	NE	
6		RB	13°.13'.0"	1°.12'.40"	48°.52'.30	61°.7'.40"	65°.41'.10"	
5		WCB	13°.30'.00"	271°.42'40"	228.52°.30'	118°.52'20"	65°.41'.10"	
4		Corrected angles	128°.48'.50"	79°.42'.40"	139°.39'.00"	71°.59'.50	129°.48'.50"	
3		Correction	+50"	+50"	+50"	+50"	+50"	4'.10"
2		Angles	128°.48'.00"	79°.41'.50"	139°.39'.00"	71°.59'.00	129°.48'.00"	549°.55'.50"
1		Station	D	E	F	G	H	

Determine omitted measurement

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine omitted side of the triangle POQ.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Ranging rods - 4 Nos
- Pegs - 4 Nos
- Hammer - 1 No.
- Measuring tape - 1 No.

Materials

- White paper - 1 No.

PROCEDURE

1 Erect two stations, P and Q by driving pegs on the field and erect ranging rods vertically behind the pegs.

2 Fix an instrument station O. (Fig 1)

3 Set up the instrument over the station O with telescope normal.

4 Perform all the temporary adjustments.

5 Release both upper and lower clamps.

6 Set the vernier A to the zero. Lock the upper clamp.

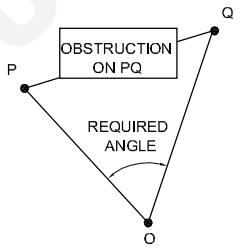
7 Direct the telescope to sight the ranging rod at the left hand station (P) and bisect the station.

8 Lock the lower clamp.

9 Loosen the upper clamp, turn the telescope in the clockwise direction to sight Q.

10 Observe and enter readings in the respective columns of table 1.

Fig 1



OMITTED SIDE OF A TRIANGLE

11 Change face of the instrument and repeat appropriate steps and complete set of readings.

12 Measure the horizontal distance OP and OQ.

13 Deduce the distance PQ using cosine rule.

Omitted side of a traverse measurement

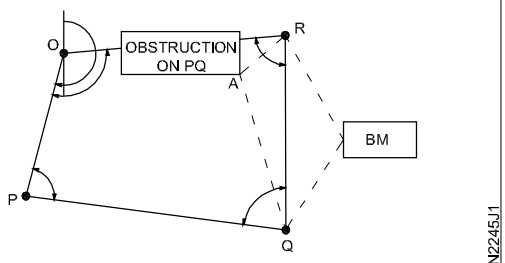
Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine omitted side of the closed traverse OPQRO.**

1 Erect four stations O, P, Q and R, by driving pegs on the field and erect ranging rods vertically behind the pegs.

2 Take magnetic bearing of the line OP.

3 Set up the theodolite over the station O with telescope normal. (Fig 1)

Fig 1



OMITTED SIDE OF A TRAVERSE

4 Perform all the temporary adjustments.

5 Set the vernier A to the zero. Lock the upper clamp.

6 Direct the telescope and sight the station R.

7 Lock the lower clamp.

8 Loosen the upper clamp, turn the telescope in the clockwise direction to sight P.

9 Observe and enter readings in the respective columns of table (Minimum two repetitions should be done)

10 Change face of the instrument and repeat appropriate steps and complete set of readings.

11 Run traverse anticlockwise and observe possible horizontal angles at each stations.

12 Measure the horizontal distance OP, PQ and QR.

13 From stations Q and R, take BM readings keeping vertical angle zero and an angle of elevations to the corner of the buildings A.

14 Measure the horizontal distance QA and RA.

15 Omitted length and direction of side OR is calculated.

16 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

17 Enter the table 1.

Table 1 - Column

Instru-ment	Sight to	Length (m)	Face left								Right swing				Face Right								Left Swing				Average Horizontal angle			Remarks	Rough sketch
			A			B		Mean (m)			No: of Repe-titions	Horizontal angle			A			B		Mean			No:of Repe-titions	Horizontal angle							
			0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“		
A	D																													Bearing of AB=	

Practice in setting up of dumpy level and performing temporary adjustments

Objectives: At the end of this exercise you shall be able to
- **set up the tripod on the ground**
- **fix the instrument on the tripod**
- **level the instrument**
- **perform elimination of parallax.**

Requirements

Tools/Instruments

- Dumpy level with tripod - 1 No.
- Telescopic levelling staff - 1 No.
- Level field book - 1 No.
- Pegs - 2 Nos.
- Steel tape 30m - 1 No.

Materials

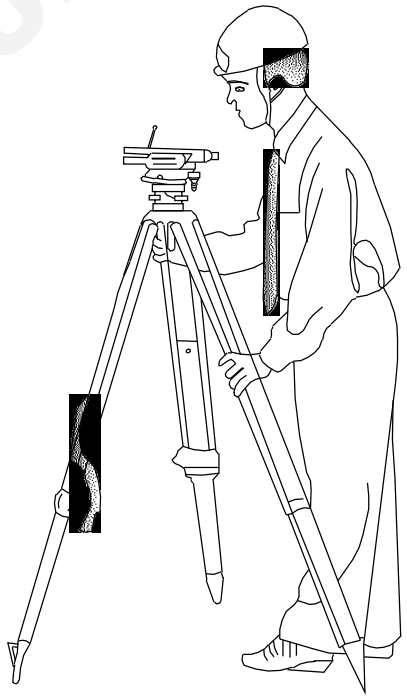
- Levelling field book - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

TASK 1: **Setting up the tripod on the ground (Fig 1)**

- Loosen the strap of the tripod
- Spread the legs of the tripod to a convenient height
- Keep the two legs firmly on one side of a non-slippery ground and the third on the other side.
- Adjust the third leg so that the top of the tripod is approximately horizontal by eye judgement.

Fig 1



LEG ADJUSTMENT

SUN2351H1

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TASK 2: **Fix the instrument on the tripod (Fig 1)**

- After noting the position of the level in the box, remove it from the box.
- Release the clamp screw of the instrument and hold it with right hand.
- Turn round the lower part of the level with the left hand and screw the instrument firmly on the tripod

TASK 3: **Levelling of the instrument (Fig 2)**

1 Place the telescope parallel to the line joining the two foot screws.

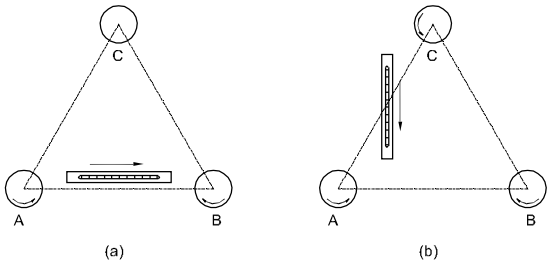
2 Bring the bubble of the spirit level on the telescope to the centre of its run by turning the foot screws beneath the telescope either inward or outward.

3 Turn the telescope through 90° to its previous position

4 Turn the third foot screw inward or outward and bring the bubble of the spirit level on the telescope to the centre of its run.

5 Repeat the step 2 and step 4 several times so that the bubble remains in the centre in all positions of the telescope.

Fig 2



LEVELLING UP WITH THREE FOOTSCREWS

SUN2351H2

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TASK 4: **Elimination of parallax**

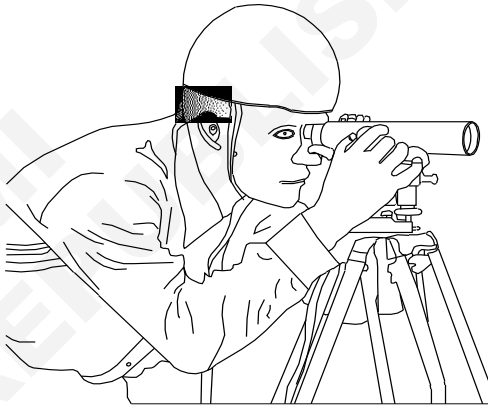
i) Focusing of the eye-piece

- Remove the lid of the telescope.
- Direct the telescope towards the sky or towards a white paper
- Looking through the telescope, turn the eye-piece inward or outward till clear image of cross wires is obtained.

ii) Focusing of the object glass (Fig 3)

- Direct the telescope towards the levelling staff
- Turn the focusing screw inward or outward till clear image of the levelling staff is seen
- Check for the parallax by moving the eye up or down.

Fig 3



FOCUSSING THE OBJECT

SUN2351H3

Permanent adjustment of levelling

Objectives: At the end of this exercise you shall be able to
- **perform the permanent adjustments of a dumpy level**
- **perform the permanent adjustments of a tilting level.**

Perform the permanent adjustments of a dumpy level

There are two permanent adjustments of a dumpy level.

1 To make the axis of the bubble tube perpendicular to the vertical axis.

2 To make the line of collimation parallel to the axis of the bubble tube.

First adjustment

1 To make the axis of bubble tube perpendicular to the vertical axis.

2 Set up the level on a firm ground and level it by giving temporary adjustments.

3 Bring the telescope through 180° in the horizontal plane.

4 Check the bubble whether it remains central or not.

5 If the bubble does not remain central, note down the deviations of the bubble from the centre.

6 If the bubble deviated by say '2n' divisions, half of the deviations corrected by raising or lowering the end of the bubble tube by means of capstan headed nuts.

7 Correct the remaining half of divisions by using a pair of foot screws.

8 Turn the telescope through 90° so that it lies over the single foot screw below the telescope and bring the bubble in the centre of its run by means of this screw.

9 Rotate the telescope and see if the bubble remains central for all positions of the telescope.

10 Repeat the same procedure until the adjustment is correct.

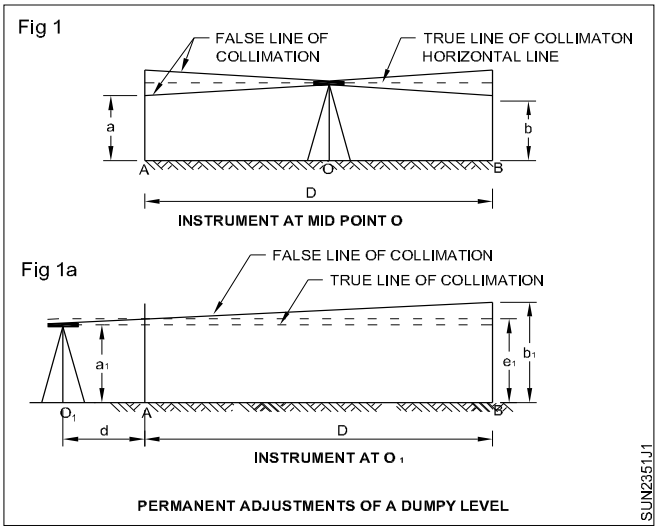
Second adjustment

To make the line of collimation parallel to the axis of bubble tube.

1 This adjustment is done by two peg method.

Test

2 In Fig 1, drive two pegs A and B at a distance of D metres on a fairly level ground.



PERMANENT ADJUSTMENTS OF A DUMPY LEVEL

3 Drive another peg at O exactly in the midway between A and B.

4 Set up and level the instrument at O and take the staff readings on A and B.

Always the bubble must be in central while taking readings.

5 Let the staff readings on A and B 'a' and 'b' respectively.

6 In fig 1a, shift the level and set it up a point O_1,'d' metres away from A along the same line BA.

7 While bubble in central, take the staff readings at A and B.

8 Let the readings be 'a_1' and 'b_1' respectively.

9 Find the difference between the staff readings 'a' and 'b' and that between the staff readings 'a_1' and 'b_1'.

10 The difference of staff readings a and b which gives the true difference in elevation between A and B as the instrument was set up exactly midway between them. Whereas staff reading of a_1 and b_1 gives the apparent difference.

11 If the two differences are equal the line of collimation is in adjustment.

12 If not the line of collimation is inclined and it needs adjustment.

Adjustments

13 Find, whether the difference is a rise or a fall from the peg A to B.

14 If the reading 'a' is greater than 'b', the peg A is lower than peg B and the ground is rising from A to B.

15 If the reading 'b' is greater than 'a', the ground is falling from A to B.

16 Find the reading on the far peg B, at the same level as of 'a_1' by adding the true difference to a_1 if it is fall, (or) by subtracting the true difference from a_1 if it is a rise. Let the reading be 'b_2'.

(i.e.) $b_2 = a1 \pm$ true difference (+ sign for fall, - sign for rise)

17 Find the difference between the readings 'b_1' and 'b_2'.

If 'b_1' is greater than 'b_2' the line of collimation inclined upwards and if b_1 is smaller than b_2 the line of collimation is inclined downwards (i.e.,) b_1-b_2 and this is the collimation error to the distance of 'D'.

Find the collimation error per unit distance = b1-b2/D

18 Find the corrections to be applied for the readings taken on the pegs A and B as per the following formula.

Correction to the reading on the near peg A

$$= C_n = \frac{d}{D}(b_1 - b_2)$$

Correction to the reading on the far peg B

$$= C_f = \frac{d+D}{D}(d_1 - b_2)$$

19 Add the corrections if the line of collimation is inclined downwards and subtract if the line of collimation inclined upwards.

The correct reading on the near peg A = $a_1 \pm c_n$.

The correct reading on the far peg B = $b_1 \pm c_f$

The difference between the corrected readings will be equal to the true difference of level.

Practice in staff reading

Objectives: At the end of this exercise you shall be able to
- **observe and enter readings in field book**
- **reduce the levels in two methods.**

Requirements

Tools/Equipments/Instruments

- Dumpy level with tripod - 1 No.
- Levelling staff - 1 No.

Materials

- Levelling field book - 1 No.

PROCEDURE

TASK 1: **Observe and enter readings in field book**

1 Setup and level the instrument position at 'O' which is visible and approximately equal distance to all station. (Fig 1)

2 Direct the telescope towards the staff held vertically on BM and focus it carefully to obtain clear graduations.

3 Take the reading (X) and enter Back sight in a field book.

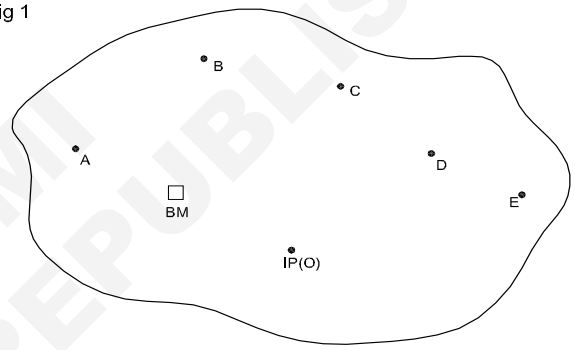
4 Send the staff man to the station A

5 Direct the telescope towards the station A, focus it with again take the inter sight reading (say X1) and enter in a field book.

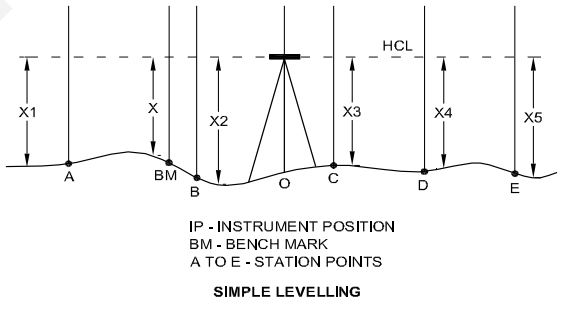
6 Send the staff man to all stations B,C,D direct the telescope towards the above stations take all the inter sight reading and enter the in a field book (say X2, X3 and X4)

7 Send the staff man to the station E and take the fore sight reading (say X5) and enter in a field book.

Fig 1



PLAN SHOWING THE INSTRUMENT POSITION AND STATION POINTS



IP - INSTRUMENT POSITION
BM - BENCH MARK
A TO E - STATION POINTS

SIMPLE LEVELLING

SUN2352H1

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TASK 2: **Reduce the levels in two methods**

1 Reduce the levels to all the stations by either

i Height of collimation method (or)

ii Rise and Fall method.

2 Apply usual arithmetical check.

a The specimen page of a level book illustrating the method of booking staff readings and calculating RL of stations by Height of collimation method is shown under.

Height of collimation = R.L of BM + Back sight Reading (X)

Reduced level at A = HCL - Reading at A (x1)

Reduced level at B = HCL - Reading at A (x2)

Reduced level at C = HCL - Reading at A (x3)

Reduced level at D = HCL - Reading at A (x4)

Reduced level at E = HCL - Reading at A (x5)

Back sight	Inter sight	Fore sight	HC	Reduced Levels	Remarks
X	X1				Reading taken on BM
	X2				- do - at A
	X3				- do - at B
	X4				- do- at C
		X5			-do- at D
					- do - at E

Arithmetical check

$\sum$ Back sight - $\sum$ Fore sight = Last RL - First RL

b The specimen page of a level book illustrating method of booking staff readings and calculating R.Ls of stations by the rise and fall method is shown under.

Back sight	Inter sight	Fore sight	Rise	Fall	Reduced Levels	Remarks
X	X1					Reading taken on BM
	X2					- do - at A
	X3					- do - at B
	X4					- do- at C
		X5				-do- at D
						- do - at E

If x-x1 is +ve, enter the difference in Rise column. If it is -ve, enter the difference in Fall column.

Similarly x1-x2, x2-x3, x3-x4, x4-x5 is +ve enter the difference in Rise column. If it is -ve, enter the difference in Fall column.

If the R.L of the BM is known, then R.L of the stations A, B, C, D and E may be obtained by adding its respective rise or subtracting its respective fall from the R.L of proceeding point.

Arithmeticl check

$\sum$ B.S - $\sum$ F.S = $\sum$ Rise - $\sum$ Fall = Last RL - First RL

Practice in Simple levelling

Objectives: At the end of this exercise you shall be able to
- **measure the level difference between the points A and B**
- **determine the reduced level of one point with reference to the other.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic levelling staff - 1 No.

Materials

- Levelling field book, pen - 1 No.

PROCEDURE

1 Select two station points A and B on a firm ground

2 Set up and level the instrument approximately at midpoint O. (Fig 1)

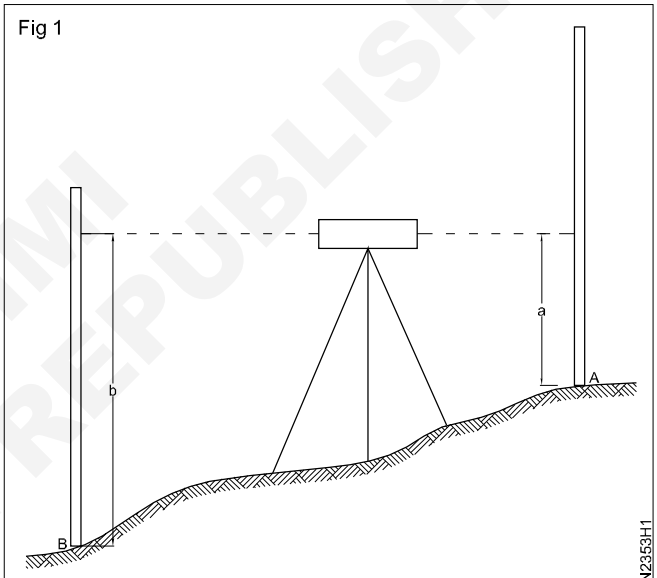
3 Take staff readings on A and B, let the readings be a and b respectively.

4 The level difference between A and B is equal to the difference of the staff readings observed at station A and station B

ie., level difference = b - a (if b > a)

5 If the reduced level of A is known, the reduced level of B = reduced level of A - level difference

Fig 1



SIMPLE LEVELLING

Practice Differential levelling (fly levelling)

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

- **determine the level difference between two points A and B, when it is not possible to see both stations from a single set up.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic levelling staff - 1 No.
- Hammer - 1 No.
- Peg - 4 Nos.

Materials

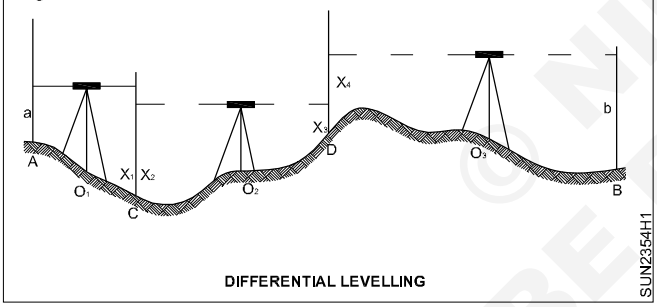
- Level field book, pencil, eraser - 1 No.

PROCEDURE

Let A and B be the two points whose level difference is to be determined, which are far away from each other.

a Set up and level the instrument at O_1. (Fig 1)

Fig 1



DIFFERENTIAL LEVELLING

b Take staff readings on stations A and C. Enter the readings on field book as 'a' and 'X_1' respectively.

c Shift and place the instrument on O_2. Carry out temporary adjustments. Then take staff readings on C and D. Note it on the field book as X_2 and X_3.

d Repeat the process until a foresight reading (b) is taken on station B.

e Level difference between A and B = å BS - å FS

$= (a+X_2+X_4) - (X_1+X_3+b)$

f Reduced level of B = reduced level of A ± $[(a+X_2+X_4) - (X_1+X_3+b)]$

BS	IS	FS	HI	RL	Remarks
a					Station A
X_2		X_1			Station C
X_4		X_3			Station D
		b			Station B

Practice in Reciprocal levelling

Objectives: At the end of this exercise you shall be able to
- **determine the true level difference between two points A and B**
- **determine the total error due to curvature, refracture, refraction and faulty line of collimation.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic levelling staff - 1 No.
- Peg - 2 Nos.
- Hammer - 1 No.
- Level field book, pencil, eraser - 1 No.

PROCEDURE

1 Set up and level the instrument very near to A.

2 Take the staff readings at A and B and let them be a_1 and b_1 respectively. (Fig 1)

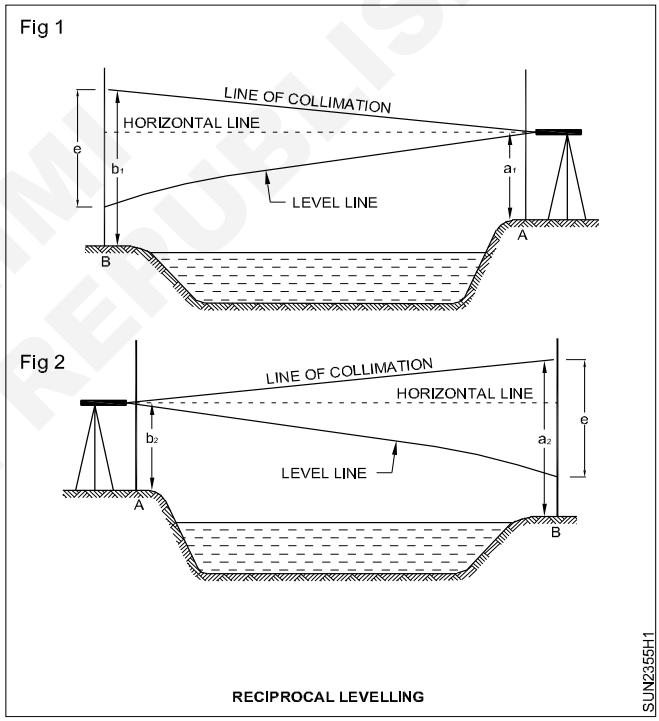
3 Shift the instrument to B and set up and level it very near to B.

4 Take the staff readings at A and B and let them be a2 and b2 respectively (Fig 2). Assume that the staff reading taken at station A is greater than that at B.

True level difference = $d = \left[\frac{(a_1 - b_1) + (a_2 - b_2)}{2}\right]$

Total error = $e = \left[\frac{(a_1 - b_1) - (a_2 - b_2)}{2}\right]$

Fig 1



RECIPROCAL LEVELLING

Carryout levelling field book

Objectives: At the end of this exercise you shall be able to
- **hold the levelling staff at a station**
- **read the levelling staff**
- **record the level field book.**

Requirements

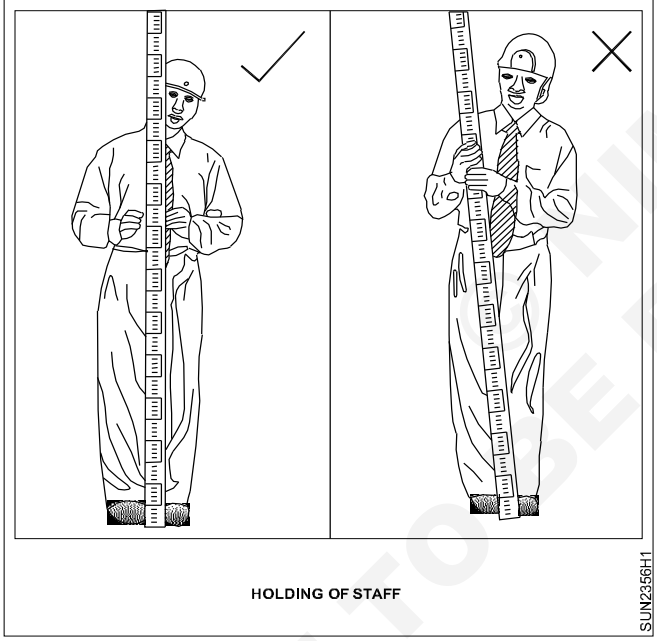
Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic levelling staff - 1 No.
- Level field book, pen - 1 No.

PROCEDURE

TASK 1: **Holding of staff** (Fig 1)

Fig 1



- Stretch the staff to its full length.
- Place the bottom of the staff between the toes.
- Hold the staff between the palms of the hands at the height of the face.

TASK 2: **Reading the levelling staff**

1 Set up and level the dumpy level at a suitable position.

2 Hold the staff vertically at staff station.

3 Direct the telescope towards the levelling staff and focus the telescope.

4 Check the verticality of the staff with the vertical hair and adjust it with the use of hand signals. (Fig 2)

5 Check the position of the bubble. If it is not at the centre, bring it to the centre of its run using the foot screw beneath or nearer to telescope.

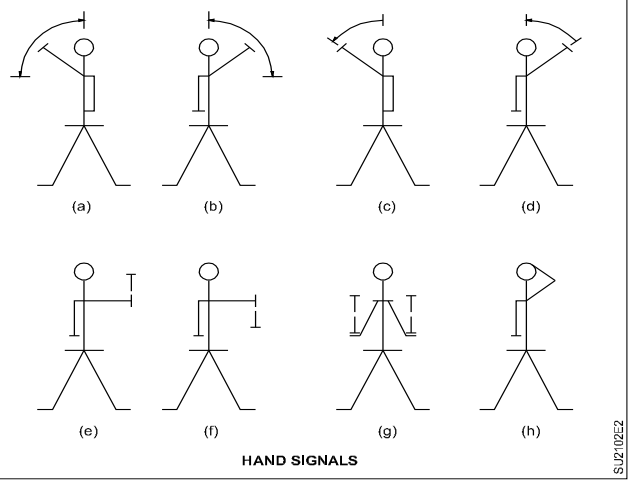
6 Note the reading against the horizontal hair appears to cut the staff.

7 First note the red figure denoting the metre numeral on the left of the staff.

8 Secondly note the black figure denoting the minimum decimeter reading.

9 Finally count the number of black and white strips graduated to read the centimeters and millimeters, where the horizontal cross hair cuts the staff.

Fig 2



HAND SIGNALS

The graduations are marked erect in the staff, and therefore, while looking through the telescope the staff is seen as inverted. Hence the staff should be read from top to bottom.

Signal	Message
Movement of the left arm over 90°	Move to my left
Movement of the right arm over 90°	Move to my right
Movement of the left arm over 30°	Move top of staff to my left
Movement of the right arm over 30°	Move top of staff to my right
Extension of arm horizontally and moving hand upwards	Raise height of peg or staff
Extension of arm horizontally and moving hand downwards	Lower height of peg or staff
Extension of both arms and slightly thrusting downwards	Establish the position
Extension of arms and placement of hand on top of head	Return to me

TASK 3 : **Recording Field Book**

If the observations X1, X2, X3, X4, and X5 were taken from a single set up of level, the readings may be recorded as follows.

Each row represents a station point. The first staff reading is taken to a point of known elevation and it is known as back sight (X1). It is entered in the BS column in the first row. The last staff reading is taken on a point of unknown elevation (X5). It is entered in the FS column. The sights in between BS and FS are called intermediate sights (IS) i.e. X2, X3, X4. They are entered in the IS column.

Check: ∑BS - ∑FS = Last RL - First RL

1 Height of collimation method

BS	IS	FS	HI	RL	Remarks
X_1			$HI_1 = R_1 + X_1$	RL	BM
	X_2			$HI_1 - X_2$	Station A
	X_3			$HI_1 - X_3$	Station B
	X_4			$HI_1 - X_4$	Station C
		X_5		$HI_1 - X_5$	Station D

2 Rise and Fall Method

BS	IS	FS	Rise	Fall	RL	Remarks
X_1					RL	BM
	X_2					Station A
	X_3					Station B
	X_4					Station C
		X_5				Station D

Check: (∑ BS -∑ FS)=(∑RISE - ∑ FAll) = (Last RL - First RL)

Equate reduction of level (Rise and fall method and height of collimation method) comparison of method

Objectives: At the end of this exercise you shall be able to
- **select an instrument position for the successive setup of instrument for finding reduced levels**
- **determine the RLs of all the given points.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Levelling staff - 1 No.

Materials

- Levelling field book - 1 No.

PROCEDURE

1 Select and setup the instrument at position O1. (Fig 1)

2 Direct the telescope towards levelling staff held vertically on BM (A) and focus it carefully and take the reading (say 0.535) and enter back sight in a field book.

3 Send the staff man to the station B, C and D and take inter sight readings 2.145, 2.435, 1.585 and enter in the field book.

4 Send the staff man to the station E, (as a change point 1) direct the telescope and take the readings 0.630 and enter fore sight in the field book.

5 Select, shift and setup the instrument position at O2.

6 With the bubble central, take the back sight reading on the staff, held vertically at E again 1.535 and enter in the field book.

7 Similarly direct the telescope towards the station F take readings 2.015 enter inter sight in the field book.

8 Send the staff man to the station G (as a charge point 2) direct the telescope and take readings 3.510 and enter fore sight in a field book.

9 Select shift and setup the instrument at position O3 take staff readings 3.340 at station G enter back sight in the field book.

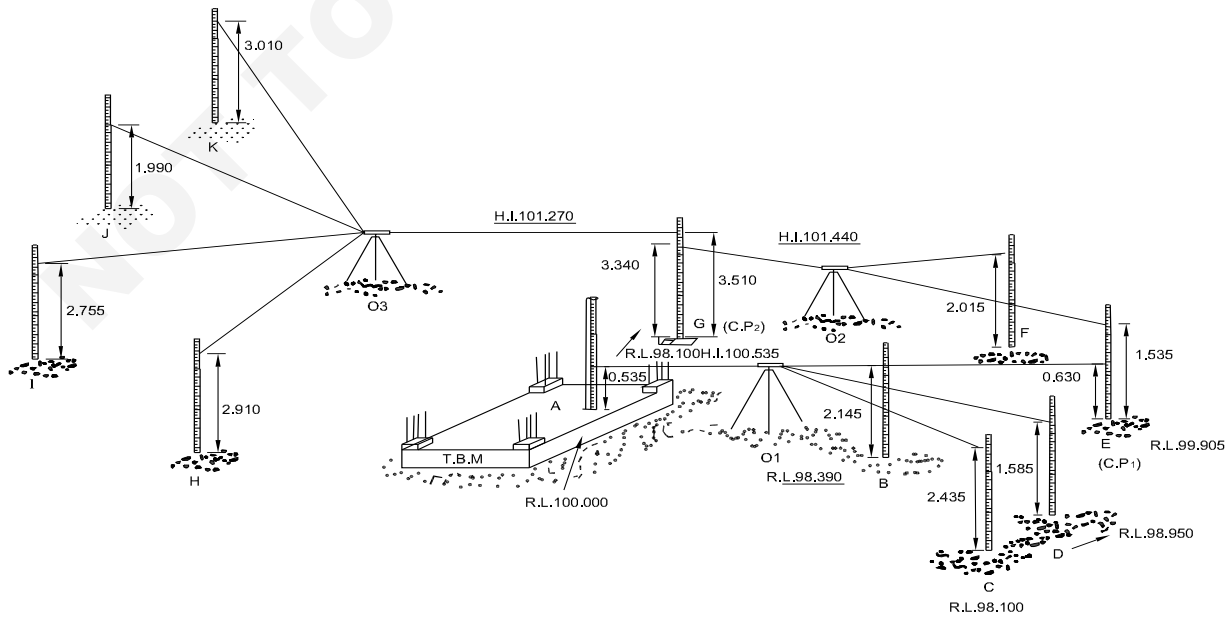
10 Similarly take staff man readings at station H, I and J enter the inter sight readings 2.910, 2.755, 1.990 in the field book.

11 Send the levelling staff man at last station 'k' take fore sight reading 3.010 enter in the field book.

12 Reduce the levels by any one method.

13 Apply arithmetical check.

Fig 1



OBTAINING R.L. BY COLLIMATION METHOD

SUN2357H1

Height of collimation method

Back sight	Inter sight	Fore sight	HC	Reduced Levels	Remarks
0.535			100.535	100.000	Reading at B.M at A
	2.145			98.390	Reading at station B
	2.435			98.100	-do- at C
	1.585			98.950	-do - at D
1.535		0.630	101.440	99.905	-do- at E
	2.015			99.425	-do-at F
3.340		3.510	101.270	97.930	-do- at G
	2.910			98.360	-do- at H
	2.755			98.515	-do- at I
	1.990			99.280	-do- at J
		3.010		98.260	-do- at K
5.410		7.150			

Arithmetical check: $\sum$ B.S - $\sum$ F.S = Last R.L - First R.L

5.410 - 7.150 = 98.260 - 100.00 (-) 1.740 = (-) 1.740

Rise and Fall Method

Station	Reading			Rise	Fall	RL	Remarks
	BS	IS	FS				
01	0.535					100.000	Reading at BM at A
		2.145			1.610	98.390	Reading at station B
		2.435			0.290	98.100	- do - at C
		1.585		0.850		98.950	- do - at D
02	1.535		0.630	0.955		99.905	- do - at E
		2.015			0.480	99.425	- do - at F
03	3.340		3.510		1.495	97.930	- do - at G
		2.910		0.430		98.360	- do - at H
		2.755		0.155		98.515	- do - at I
		1.990		0.765		99.280	- do - at J
			3.010		1.020	98.260	- do - at k
Total	5.410		7.150	3.155	4.895		

Arithmetical check

$\sum$ B.S - $\sum$ F.S = $\sum$ Rise - $\sum$ Fall = Last R.L - First R.L - 1.740 = - 1.740 = - 1.740

5.410 - 7.150 = 3.155 - 4.895 = 98.260 - 100.000

Solve problems on reduction of levels (R L)

Objective: At the end of this exercise you shall be able to
- **compute the reduced levels of points and gradients of lines on sloping ground.**

Problem in differential levelling

Example

Following consecutive readings were taken on points 1 to 7 along a line

0.785, 1.326, 2.538, 3.435, 1.367, 2.328, 1.234, 1.657

The instrument was shifted after the fourth reading and the first reading was taken on BM with RL = 100,00. rule out a page of level book and work out the RL of all points by collimation method and rise and fall method.

Solution for the above problem in height of collimation method

Station	Readings			Height of line of collimation	RL	Remarks
	B.S	I.S	F.S			
1	0.785			100.785	100.00	BM
2		1.326			99.459	RL= 100
3		2.538			98.247	
4	1.367		3.435	98.717	97.350	
5		2.328			96.389	
6		1.234			97.483	
7			1.657		97.060	
Total	2.152		5.092			

H.I = R.L + B.S = 100.00 + 0.785 = 100.785

R.L = H.I - I.S/F.S = 100.785 - 1.367 = 99.459

Arithmetical Check

Σ B.S - Σ F.S = 2.152 – 5.092 = - 2.940

Last R.L - First R.L = 97.060 - 100.00 = - 2.940 Ans.

Solution for the above problem in Rise and fall method.

Station	Readings			Rise	Fall	RL	Remarks
	BS	IS	FS				
1	0.785					100.00	BM
2		1.326			0.541	99.459	RL = 100
3		2.538			1.212	98.247	
4	1.367		3.435		0.897	97.350	CP
5		2.328			0.961	96.389	
6		1.234		1.094		97.483	
7			1.657		0.423	97.060	
Total	2.152		5.092	1.094	4.034		

Arithmetical check

Σ B.S - Σ F.S = 2.152 – 5.092 = - 2.940

Σ Rise - Σ Fall = 1.094 - 4.034 **=** - 2.940

Last R.L - First R.L = 97.060 - 100.00 = - 2.940 Ans.

Exercise 1

Following staff readings were taken with a level. The instrument having been shifted after the fourth. Seventh and tenth readings. R.L of the starting BM is 150.00m. Enter the readings in the level book page and reduce the level by the collimation method and apply the usual checks.

1.420, 0.650, 3.740, 3.830, 0.830, 2.270, 4.640, 0.960, 1.640, 2.840, 4.680 and 4.980.

Practice levelling with (auto/digital level)

Objectives: At the end of this exercise you shall be able to
- **method of setting up on automatic level**
- **reading the staff**
- **laser level.**

Requirements

Tools/Instruments

- Auto level with tripod - 1 No.
- Levelling staff - 1 No.

Materials

- Level field book, pencil, eraser - 1 No each.

PROCEDURE

- Method of setting up on automatic level.
- Set up the tripod at just above chest height.
- make it stable
- Mount the level on the top.
- Adjust the levelling screws until the bubble is central
- The automatic compensators are able to finely level the instrument
- Sight towards the staff using the given sight
- Look through the eyepiece and focus.
- Turn the focusing knob to focus on the staff
- Turn the fine motion screw to centre the staff in the field view.
- Turn the focusing knob to eliminate parallax between the staff.

Reading the staff

- Take the number shown below the reticle
- Count the number while 10mm increments between the whole number and the reticle
- Estimate the number of mm between the last whole 10 mm block and the centre of the reticle.
- Holding the staff as straight as possible.
- When viewing the staff, the reading will vary between a high and low point.
- The correct reading is the lowest valve.

Laser level

- Laser level is visible and detectable by a sensor on levelling rod
- The sensor can be mounted on earth moving machinery to allow automated grading's.

Practice profile levelling or longitudinal and cross section levelling - plotting profile

Objectives: At the end of this exercise you shall be able to
- **prepare the working profile of the route having gradient 1 in 50**
- **prepare the cross sections at chain ages 'O' and 200.**

Requirements

Tools/Instruments

- T- Square - 1 No.
- Scale set - 1 No.

Materials

- Level field book, pencil, eraser - 1 No each.
- Drawing sheet - A2 size - 1 No.
- Colour pencil / pen - 1 set

PROCEDURE

1 Calculate the levels according to 1 in 50 from chain age 10 to chain age 200. With reduced level at '0' chainage 680.00

2 Follow the steps 1 to 11 of Exercise No 2.3.51 (parmanent adjustment)

Chain age	Ground Level	Formation Level	Depth of Cutting	Height of Filling
0	680.245	680.00	0.245	
10	680.335	680.5		0.165
20	680.395	680.30	0.090	
30	680.525	680.45	0.075	
40	680.665	680.60	0.065	
50	680.775	680.75	0.025	
60	680.965	680.90	0.065	
70	681.210	681.05	0.160	
80	681.370	681.20	0.170	
90	681.645	681.35	0.295	
100	681.840	681.50	0.340	
110	681.930	681.65	0.280	
120	682.015	681.80	0.215	
130	682.115	681.95	0.165	
140	682.240	682.10	0.140	
150	682.345	682.25	0.095	
160	682.400	682.40	0.000	
170	682.520	682.55		0.03
180	682.640	682.70		0.06
190	682.730	682.85		0.12
200	682.825	683.00		0.175

3 Mark a point at 680.000 at ... on Y- Axis

4 Similarly scale of other formation levels on respective chain age points.

5 Join these points with straight line to get the formation line.

6 Draw the formation line with red ink.

TASK 2: **Preparation of cross section at chain age '0' m and chainage 200m**

1 Calculate the formation level for cross section at chainage '0' and chain age '200'

2 Follow the steps 1 to 11 of exercise No 1.8.48

3 Mark levels of the respective distances on each cross section.

4 Join all these points with a straight line.

5 Use black colour for the natural surface line and red colour for formation line.

Fig 1

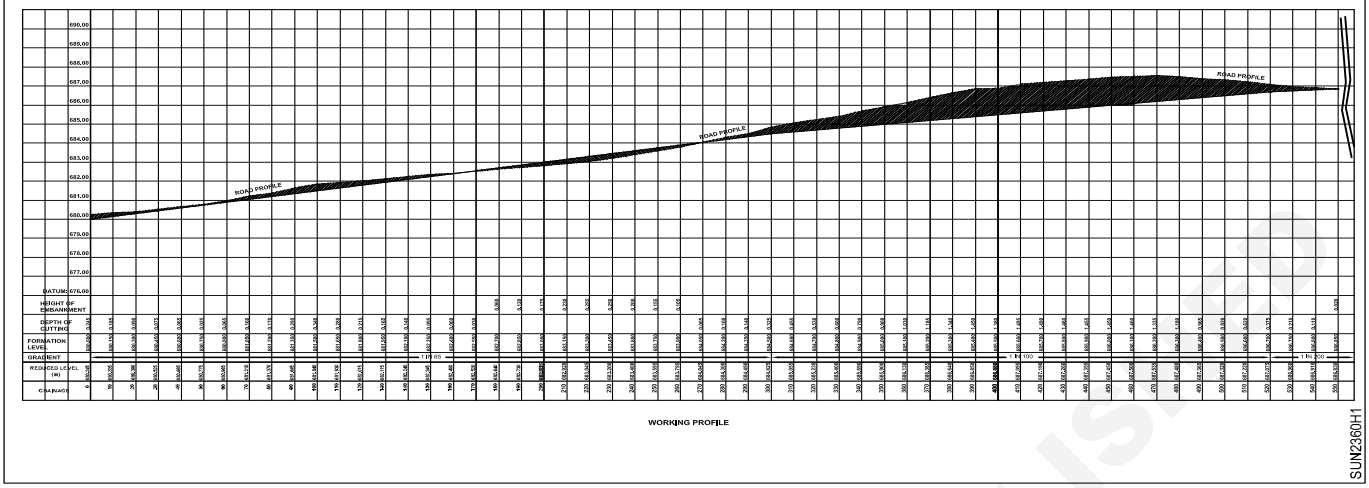


Fig 2

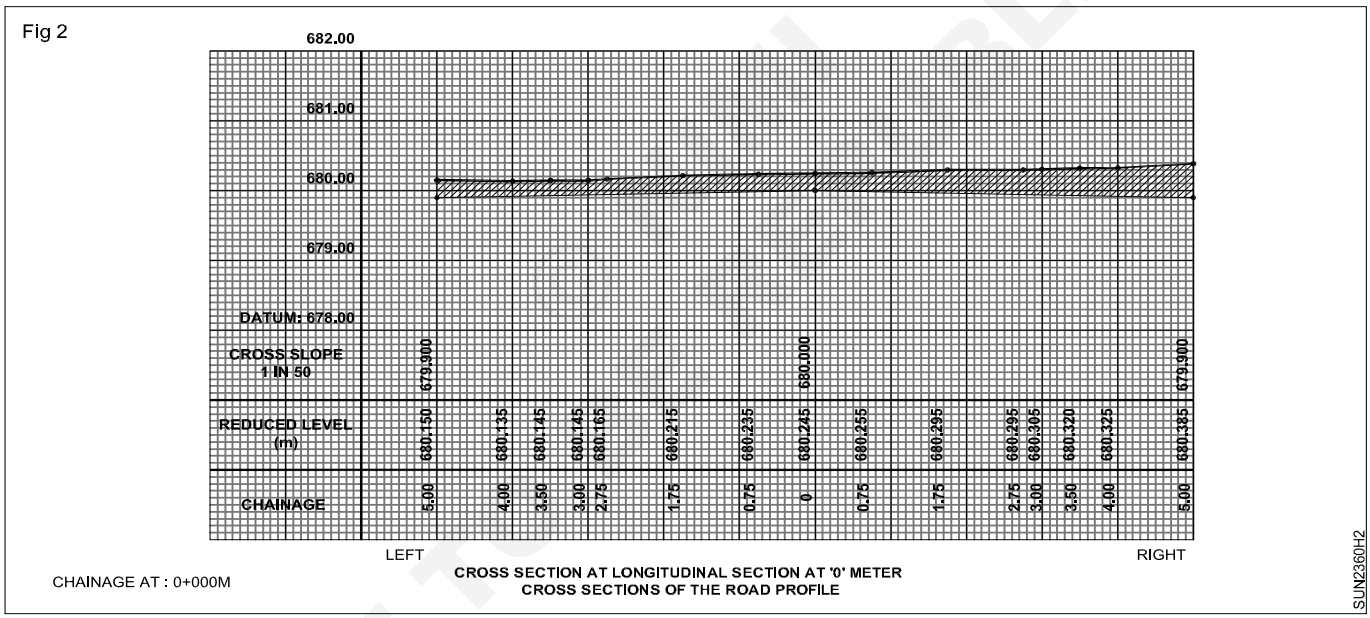
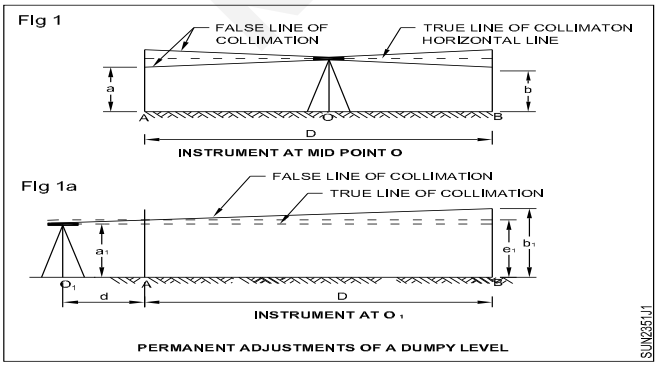


Fig 1



Check levelling

Objectives: At the end of this exercise you shall be able to
- **select on instrument position for the successive get up instrument**
- **find the reduced levels of all the given point**
- **calculate R.L by height of collimation method**
- **check the readings for accuracy.**

Requirements

Tools / Instruments

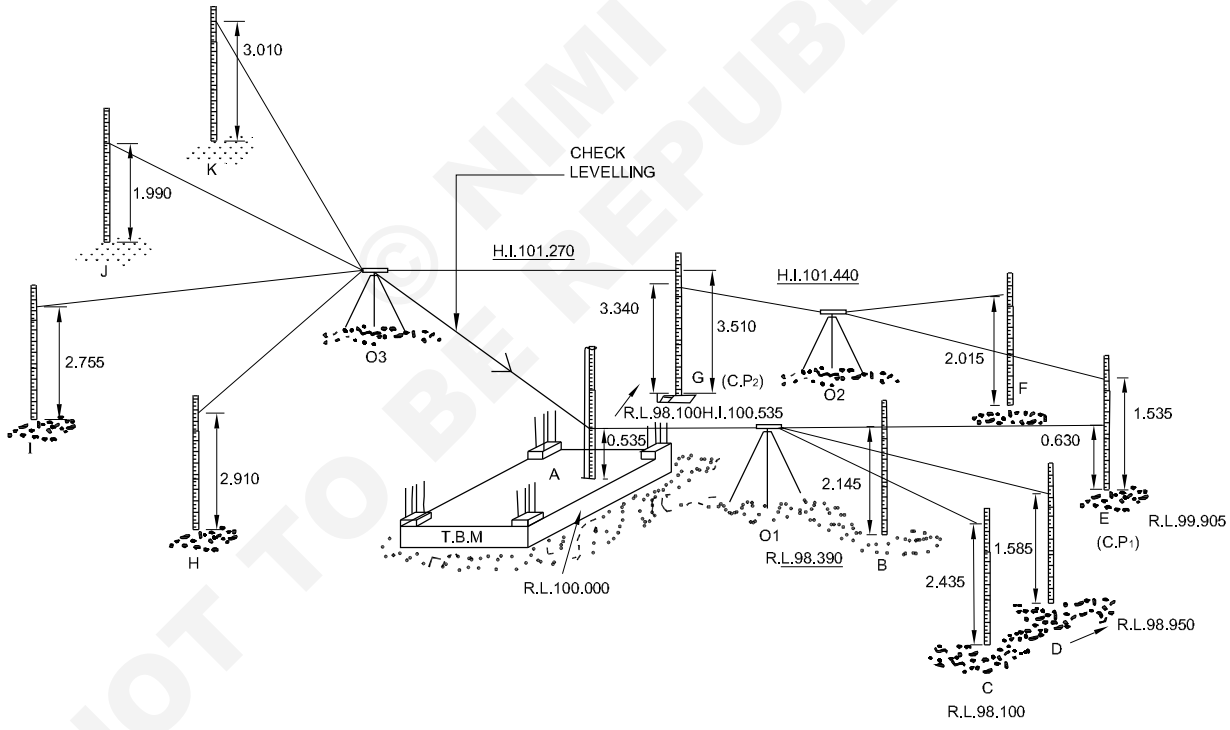
- Auto level with tripod - 1 No.
- Levelling staff - 1 No.

Materials

- Levelling field note book - 1 No each.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

Fig 1



OBTAINING R.L. BY COLLIMATION METHOD

1 Select and setup the instrument at position O1.

2 Direct the telescope towards levelling staff held vertically on BM (A) and focus it carefully and take the reading (say 0.535) and enter Back sight in a field book.

3 Send the staff to the station B,C and D and take inter sight readings 2.145, 2.435, 1,585 and enter in the field book.

4 Send the staff man to the station E, (as a change point 1) direct the telescope and take the readings 0.630 and enter fore sight in the field book.

5 Select, shift and setup the instrument position at O2.

6 With the bubble central, take the back sight reading on the staff, held vertically at E again 1.535 and enter in the field book.

7 Similarly direct the telescope towards the station F take readings 2.015 enter inter sight in the field book.

8 Send the staff to the station G (as a charge point 2) direct the telescope and take readings 3.510 and enter fore sight in a field book.

9 Select shift and setup the instrument at position O3 take staff readings 3.340 at station G enter back sight in the field book.

10 Similarly take staff readings at station H, I and J enter the intersight readings 2.910, 2.755,1.990 in the field book.

11 Send the levelling staff at last station 'k' take fore sight reading 3.010 enter in the field book.

12 Finally due to the closing hours, we have to close the levelling work at the day.

13 So, send the staff man to the beginning station at 'A' take the reading as same the fore sight. (1.740)

At the closing point, if the reading is coinciding with the 'RL' of the Ist reading, then the levelling for the day is correct. Check levelling is completed.

Height of collimation method

Back sight	Inter sight	Fore sight	HC	Reduced Levels	Remarks
0.535			100.535	100.000	Reading at B.M at A
	2.145			98.930	Reading at station B
	2.435			98.100	- do - at C
	1.585			98.950	- do 0 at D
1.535		0.630	101.440	99.905	- do - at E
	2.015			99.425	- do - at F
3.340		3.510	101.270	97.930	- do - at G
	2.910			98.360	- do - at H
	2.755			98.515	- do - at I
	1.990			99.280	- do - at M.J
		3.010		98.260	- do - at K
Total = 5.410		7.150			

A.C : Σ B. S – Σ F.S = Last R.L - First R. L

5.410 - 7.150 = 98.260 - 100.00

(-) 1.740 = (-) 1.740

Road Project: Reconnaissance Survey

Objectives: At the end of this exercise you shall be able to
- **conduct map study**
- **conduct reconnaissance survey.**

Requirements

Tools / Instruments

- Prismatic compass with tripod
- Plane table with all accessories
- Levels with levelling staff
- Theodolites
- Tapes

Materials

- Drawing sheets
- Pencils
- Eraser.

TASK 1: **Map study**

1 Mark the various possible routes on the map connecting the terminal points observing the criteria of route selection.

2 Study well various routes by conducting reconnaissance survey.

— — — — — — — —

TASK 2: **Reconnaissance survey**

1 Measure the magnetic bearing of the lines of the alignment by a prismatic compass and note in the field book.

2 Measure the distances along the alignment approximately by pacing.

3 Note the objects and nature of the ground on both sides of the alignment up to 50 m on the field book.

4 Avoid obstacles like religions places or valuable structure if any while fixing alignment.

5 Avoid crossing the alignment obliquely over the river by diverting the alignment suitably.

6 Note all other important points like the railway crossing, canal crossing, etc.

7 Collect the HFL (High Flood Level) ever attained and the discharge records for the last few yeas from the appropriate authorities to design the culverts and bridges.

8 Prepare preliminary records of properties eligible for compensation.

— — — — — — — —

Road Project: Preliminary Survey

Objective: At the end of this exercise you shall be able to
• conduct preliminary survey.

Requirements

Tools / Instruments

- Prismatic compass with tripod
- Plane table with all accessories
- Levels with levelling staff
- Theodolites
- Tapes

Materials

- Drawing sheets
- Pencils
- Eraser.

TASK 1: **Preliminary survey**

1 After fixing suitable alignment construct a pillar at the staring point of the alignment of the road which is already fixed by reconnaissance survey.

2 Consider by fly level to connect the nearby GTS bench mark with the starting point of the road project.

3 Conduct a prismatic compass survey or plane table survey to prepare route survey map covering about 50M on both sides of the alignment.

4 Conduct a longitudinal map levelling along the alignment at regular interval (say 20 or 40 m).

5 Take cross sections at regular intervals (say 100 m).

6 Establish permanent bench marks at suitable places along the alignment for future reference.

7 Take cross sections of the rivers, etc., accurately.

8 Prepare the following drawings:

a Route survey map

b Longitudinal map section with formation levels

c Cross sections with formation width and side slope

d Contour map of the strip of land along alignment

e Design of curves with setting out tables.

F Mass diagram for the earthwork.

Road Project : Final location Survey

Objectives: At the end of this exercise you shall be able to
- **conduct final location survey**
- **preparing construction survey.**

Requirements

Tools / Instruments

- Prismatic compass with tripod
- Plane table with all accessories
- Levels with levelling staff
- Theodolites
- Tapes

Materials

- Drawing sheets
- Pencils
- Eraser

TASK 1: **Final location survey**

1 Fix the centre line of the road after selecting the most economical alignment by set out pegs or pillars at intervals of 30m.

2 Mark the total land width required by pillars at regulars intervals (say 30 m)

3 Mark tangent points and intersection points of the curves by pillars.

— — — — — — — —

TASK 2: **Construction survey**

1 After location survey retrace the centre line shown on the plan and referencing centering points on the curve.

2 Check bench marks, running centre line levels over the retraced lines.

3 Take elevations at all stations, at all breaks on the ground and at other points where it is necessary to take cross section for volume.

4 Set slope stakes and grade stakes.

5 Set stakes for complete layout of culverts and bridges.

6 Set out curves.

7 Report and make advantageous changes, if any in line grade or minor adjustment of the drainage structure.

8 Reset the stakes that have been destroyed as the progresses.

— — — — — — — —

Profile of longitudinal and levelling and plotting

Objective: At the end of this exercise you shall be able to
- **determine the reduced levels of points at known distances along the given routs.**

Requirements

Tools/Equipments/Instruments

- Dumpy level with tripod
- Telescopic levelling staff
- Pegs, hammer
- Set Squares, T- Square, Scale set

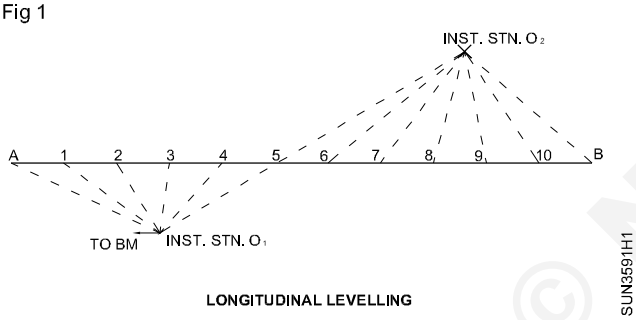
Materials

- Levelling field book, pencil, eraser
- Drawing sheet - A2 size
- Colour pencil / pen- 1 set

PROCEDURE

1 Mark the end points of the centre line AB with ranging rods. (Fig 1)

Fig 1



LONGITUDINAL LEVELLING

2 Measure the direction of the line using prismatic compass.

3 Measure the length of the line AB using tape and erect pegs at an interval of 200 m along the line AB. Also erect pegs at the points where the ground level changes abruptly.

4 Set up and level the instrument at a suitable point '0_1' from where maximum number of observations is possible.

5 Take a BS reading on the bench mark and intermediate sights on the longitudinal section points.

6 Also take a foresight reading on a suitable change point on account of the length of sight being beyond the power of the telescope.

7 Shift the instrument to a suitable position and carry out the temporary adjustments.

8 Take a BS reading on the change point and continue the process until the last point is reached.

9 Record the readings in the respective columns as soon as they are taken, in the following tabular form.

10 Calculate the reduced levels of the points by height of instrument method.

Note: Work should always commence from a bench mark and should end on a bench mark.

Station	Chain age	Bearing		BS	IS	FS	HI	RL	Remarks
		FB	BB						

Plotting of longitudinal section

Objective: At the end of this exercise you shall be able to
- **prepare the longitudinal section of the route.**

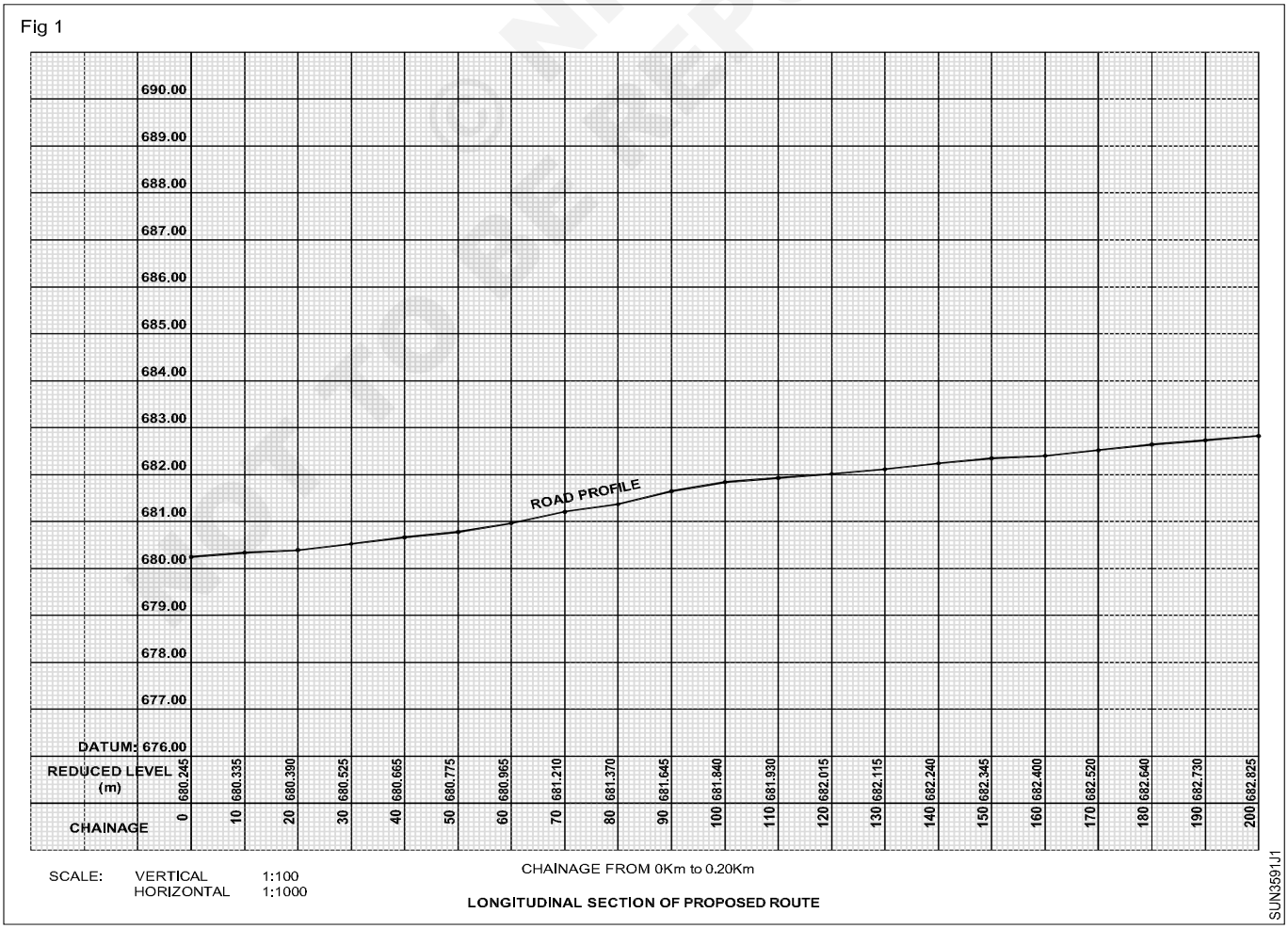
1 Read and interpret the chain ages and levels of the route.

Chainage	Ground level
0	680.245
1	680.335
20	680.395
30	680.525
40	680.665
50	680.775
60	680.965
70	681.210
80	681.370
90	681.645
100	681.840
110	681.930
120	682.015
130	682.115
140	682.240
150	682.345
160	682.400
170	682.520
180	682.640
190	682.730
200	682.825

2 Select a suitable horizontal scale (1:1000) and a vertical scale (1:100) (Fig 1)

3 Draw a horizontal line of length 20cm, equal to the length of the section line.

Fig 1



4 Mark the longitudinal section points on this line and also note the chain ages of these points.

5 Note the reduced levels of the ground points against the respective chain age points.

6 Draw another horizontal line parallel and equal to the first, keeping a vertical distance of 2 cm, representing the datum line.

7 Choose a suitable datum level 676.000

(Datum level should be selected in such a way that the length of the ordinate should be between 4 cm to 15 cm)

8 Mark the longitudinal section points on the datum line.

9 Draw vertical lines through these points.

10 Scale off the ground level and mark the ground levels on the respective lines.

11 Join these points by straight lines to get the outline of the ground surface.

Note: The datum line and ground line are drawn in black and the perpendicular lines in thin blue lines.

Cross sectioning

Objective: At the end of this exercise you shall be able to
- **determine the reduced levels of points along the transverse direction.**

1 Mark the end point of the centre line AB with ranging rods.

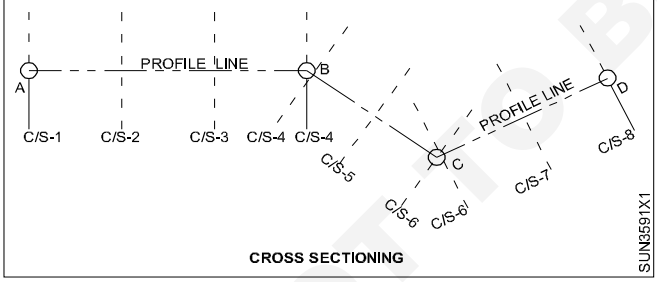
2 Measure the direction of the line using prismatic compass.

3 Measure the length of the line AB using tape and erect pegs at an interval of 200m long the line AB. Also erect pegs at the points where the ground level changes abruptly.

4 Erect cross section lines at right angles to the longitudinal section line at an interval of 20 m along the centre line.

5 Mark cross section points at an interval of 5m from the centre point on either side of the cross section line.

Fig 1



CROSS SECTIONING

6 Set up and level the instrument at a suitable point '0' from where maximum number of observations is possible.

7 Take a back sight readings on the bench mark.

8 Also take staff reading at '0' chain age and on the cross section points on either side of the centre line.

9 The staff reading on the cross section points and their distance from the centre line are entered in the level book accordingly as they are on the right or left of the centre line.

10 Take a foresight reading on a change point on account of the length of sight being beyond the power of the telescope.

11 Shift the instrument to a suitable position and carry out the temporary adjustments.

12 Resume the work from the change point and continue the process untill the last point is reached.

13 Compute the reduced levels of the points by height of collimation method.

Note: Work should always commence from a bench mark and should end on a bench mark.

Observations taken on longitudinal section points and observations taken on each cross section line should be recorded separately.

Tabular form - Longitudinal section.

Station	Chain age	BS	IS	FS	HI	RL	Remarks

Cross - Section at chain age 'O'.

Station	Distance			BS	IS	FS	HI	RL	Remarks
	L	C	R						

Plotting of cross section

Objective: At the end of this exercise you shall be able to
- **plot the cross section on a drawing sheet.**

1 Read and interpret the given levels.

Cross section at “0m” chain age.

Distance		Reduced level
Left	Right	
0		680.245
0.75		680.235
1.75		680.215
2.75		680.165
3.0		680.145
3.5		680.145
4.0		680.135
5.0		680.150
	0.75	680.255
	1.75	680.295
	2.75	680.295
	3.0	680.305
	3.5	680.320
	4.0	680.325
	5.0	680.385

Cross section at “50m” chain age

Distance		Reduced level
Left	Right	
50		680.775
0.75		68.760
1.75		680.740
2.75		680.740
3.0		680.660
3.5		680.630
4.0		680.645
5.0		680.395
	0.75	680.785
	1.75	680.785
	2.75	680.730
	3.0	680.770
	3.5	680.795
	4.0	680.815
	5.0	680.875

Cross section at “100m” chain age

Distance		
Left	Right	Reduced level
100		681.840
0.75		681.855
1.75		681.870
2.75		681.870
3.0		681.885
3.5		681.850
4.0		681.850
5.0		681.745
	0.75	681.760
	1.75	681.705
	2.75	681.665
	3.0	681.665
	3.5	681.685
	4.0	681.715
	5.0	681.735

Cross section at “150m” chain age

Distance		
Left	Right	Reduced level
150		682.345
0.75		682.335
1.75		682.325
2.75		682.310
3.0		682.645
3.5		682.385
4.0		682.515
5.0		682.590
	0.75	682.330
	1.75	682.320
	2.75	682.300
	3.0	683.355
	3.5	682.385
	4.0	682.485
	5.0	682.535

Cross Section at “200m” chain age

Distance		
Left	Right	Reduced level
200		682.825
0.75		682.820
1.75		682.865
2.75		682.905
3.0		682.935
4.0		683.095
5.0		683.195
	0.75	682.800
	1.75	682.800
	2.75	682.805
	3.0	682.885
	3.5	682.915
	4.0	682.950
	5.0	682.775

2 Select a suitable horizontal scale (1:100) and a vertical scale (1:100).

3 Draw a horizontal line of length 10 cm, equal to the length of the section line.

4 Mark the cross section points on this line and also write the distance of these points from centre point.

5 Note also the ground levels of these points.

6 Draw another horizontal line representing the datum line, keeping a vertical distance of 2 cm.

7 Choose a suitable datum level 678.000.

8 Mark section points on the datum line.

9 Draw vertical lines through these cross section points.

10 Scale off the ground level and ground points on the respective vertical lines.

11 Join these points by straight lines to get the ground surface along the traverse direction.

12 Similarly draw other cross sections. Datum level need not be constant for all cross sections.

Read and interpret the given levels of a road profile for cross section

C/S at L.S 0m chai nage datum: 678.000

0m	680.245m		
L 0.75	680.235	R 0.75	680.255
L 1.75	680.215	R 1.75	680.295
L 2.75	680.165	R 2.75	680.295
L 3.00	680.145	R 3.00	680.305
L 3.5	680.145	R 3.5	680.320
L 4.0	680.135	R 4.0	680.325
L 5.0	680.150	R 5.0	680.385

C/S at L.S 50m chain age datum: 678.000

50m	680.775m		
L 0.75	680.760	R 0.75	680.785
L 1.75	680.740	R 1.75	680.780
L 2.75	680.670	R 2.75	680.730
L 3.00	680.660	R 3.00	680.770
L 3.5	680.630	R 3.5	680.795
L 4.0	680.645	R 4.0	680.815
L 5.0	680.395	R 5.0	680.875

C/S at L.S 100m chain age datum: 679.000

100m	681.840m		
L 0.75	681.855	R 0.75	681.760
L 1.75	681.870	R 1.75	681.705
L 2.75	681.870	R 2.75	681.665
L 3.00	681.885	R 3.00	681.655
L 3.50	681.850	R 3.50	681.685
L 4.0	681.830	R 4.00	681.715
L 5.0	681.745	R 5.00	681.735

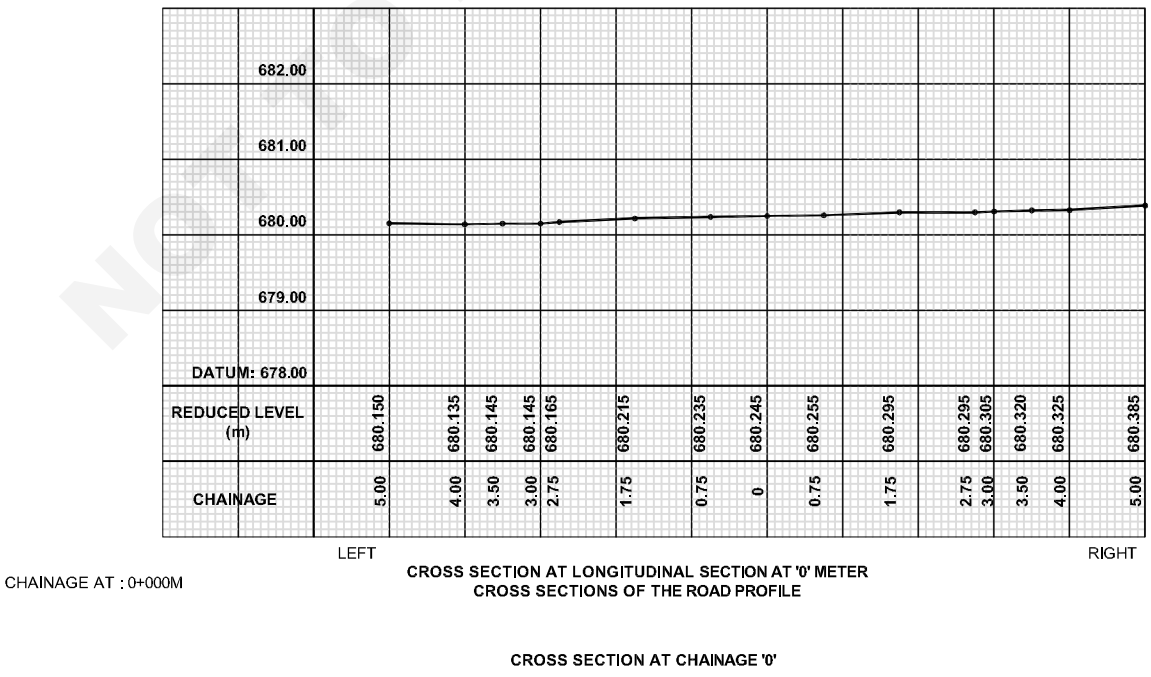
C/S at L.S 150m chain age datum: 681.000

150m	682.345m		
L 0.75	682.335	R 0.75	682.330
L 1.75	682.325	R 1.75	682.320
L 2.75	682.310	R 2.75	682.300
L 3.00	682.345	R 3.00	682.355
L 3.50	682.385	R 3.50	682.385
L 4.0	682.515	R 4.00	682.485
L 5.0	682.590	R 5.00	682.535

C/S at L.S 200m chain age datum: 681.000

200m	682.825m		
L 0.75	682.820	R 0.75	682.800
L 1.75	682.865	R 1.75	682.800
L 2.75	682.905	R 2.75	682.805
L 3.00	682.935	R 3.00	682.885
L 3.50	683.005	R 3.50	682.915
L 4.00	683.095	R 4.00	682.950
L 5.00	683.195	R 5.00	682.775

Fig 1



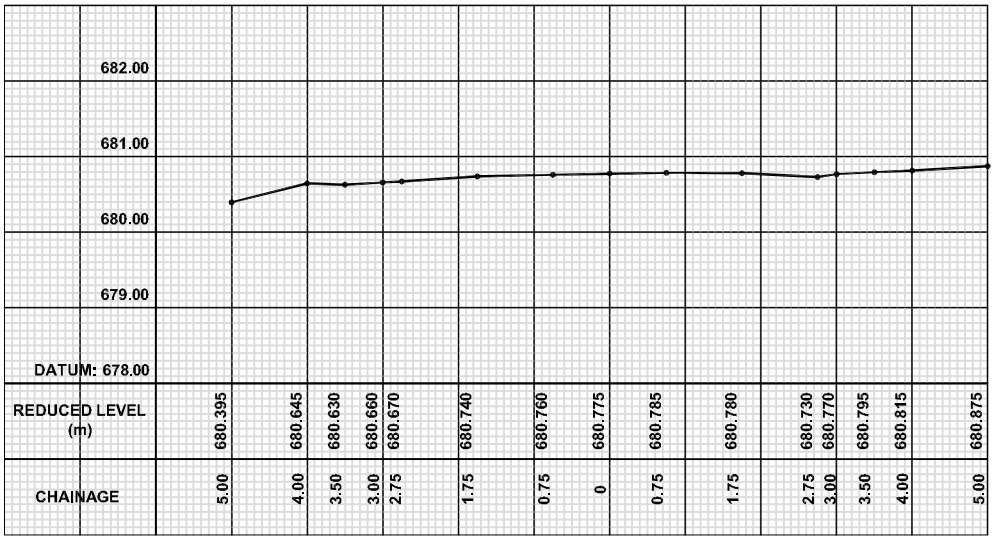
CHAINAGE AT : 0+000M

CROSS SECTION AT LONGITUDINAL SECTION AT '0' METER
CROSS SECTIONS OF THE ROAD PROFILE

CROSS SECTION AT CHAINAGE '0'

SUN3591Y1

Fig 2

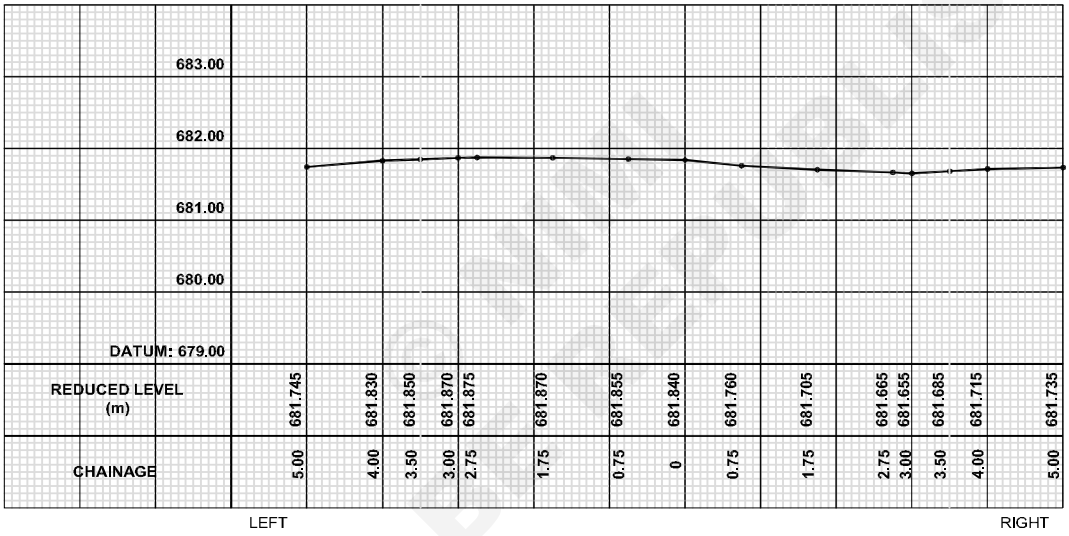


CHAINAGE AT : 0+050M

CROSS SECTION AT CHAINAGE 50M

SUN3591Y2

Fig 3

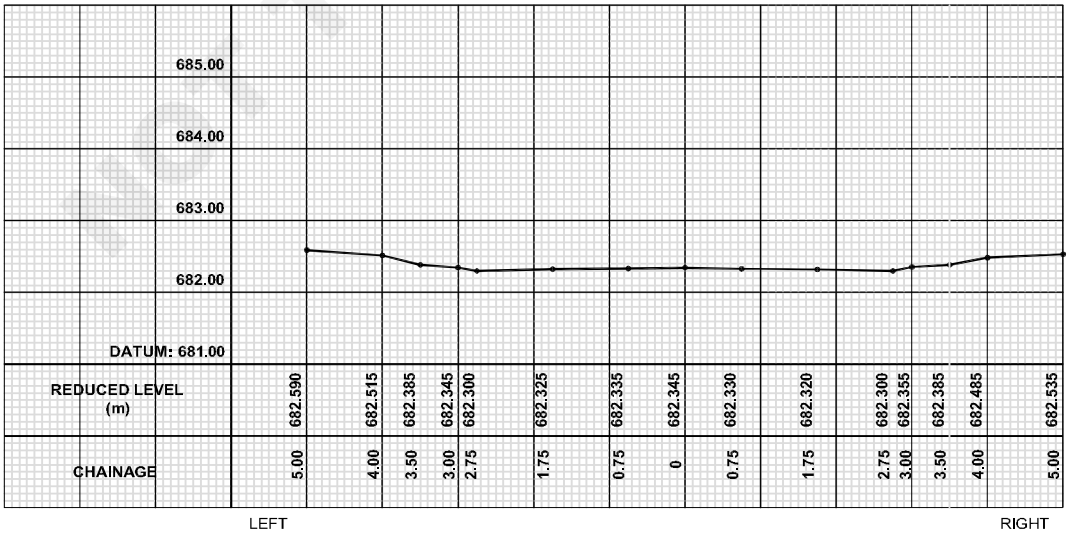


CHAINAGE AT : 0+100M

CROSS SECTIONS AT CHAINAGE 100

SUN3591Y3

Fig 4

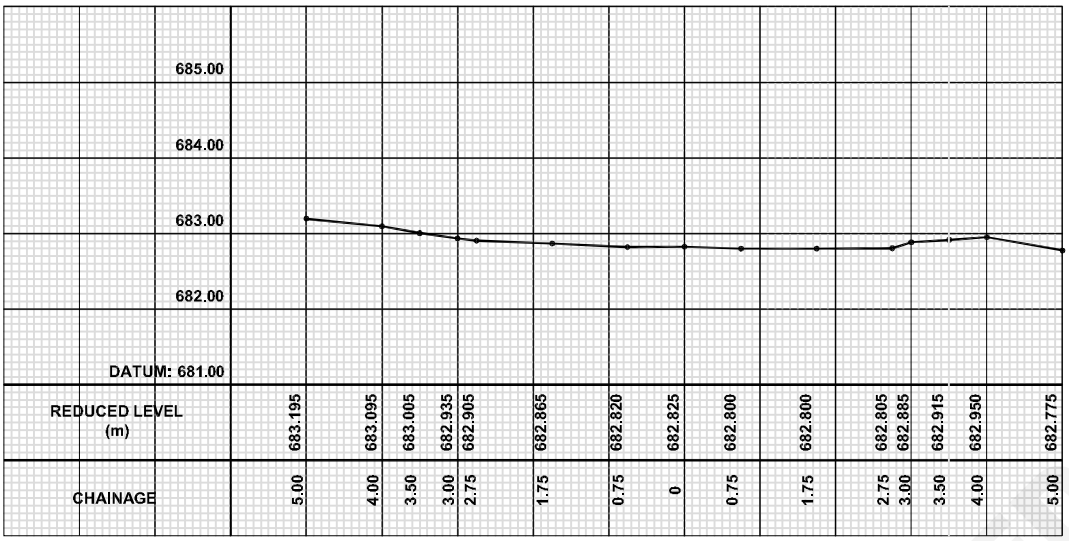


CHAINAGE AT : 0+150M

CROSS SECTIONS AT CHAINAGE 150M

SUN3591Y4

Fig 5



CHAINAGE AT : 0+200M

SCALE: VERTICAL 1:100
HORIZONTAL 1:1000

CROSS SECTION AT CHAINAGE 200M

SUN3591Y5

Prepare traverse drawing using Auto Cad (Co-ordinate system)

Objectives: At the end of this exercise you shall be able to
- **reset model space limit**
- **draw the given line diagram using absolute co - ordinate method**
- **draw the given figure - using relative co - ordinate method**
- **draw the given figure - using polar co - ordinate method.**

Requirements

Tools / Instruments
- Computer with CAD software
- Printer

Materials
- Paper A4 size

PROCEDURE

TASK 1: **To draw a line diagram using absolute coordinate method, follow the steps mentioned below (Fig 1)**

1 Command : **LIMITS (↵)**

Reset model space limits:

Specify lower left corner or [ON/OFF]

<0.0000,0.0000> : (↵)

Specify upper left corner <12.0000,9.0000>:120,90 (↵)

2 Command : **ZOOM (↵)**

Specify corner of window, enter a scale factor (nx or nxP), or [All/Center/Dynamic/Extents/Previous/Scale/ Window] <real time>: All (↵)

Regenerating model space limits:

3 Command : **LINE** (↵)

Specify first point **20,20** (↵)

Specify first point or [Undo] : **100,20** (↵)

Specify next point or [Undo] : **100,50** (↵)

Specify next point or [Close/Undo] : **90,50 (↵)**

Specify next point or [close/Undo] : **86,65 (↵)**

Specify next point or [Close/Undo] : **75,65 (↵)**

Specify next point or [Close/Undo] : **70,50 (↵)**

Specify next point or [Close/Undo] : **50,50 (↵)**

Specify next point or [Close/Undo] : **30,65 (↵)**

Specify next point or [Close/Undo] : **30,50(↵)**

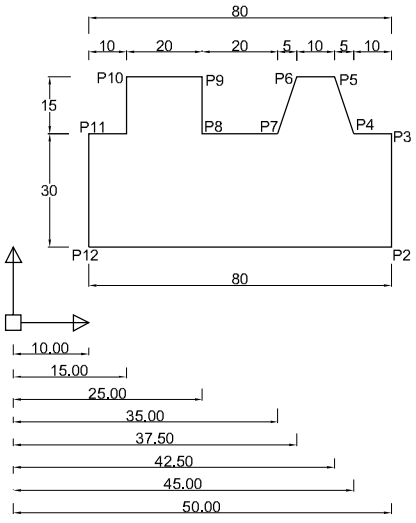
Specify next point or [Close/Undo] : **20,50(↵)**

Specify next point or [Close/Undo] : **C (↵)**

4 Save this file.

Output

Fig 1



ABSOLUTE COORDINATE METHOD

— — — — — — — —

TASK 2 : **To draw a line diagram using relative coordinate method, follow the steps mentioned below. (Fig 2)**

1 Command : **LIMITS (↵)**

Reset model space limits:

Specify lower left corner or [ON/OFF] 0.0000,0.0000> : **(↵)**

Specify upper right corner <12,0000,9,0000> : 120,90 **(↵)**

2 Command : **ZOOM**

Specify corner of window, enter a scale factor (nX or nXP), or [All/Center/Dynamic/Extents/Previous/ Scale/ Window] <reak time?: **All (↵)** regenerating model.

3 Command : **LINE (↵)**

Specify first point : **20,20 (↵)**

Specify next point or [Undo] :@ **80,0 (↵)**

Specify next point or [Unod] :@ **0,30 (↵)**

Specify next point or [Close/Undo] : @ : **-10,0 (↵)**

Specify next point or [Close/Undo] : @ **-5,15 (↵)**

Specify next point or [Close/Undo] : @ **-10,0 (↵)**

Specify next point or [Close/Undo] : @-**5,15 (↵)**

Specify next point or [Close/Undo] : @ **-20,0 (↵)**

Specify next point or [Close/Undo] : @ **0,15 (↵)**

Specify next point or [Close/Undo] : @ **-20,0 (↵)**

Specify next point or Close/Undo : @ 0,-15

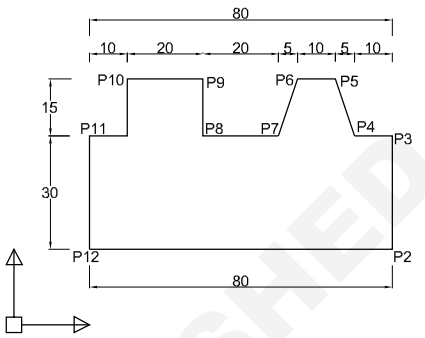
Specify next point or Close/Undo : @ -10,0

Specify next point or Close/Undo : C

4 Save this file

Output

Fig 2



RELATIVE COORIDNATE METHOD

SUN2564H2

— — — — — — — —

TASK 3 : **To draw a line diagram using polar coordinate method, follow the steps mentioned below (Fig 3)**

1 Command : **LIMITS (↵)**

Reset model space limits:

Specify lower left corner or [ON/OFF] <0.0000,0.0000>: **(↵)**

Specify upper right corner <12.0000,9.0000>:**120,90 (↵)**

2 Command : **ZOOM (↵)**

Specify corner of window, enter a scale factor (nX or nXP), or All/Center/Dynamic/Extents/Previous/ Scales/ Window <real time?: All (↵) regenerating model.

3 Command : LINE (↵)

Specify first point : 20,20 (↵)

Specify next point or Undo : @ 80<0 (↵)

Specify next point or Undo :@ 30<90 (↵)

Specify next point or close/Undo : @ :10<180 (↵)

Specify next point or Close/Undo : @ 15<108 (↵)

Specify next point or Close/Undo : @ 10<180 (↵)

Specify next point or Close/Undo : @ 15<252 (↵)

Specify next point or Close/Undo : @ 20<180 (↵)

Specify next point or Close/Undo : @ 14.27<90 (↵)

Specify next point or Close/Undo : @ 20<180 (↵)

Specify next point or Close/Undo : @ 4.27<270 (↵)

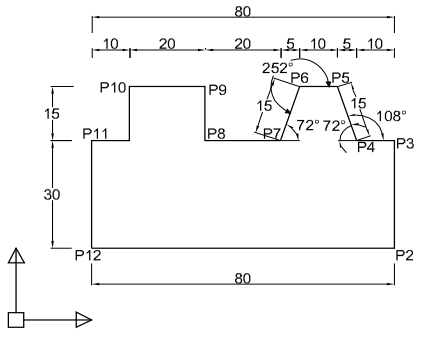
Specify next point or Close/Undo : @ 10.73<180 (↵)

Specify next point or Close/Undo : C

4 Save this file

Output

Fig 3



POLAR COORDINATE METHOD

SUN2564H3

— — — — — — — —

Prepare a simple building

Objectives: At the end of this exercise you shall be able to
- **draw the plan, section and elevation of a building**
- **dimension the drawing**
- **plot the drawing.**

Requirements

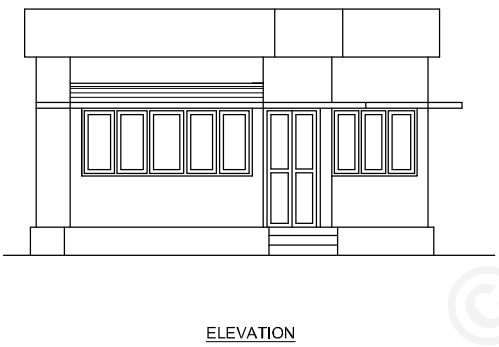
Tools / Instruments
- Computer with CAD software
- Printer

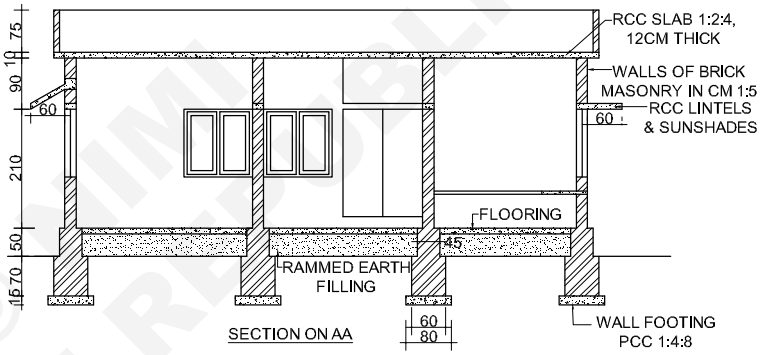
Materials
- Paper A4 size

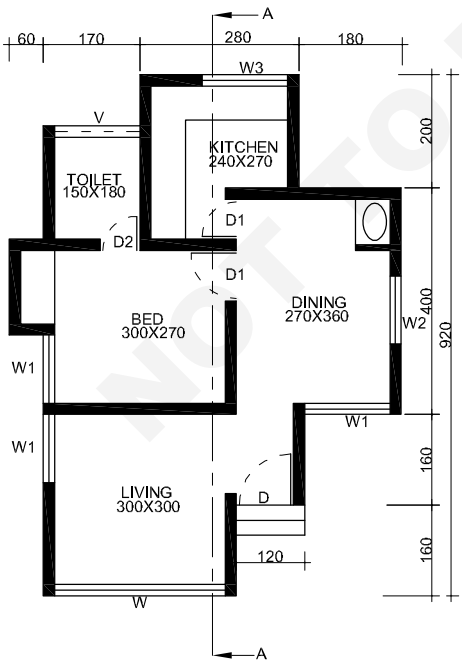
PROCEDURE

- **Draw the plan section and elevation of the residence (Fig 1)**

Fig 1







SCHEDULE OF JOINERY

MARK	ITEM	SIZE	TYPE	NOS.
D	DOOR	110X210	PANELLED	1
D1	DOOR	100X210	PANELLED	2
D2	DOOR	90X210	PANELLED	1
W1	WINDOW	300X150	GLAZED	1
W2	WINDOW	120X150	GLAZED	1
W3	WINDOW	150X120	GLAZED	1
V	VENTILATOR	150X60	GLAZED	1

SPECIFICATIONS
1) FOUNDATION:-
2) WALLS:-
3) LINTELS:-
4) ROOF SLAB:-
5) PLASTERING:-
6) FLOORING:-
7) PAINTING:-

Note:- Provide Foundation according to the condition of soil

PLAN AND SECTION OF A BUILDING

SUN2565E1

1 Open the AutoCAD software.

2 Draw the building outline of the house by using the "Line" command. Click the "Line" icon to activate the command. Left -click to start and end the line.

3 Offset the building outline the desired thickness of the exterior wall. Use the "Offset" command.

4 Draw all interior walls by using the same "Line" and "Offset" commands.

5 Use the "Trim" command to trim any messy intersections on the exterior or interior conditions. Left-click the "Trim" icon to activate the too. Select the "cutting edge" line followed by the line that you would like to him off.

6 Cut openings for doors and windows by drawing lines and then trimming away the opening. If you want a 3'-0" door (90 cm), draw a line perpendicular to the wall, set it 3'0", and trim way the excess lines.

7 Draw the doors and windows where the new openings exits.

8 Activate the text command to enter the names of rooms and their sizes.

9 Activate the dimension icon and click the edges of each wall that you would like to dimension to. This will give the drawing a more professional look and also gives people a sense of the space.

10 Insert the table and prepare the details of joinery.

11 Using ploylne command draw a line over the outer wall and using area command find the area of the building.

12 Plot the drawing to a printer or to a PDF format. Hit the plot icon to open the plot settings. Choose the layout type, pen settings, and window view that you would like to use.

- **Draw the roof plan of the residence**

1 Draw the roof plan of the building according to the design

2 Using hatch command draw the roof titles and assign proper line weights.

3 Complete the roof plan by using dimension and text commands

4 Plot the drawing to a printer or to a PDF format. Hit the plot icon to open the plot setting. Choose the layout type, pen settings, and window view that you would like to use.

- **Draw the elevation of the residence**

1 Draw the base line to draw the elevation of the residence

2 Draw the projected lines from the plan to create front view of the residence using line command.

3 Draw the elevation of the residence using modify commands like offset, trim, fillet, extend to complete the outline.

4 Using block, insert block commands prepare the doors and windows in elevation

5 Assign proper line weights to create the effective appearance of the building.

6 Plot the drawing to a printer or to a PDF format. Hit the plot icon to open the plot settings. Choose the layout type, pen settings, and window view that you would like to use.

- **Draw the section of the residence**

1 Draw the base line to draw the section of the residence

2 According to the section line shown in the plan, the width of walls, rooms has to be drawn according to the design using line, offset, trim commands.

3 Use the hatch commands to show the R.C.C brick masonry in the section.

4 Activate the text commands for mentioning the name and size of the rooms.

5 Using dimension command complete the dimensioning of the section drawing.

6 Plot the drawing to a printer or to a PDF format. Hit the plot icon to open the plot settings. Choose the layout type, pen settings. and window view that you would like to use.

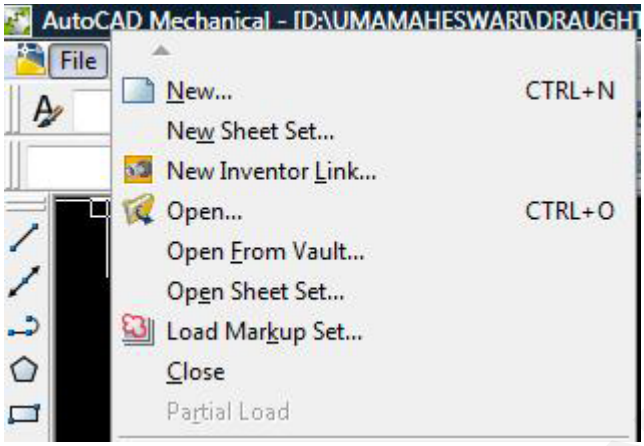
Drawing using AutoCAD (Starting a drawing)

Objectives: At the end of this exercise you shall be able to
- **starting a new drawing**
- **opening a template**
- **create a template.**

CREATE A TEMPLATE

Now you can create a template. This will be a very easy task.

1 Start AutoCAD as follows:

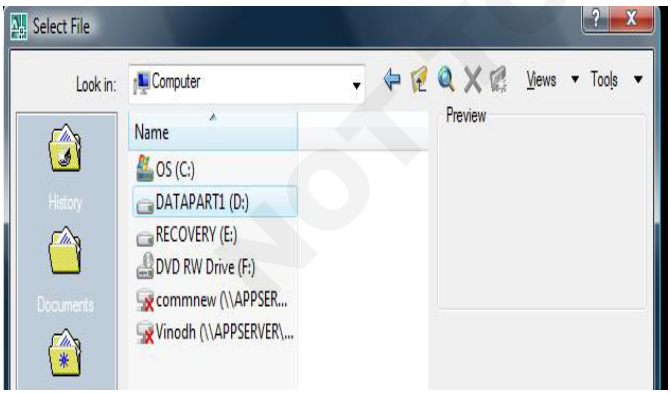


Start Button/programs/AutoCAD.

The 3 letter extension for .dwg file is drawing If a dialog box appears select the "Cancel" Button.

2 Select **File / Open**

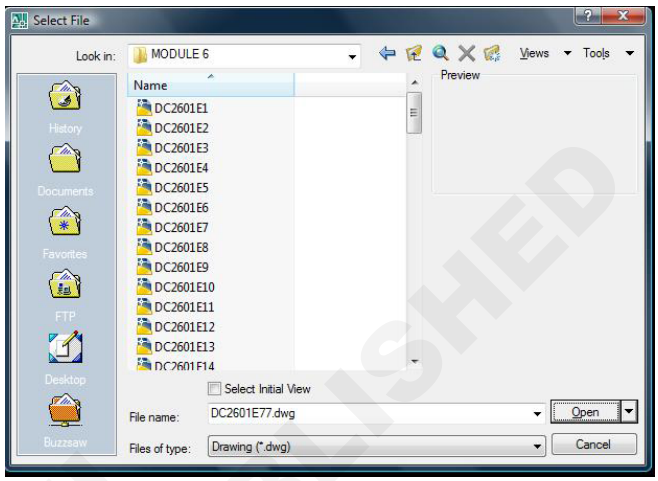
3 Select the **Directory** in which the files located.(Click on the)

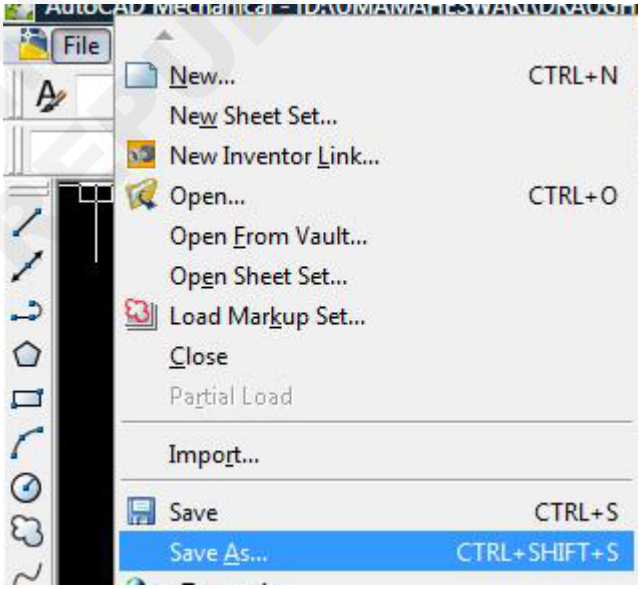


4 Select the file **"Workbook"** and then **"Open"** button.

5 Select **"File / Save AS"**

6 Select the **"File of type"** down arrow to display different saving formats. Select " AutoCAD drawing template (*.dwt)".



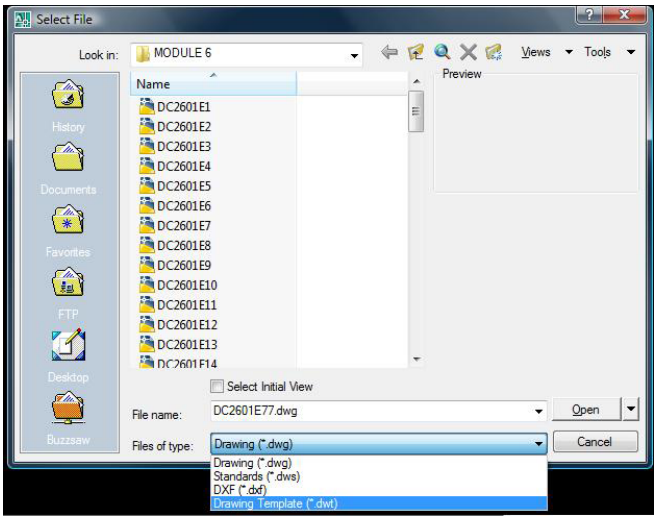


The 3 letter extension for template is "dwt".

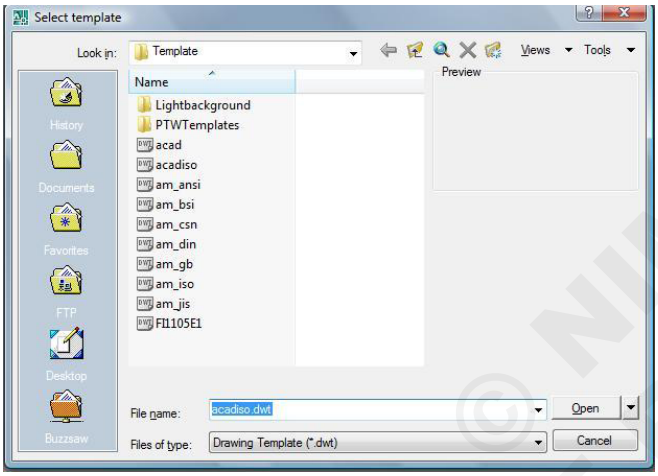
A list of all the AutoCAD templates will appear. (Your list may be different)

7 Type the new name "1 Workbook" in the File name". box and then select the save button.

The "1" before the name will place the file at the top of the list.

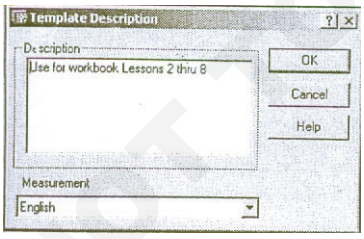


Auto CAD displays numerical first and then alphabetical.



8 Type a description and the select the “OK” button.

Using a template as a master setup drawing is good CAD management.



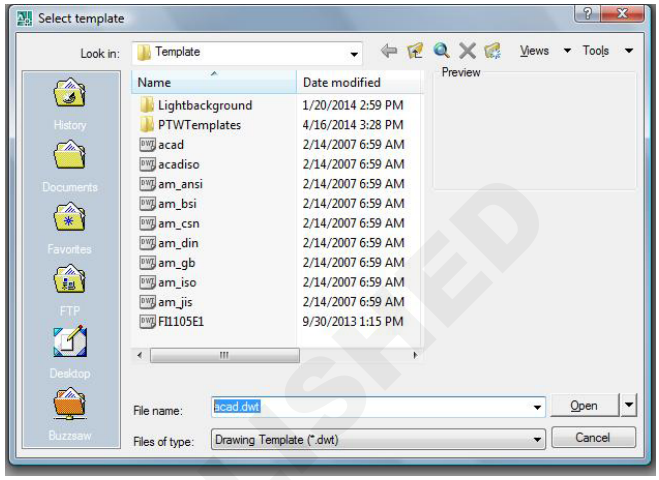
Creating a new Drawing

New command

Create a new drawing file.

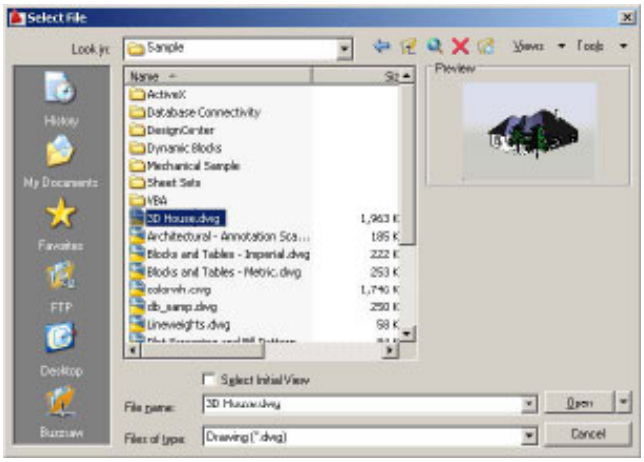
1 Choose	File, New. **Or**
2 Press	CTRL + N or
3 Click	The New icon. or
4 Type	NEW at the command prompt. Command: NEW
5 Choose	One of the options for creating a new drawing.
6 Click	The OK button.
7 Save	The drawing as another name.

TIP: New drawings can also be created from Template Files.



Open Existing Drawings

1. Choose	File, OPEN. or
2. Press	CTRL + O
3. Click	the OPEN icon. or
4. Type	OPEN at the command prompt.command: OPEN
5. Press	ENTER
6. Double Click	the desired directory to find the drawing to open.
7. Click	the drawing name to open.
8. Click	The OK Button.



Saving Drawings

Saves the most recent changes to a drawing. The first time an unnamed drawing is saved the "Save As" Dialog box appears. AutoCAD saves its drawings as files with extensions ending in.DWG.

1. Choose File, Save or Save as

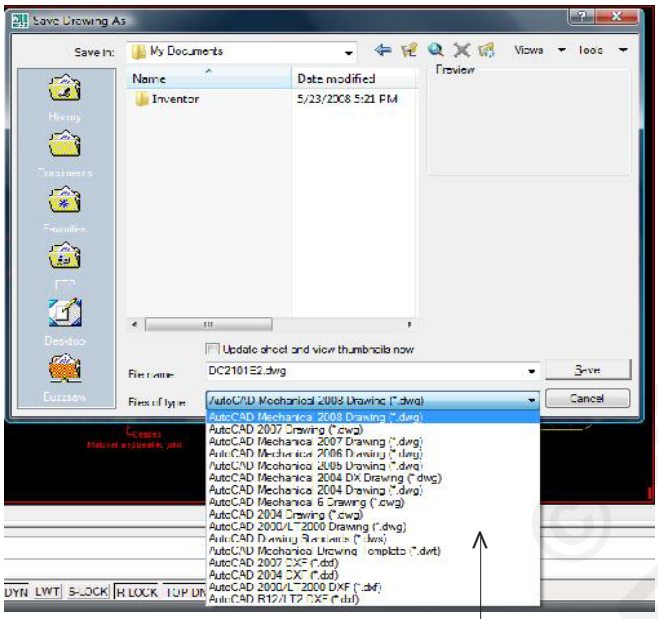
   or

2. Type SAVE or SAVES at the command prompt command: SAVE or SAVEAS

3. Press ENTER

4. Type A new drawing name or keep the existing drawing name.

5.Click The OK button.



Various file type can be saved as

TIP: Clicking the dropdown list for File type changes the format that the drawing can be saved in.

Quick Save

The QSAVE command is equivalent to clicking Save on the File menu.

1. Press CTRL+ S.

   or

2. Click the save icon.

   or

3. Type QSAVE at the command prompt, Command: QSAVE

TIPS: Drawings can be saved as different versions of AutoCAD (e.g. R13, R14, R2000, etc.)

AutoSave settings under Tools, options...

Existing AutoCAD

1. Choose File, Exit.

   or

2. Type QUIT at the command prompt. Command: QUIT

3. Press ENTER

4. Click Yes to save changes or No to discard changes.

Drawing Area Control

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

- **identify method of Entering commands.**
- **practice drawing command set up.**
- **practice drawing Area set up.**

Methods of entering commands

AutoCAD has 3 different methods of entering commands. All 3 methods will accomplish the same end result.

1. Pull down Menu (Select Draw / Line)

   a. Move the cursor to the Menu Bar

   b. Click on a Menu header such as "Draw"

   c. Slide the cursor down the list of commands and click to select.

2. Tool Bars (Select the line icon from the Draw toolbar)

   Move the cursor to an icon on a toolbar and press the left mouse button.

3. Keyboard (Type L and <enter>)

   Type the command on the command line.

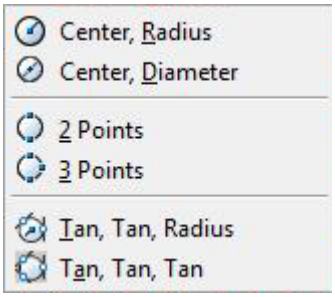
What is a SHORTCUT menu?

Example

Select: Draw /Circle / Center, Radius

_Circle specify center point for circle or **[3P / 2P/ Ttr (tan tan radius)]:**

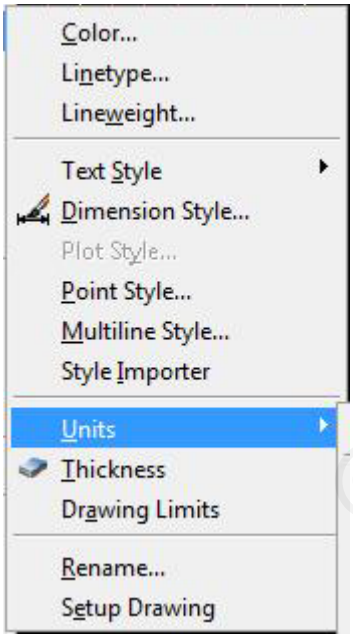
If you press the right mouse button now, the shortcut menu on the left will appear. This allows you to select the options 3P, 2P, or Ttr with the mouse rather than typing your selection.



Drawing Units Setup

Every object we construct in a CAD system is measured in Units. We should determine the system of units within the CAD system before creating the first geometric entities.

1 In the Menu Bar select:



[Format] [Units]

1 The AutoCAD Menu Bar contains multiple pull down menus, where all of the AutoCAD commands can be accessed.

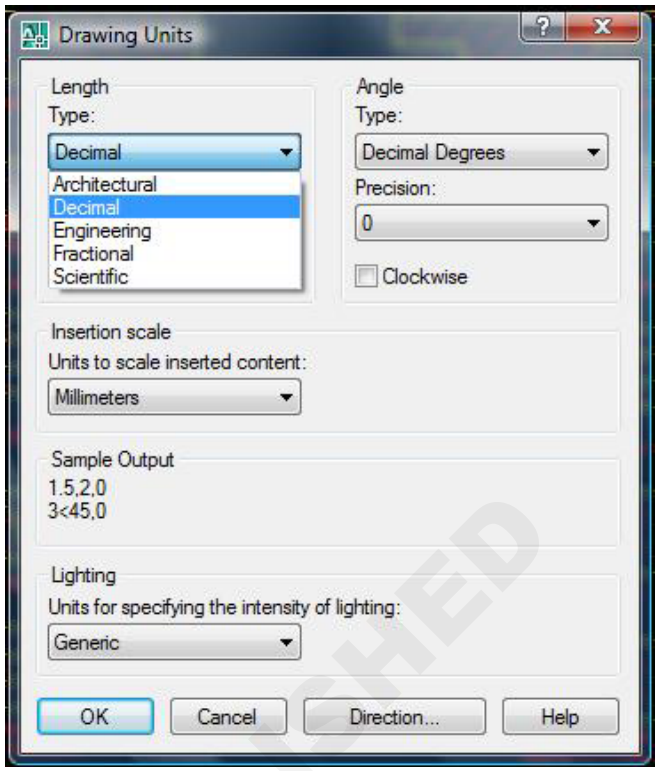
2 Click on the Length Type option to display the different types of length units available. Confirm the Length Type is set to **Decimal.**

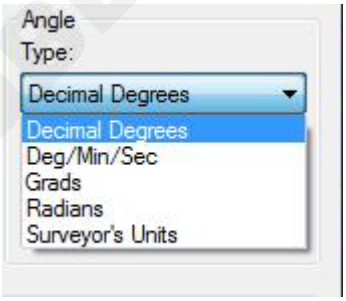
3 On your own, examine the other settings that are available.

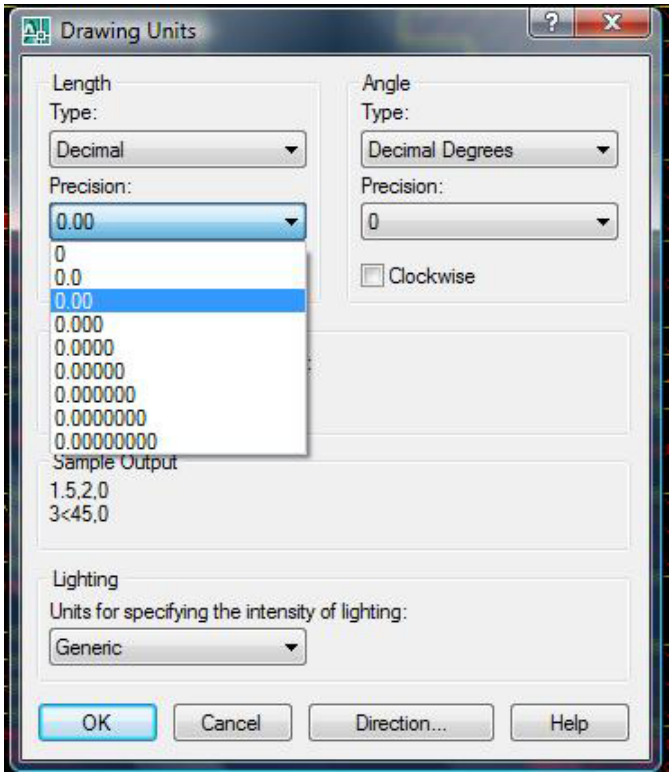
4 In the Drawing Units dialog box, set the Length Type to Decimal. This will set the measurement to the default English Units, inches.

5 Set the Precision to Two digits after the decimal point as shown in the above figure.

6 Pick OK to exit the Drawing Units dialog box.





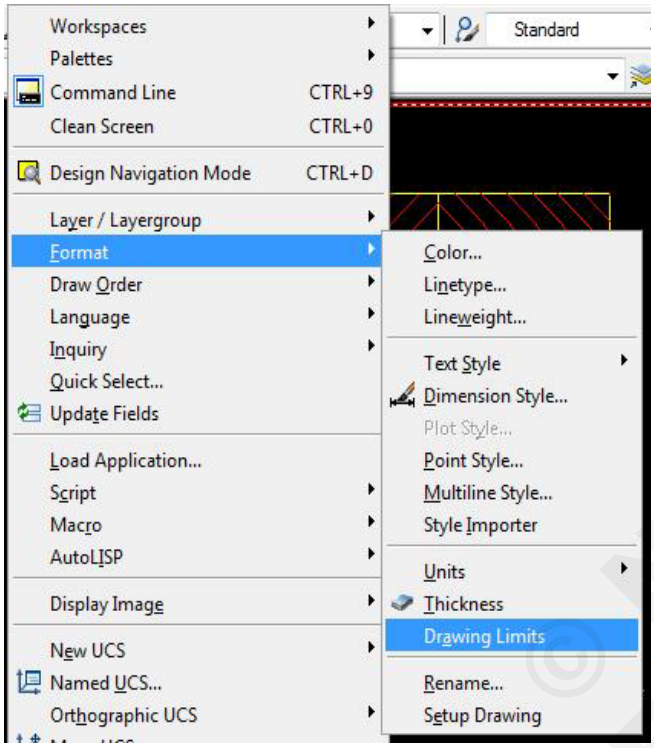


Drawing Area Setup

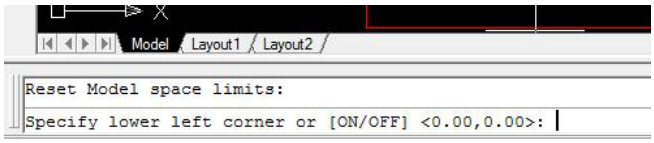
Next, we will set up the **Drawing Limits** by entering a command in the command prompt area. Setting the Drawing Limits controls the extents of the display of the grid. It also serves as a visual reference that marks the working area. It can also be used to prevent construction outside the grid limits and as a plot option that defines an area to be plotted / printed. Note that this setting does not limit the region for geometry construction.

1 In the Menu Bar select:

[Format] [Drawing Limits]

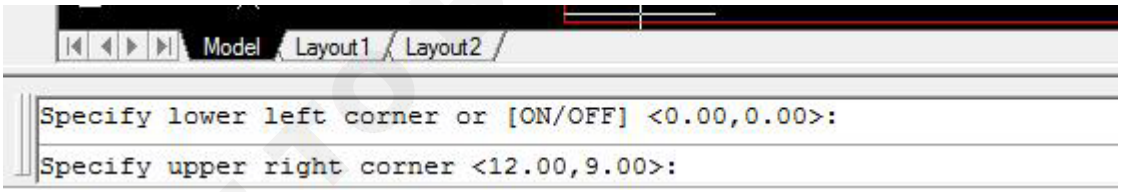


2 In the command prompt area, the message "Reset Model Space Limits: Specify lower left corner or [on/off] <0.00,0.00>." is displayed. Press the **ENTER** key once to accept the default coordinates <**0.00,0.00**>.



3 In the command prompt area, the message "specify upper right corner <12.00,9.00>" is displayed. Press the ENTER key again to accept the default coordinates <12.00,9.00>.

4 On your own, move the graphic cursor near the upper - right comer inside the drawing area and note that the drawing area is unchanged. (The Drawing Limits command is used to set the drawing area, but the display will not be adjusted until a display command is used.)



Setting limits of a drawing

In AutoCAD The drawing must be drawn in full scale. So limits are needed to size up a drawing area. The limits are determined by the following factor.

i Size of drawing.

ii Space needed for dimensions, notes and other details.

iii Space between different views.'

iv Space for the border and a title block etc.

Limits

Pull down: Format, Drwing Limits

Command: Limits

The command **LIMITS** allows you to change the upper and lower limits of the drawing.

Example: Set the drawing screen to A4 size (210 x 297)

Command: LIMIT

Specify lower left corner or (ON/OFF) <0.000,0.000>:

Specify upper right corner <12.000,9.000>: 210,297

Give ZOOM command with ALL option to view all the drwing area (A4 size)

MVSETUP = MultiView Setup

MVSETUP offers two different setup options depending on whether you are in Model Space or in a Layout (Paper Space).

In model space- you set the units type, drawing scale factor, and paper size at the command prompt using MVSETUP. Using the settings you provide, a rectangular border is drawn at the grid limits.

Command : MVSETUP ↵

Enable paper space : YES/NO : NO ↵

Enter units type (Scientific, Decimal, Engineering, Architectural Metric : Select only

Enter scale factor = 1:1

From here, set up dimensions styles, text styles. layer...

If these settings will used in other drawings here are two suggestions, the first of which is recommended because it is less error prone.

1. After creating the desired settings, do a save-as and save t as a . dwt. All of the settings that you created will be saved.

2. After using this drawing, open it and erase all objects. The settings will remain but you will have to hunt down the objects that need to be erased in layouts.

2 Setting Units of a Drawing

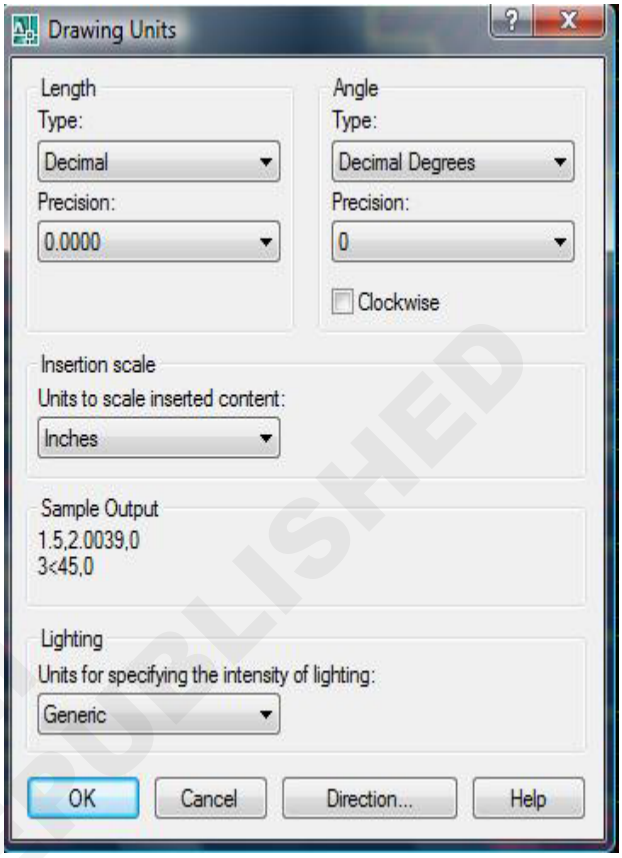
Every object you create is measured in drawing units. Before you start to draw, you must decide what one drawing unit will represent based on what you plan to draw. Then you create your drawing at actual size with that convention. For example, a distance of one drawing unit typically represents one millimeter, one centimeter, one inch, or one foot in real - world units.

UNITS Command is used to set the units of measure, angle measurement, direction and precision. Pull down Menu: Format, UNITS

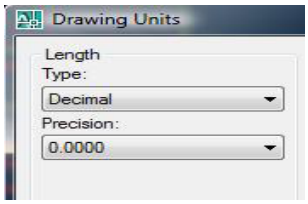
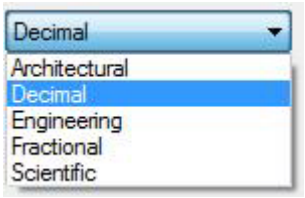
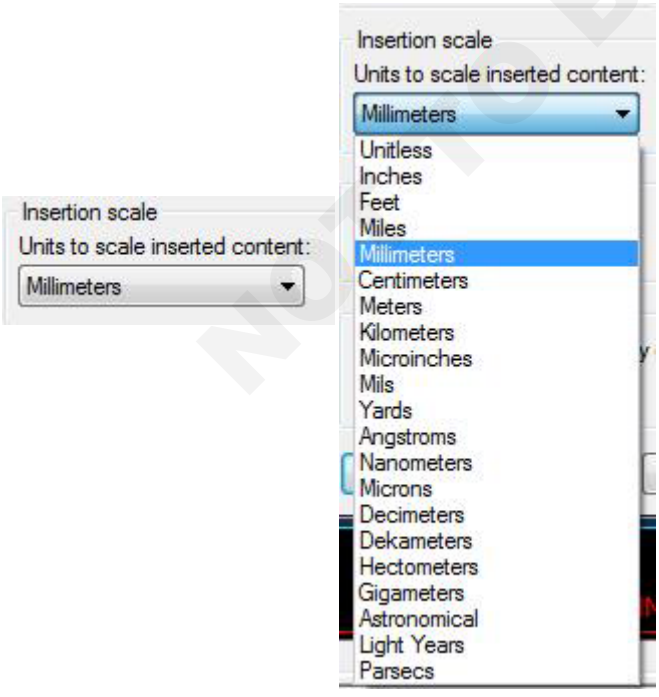
Command: UNITS

If you enter - units at the command prompt, UNITS displays prompts on the command line.

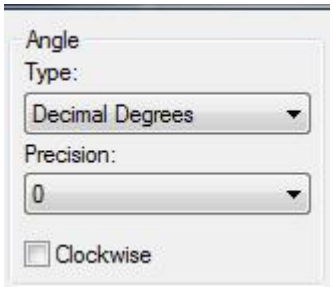
The text window displays the following prompt:

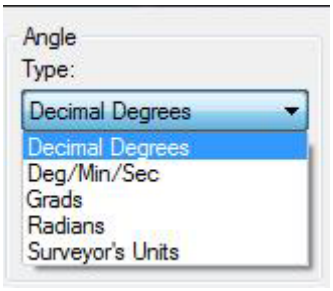


There are five fundamental types of units i.e. Decimal, Architectural, Engineering, Fractional & Scientific.

Icon/Button	Description
 	There are five fundamental types of units i.e. Decimal, Architectural, Engineering, Fractional & Scientific. Report formats: (Examples) 1. Scientific (1.55E + 01) 2. Decimal (915.50) 3. Engineering 1'-3.50" 4. Architectural 1'-3 1/2" 5. Fractional 15 1/2 Enter choice, 1 to 5 <Current >: Enter a value (1-5) or press ENTER The following prompt for decimal precision is displayed if you specify the scientific, decimal, or engineering format. Enter number of digits to right of decimal point (0 to 8) <Current >: Enter a value (0-8) or press ENTER. The following prompt for the denominator of the smallest fraction is displayed if you specify the architectural or fraction format. Enter denominator of smallest fraction to display. (1,2,4,8,16,32,64,128,or 256) <current>: Enter a value (1,2,4,8,16,32,64,128,or 256) or press ENTER
	**Insertion Scale** Controls the unit of measurement for blocks and drawings that are inserted into the current drawing. A block or a drawing that is created with units that are different from the units specified with this option is scaled when inserted. The insertion scale is the ratio of the units used in the source block or drawing and the units used in the target drawing. Select Unit less to insert the block without scaling it to match the specified units.

The next prompts is for angle formats and precision





Systems of angle measure: (Examples)

1. Decimal degrees 45.0000

2. Degrees / minutes / seconds 45°0’0”

3. Grads 50.0000g

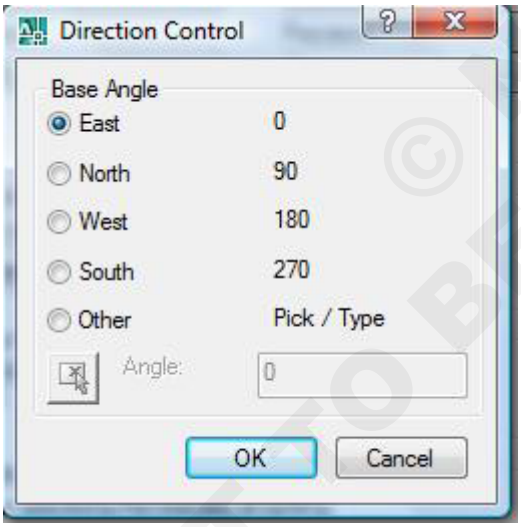
4. Radians 0. 7854 r

5. Surveyor’s units N 45° 0’0” E

Enter choice, 1 to 5 <Current >: Enter a value (1-5) or press ENTER

Enter number of fractional places for display of angles (0 to 8) <current>: Enter a value (0-8) or press ENTER

The next prompt is for the direction for angle 0:



Direction for angle 0:

East 3 o’clock = 0

North 12 o’clock = 90

West 9 o’ clock = 180

South 6 o’ clock = 270

Enter direction for angle 0<current>: Enter a value or press ENTER

The default direction for 0 degrees is to the east quadrant, or 3 o’ clock. The default direction for positive angular measurement is counterclockwise.

Measure angles clockwise? [Yes/No] <current>: Entry or n or press ENTER

Select the unit you want from the dialogue box. This unit is used for dimensioning of the drawing. Input from the user accepted in this unit only.

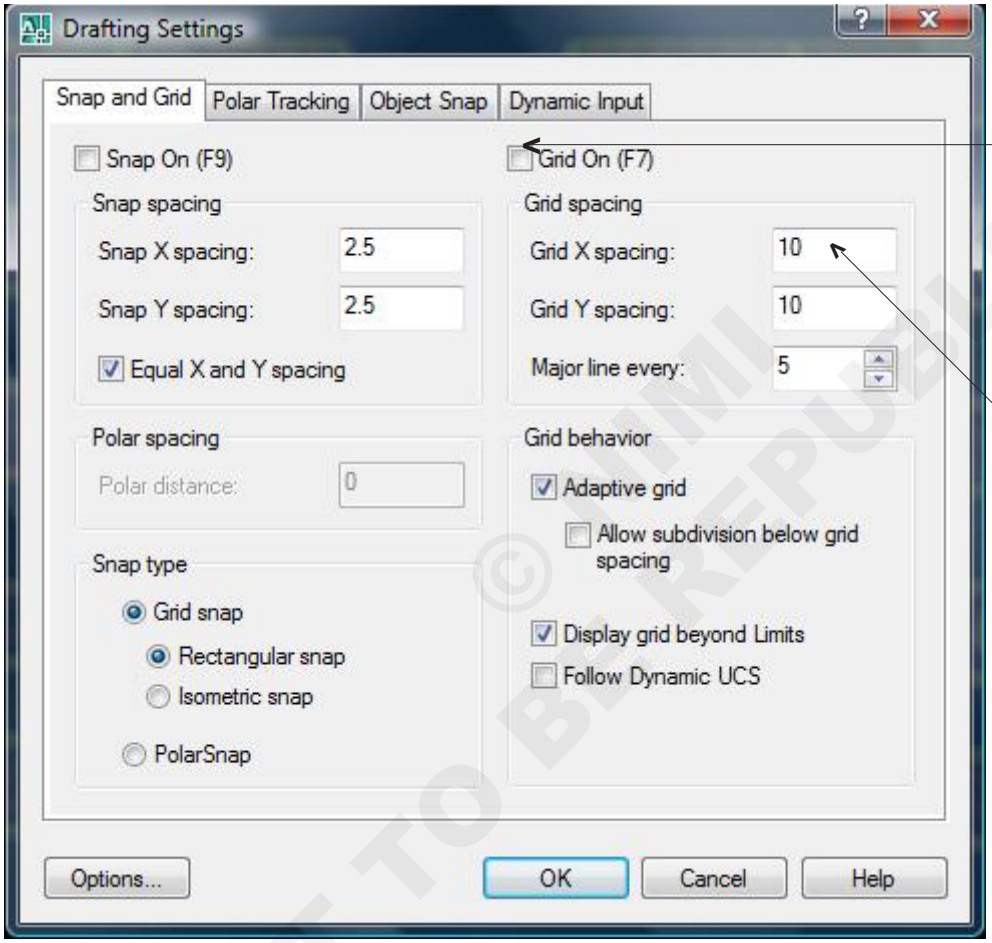
Drafting Setting a Display Commands

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

- **practice the drafting setting**
- **identify the visual reference**
- **identify Esc, Undo, Redo**
- **practice display commands.**

Drafting Settings

Drafting settings includes the commands for initial setting of a drawing. Some of the drafting settings are SNAP, GRID, POLAR TRACKING, OSNAP



SNAP

SNAP is used to move the cursor at a defined value. This will set a position on the drawing quickly and accurately. The snap mode can be switched ON / OFF by pressing function key F9.

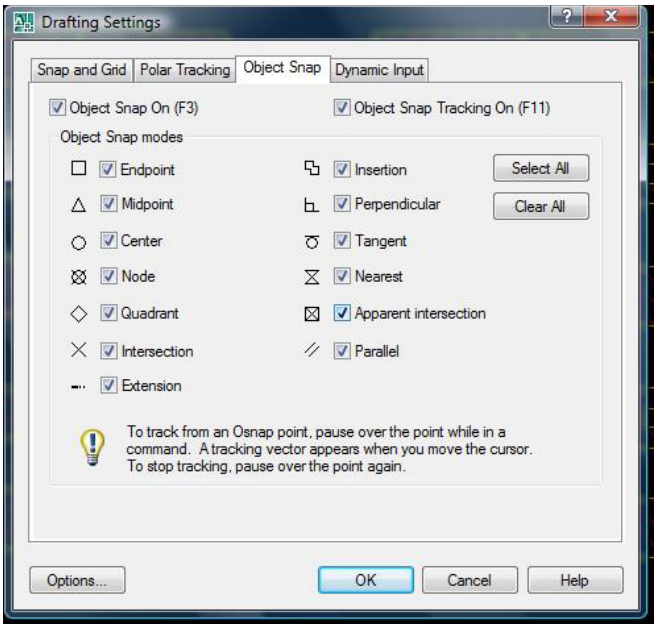
GRID

GRID command is used to display dots, which is easy for us to fix the points. But these dots were not printed. Grid points have default spacing of one unit. We can change the spacing too. This mode can be ON / OFF by using the function key F7.

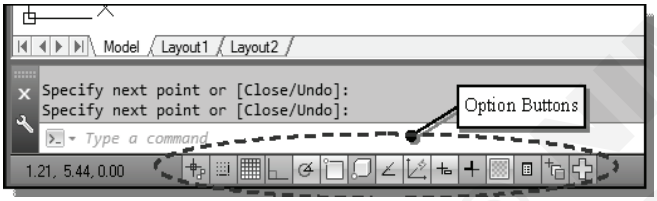
Object snap settings

Object snap settings are used to pick a geometric point on an object. Object snap mode can be ON / OFF by using the function key F3 or by clicking O snap button on the status bar. There are various options for object snap settings such as End point, Midpoint, Centre, Quadrant etc.

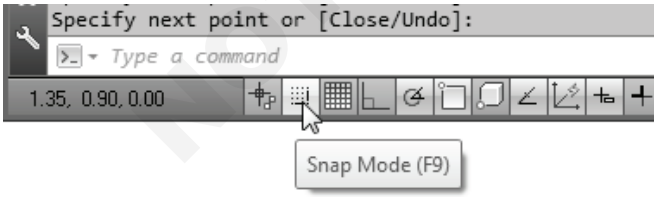
Ortho: Ortho Command forces lines to be drawn exactly perpendicular directions. While using this command we have to turn Ortho ON /OFF (otherwise press F8) according to our need.

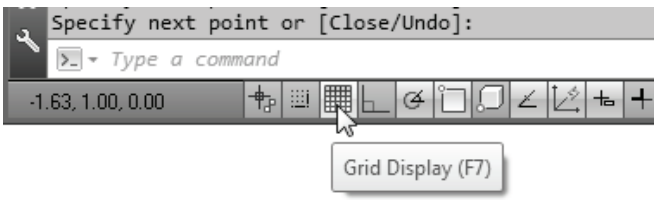


Place a tick in the object snap you want a use. The GRID and SNAP MODE options can be turned ON to rise place a tick in the object snap you want or OFF through the Status Bar. The Status Bar area is located at the bottom left of the AutoCAD drawing screen, next to the cursor coordinates.



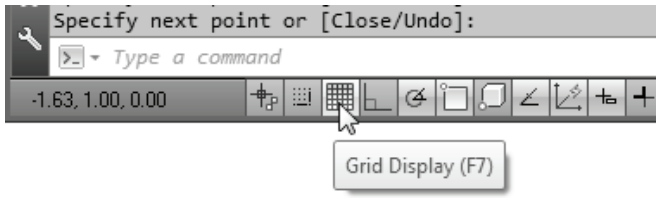
The second button in the Status Bar is the SNAP MODE option and the third button is the GRID DISPLAY option. Note that the buttons in the Status Bar area serve two functions: (1) the status of the specific option, and (2) as toggle switches that can be used to turn these special options ON and OFF. When the corresponding button is highlighted, the specific option is turned ON. Using the buttons is quick and easy way to make changes to these drawing aid options. Another aspect of the buttons in the Status Bar is these options can be switched on and off in the middle of another command.



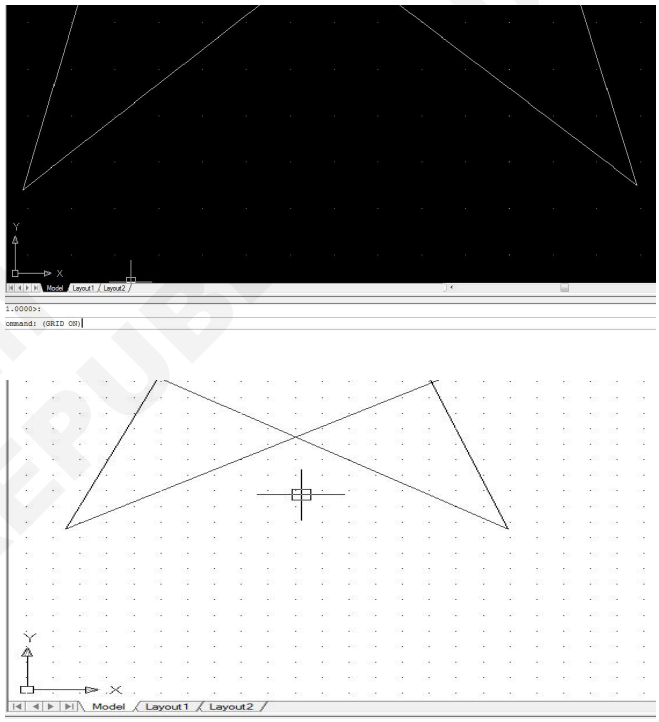


GRID ON

1. Left - click the GRID button in the Status Bar to turn ON the GRID DISPLAY option. (Notice in the command prompt area, the message "<Grid on>" is also displayed.)



2. Move the cursor inside the graphics window, and estimate the distance in between the grid lines by watching the coordinates display at the bottom of the screen.

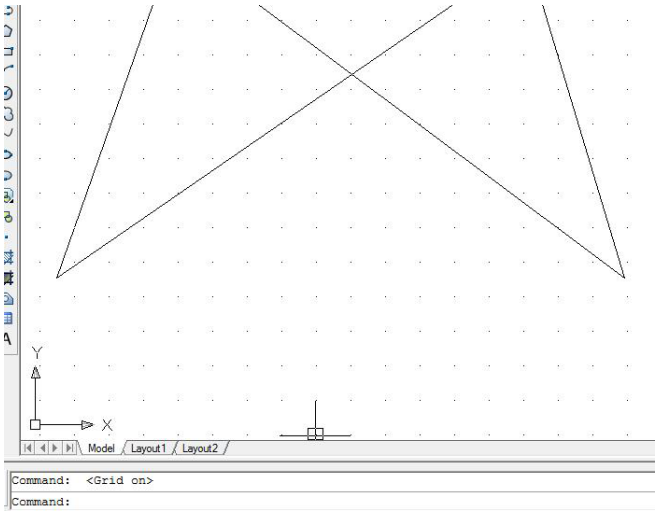


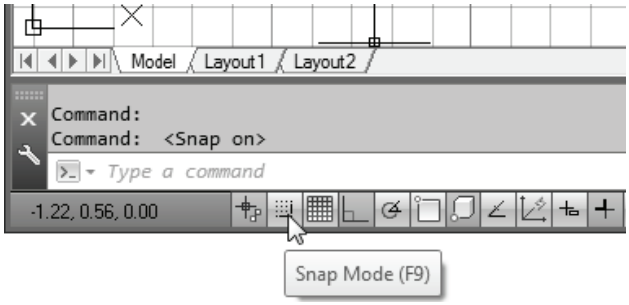
The GRID option creates a pattern of lines that extends over an area on the screen. Using the grid is similar to placing a sheet of grid paper under a drawing. The grid helps you align objects and visualize the distance between them. The grid is not displayed in the plotted drawing. The default grid spacing, which means the distance in between two lines on the screen, is 0.5 inches. We can see that the sketched horizontal line in the sketch is about 4.5 inches long.

Snap mode on

1. Left- click the SNAP MODE button in the Status Bar to turn ON the SNAP option.

2. Move the cursor inside the graphics window, and move the cursor diagonally on the screen. Observe the movement of the cursor and watch the Coordinates display at the bottom of the screen.





The SNAP option controls an invisible rectangular grid that restricts cursor movement to specified intervals. When SNAP mode is on, the screen cursor and all input coordinates are snapped to the nearest point on the grid. The default snap interval is 0.5 inches, and aligned to the grid points on the screen.

In case of any mistake

Pressing the ESC key

The Esc key at the top of the key board will get you out of most problems you encounter using AutoCAD. Here are some examples of the times you would press Esc key.

- If a command is not responding the way you expect.
- If you want to cancel a command you started
- If you clicked a point on the screen unintentionally
- If a dialogue box appears on the screen accidently.

In all these cases above, pressing Esc once will free the command line.

Example:

Issue the line command, click a point on the screen and then press the Esc key to cancel the command.

Using Undo

You can undo the last command by typing U at the command line and pressing the enter key, or by clicking on the Undo icon on the tool bar.

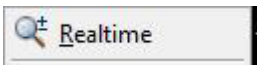
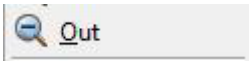
Using Redo

The Redo command will reinstate the last command you applied undo to. You may undo as may commands as like you, but you may only redo once

DISPLAY COMMANDS

Zoom

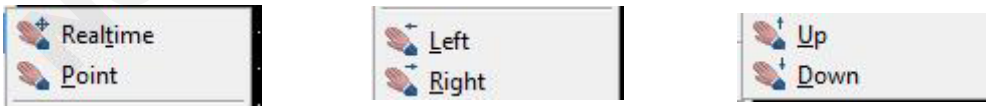
Zoom command enlarges or reduces the view of the drawing. When we are working on a drawing it is always required to bring the area of our interest to focus on to the screen. The Zoom toolbar may be accessed from the standard tool bar at the top of the screen or from the dropdown menu > view >Tool bars....> Zoom. The icons are

Icon	Function
	This allow you to select a window or box around the area you want to magnify
	This is both zoom and pan. When the command is issued a view box will be displayed with the drawing inside. The view box can be resized (Zoom) and moved around pan.
	The drawing is at a scale of 1.A zoom scale of 2 doubles the magnification of the drawing, while 0.5 halves it.
	Allows you to pick a point which will be the center of the zoom area.
	Just click on it zoom in on the drawing. You may preset the amount it zooms in a the command line.
	Just click on it zoom out from the drawing. You may preset the amount it zooms out at the command line.
	This zooms to show the complete electronic page you set up. It zooms out to the electronic sheet limits.
	This will zoom to fit the complete drawing on the screen.
	This displays the last view created by zoom, pan or view command.

Pan

Pull down menu: view, pan

The cursor changes to a hand cursor

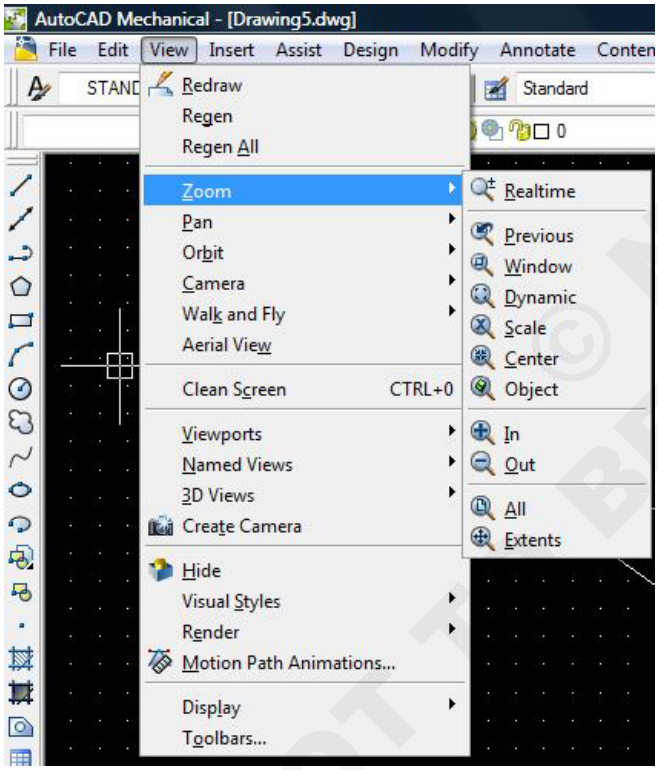


By holding down the pick button on the pointing device, you lock the cursor to its current location relative to the view port coordinate system. Graphics within the window are moved in the same direction as the cursor.

when you reach a logical extent (edge of the drawing space), bar is displayed on the hand cursor on the side where the extend has been reached. Also a message is displayed in the status bar as “already bottom most extent”. Depending upon whether the logical extent is at the top, bottom, or side of the drawing, the bar is either horizontal (top or bottom) or vertical (left or right side)

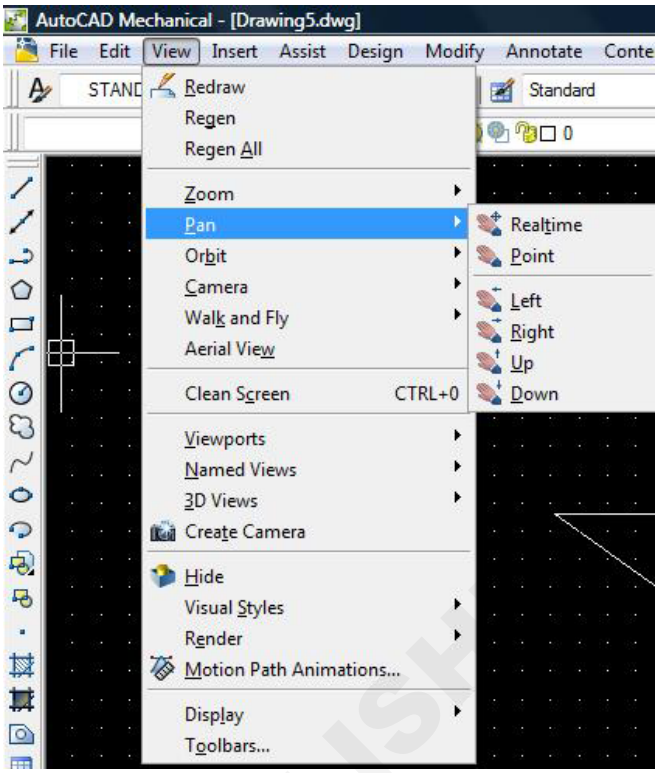
When you release the pick button, panning stops. You can release the pick button move the cursor to another location in the drawing, and the press the pick button again to pan the display from that location.

On your own, move the graphic cursor near the upper-right comer inside the drawing area and note that the drawing area is unchanged. (The Drawing Limits command is used to set the drawing area, but the display will not be adjusted until a display command is used.) Inside the Menu Bar area



Select: **[View] [Zoom] [All]**

Zoom All command will adjust the display so that all objects in the drawing are displayed to be as large as possible. If no objects are constructed, the Drawing Limits are used to adjust the current viewport.



Move the graphic cursor near the upper - right comer inside the drawing area and note that the display area is updated.

In the Menu Bar area select: [View] [pan] [Realtime]

The available Pan commands enable us to move the view to a different position. The Pan - Realtime function acts as if you are using a video camera.

Move the cursor, which appears as a hand inside the graphics window, near the center of the drawing window, then push down the left - mouse - button and drag the display toward the right and top side until we can see the sketched line. (Notice the scroll bars can also be used to adjust viewing of the display.)

Practice - I

Instructions

1. Start a **New file**
2. **Draw** the objects below using: (Fig 1)

   LINE command

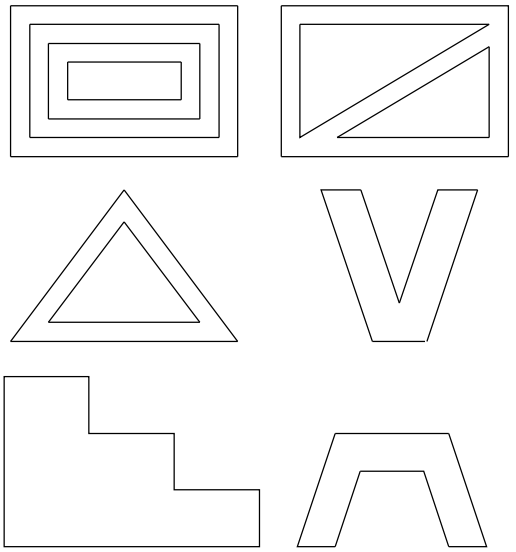
   Ortho (f8) **ON** for **Horizontal** and **Vertical** lines

   Ortho (f8) **OFF** for lines drawn on an **Angle.**

   Increment Snap (f9) **ON** Osnap (f3) **OFF**

3. **Save** this drawing using: Ctrl+S

Fig 1



PRACTICE ON LINE COMMANDS

SUN2566E1

Practice - II

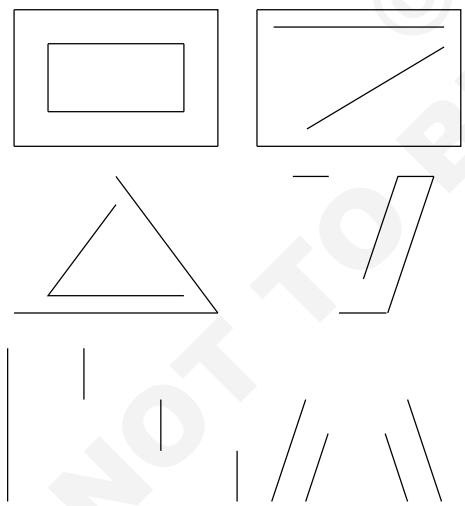
Instructions

1 Using drawing DRG NO **ERASE** the missing lines. (Fig 2)

2 **Save** this drawing using

File / Save as / DRG NO

Fig 2



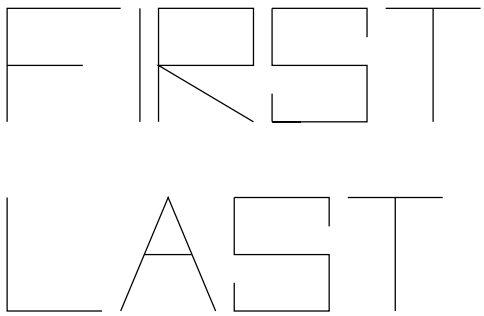
PRACTICE ON ERASE COMMAND

SUN2566E2

Practice - III (Fig 3)

Same as Practice I.

Fig 3

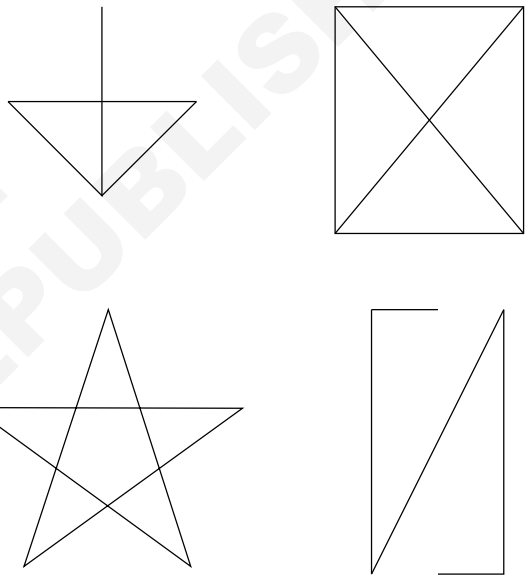


PRACTICE ON LINE & ERASE COMMANDS

SUN2566E3

Practice - IV (Fig 4)

Fig 4



PRACTICE ON LINE COMMANDS

SUN2566E4

Practice on dimensioning line (Figs 5, 6, 7 & 8)

Fig 5

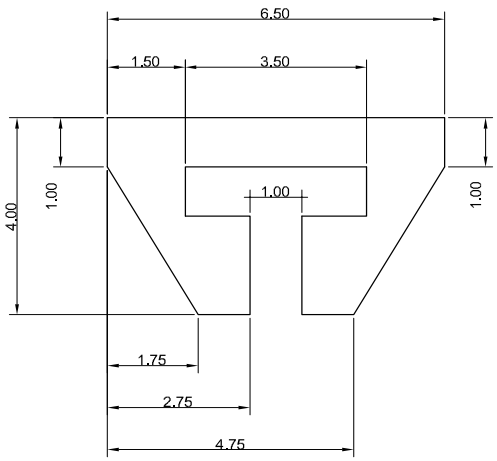


Fig 8

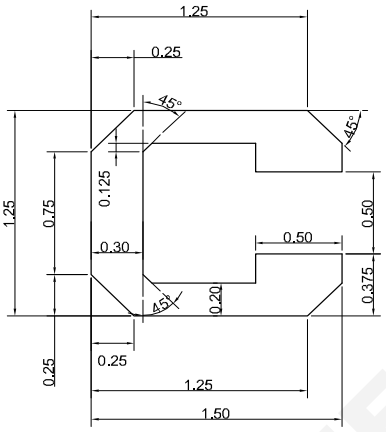


Fig 6

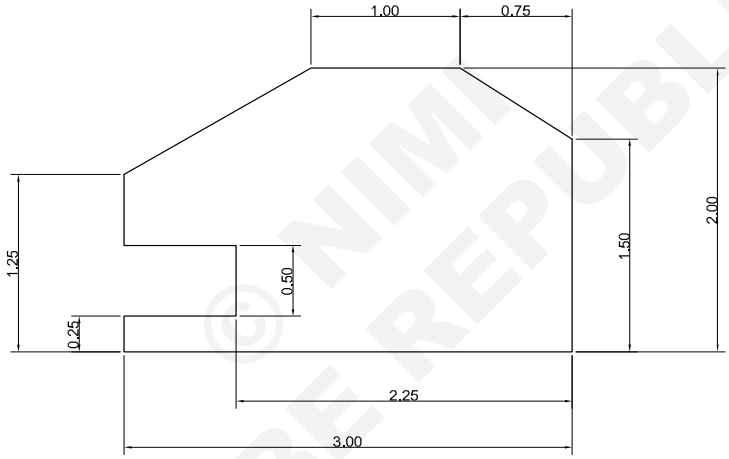
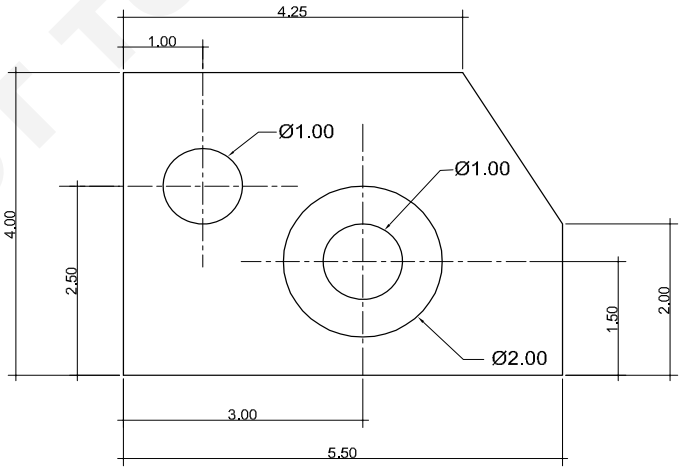


Fig 7



SUN2566E5

Text

This command is used for entering the related details on a drawing. Text is used for entering details in the title blocks, for labelling the parts of drawing, For giving specifications and for making annotations etc. There are two types of text used in Auto CAD.

1. Single line text or Dtext

2. Multiline text or M text

1. SINGLE LINE TEXT OR D TEXT

Pull down: Draw, TEXT, single line text

Command: TEXT or DT

Current text style: "Standard"

Text height: 0.2000

Specify start point of text or [Justify/Style]: Select start point

Specify height<0.2000>: 25

Specify rotation angle of text <0>:

Type on the screen: TEXT

2. MULTI LINE TEXT OR M TEXT

Pull down: Draw, TEXT, Multi line text

Command: MTEXT or MT

Current text style: " Standard"

Text height : 0.20000

Specify first corner: Click on the first corner

Specify opposite comer or [Height/Justify/

Line spacing /Rotation/Style/Width]: click on the second corner Give text height, type, style, etc.

Enter the text, And press button OK.

Text style

This command is used to change the text style.

After giving changes click on apply.