TVET CERTIFICATE III in DOMESTIC ELECTRICITY

DOMESTIC ELECTRICAL DRAWING

ELCED302

# Perform domestic electrical drawing

Competence

**Learning hours: 50**

**Credits: 5**

**Sector:** Energy

**Sub-sector:** Domestic electricity

**Module Note Issue date:** June, 2020

## Purpose statement

This module describes the skills, knowledge and attitude required to perform domestic electrical drawing. It is intended for learners who have successfully completed the 9 years' basic education or its equivalent and pursuing TVET Certificate III in Domestic electricity or other related qualifications. At the end of this module, learners will be able to Use Technical drawing instruments, materials and equipment, draw lines and symbols used in electrical drawing, perform drawing projections, draw electrical diagrams. Qualified learners deemed competent to this competency may work alone or with others on routine tasks in various places such as Home buildings, shops, warehouses, supermarket, hospitals, pharmacies, banks, schools, garage, market, home, churches, hotels under minimum supervision.

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|---|---|---|
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# Learning Unit 1 – **Use Technical drawing instruments, materials and equipment**

## LO 1.1 – Select drawing instruments and equipment according to their use.

- **Content/Topic 1: Identify drawing instruments and equipment according to their use**

### 1.1 Introduction

One of the best ways to communicate one's ideas is through some form of picture or drawing. We will treat "sketching" and "drawing" as one. "Sketching" generally means freehand drawing. "Drawing" usually means using drawing instruments, from compasses to computers to bring precision to the drawings.

Drawing, as an art, is the picturisation of the imagination of the scene in its totality by an individual-the Artist. It has no standard guidelines and boundaries. Engineering drawing on the other hand is the scientific representation of an object, according to certain national and international standards of practice. It can be understood by all, with the knowledge of basic principles of drawing.
The graphical representation of any object or idea can be termed as drawing. A drawing can be prepared either using free hand or using engineering instruments or using computer program.

### 1.2.Types of Drawing

1. Artistic Drawing
2. Engineering Drawing

#### 1.2.1 Artistic Drawing

The drawing representing any object or idea which is sketched in free hand using imagination of artist and in which proper scaling and dimensioning is not maintained is called an artistic drawing.
***Example: Painting, Posters, arts etc.***

#### 1.2.2 Engineering Drawing

Engineering drawing can be defined as a graphical language used by engineers and other technical personnel associated with the engineering profession which fully and clearly defines the requirements for engineered items. It is a two dimensional representation of a three dimensional object. In other words, The art of representing a real or imaginary object precisely using some graphics, symbols, letters and numbers with the help of engineering drawing instruments is called engineering drawing.
The art of representing engineering objects such as buildings, roads, machines, circuits etc. on a paper is called engineering drawing. It is used by engineers and technologists. An engineering drawing provides all information about size, shape, surface type, materials etc. of the object. Example: Building drawing for civil engineers, Machine drawing for mechanical engineers, Circuit diagrams for electrical and electronics engineers, computer graphics for one and all etc.

**1.3 Electrical Engineering Drawing**

The art of representing electrical engineering objects such as motors, generators, transformers, wiring diagrams etc. on a paper are called electrical engineering drawing. It is used by electrical engineers to express electrical engineering works and projects for actual execution.

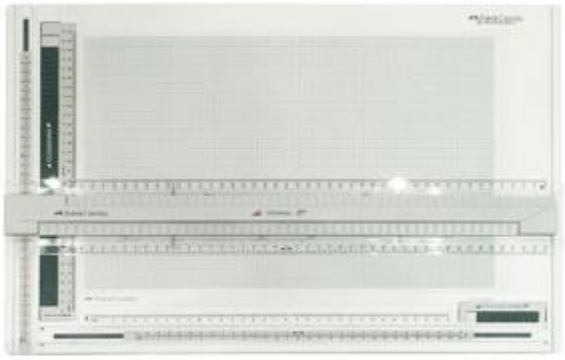
The art of representing electronic circuits of TV, Phones, computers etc. on a paper are called electronic engineering drawing or electronic drawing. It is used by electronic engineers to express electronic engineering works and projects for actual execution.

**1.4 Types of drawing equipment**:

**1.4.1 A.1. Drawing board** (approximately 20" 24"), drafting table, or desk

It is one of the most important aids to make drawings. There are mainly made of wood and plastic. The best ones are of plastic types because they provide a smooth surface which cannot destroy the paper and allow smooth movement of the Tee square. Their main feature is to hold the paper and the Tee Square.

A drawing board



**1.4.2 T-square** (24", transparent edge)

It helps in drawing reference lines. A good Tee square should be able to move freely on the drawing board and hold fixed, while lines are being drawn to allow proper alignment.

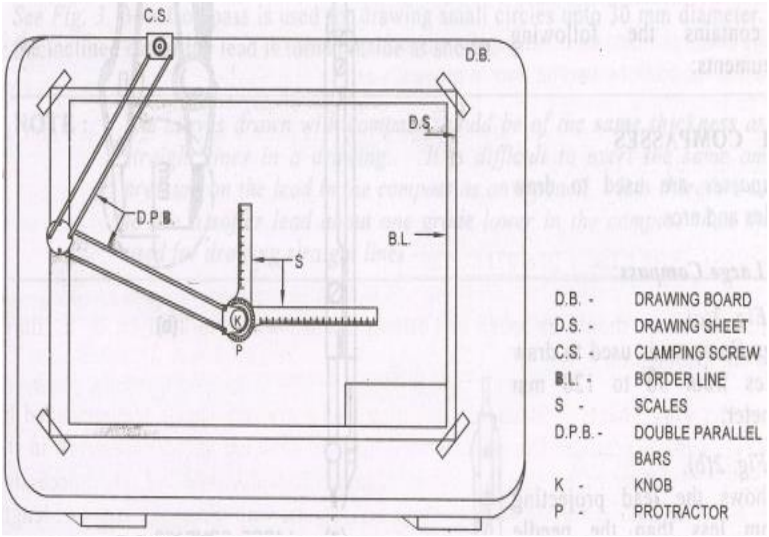
A Tee Square

**1.4.3 Drafting machine**

A drafting machine is used by professional draftsman to prepare drawings. It combines the functions of T-squares, scales, clinograph and protractor. A miniature version of drafting machine known as Mini Drafter is used by students

**Mini Drafter:** One end of the mini- drafter is clamped by means of a clamping screw (C.S.) to the longer edge of the drawing Board (D.B). At its other end an adjustable knob (K) having protractor (P) markings is fitted. Two scales (S) of transparent celluloid, set at right angles to each other are attached to the knob.

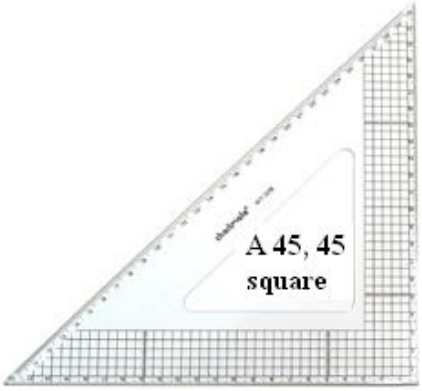
The mini- drafter machine is used to draw horizontal, vertical and inclined lines and also for measuring lines and angles.

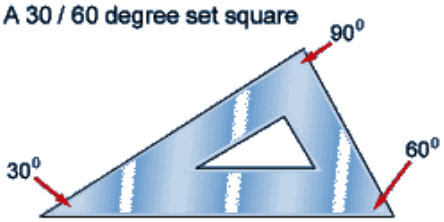


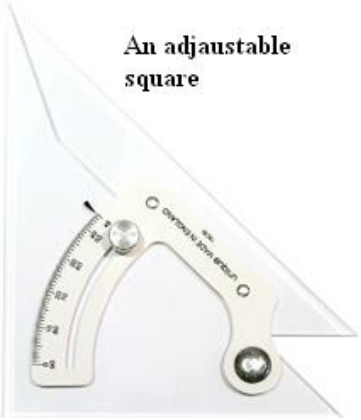

### 1.5 Types of drawing instruments

#### 1.5.1 Set Square

Two are necessary, unless you have an adjustable square. A 60, 30 and a 45, 45 are needed. If you have an adjustable square, it can be adjusted to the angle required, but even then it is also probably best to have a 60, 30 and a 45, 45 as well in order not to keep adjusting your square. Set squares are usually made from plastic and require regular cleaning with paper or cloth.




#### 1.5.2 Set of instruments

**INSTRUMENT BOX**

An Instruments Box contains several pairs of compasses and dividers

It contains the following instrument:

- **Compasses:** are used to draw circles and arcs.
- **Dividers** are used:- For divide straight curved lines into a number of equal parts

-For setting-off dimensions from the-scale to the drawing and

-For transferring dimensions from one part of the drawing to another part.

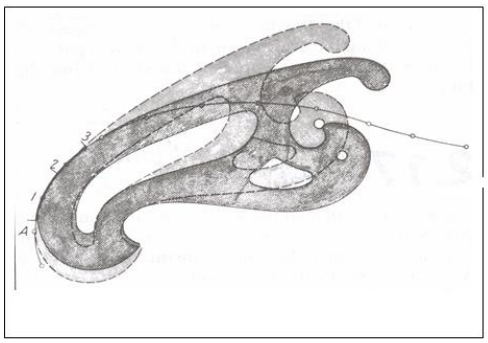
Ruling pens are not normally used in Mechanical Engineering drawing but more on Architectural Drawings.

-Compasses are used to draw arcs and curves. Compasses can also be used to transfer distances and for dividing space into equal parts. Spring compasses are used to draw very small circles.

-Ruling pens are used for inking drawings and have capacity to change the pencils or pen points.

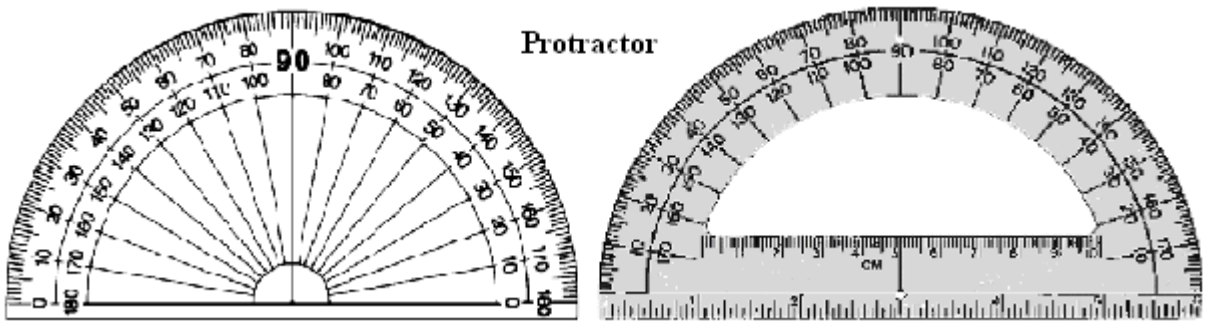
### 1.5.3 Irregular curve /French curve

French Curves also referred to as Irregular Curves are used in drawing regular and smooth curves with varying radii or curvature that cannot otherwise be drawn using other drawing equipment. French Curves are based on various combinations of ellipses, spirals and other geometrical curves and are made in different shapes and sizes.



### 1.5.4 Protractor

Used for constructing angles which are not set square angles. A plastic protractor, measuring up to $180^0$ degrees is suitable.



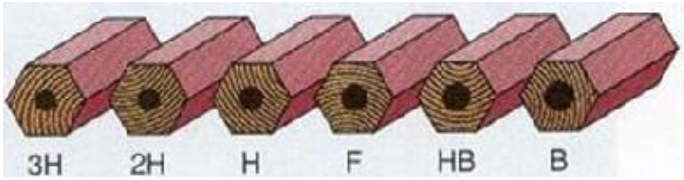
**1.5.5 Mechanical pencils** and/ thin-lead mechanical pencils and HB, F,2H, and 4H to 6H leads/ drawing pencils /lead holder

**Mechanical pencil** is a pencil that has a mechanism that extends solid pigment core called a lead which is made of graphite or a solid pigment


**1.5.6 Drawing Pens**

- **Pencils:** They are in nine grades of hardness H and six grades of blackness B. There are also two other grades: F (Firm) and HB. Two pencils are advisable for drawing with instruments 2H and 3H while HB is advisable for freehand drawing. For pencils to be used with instruments, it is advisable to sharpen them to chisel point or sided-shaped. Pencils to be used for freehand drawing should be shaped to round point.

| B=Black | | | | HB=Hard-Black | F=Firm | H=Hard | | | |
|---|---|---|---|---|---|---|---|---|---|
| … | 3B | 2B | B | HB | F | H | 2H | 3H | … |
| Softer ← | | | | | Harder → | | | | |




The medium grades are used for general use on technical drawings. The harder grades are for instrument drawings and the softer for sketching.

- **Lead-mine pens:** They have appropriate line thickness for engineering drawings and are more suitable to use in the long run because you can use the lead until the very end. They do not have to be sharpened; the drawn lines always have the same thickness. 0.5 and 0.7mm are suitable to do the work. Lead-mine pens are really recommended for good drawing.

- **Ink pen:** They ensure exact, edge sharp and always even line thickness. Three of different line thickness can well do the job. Ink bottles or cartridge are necessary when these are being used.

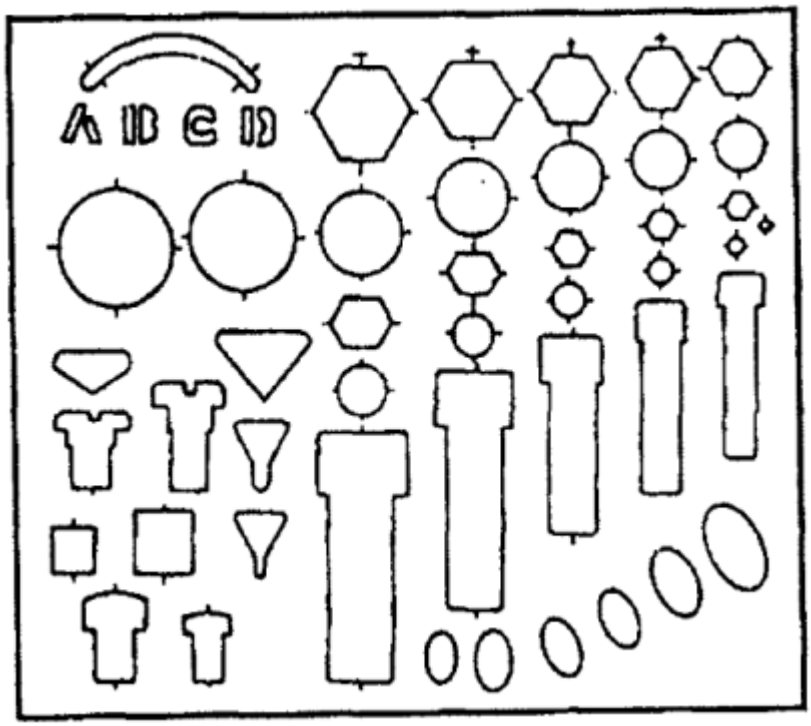
**1 .5.7 Erasing shield**

Erasing shield is used to protect the adjacent lines on the drawing when some part of a line is being erased. It is usually made of thin metal in which gaps of different widths, curves, small circles, arcs, etc. are cut according to the lines to be eraser

**1.5.8 Eraser**

Eraser is used to remove the lines or spots which drawn by mistake or with wrong measurements. The eraser used should be of good quality and soft. It should not damage the paper while erasing.


**1.5.9 Templates:** are used to speed up the drafting process by tracing the punched shapes directly onto a drawing. Templates come



**Other drawing instruments**

- ✓ 45 triangles (8" sides)
- ✓ 3060triangle (10" long side)
- ✓ Ames Lettering Guide or lettering triangle
- ✓ Architects' triangular scale

**Architect Triangular Scale** has a perfectly designed for accuracy and longevity with **Architect's Ruler** Features 3 Sides with 6 Different **Scales**. It can be used in professional applications, such as Engineering, Technical drawing, and **Architecture**.


Although similar in appearance to an **architect's scale**, the **engineering scale** is designed to be more precise and has a decimal **scaling** scheme whereas an **architect's scale** uses fractional **scaling**. It is designed to only be read from left to right. An **architect's scale** can be read from either the left or right side.

- ✓ Engineers' triangular scale
- ✓ Metric triangular scale

**1.6 Types of drawing materials**

- ✓ Lead pointer and sandpaper pad
- ✓ Drawing paper, tracing paper, tracing cloth, or films as required; backing sheet (drawing paper—white, cream, or light green) to be used under drawings and tracings
- ✓ Drafting tape
- ✓ Drawing ink

## LO 1.2 – Use technical drawing materials, instruments and equipment when making graphics.

- Content/Topic 1 : **Technics to use drawing equipments**

**Technics to use drawing equipments**

- ✓ Holding of equipment
- ✓ Manipulation of equipment

**Use of drawing equipments**

## Use of drawing board

Drawing board is rectangular in shape and is made of strips of well-seasoned soft wood about 25 mm thick. It is cleated at the back by two battens to prevent warping. One of the edges of the board is used as the *working edge*, on which the T-square is made to slide. It should, therefore, be perfectly straight. In some boards, this edge is grooved throughout its length and a perfectly straight ebony edge is fitted inside this groove. This provides a true and more durable guide for the T-square to slide on.

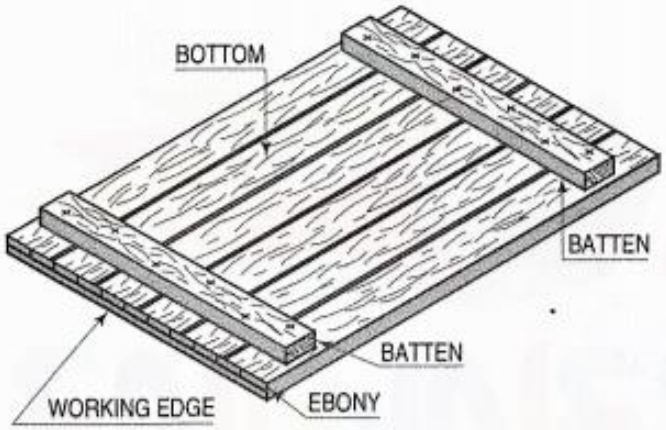



FIG. 1-1

TABLE 1-1
SIZES OF DRAWING BOARDS

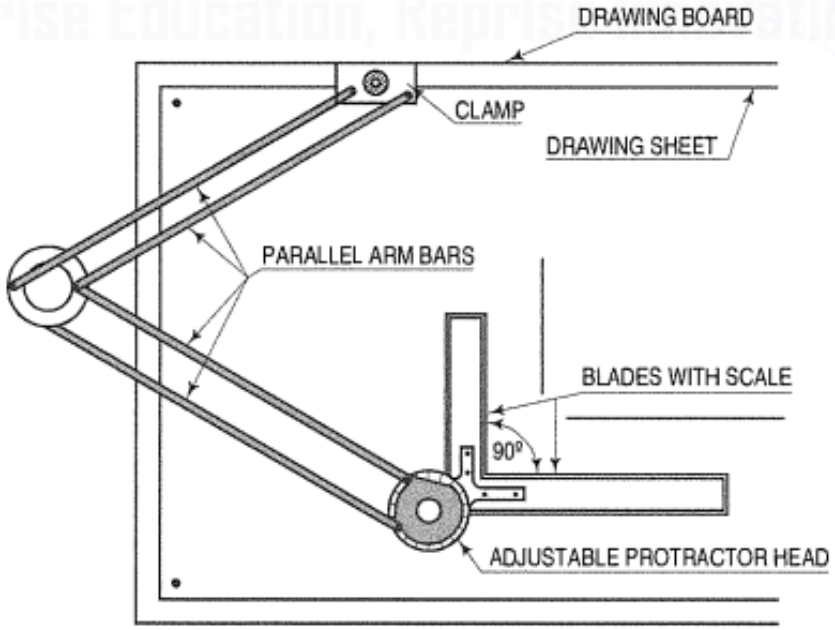
| Designation | Size (mm) |
|---|---|
| B0 | 1000 × 1500 |
| B1 | 700 × 1000 |
| B2 | 500 × 700 |
| B3 | 350 × 500 |

Drawing board is made in various sizes. Its selection depends upon the size of the drawing paper to be used. The sizes of drawing boards recommended by the Bureau of Indian Standards (IS:1444-1989) are tabulated in table 1-1.

For use in schools and colleges, the last two sizes of the drawing boards are more convenient. Large-size boards are used in drawing offices of engineers and engineering firms. The drawing board is placed on the table in front of the student, with its working edge on his left side. It is more convenient if the table-top is sloping downwards towards the student. If such a table is not available, the necessary slope can be obtained by placing a suitable block of wood under the distant longer edge of the board.

## Use of drafting machine

The uses and advantages of the T-square, set-squares, scales and the protractor are combined in the drafting machine. Its one end is clamped by means of a screw, to the distant longer edge of the drawing board. At its other end, an adjustable head having protractor markings is fitted. Two blades of transparent celluloid accurately set at right angles to each other are attached to the head.




The machine has a mechanism which keeps the two blades always parallel to their respective original position, wherever they may be moved on the board. The blades have scales marked on them and are used as straight edges. In some machines, the blades are removable and hence a variety of scales can be used. The blades may be set at any desired angle with the help of the protractor markings.

Thus, by means of this machine, horizontal, vertical or inclined parallel lines of desired lengths can be drawn anywhere on the sheet with considerable ease and saving of time. Drafting machines are common among the college students and draughtsmen.

## Use of T-Square

(i) The T-square is used for drawing horizontal lines. The stock of the T-square is held firmly with the left hand against the working edge of the board, and the line is drawn from left to right as shown in fig. 1-3. The pencil should be held slightly inclined in the direction of the line (i.e. to the right) while the pencil point should be as close as possible to the working edge of the blade. Horizontal parallel lines are drawn by sliding the stock to the desired positions.

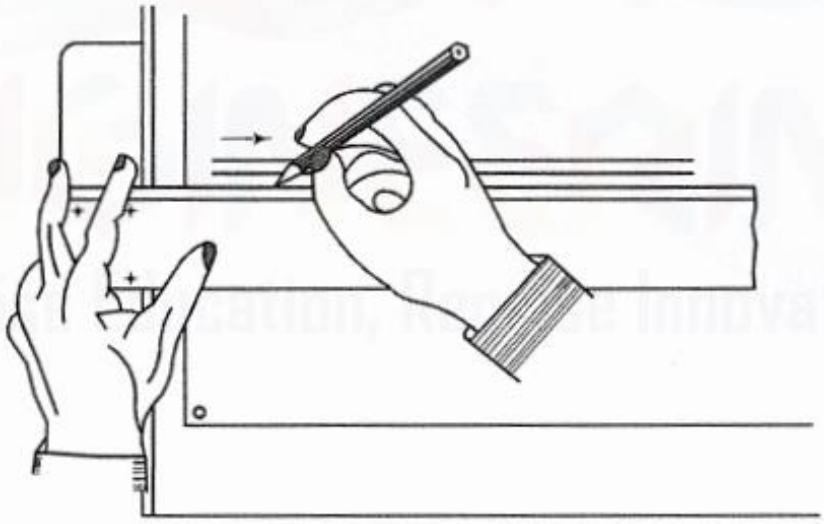


FIG. 1-3

(ii) The working edge of the T-square is also used as a base for set-squares to draw vertical, inclined or mutually parallel lines. A pencil must be rotated while drawing lines for uniform wear of lead. The T-square should never be used on edge other than the working edge of the board. It should always be kept on the board even when not in use.

(iii) Testing the straightness of the working edge of the T-square: Mark any two points *A* and *B* (fig. 1-4) spaced wide apart and through them, carefully draw a line with the working edge. Turn the T-square upside down as shown by dashed lines and with the same edge, draw another line passing through the same two points. If the edge is defective the lines will not coincide. The error should be rectified by planing or sand-papering the defective edge.

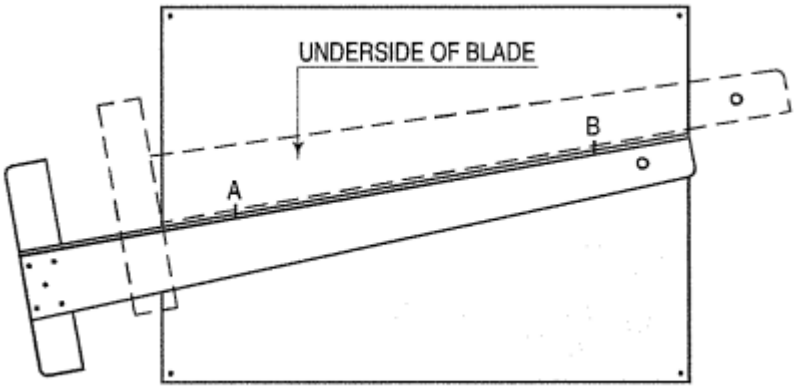



FIG. 1-4

- Content/Topic 2 : **Technics to use drawing instruments**

**Technics to use drawing instruments**

- ✓ Holding of instruments
- ✓ Manipulation of instruments

**Use of Set- Square**

(i) Set-squares are used for drawing all straight lines except the horizontal lines which are usually drawn with the T-square. Vertical lines can be drawn with the T-square and the set-square.

(ii) In combination with the T-square, lines at 30° or 60° angle with vertical or horizontal lines can be drawn with 30°- 60° set-square and 45° angle with 45° set-square. The two set-squares used simultaneously along with the T-square will produce lines making angles of 15°, 75°, 105° etc.

(iii) Parallel straight lines in any position, not very far apart, as well as lines perpendicular to any line from any given point within or outside it, can also be drawn with the two set-squares.

(iv) A circle can be divided in six, eight, twelve and twenty four equal parts by using set-squares and T-square.

**Problem 1-1.** *To draw a line perpendicular to a given horizontal line from a given point within it.*

(i) Place the T-square a little below the given line (fig. 1-6).

(ii) Arrange any one set-square with one of the edges containing the right angle touching the working edge of the T-square, and the other edge passing through the given point.

(iii) Hold the T-square and the set-square in this position firmly with the left hand.

(iv) With the right hand, draw the required line through the given point in the upward direction as shown by the arrow. The pencil point should always be in contact with the edge of the set-square. A perpendicular from any given point outside the line can also be drawn in the same manner. Vertical parallel lines may be drawn by sliding the set-square along the edge of the T-square to the required positions.

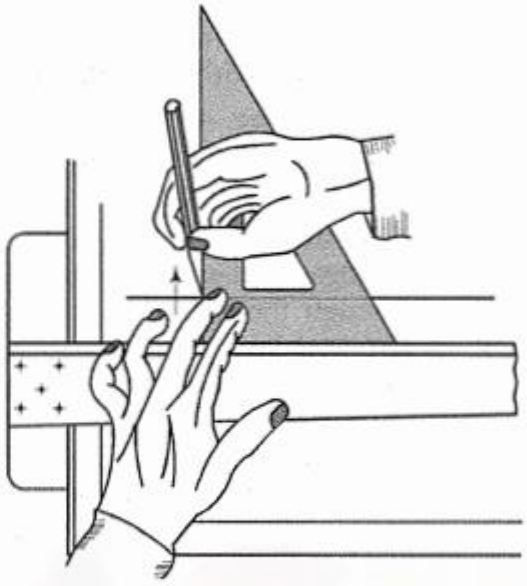


FIG. 1-6

**Problem 1-2.** *To draw a line inclined at 45°, 30° or 60° to a given horizontal line from a given point.*

(i) Place the edge containing the right angle of the 45° set-square on the edge of the T-square (fig. 1-7).

(ii) Slide it so that its longest edge (hypotenuse) passes through the given point and then draw the required line. The same line will make 45° angle with the vertical line passing through that point.

(iii) By turning the set-square upside down, the line making 45° angle in the other direction will be drawn. The lines can also be drawn by placing the set-square so that its longest edge coincides with the edge of the T-square and the other edge passes through the given point. A circle can similarly be divided into eight equal parts by lines passing through its centre (fig. 1-8).

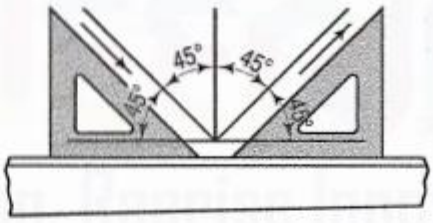



FIG. 1-7


FIG. 1-8

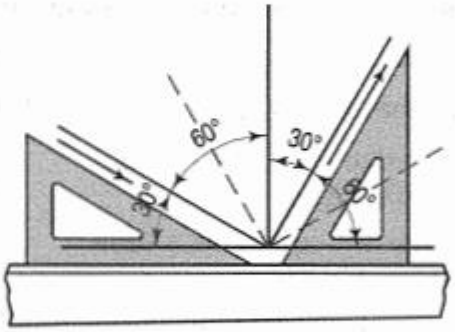



FIG. 1-9

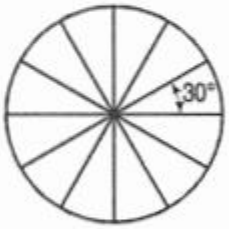



FIG. 1-10

Lines inclined at 30° or 60° to a given horizontal line can similarly be drawn with the aid of a 30°- 60° set-square (fig. 1-9). A circle may be divided into twelve equal divisions in the same manner (fig. 1-10).

## Use of Ink pen

**Inking pen** (fig. 1-25): This is used for drawing straight lines and non-circular arcs in ink. It consists of a pair of steel nibs fitted to a holder made of metal or ivory. Ink is filled between the two nibs to about 6 mm length by means of a quill which is usually fitted to the cork of the ink bottle. The gap between the nibs through which the ink flows and upon which the thickness of the line depends is adjusted by means of the screw *S*.

The pen should be kept sloping at about 60° with the paper in the direction of drawing the line and the ends of the nibs should be slightly away from the edge of the T-square or set-square. The screw should be on the side, farther from the T-square.

As the ink dries rapidly, the pen should be used immediately after it is filled. The inside faces of the nibs should be frequently cleaned for the ink to flow freely and to maintain uniformity in thickness of lines. Ink should never be allowed to dry within the pen. There should be no ink on the outside of the nibs and hence, the pen should never be dipped in ink.

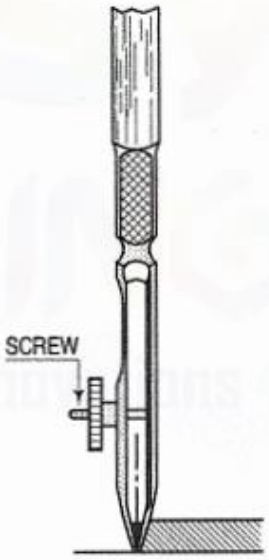



FIG. 1-25

For drawing large circles and circular arcs, inking attachment should be fitted in place of the pencil leg in the compass.

### Use of protractor

The protractor is used to draw or measure such angles as cannot be drawn with the set-squares. A circle can be divided into any number of equal parts by means of the protractor.

**Problem 1-** *To draw a line making an angle of 73° with a given line through a given point in it.*

Let *AB* be the line and *C* the point in it.

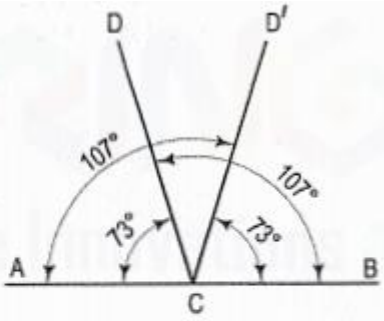


FIG. 1-28

(i) Set the protractor with its base coinciding with *AB* (fig. 1-28) and its centre exactly on the point *C*.

(ii) Mark a point *D* opposite to the 73° division and join *C* with *D*. Then $\angle ACD = 73°$ (fig. 1-28). Another point *D'* can be marked against the reading from the other side. In this case $\angle BCD' = 73°$ while $\angle ACD' = 107°$.

### Use of French curve

French curves are made of wood, plastic or celluloid. They are made in various shapes, one of which is shown in fig. 1-29. Some set-squares also have these curves cut in their middle.


FIG. 1-29

French curves are used for drawing curves which cannot be drawn with a compass. Faint freehand curve is first drawn through the known points. Longest possible curves exactly coinciding with the freehand curve are then found out from the french curve. Finally, neat continuous curve is drawn with the aid of the french curve. Care should be taken to see that no corner is formed anywhere within the drawn curve.

- Content/Topic 3 : **Technics to use drawing materials**

**Technics to use drawing materials**

- ✓ Holding of materials
- ✓ Manipulation of materials

### Use of eraser

Soft India-rubber is the most suitable kind of eraser for pencil drawings. It should be such as not to spoil the surface of the paper. Frequent use of rubber should be avoided by careful planning.

## Use of drawing pins, clips or adhesive tapes

These are used to fix the drawing paper on the drawing board. The needle part of the pin is generally made of steel, while the head may be of plated mild steel or brass. Pins of about 15 mm to 20 mm diameter and about 1 mm thick flat heads made of brass are quite convenient, as they do not rust. Pins should be so inserted that the heads sit on the surface of the paper. Clips or adhesive tapes are often used instead of the pins. (Refer fig. 1-32).

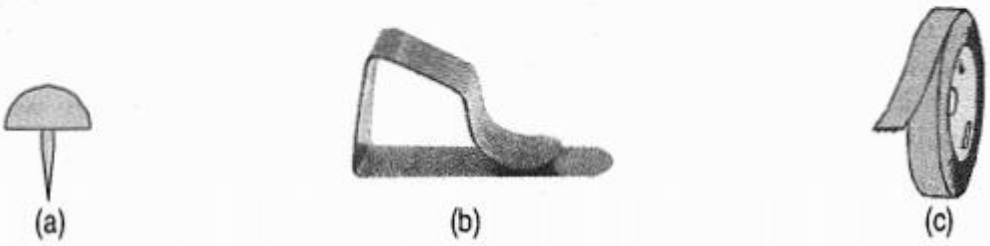



FIG. 1-32

## Use of drawing papers

Drawing papers are available in many varieties. For ordinary pencil-drawings, the paper selected should be tough and strong. It should be uniform in thickness and as white as possible. When the rubber eraser is used on it, its fibres should not disintegrate. Good quality of paper with smooth surface should be selected for drawings which are to be inked and preserved for a long time. It should be such that the ink does not spread. Thin and cheap quality paper may be used for drawings from which tracings are to be prepared. The standard sizes of drawing papers recommended by the Bureau of Indian Standards (B.I.S.). are given in table 2-1.

Surface area of A0 size is one square metre. Successive format sizes (from A0 to A5) are obtained by halving along the length or doubling along the width. The areas of the two supsequent sizes are in the ratio 1:2. See fig. 1-30.

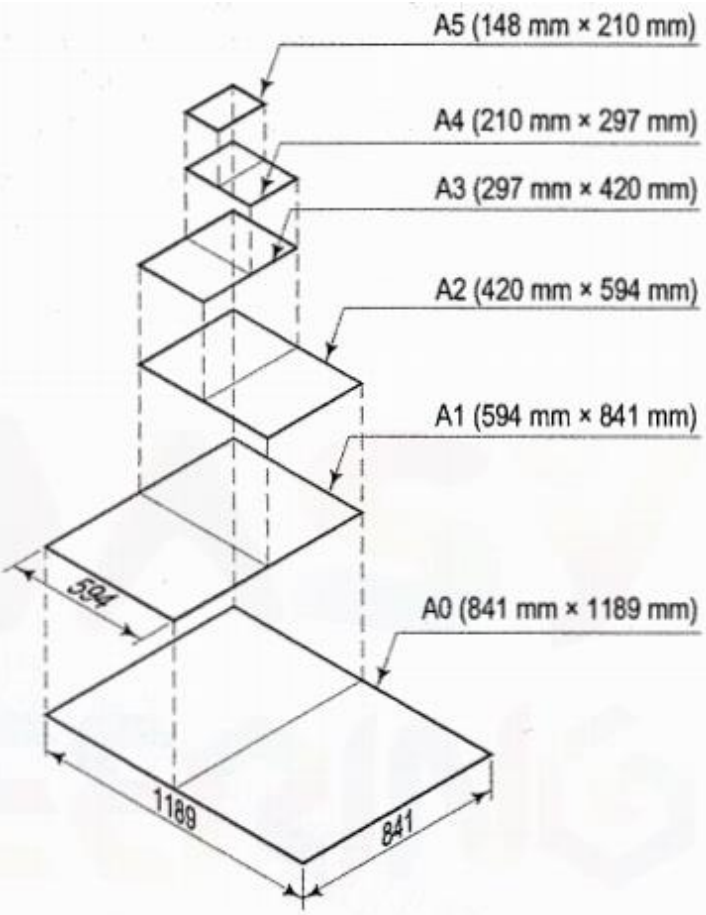



FIG. 1-30

## LO 1.3 – Store drafting materials, instruments and equipment in accordance with their types

- Content/Topic 1 : Use of drafting storage

Use of drafting storage

- ✓ Mobile shelving
- ✓ Rotary cabinet
- ✓ Storage trays
- ✓ Storage cases
- ✓ Bags and pencil pouches

**Mobile shelving**

**Mobile shelving**, **mobile aisle shelving**, **compact us, roller racking**, or **rolling stack**, are terms applied to shelving or storage units fitted with wheeled traction systems. Units can be closely packed when access is not required, but can be readily moved to open up an aisle to allow access. By eliminating the need for a permanently open aisle between every unit, a smaller proportion of floor space can be allocated to storage than in the case of conventional fixed shelving, or a higher capacity of storage can be met using the same footprint as fixed shelving.

Each shelving unit is normally mounted on a level track way (to eliminate gradients in the supporting floor), making it possible to move heavy units with minimal effort. Mobile shelving can be moved manually or by the use of electrical motors. The track/flooring can either sit on top of an existing floor or be integrated into raised access flooring allowing for a smooth transition between unit and surrounding floor levels

**A rotary cabinet** is a type of mobile storage that is flexible, secure and space efficient. The extra space created by a rotary cabinet helps to keep the workplace clutter free.

The interior of the rotary cabinet is similar to that of a standard four-sided storage cabinet with the difference being that it spins completely in both directions. A rotary cabinet can be stopped in any desired position.

Whilst two of its positions provide storage in the form of compartments, the other two positions remain closed. The rotary cabinets can be rotated quickly, saving a lot of time when accessing their required content.

Rotary cabinets dramatically increase floor space availability and decrease retrieval time, making them extremely efficient for larger organizations and offices. They are also frequently used as multimedia storage equipment due to their capacity.

Rotary cabinets are easy to access and can be shared by two separate workstations due to their spinning facility. This makes the rotary cabinet twice as efficient as other storage systems. A rotary cabinet requires professional installation. Whilst rotary cabinets remain open from the front, they can be custom-made with doors and locks for safety and security.

**Store drafting tools**

Find or create and organizer where you can hang your measuring **tools**. Have a separate container for making **tools**. **Keep** your **drawing** sheets in a plastic tube to protect them from a dust and dirt. Never lend or borrow **drafting tools** and materials if may.

**Pencil cases** can be **made from** a variety of materials such as wood or metal. Some **pencil cases** have a hard and rigid shell encasing the pens inside, while others use a softer material such as plastic, leather or cotton. Soft versions are typically fastened with a zipper.

# Learning Unit 2 Draw lines and symbols used in electrical drawing

## LO 2.1 – Differentiate types of line according to their uses and thickness

- Content/Topic 1 : **Differentiate types of line according to their uses and thickness**

### 1. Types of lines

Technical Drawing is all about Lines. There are many types of lines used in Technical Drawing which are different according to their thickness (Thick and Thin lines) and applications. Mostly they are for actual drawing, but some serve as symbols to represent things happening in the drawing itself or direct you to something happening in real life. In other words, Lines in Technical Drawing communicate with you. Recommended thicknesses of lines are:
Thick 0.7mm; Thin 0.35mm.

| Sr. No. | Type of Line | Thickness (mm) | Illustration | General Application |
|---|---|---|---|---|
| 1 | Continuous thick | 0.5 | THICK | Visible outlines |
| 2 | Continuous thin | 0.2 | THIN | Dimension lines, extension lines, projection lines, leader lines, hatching, revolved section, construction lines etc. |
| 3 | Dashed medium thick | 0.3 | MEDIUM THICK | Hidden lines |
| 4 | Chain thin | 0.2 | THIN | Centre line, lines of symmetry. |
| 5 | Chain thin and thick at ends only | 0.2 for thin & 0.5 for thick ends | THICK THIN THICK | Cutting plane lines |
| 6 | Continuos thin wavy | 0.2 | THIN | Irregular boundary line. |
| 7 | Continous thin with zig-zigs | 0.2 | THIN | Long break line |
| 8 | Continuos thin and arrow-heads at both ends | 0.2 | THIN | Dimension lines |

## LO 2.2 – Draw lines according to their uses

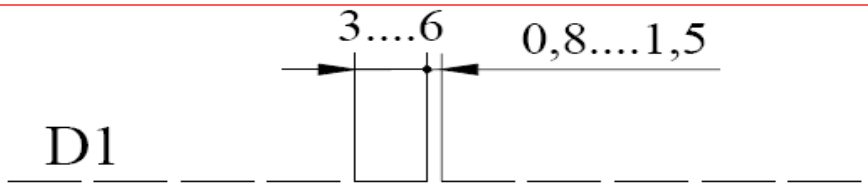
- Content/Topic 1 : Draw different types of lines

There many types of line used in engineering drawing. Their thickness and continuity allow differentiating between their types. Following are the most used ones .

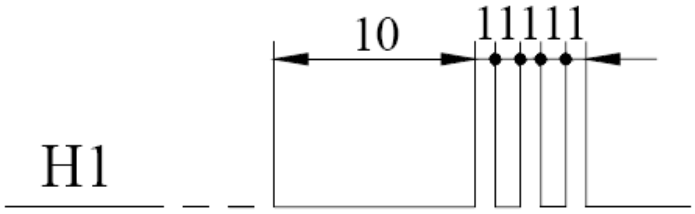
a- Thickness of lines should be drawn according to the standards.
b- At free hand drawing:

Continuous and thick lines should be drawn by B or 2B pencil.
Continuous and thin lines should be drawn by H or 2H pencil.
c- Dash lines should be drawn at equal spaces and

thickness. They should be 3~6 mm, or 0,8~1,5 mm

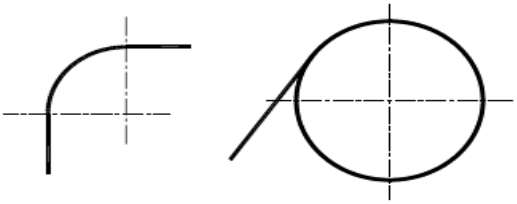



d- Dash lines with point should be drawn according to the size of the picture with below mentioned sizes.

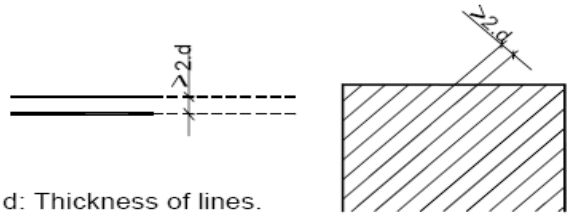



f- Intersected continuous lines should not be overflowed or uncompleted at the intercept points. Thicknesses should be same and corners should

g- Junctions of circle arcs and lines should be tangent.



h- Minimum space of two parallel lines should not be less than two times of the thick lines




d: Thickness of lines.

## LO 2.3 – Present drawing sheet layout in accordance with the drawing standards

- Content/Topic 1 :**Present drawing sheet layout in accordance with the drawing standards**

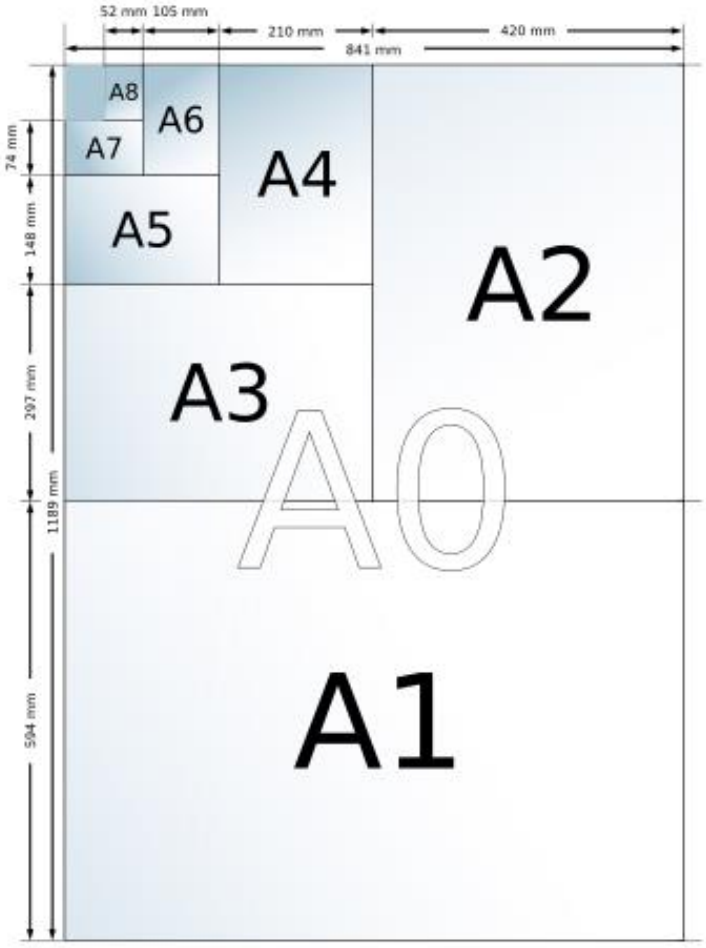
**Drawing Sheet**

The standard drawing sheet sizes are arrived at on the basic Principal of x: y = 1 :√2 and xy = 1 where x and yare the sides of the sheet. For example AO, having a surface area of 1 Sq.m; x = 841 mm and y = 1189 mm. The successive sizes are obtained by either by halving along the length or doubling the width, the area being in the ratio 1 : 2. Designation of sizes is given in Fig. below and their sizes are given in Table below. For class work use of A2 size drawing sheet is preferred.

**Drawing Papers**: They are mainly classified as per their sizes from A0 to A6. There are also larger size like 2A0and 4A0however at school we will be using A4 size. A0 s a rectangle with an area of $1m^2$. All A size sheets have their edge lengths in the same proportion. This proportion is in the ratio of short side to the long side and is equal to $1:\sqrt{2}$ . Each lower size in the A series is obtained by exactly dividing the A sheet along its middle as shown in the following figure:

***Table of sheets sizes***

| Format | Measurements in mm |
|---|---|
| A0 | 841 x 1189 |
| A1 | 594 x 841 |
| A2 | 420 x 594 |
| A3 | 297 x 420 |
| A4 | 210 x 297 |
| A5 | 148 x 210 |
| A6 | 105 x 148 |




**LAYOUT OF THE DRAWING SHEET**

The selection of suitable scale and proper space for margin, title block, part list, folding marks etc. on the drawing sheet is known as layout of drawing sheet

**Important terms**

1. **MARGIN:** A margin is provided around the sheet by drawing margin lines. The provision of margin lines will enable prints to be trimmed along margin lines. Prints after trimming would be of recommended sizes of sheets.
2. **BORDER LINES:** The clear working space on the drawing sheet is obtained by drawing border lines. In general practice, more space is kept on the left side for filling or binding when necessary.
   The layout of a drawing sheet used on the shop floor is shown in Fig.a. below, The layout suggested to students is shown in Fig.b.below

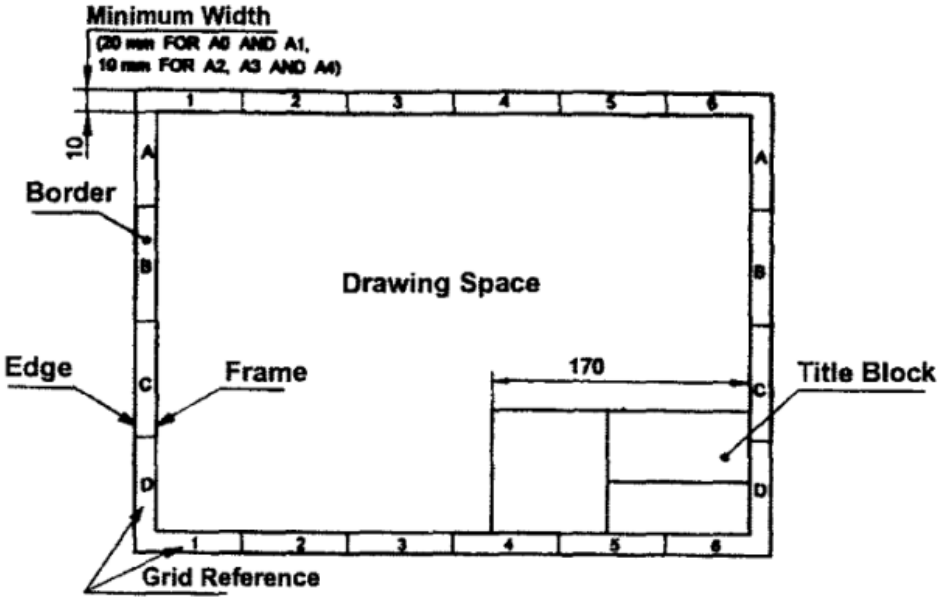



Fig. (a) General features of a drawing sheet

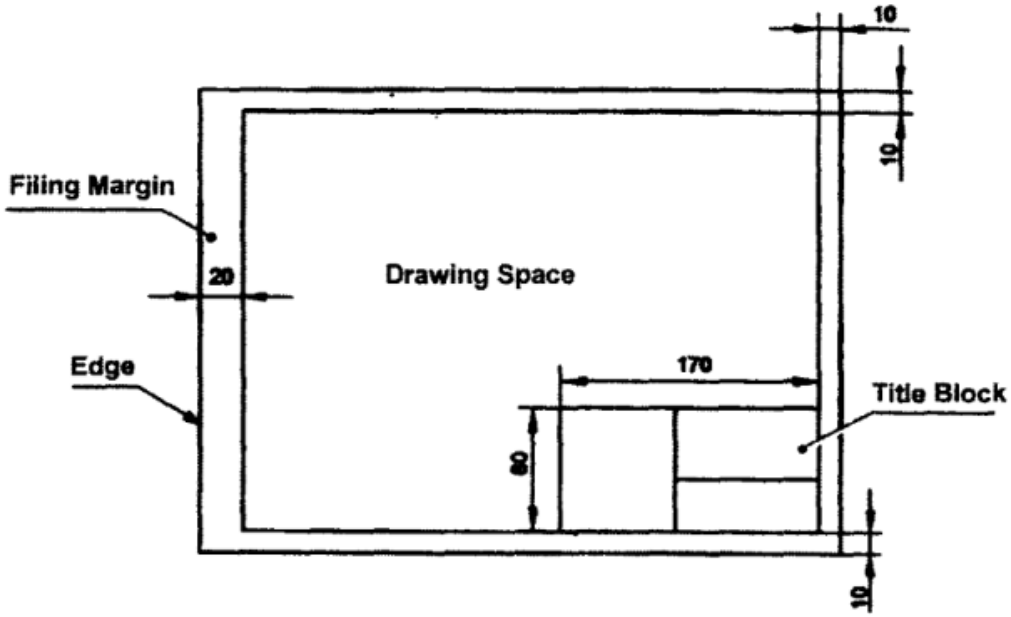
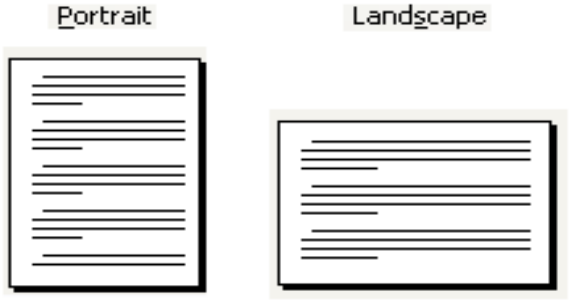



Fig. (b) Layout of sheet for class work

***Drawing sheet layout***

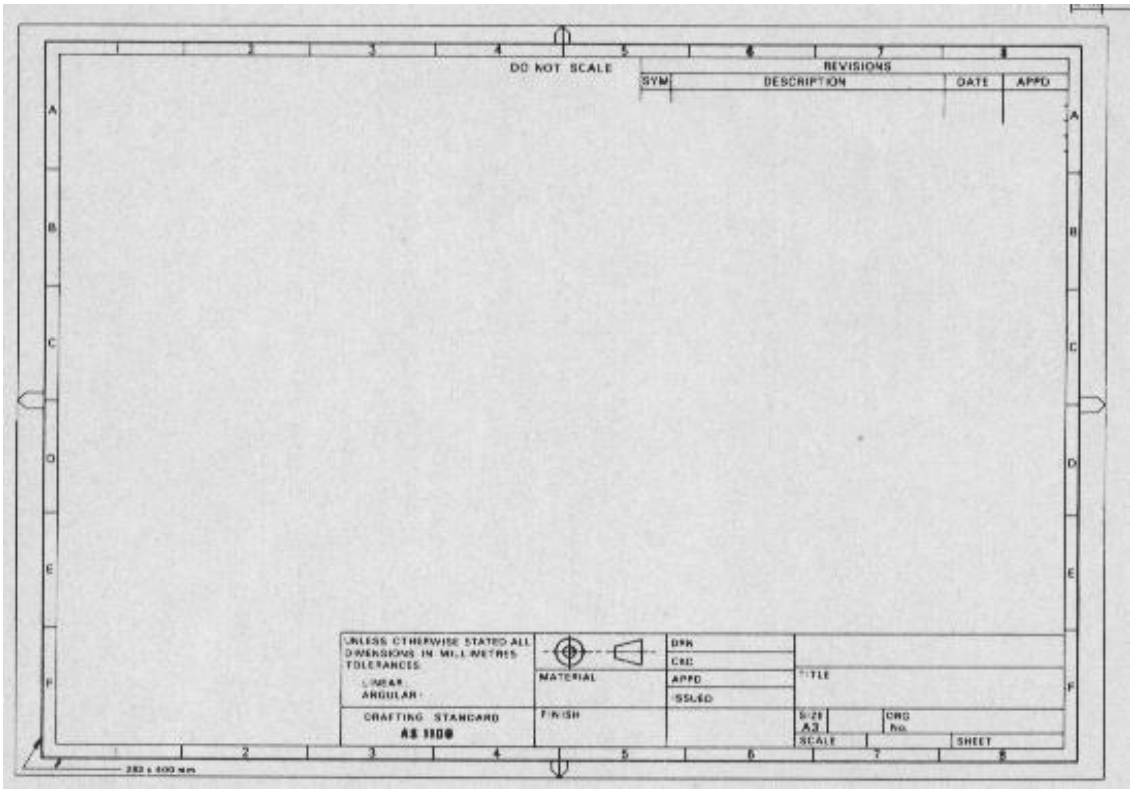
Depending on the shape and size of the object being represented on the drawing, the drawing sheet can be taken in the Portrait or Landscape position.



**TITLE BLOCK**

**Definition:** The title block is an important feature in the drawing because it gives all the information of the prepared drawing. It should be located at right bottom corner of drawing paper
In such manner that it will be appeared after folding drawing paper. Normally title block must contains the followings information:

- Type and location of construction project
- Names and location of Client or Owner's properties
- Types of drawings( Plans, Sections, Views)
- Numeric scale
- Names, location and signature of Designer.
- Date of drawing




A typical title block

| | |
|---|---|
| TITLE WHEEL BEARING | |
| NAME John Smith | CHECKED |
| VERSION 1.1 | DATE 16.10.98 |
| NO NEED TO MEASURE -ALL MEASUREMENTS IN MM | SCALE 1:1 |
| ITI ENGINEERING | |

## LO 2.4 – Apply techniques of free hand sketching based on the given object

- Content/Topic 1: **Apply techniques of free hand sketching**

### 1 Introduction

Freehand sketching is one of the effective methods to communicate ideas irrespective of the branch of study. The basic principles of drawing used in freehand sketching are similar to those used in drawings made with instruments. The sketches are self-explanatory in making them.

Techniques of free hand sketching

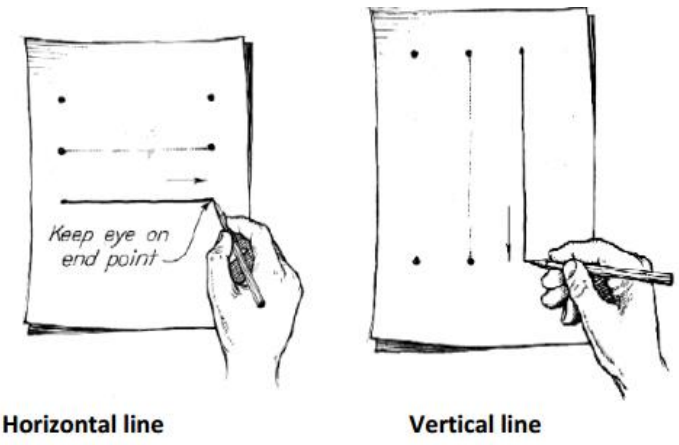
- ✓ Put the starting point
- ✓ Keep your eyes on the terminal point
- ✓ Keep your continuous stroke
- ✓ Control the motion of pencil

**Examples of freehand sketches:**

**1. Sketching straight lines**

**Procedures :**

1. Hold the pencil naturally.
2. Spot the beginning and end points.
3. Swing the pencil back and forth between the points, barely touching the paper until the direction is clearly established.
4. Draw the line firmly with a free and easy wrist-and-arm motion.




**Horizontal line** **Vertical line**

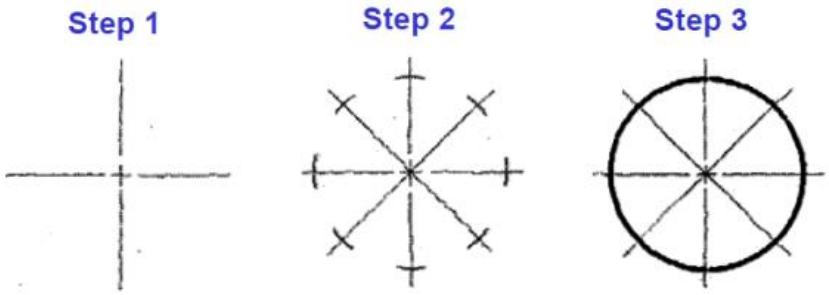
**3. Sketching small circle**

**Method1: Starting with a square**

1. Lightly sketching the square and marking the mid-points.
2. Draw light diagonals and mark the estimated radius.
3. Draw the circle through the eight points.

**Method 2: Starting with center line.**

1. Lightly draw a center line.
2. Add light radial lines and mark the estimated radius.
3. Sketch the full circle




## LO 2.5 – Print letters and figures following the standards

- Content/Topic 1:**Identify types of lettering**

- **LETTERING**

Lettering is defined as writing of titles, sub-titles, dimensions, etc., on a drawing.

**Importance of Lettering**
To undertake production work of engineering components as per the drawing, the size and other details are indicated on the drawing. This is done in the form of notes and dimensions.

**Main Features of Lettering** is legibility, uniformity and rapidity of execution. Use of drawing instruments for lettering consumes more time. **Lettering should be done freehand with speed.** Practice accompanied by continuous efforts would improve the lettering skill and style. Poor lettering mars the appearance of an otherwise good drawing.

**Single Stroke Letters**
The word single-stroke should not be taken to mean that the lettering should be made in one stroke without lifting the pencil. It means that the thickness of the letter should be uniform as if it is obtained in one stroke of the pencil.

**Types of Single Stroke Letters**
1. Lettering Type A: (i) Vertical and (ii) Sloped (at $75^0$ to the horizontal)
2. Lettering Type B : (i) Vertical and (ii) Sloped (at $75^0$ to the horizontal)

**Type B Preferred**
In Type A, height of the capital letter is divided into 14 equal parts, while in Type B, height of the capital letter is divided into 10 equal parts. Type B is preferred for easy and fast execution, because of the division of height into 10 equal parts.

**Vertical Letters Preferred**
Vertical letters are preferred for easy and fast execution, instead of sloped letters.
Note: Lettering in drawing should be in CAPITALS (i.e., Upper-case letters).
Lower-case (small) letters are used for abbreviations like mm, cm, etc.

**Size of Letters**

• Size of Letters is measured by the height **h** of the CAPITAL letters as well as numerals.
• Standard heights for CAPITAL letters and numerals recommended by BIS are given below:
1.8, 2.5, 3.5, 5, 6, 10, 14 and 20 mm
Note: Size of the letters may be selected based upon the size of drawing.

**Guide Lines**

In order to obtain correct and uniform height of letters and numerals, guide lines are drawn, using 2H pencil with light pressure. HB grade conical end pencil is used for lettering.

**Procedure for Lettering**

1. Thin horizontal guide lines are drawn first at a distance **' h'** apart.
2. Lettering Technique: Horizontal lines of the letters are drawn from left to right. Vertical, inclined and curved lines are drawn from top to bottom.
3. After lettering has been completed, the guidelines are not erased.

- Content/Topic 2:**Dimension of lettering**

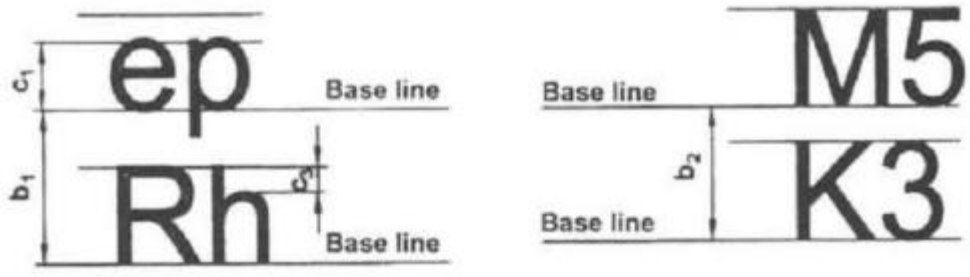
**Dimensioning of Type B Letters (Figs a and b)**

BIS denotes the characteristics of lettering as:
h (height of capita) letters),
$c_1$ (height of lower-case letters),
$c_2$ (tail of lower-case letters),
$c_3$ (stem of lower-case letters),
a (spacing between characters),
$b_1$ & $b_2$ (spacing between baselines),
e (spacing between words) and
d (line thickness),
Table of Lettering Proportions

| Recommended Size (height h) of Letters / Numerals | |
|---|---|
| Main Title | 5 mm, 7 mm, 10 mm |
| Sub-Titles | 3.5 mm, 5 mm |
| Dimensions, Notes, etc. | 2.5 mm, 3.5 mm, 5 mm |

- Content/Topic 3:**Apply lettering**

Practice of lettering capital and lower case letters and numerals of type B are shown in Figure below




**Feature of lettering**

a. Uniformity
b. Neatness
c. Rapidity

All lettering works are done either by freehand or by using drawing instruments. Skills and proficiency in freehand lettering can be achieved by the proper selection of appropriate sizes and style of lettering.

**Height of letters and numerals**

The height of letters and numerals recommended for use in engineering drawing are 2.5, 3.5, 5, 7, 10, 14 and 20mm. Height of the letters and numerals will be different for different purposes and may be selected suitably for their purpose.

**Classification of lettering**

**1. Gothic lettering**

The letter in which all the alphabets are of uniform width or thickness is known as gothic lettering

**2. Freehand lettering**

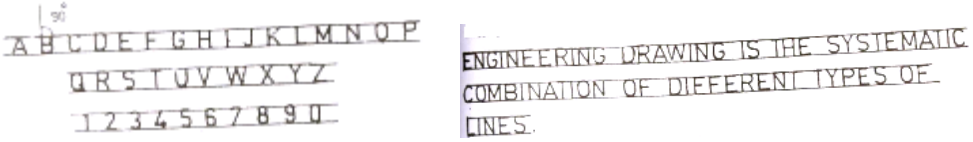
The art of writing alphabets without the use of instruments is called freehand lettering.

**3. Roman lettering**

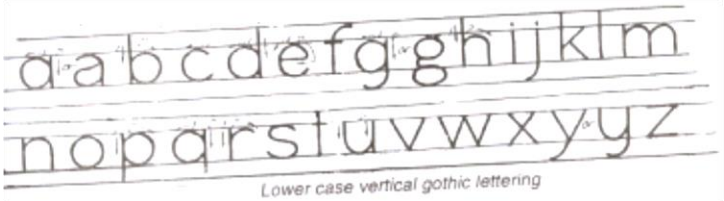
**Style of freehand lettering**

**a) Vertical or upright freehand lettering**

i) Single stroke vertical freehand lettering

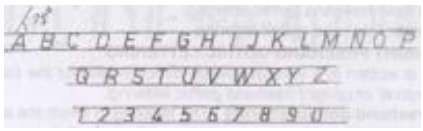



ii) Lower case vertical freehand lettering



**b) Inclined or Italic freehand lettering**

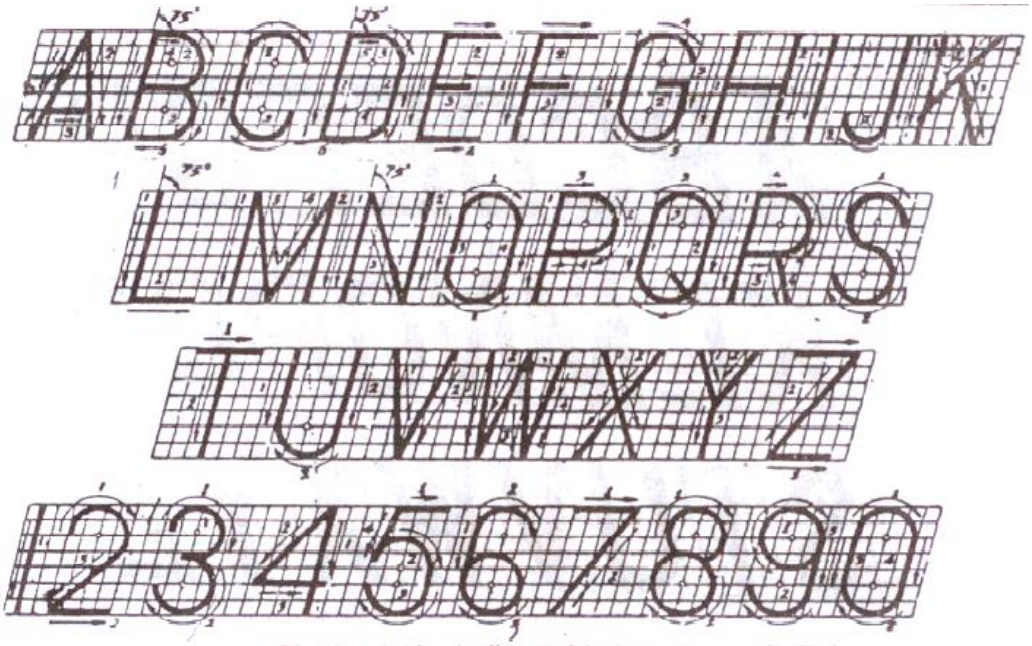
i) Single stroke italic freehand
ii) Lower case Italic freehand



i) Single stroke Italic free hand lettering (Height=3mm)

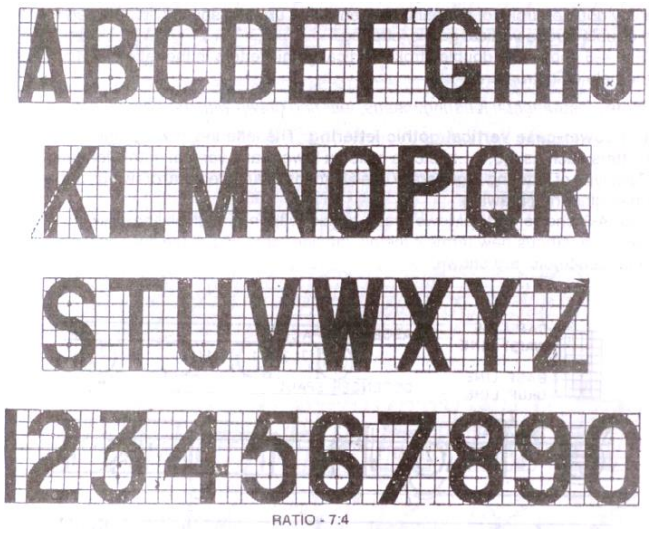
ii) Lower case Italic free hand

**Single stroke:** The lettering in which the alphabets are written with a single stroke of pencil or pen is called a single stroke



*Single stroke italic gothic lettering ratio 7:4*

**Double stroke:** The lettering in which the alphabets are written by double stroke of the pencil or pen with uniform spacing in between strokes is called double – stroke.



RATIO - 7:4

**Spacing of letters**

The spacing means the distance which is to be left between the two adjacent letters in all types of lettering

Note: - The space between each word should be kept equal to height of letter

d. The space between the two lines should be left equal to twice the height of letter.
e. The space between the two lines should be kept not less than half or more than one and a half times the height of letter.

h: Lettering height (capital letters)

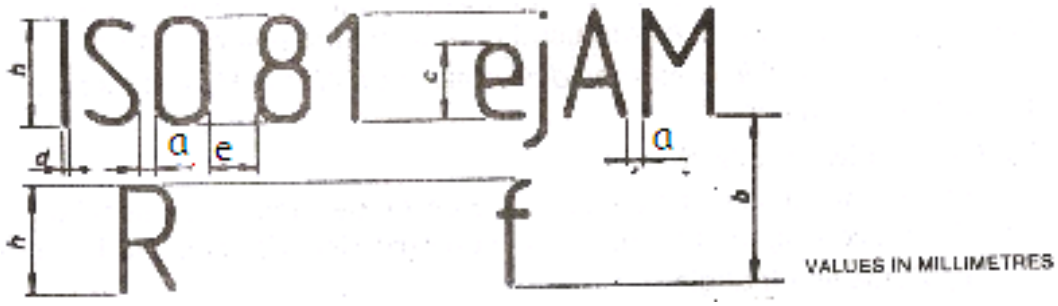
c: Height of lower case letters

a: Spacing between characters

b: Minimum spacing of base line

e: Minimum spacing between words

d: Thickness of lines




| CHARACTERISTIC | | RATIO | DIMENSION | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LETTERING HEIGHT<br>HEIGHT OF CAPITALS | h | (14/14) h | 2.5 | 3.5 | 5 | 7 | 10 | 14 | 20 |
| HEIGHT OF LOWER-CASE LETTERS<br>(WITHOUT STEM OR TAIL) | c | (10/14) h | - | 2.5 | 3.5 | 5 | 7 | 10 | 14 |
| SPACING BETWEEN CHARACTERS | a | (12/14) h | 0.35 | 0.5 | 0.7 | 1 | 1.4 | 2 | 2.8 |
| MINIMUM SPACING OF BASE LINES | b | (20/14) h | 3.5 | 5 | 7 | 10 | 14 | 20 | 28 |
| MINIMUM SPACING BETWEEN WORDS | e | (6/14) h | 1.05 | 1.5 | 2.1 | 3 | 4.2 | 6 | 8.4 |
| THICKNESS OF LINES | d | (1/14) h | 0.18 | 0.25 | 0.35 | 0.5 | 0.7 | 1 | 1.4 |

# Learning Unit 3 – **Perform drawing projections**

## LO 3.1 – Draw angles followed during fixation of electrical objects

- Content/Topic 1: **Draw angles followed during fixation of electrical objects**

Different Types of angles

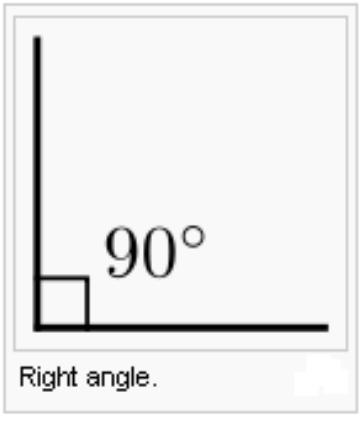
- ✓ Zero angle
- ✓ Acute angle
- ✓ Optuse angle
- ✓ Right angle
- ✓ Straight angle
- ✓ Reflex angle
- ✓ Full angle

1. ANGLES

When two straight lines meet (AB and AC below), they form an angle. Angles are measured in degree ($^0$). There are $360^0$ in a circle. Angles can be drawn and measured using a protractor.

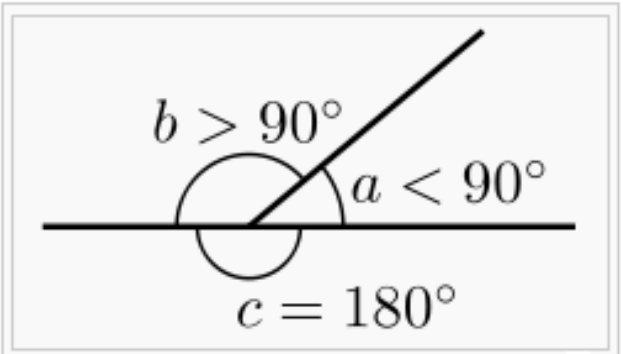
Different types of angle

| | Degrees | Radians |
|---|---|---|
| Zero | $a = 0$ | $a = 0$ |
| Acute | $0 < a < 90°$ | $0 < a < \pi/2$ |
| Right | $a = 90°$ | $a = \pi/2$ |
| Obtuse | $90° < a < 180°$ | $\pi/2 < a < \pi$ |
| Straight | $a = 180°$ | $a = \pi$ |
| Reflex | $180° < a < 360°$ | $\pi < a < 2\pi$ |
| Full | $a = 360°$ | $a = 2\pi$ |



Right angle.

Reflex angle.



Acute (*a*), obtuse (*b*), and straight (*c*) angles.

## LO 3.2 – Draw geometrical figures, followed during fixation of electrical objects

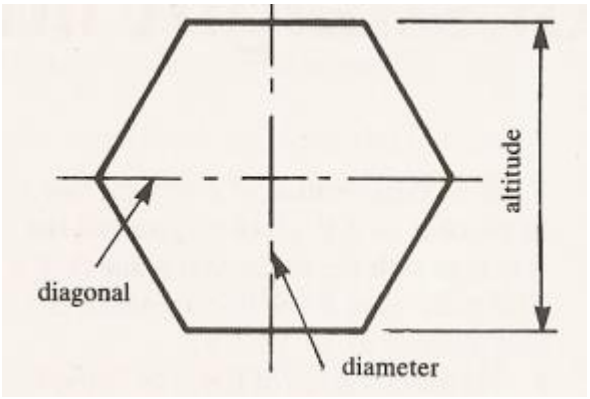
- Content/Topic 1 : **Draw polygons**

**POLYGONS**

A polygon is a figure with more than four sides. According to the number of sides, a polygon has, it may be termed a pentagon (5 sides), hexagon (6), heptagon (7), Octagon (8), nonagon (9) or Decagon (10).

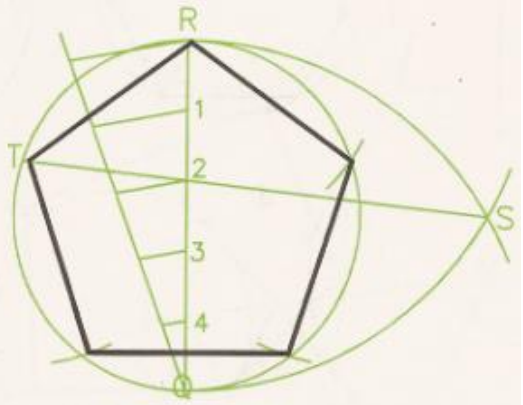
Regular polygons have sides of equal length with all included angle equal.

**Terminology**



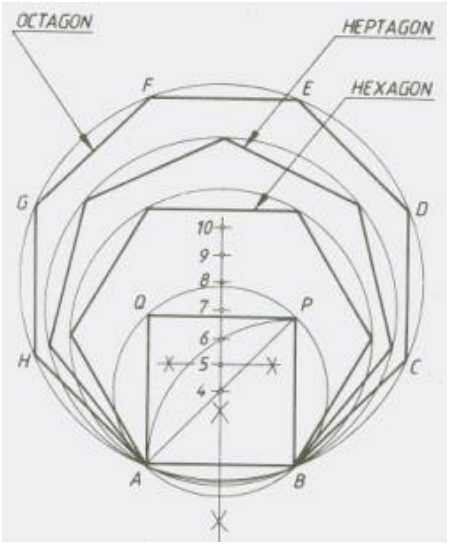

**To construct a regular polygon within a circle**

1. Draw a circle of 80 mm diameter.
2. Draw the vertical diameter QR and divide it into 5 equal parts.
3. Draw arcs radius RQ from R and Q to meet at S.
4. Draw ST through point 2 on RQ.
5. RT is the side of the required regular pentagon.



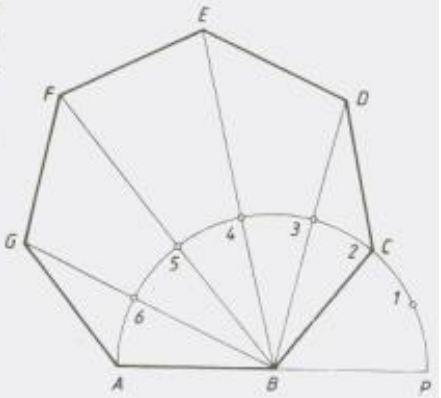

1) To draw a regular polygon given the length of one side

- Draw line AB equal in length to one of the side of polygon
- Bisect AB
- From B draw an angle of $45^0$ to intersect the bisector at point 4
- From B, draw an angle of $60^0$ to intersect bisector at 6.
- Bisect between 4 and 6 to give point 5
- Use a compass width equal to 5,6 to find Point 7,8,9 and 10.
  Note: - Point 4 is the centre of the circle, radius 4A, containing a square
    - Point 5 is the centre of circle, radius 5A, containing a pentagon
    - Point 6 is the centre of circle, radius 6A, containing a hexagon
- To draw a hexagon, mark off point 6 as described below.
- With centre at point 6, draw a circle radius 6A
- Step of sides of figure (length=AB) round circumference of circle




Method II

*AB* is the given side. It is required to draw a regular polygon, for example, say a *heptagon*. Produce *AB* to *P* such that *AB* = *BP*. With *B* as centre and radius *AB* draw a semicircle. Divide the semicircle by trial and error into number of equal arcs, equal to the number of sides of the polygon, in this case, divide into *seven* equal parts and number the division points as *1*, *2*, *3*, etc. Connect *B* to the division points *2*, *3*, *4*, *5* and *6* and produce. Always the line connecting the second division point and *B* represents the second side of the polygon, i.e, *BC*. With *C* as centre and radius equal to *AB*, cut *B3* produced at *D*. Now with *D* as centre and with the same radius cut *B4* produced at *E*. Similarly find the other points and by connecting them complete the required polygon.




Construction of Regular Polygon-Method II

- **Content/Topic 2: Draw different types of Triangles**

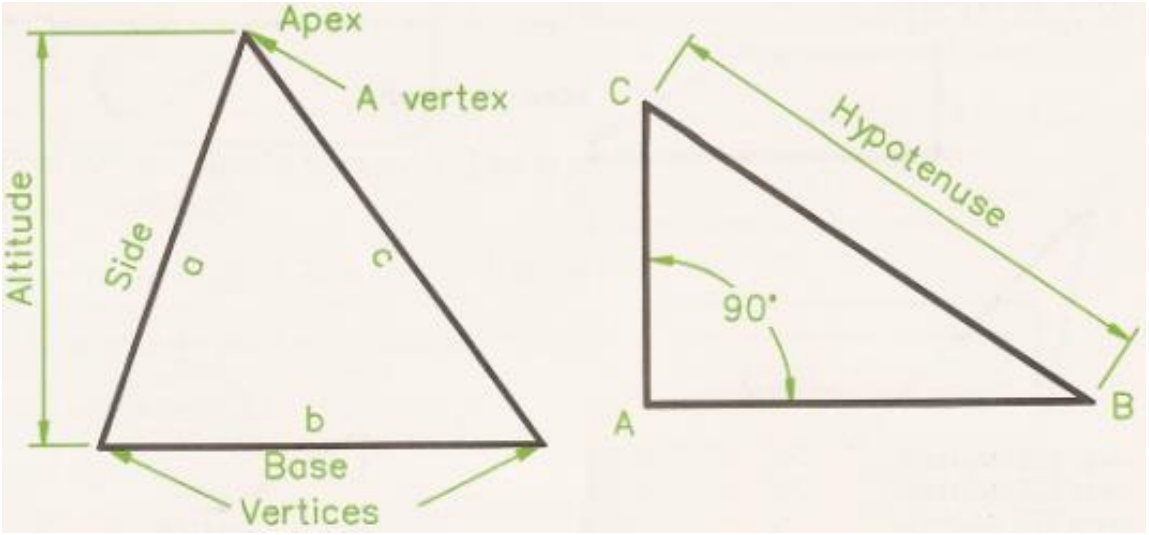
**Definition:** A triangle is a closed geometric figure having three sides and three angles.

**Types of triangles**

Triangles are classified into the following groups, depending on various properties. Note that a given triangle can be in more that one group. For example, it could be both a right triangle and a scalene triangle at the same time.

| | | | |
|---|---|---|---|
| **Right Triangle** | One angle 90°. | **Equilateral** | All sides equal |
| **Isosceles** | Two sides equal | **Obtuse** | One angle greater than 90° |
| **Scalene** | No sides equal | **Acute** | All angles less than 90° |

**Terminology**

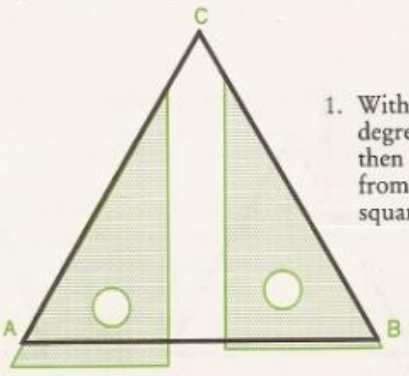



1. Triangle **vertices** are often lettered, using capitals, when the triangle may be, for example triangle ABC.
2. If **sides** are lettered, lower case is used, e.g. a and b and c.
3. The **angles** of triangle ABC are BAC, ABC and ACB – the middle letter being the angle where the letter is positioned.
4. The **base** of a triangle is the side on which it is standing.
5. The **altitude** is the vertical height above the base.
6. The term **hypotenuse** is only used with reference to right-angle triangles.
7. The **vertical angle** is the angle opposite the base.
8. Note the term **vertex**. Its plural is **vertices**.

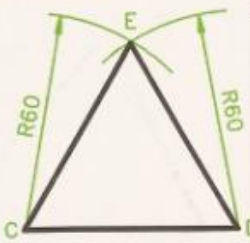
## Construction of triangles

### Constructing an equilateral triangle

Figure 3.3 shows two methods of constructing an equilateral triangle:




1. With the aid of a 30,60 set square, using the 60 degree angle. Start by drawing the base, AB, then draw lines, meeting at C, at 60 degrees from each end of the base with the aid of the set square.



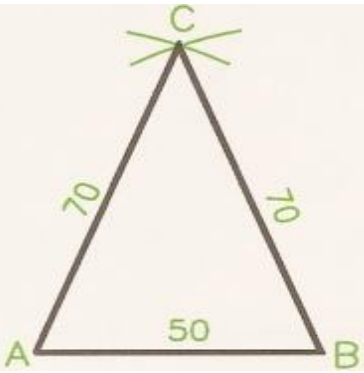

2. Strike off compass arcs with the compass set to the length of the side. Thus in the lower of the two drawings of Figure 3.3, the side length of the equilateral triangle is 60 mm. Start by drawing the base – a line 60 mm long; then set a compass to 60 mm and strike arcs from each end of the base; draw lines from the ends of the base to the intersection of the two arcs.


*Figure 3.3* Constructing equilateral triangles

## To construct triangle ABC

1. Draw the base AB, 50 mm long. Set a compass to 70 mm.
2. With the compass centred first at A, then at B strike intersecting arcs to give C.
3. Join AC and BC to complete the triangle.

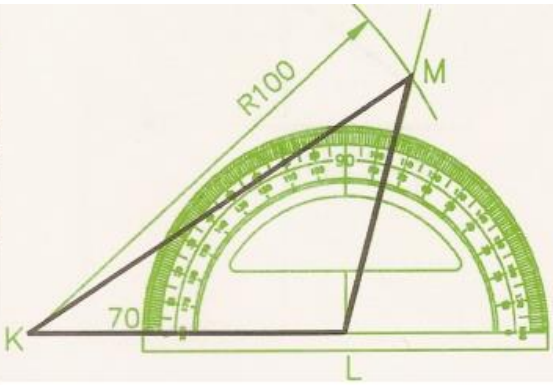
Note: triangle ABC is isosceles.




## To construct triangle KLM

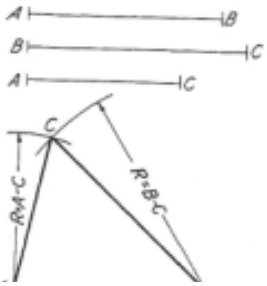
1. Draw KL 70 mm long.
2. With the aid of a protractor construct a 105 degree angle at L, and draw a line from L at that angle.
3. Set a compass to 100 mm. With the compass centred at K strike an arc across the arm of the line at 105 degrees from L, to give M.
4. Join LM to complete the triangle.

Note: KLM is a scalene triangle, which is obtuse.




To construct a triangle given its three sides

Given the three sides *AB*, *AC*, and *BC*. Draw the side *AB* in its correct location. Using its end points *A* and *B* as centers and radii equal to *AC* and *BC*, respectively, strike the two intersecting arcs locating point *C*. *ABC* is the required triangle. This construction is particularly useful for developing the surface of a transition piece of triangulation.

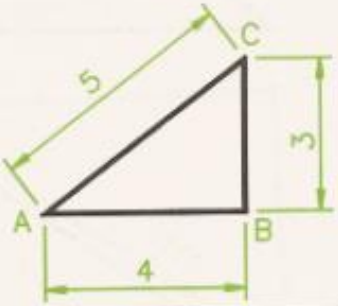


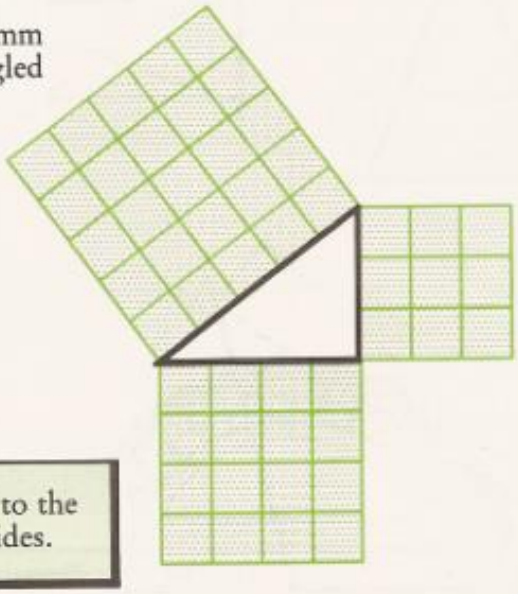
**Note on right angle triangle**

Taking the 3: 4: 5 triangle:

a) The square on the hypotenuse = 5 × 5 = 25.
b) The square on the shortest side = 3 × 3 = 9.
c) The square on the other side = 4 × 4 = 16; and 9 + 16 = 25.

Thus: if the sides of a triangle are 30 mm, 40 mm and 50 mm long, the triangle is a right-angled one.



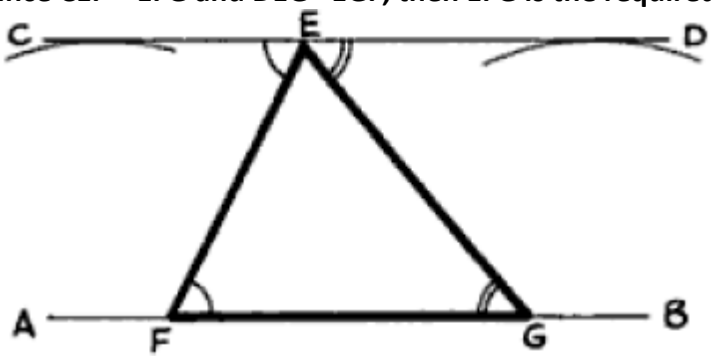



The square on the hypotenuse is equal to the sum of the squares on the other two sides.

**To construct triangle given the base angles and the altitude**

1. Draw a line AB
2. Construct line CD parallel to AB so that the distance between them is equal to the altitude.
3. From any point E on CD, draw CÊF and DÊG so that they cut AB in F and G respectively.

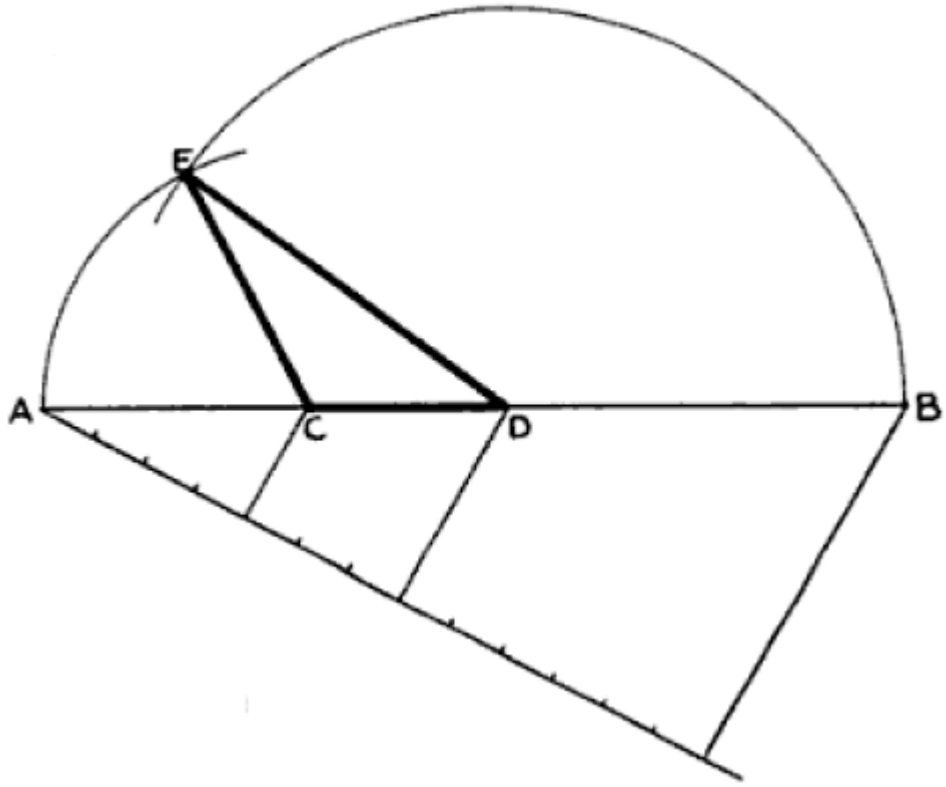
**Since CÊF = EFG and DÊG= EGF, then EFG is the required triangle.**



**To construct a triangle given the perimeter and the ratio of size**

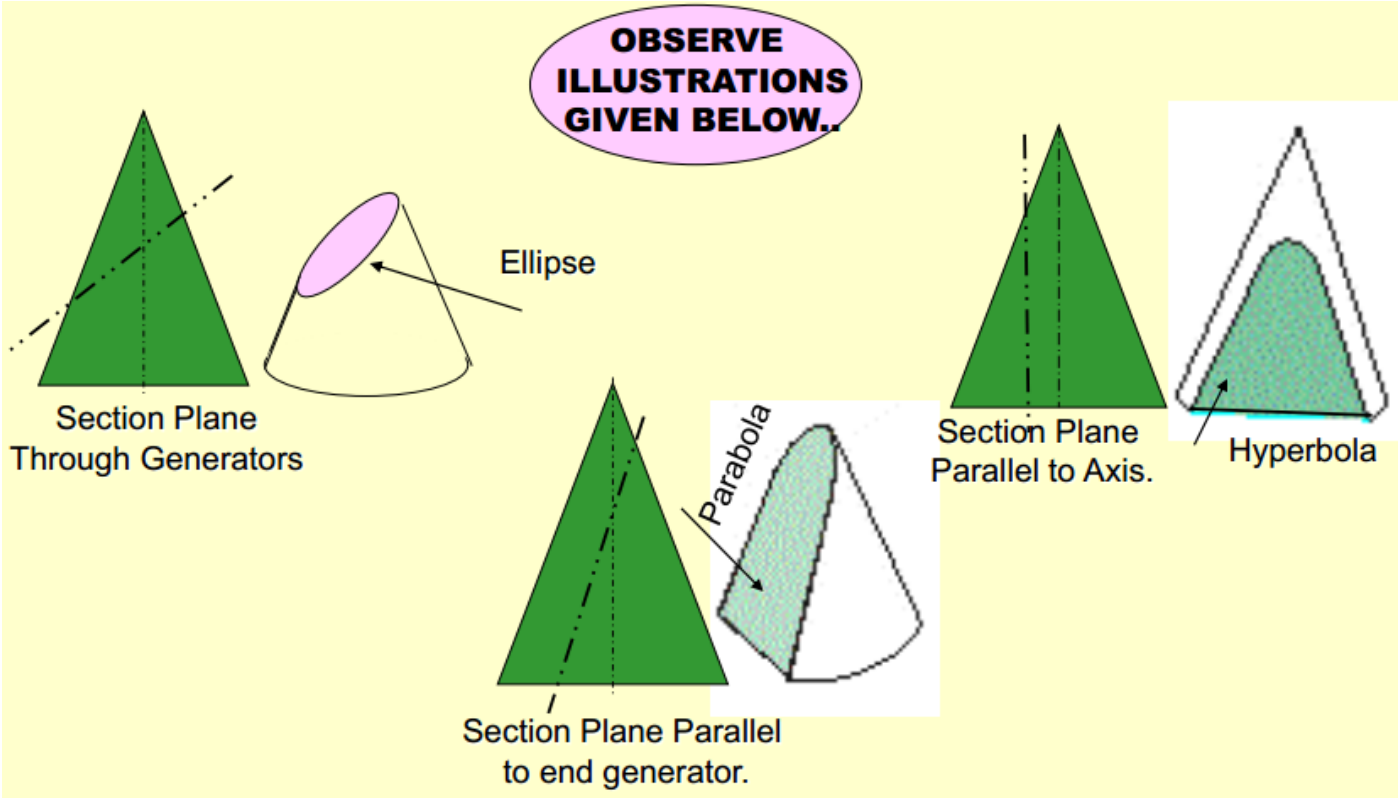
1. Draw the line AB equal in length to the perimeter.
2. Divide AB into the required ratio (say 4 : 3 : 6).
3. With centre C and radius CA draw an arc.
4. With centre D and radius DB draw an arc to intersect the first arc in E.

ECD is the required triangle.



- Content/Topic 3: Construct Conic sections

ELLIPSE, PARABOLA AND HYPERBOLA are called conic sections because these curves appear on the surface of a cone when it is cut by some typical cutting planes

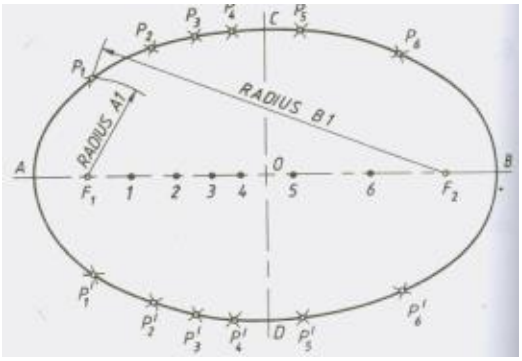



**Construction of an ellipse**

**Procedure for drawing an ellipse**

1. **Focal method**

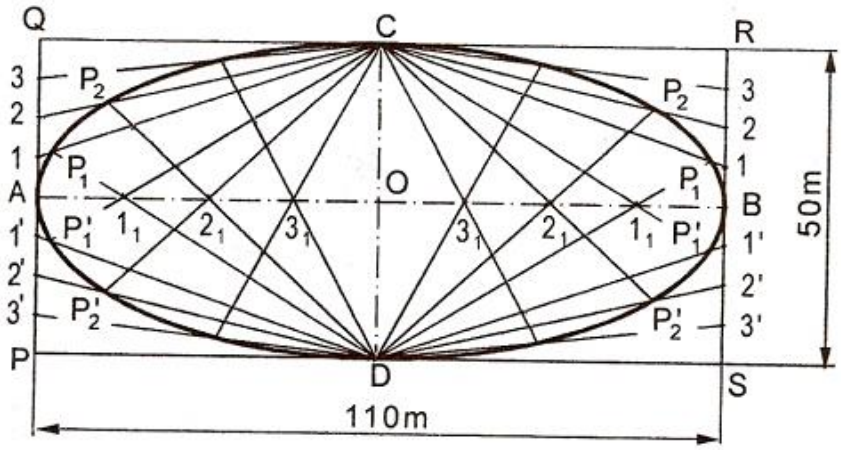
- Set out the major axis AB and minor axis CD
- To find the focal point, draw an arc equal to the semi major axis at F1 and F2. These are the focal axis point (As CF1+CF2= AB, thus satisfying the definition of an ellipse).
- Other point on the ellipse, such as $P_1$, may be found by drawing arcs from F1 and F2, such that the sum of the radii of the arcs is equal to AB (for example radius A1+ radius B1= AB). The intersection of the arcs is a point on the ellipse.




Focal method o intersection arcs method

**2) Rectangular method**

*A plot of ground is in the shape of a rectangle 110 m x 50 m. Inscribe an elliptical lawn in it. Take a suitable scale.*

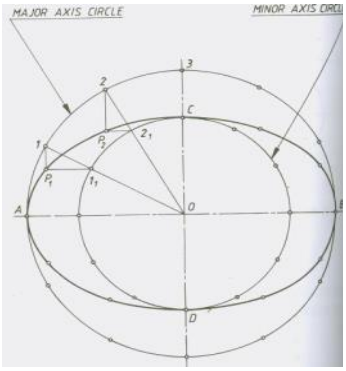



ELLIPSE - RECTANGLE or OBLONG METHOD

1. Select scale 1 : 1000.
2. Draw major axis AB = 110 mm and minor axis CD = 50 mm. Both bisect at O.
3. Through A and B draw lines parallel to CD.
4. Through C and D draw lines parallel to AB and construct the rectangle PQRS. Now PS = AB and SR = CD.
5. Divide AQ and AP into any number of equal parts (*say 4*) and name the points as 1, 2, 3 and 1′, 2′, 3′ respectively starting from A on AQ and AP.
6. Divide AO into same (4) number of equal parts, and name the points as $1_1$, $2_1$, $3_1$ starting from A on AO.
7. Join 1, 2, 3 with C.
8. Join $D1_1$ and extend it to intersect C1 at $P_1$.
9. Similarly extend $D2_1$ and $D3_1$ to intersect C2 and C3 at $P_2$ and $P_3$ respectively.
10. Join 1′, 2′, 3′ with D.
11. Join $C1_1$ and extend it to intersect D1′ at $P_1'$.
12. Similarly extend $C2_1$ & $C3_1$ to intersect D2′ & D3′ at $P_2'$ & $P_3'$ respectively.
13. Draw a smooth curve through C, $P_3$, $P_2$, $P_1$, A, $P_1'$, $P_2'$, $P_3'$, D and obtain *one half* (*left-half*) of the ellipse.
14. Repeat the above and *draw the right-half of ellipse, symmetrical to the left-half.*

**3) Concentric circle method**

- Draw the major axis AB and minor axis CD, and draw circles center O with AB and CD as diameter
- As these circles are auxiliary circles to the ellipse they may be divided into a number of parts, preferably equal, by radial line through O.
- Where these radial lines intersect the major auxiliary circle draw vertical lines.
- Where the radial lines intersect the minor auxiliary circle draw horizontal lines to intersect the verticals. These point of intersection are point on the ellipse



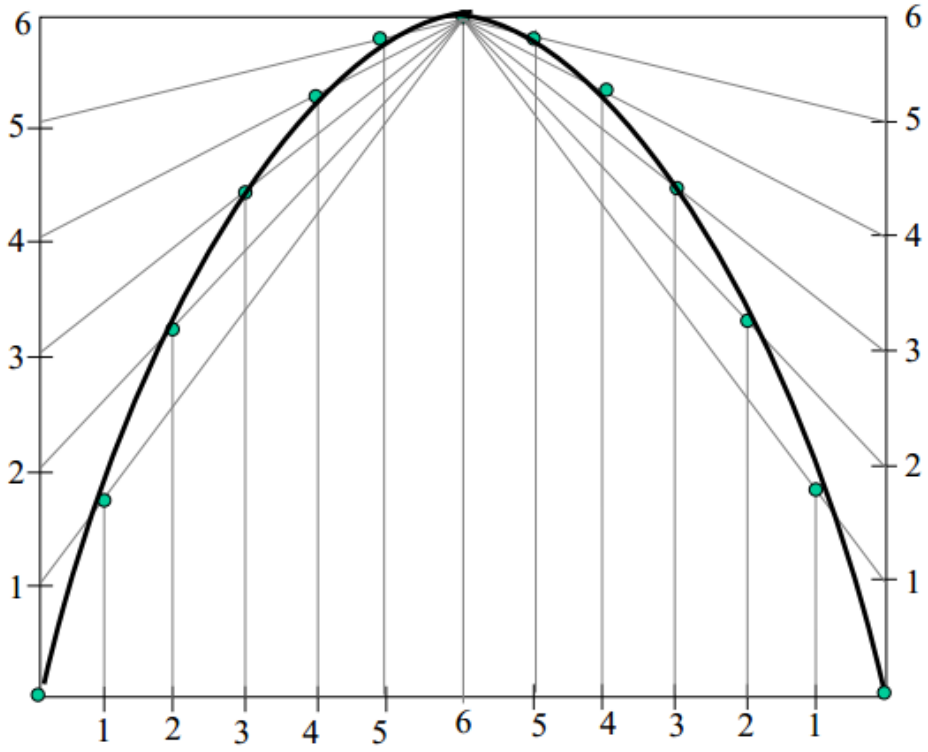

Concentric circle method

**Construction of Parabola**

**Parabola rectangle method**

A ball thrown in air attains 100 m height and covers horizontal distance 150 m on ground. Draw the path of the ball (projectile)

STEPS:
1.Draw rectangle of above size and divide it in two equal vertical parts
2.Consider left part for construction. Divide height and length in equal number of parts and name those 1,2,3,4,5& 6
3.Join vertical 1,2,3,4,5 & 6 to the top center of rectangle
4.Similarly draw upward vertical lines from horizontal1,2,3,4,5 And wherever these lines intersect previously drawn inclined lines in sequence Mark those points and further join in smooth possible curve.
5. Repeat the construction on right side rectangle also. Join all in sequence.
**This locus is Parabola.**




**PARABOLA DIRECTRIX-FOCUS METHOD**

Point F is 50 mm from a vertical straight line AB. Draw locus of point P, moving in a plane such that it always remains equidistant from point F and line AB.

SOLUTION STEPS:

1. Locate center of line, perpendicular to AB from point F. This will be initial point P and also the vertex.

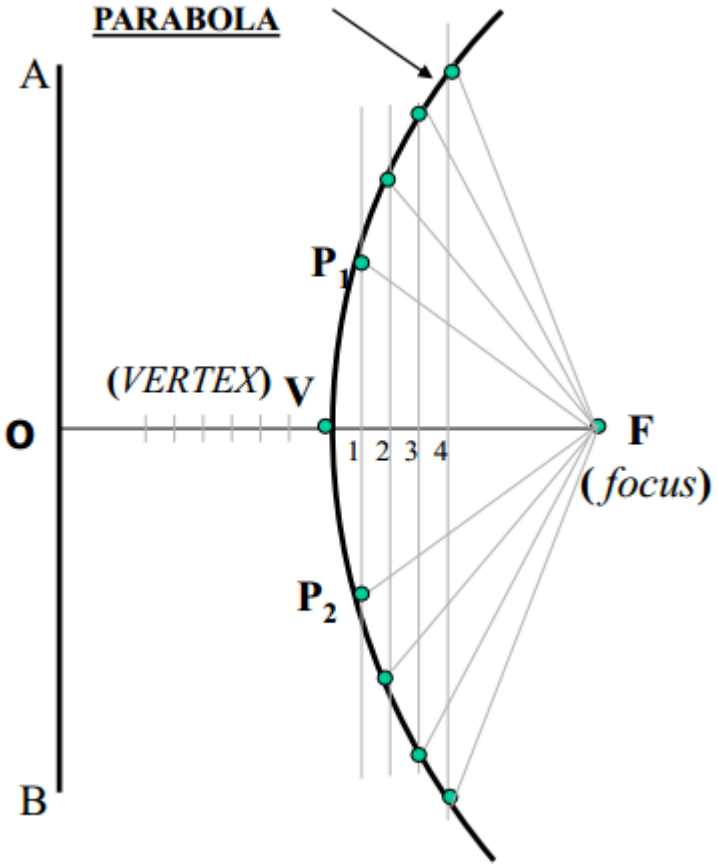
2. Mark 5 mm distance to its right side, name those points 1,2,3,4 and from those draw lines parallel to AB.

3. Mark 5 mm distance to its left of P and name it 1.

4. Take O-1 distance as radius and F as center draw an arc cutting first parallel line to AB. Name upper point $P_1$ and lower point $P_2$. (FP1=O1)

5. Similarly repeat this process by taking again 5mm to right and left and locate $P_3P_4$.

6. Join all these points in smooth curve.



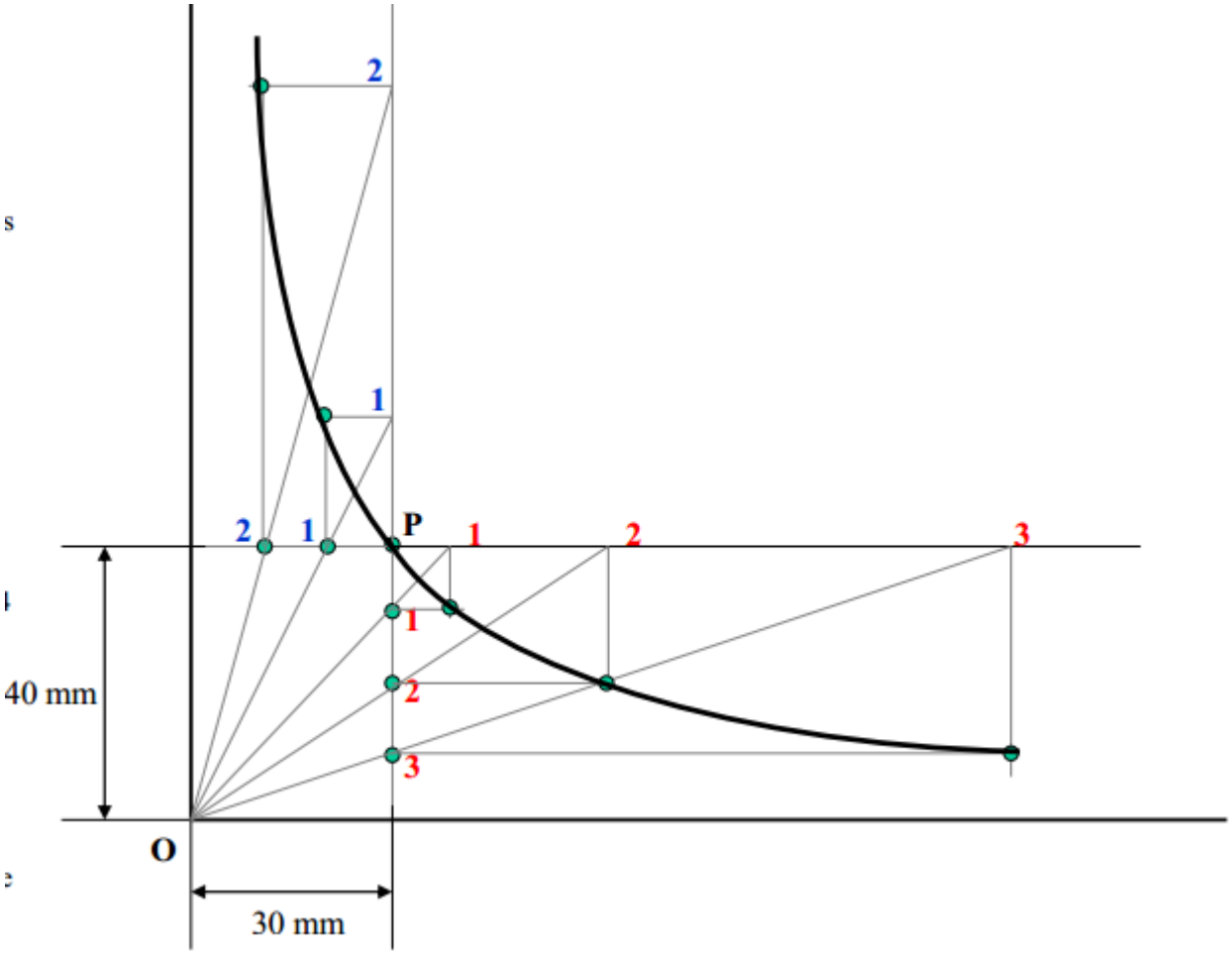

**Construction of hyperbola**

HYPERBOLA THROUGH POINT OF KNOWN CO-ORDINATES

Point P is 40 mm and 30 mm from horizontal and vertical axes respectively. Draw Hyperbola through it.

***Solution Steps:***

1) Extend horizontal line from P to right side.
2) Extend vertical line from P upward.
3) On horizontal line from P, mark some points taking any distance and name them after P-1, 2,3,4 etc.
4) Join 1-2-3-4 points to pole O. Let them cut part [P-B] also at 1,2,3,4 points.
5) From horizontal 1,2,3,4 draw vertical lines downwards and
6) From vertical 1,2,3,4 points [from P-B] draw horizontal lines.
7) Line from 1 horizontal and line from 1 vertical will meet at 1.Similarly mark P2, P3, P 4 points.
8) Repeat the procedure by marking four points on upward vertical line from P and joining all those to pole O. Name this points P6, P7, P8 etc. and join them by smooth curve.



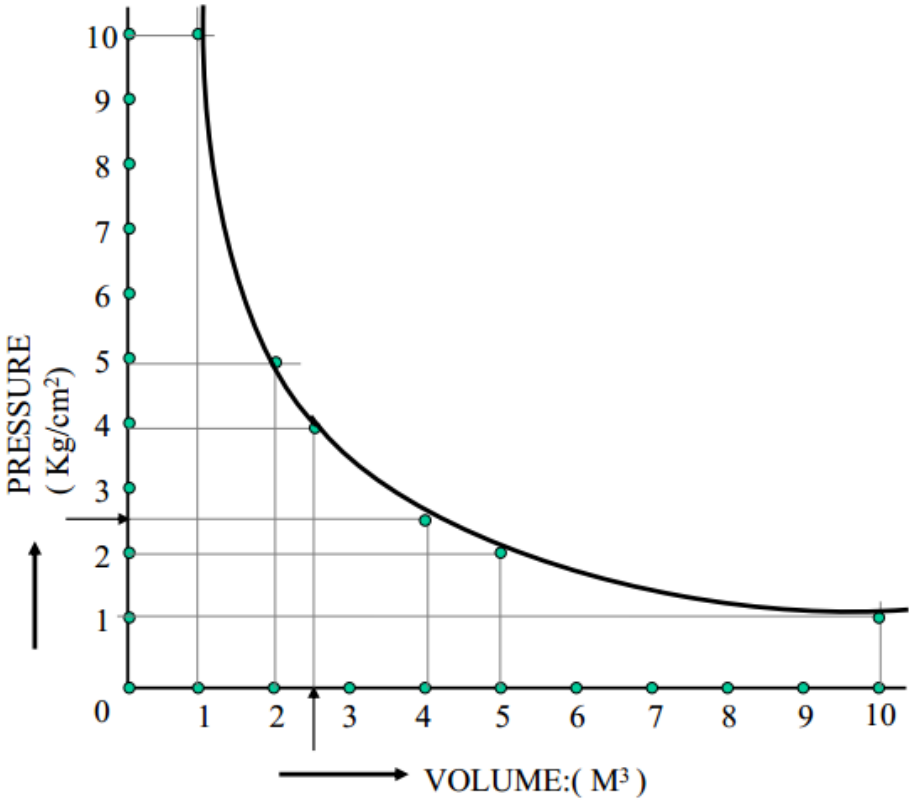

**HYPERBOLA P-V DIAGRAM**

A sample of gas is expanded in a cylinder from 10 unit pressure to 1 unit pressure. Expansion follows law PV=Constant. If initial volume being 1 unit, draw the curve of expansion. Also Name the curve.

**Form a table giving few more values of P & V**

| P × V = C |
|---|
| 10 × 1 = 10 |
| 5 × 2 = 10 |
| 4 × 2.5 = 10 |
| 2.5 × 4 = 10 |
| 2 × 5 = 10 |
| 1 × 10 = 10 |

Now draw a Graph of
Pressure against Volume.
It is a PV Diagram and it is Hyperbola.
Take pressure on vertical axis and
Volume on horizontal axis.



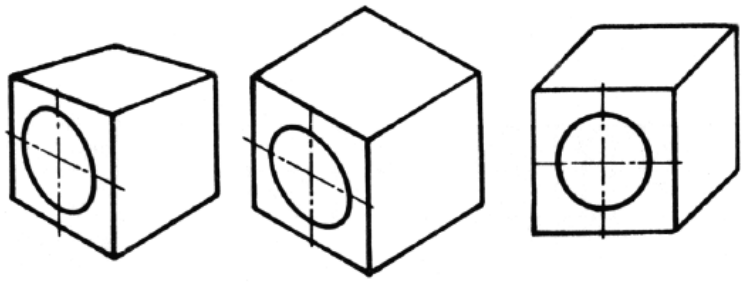
## LO 3.3 – Draw an object in 3D image.

- Content/Topic 1 : **Draw an object in 3D image**

**PICTORIAL DRAWING (Introduction to 3 Dimensional graphics)**

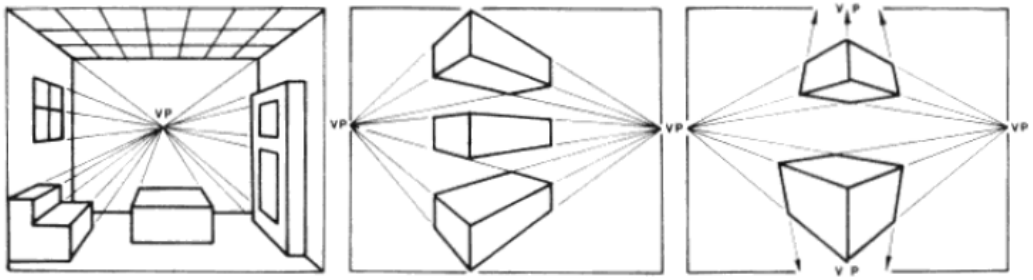
**Summary:**

Orthographic projection is used as an unambiguous and accurate way of providing information, primarily for manufacturing and detail design. This form of representation can however make it difficult to visualise objects. Pictorial views can be created to give a more three dimensional impression of the object. There are three types of pictorial projections commonly used, as shown below.

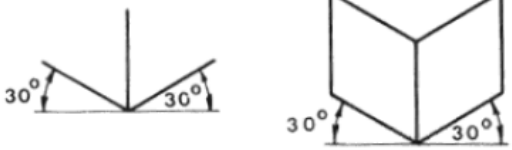


Perspective, isometric and oblique pictorial projections.

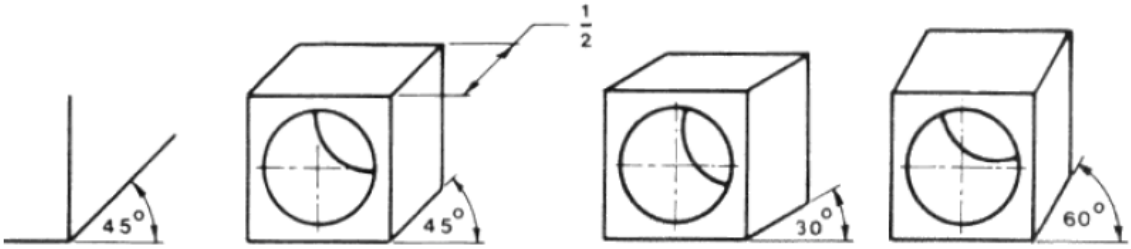
**Perspective:** Used more with freehand sketching.
Parallel lines appear to converge and meet at what is referred to as the **vanishing point**.
You can have one, two or three vanishing points (VP).




**Isometric:** Receding lines drawn at 30º and are usually kept at true measured lengths.




**Oblique:** Front face sketched as a true shape. Starts with two axes, one horizontal, one vertical. The third axis is usually drawn at 45º and lengths are reduced by 50% of true lengths. Sometimes called 'cabinet' projection.



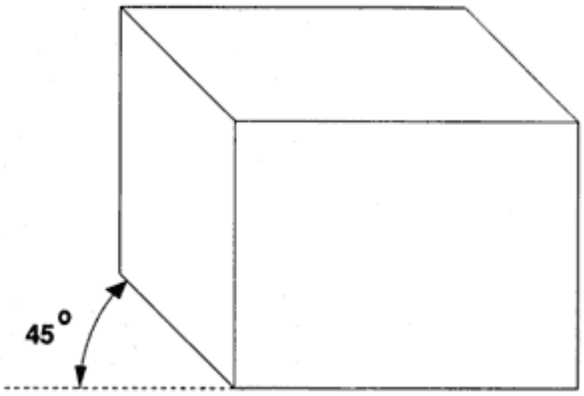
Representing 3 dimensions on a flat piece of paper is a very important skill for designers enabling them to communicate their ideas to other people. This is especially useful when showing your design to non designers such as managers and marketing personnel.

There are several tried and tested 3 Dimensional drawing systems used to produce a realistic representation of an object. Some techniques such as isometric are based on mathematical systems, others a try to convey a larger degree of realism by applying perspective to the drawing. Amongst the methods covered in this tutorial are oblique, isometric, axonometric, and perspective drawing techniques.

**1. Oblique**

Oblique drawing is the crudest '3D' drawing method but the easiest to master. Oblique is not really a '3D' system but a 2 dimensional view of an object with 'forced depth'.

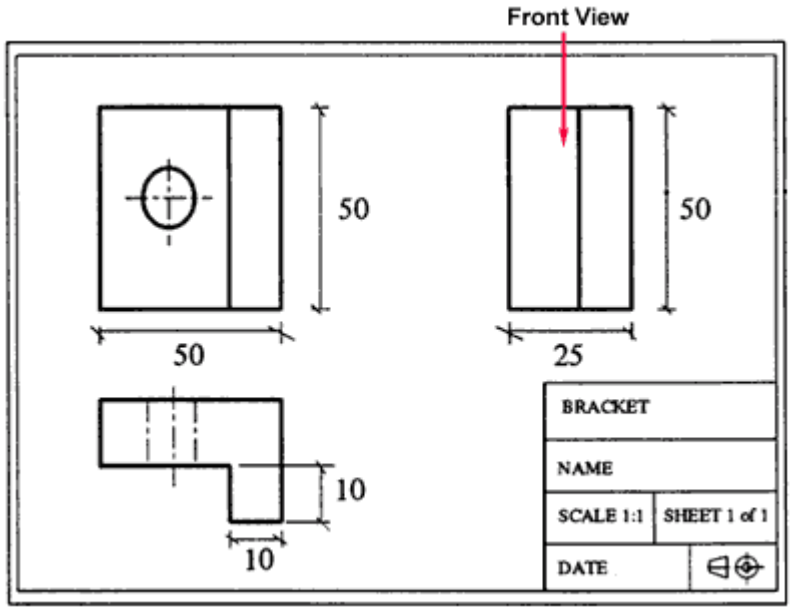
When using oblique the side of the object you are looking at is drawn in two dimensions, i.e. flat. The other sides are drawn in at 45 degrees but instead of drawing the sides full size they are only drawn with half the depth creating 'forced depth' adding an element of realism to the object.



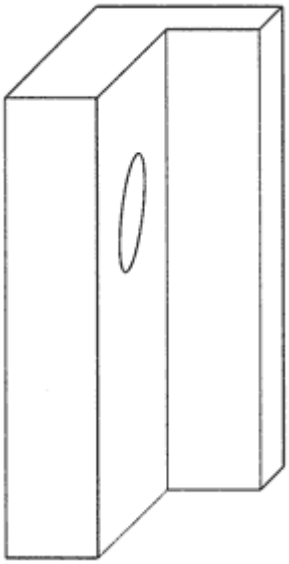

Even with this 'forced depth', oblique drawings look very unconvincing to the eye. For this reason oblique is rarely used by professional designer and engineers.

**How to draw an object using oblique**

When drawing an object in oblique, the front view of the object is drawn flat



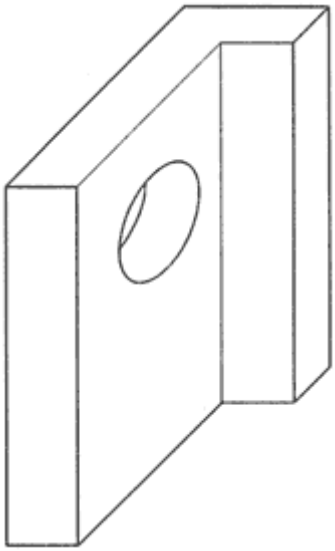
**Oblique with 'foreshortening'**



The side views are drawn in at a 45 degree angle. Standard practice is to 'foreshorten' the side views to provide a more convincing view of an object.

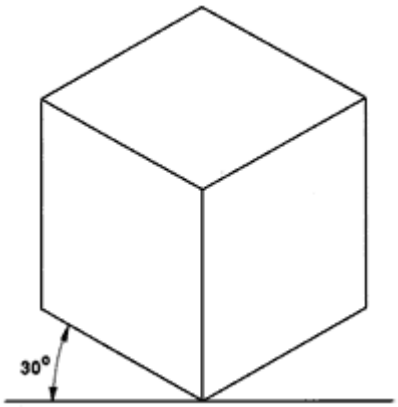
To foreshorten the side views, the objects side measurements are halved. In this case, the sides are 50 mm long, but they have been drawn in at 25 mm.

**Oblique with no 'foreshortening**



This view is drawn at full size. Notice how circle looks elongated

**2. Isometric drawing**



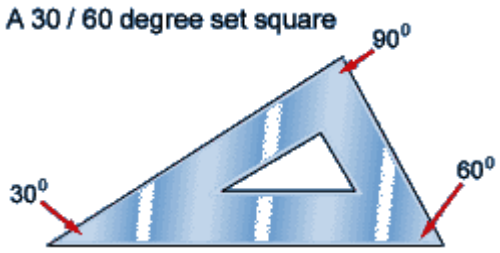

Isometric is a mathematical method of constructing a 3 dimensional object without using perspective. Isometric was an attempt to make drawings more realistic.

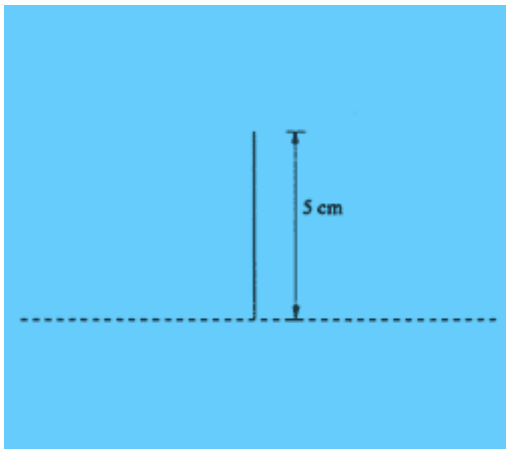
The mathematics involved mean that all lengths when drawn at 30 degrees can be drawn using their true length (in other words lines aren't shortened as with oblique drawings).

An isometric drawing shows two sides of the object and the top or bottom of the object. All vertical lines are drawn vertically, but all horizontal lines are drawn at 30 degrees to the horizontal. Isometric is an easy method of constructing a reasonable '3 dimensional' images.

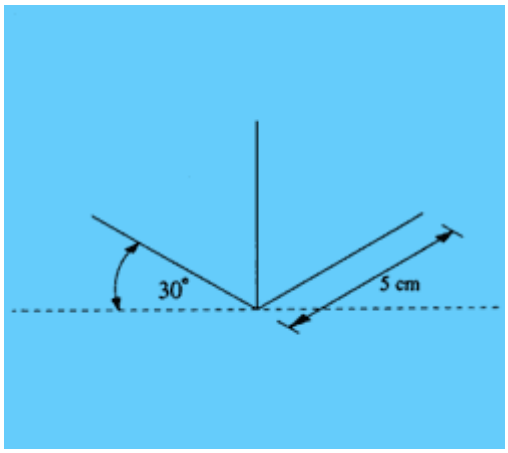
**Drawing a box in isometric**

To draw in isometric you will need a 30 / 60 degree set square (As illustrated). The steps below demonstrate how to draw a 5cm3 box in isometric.



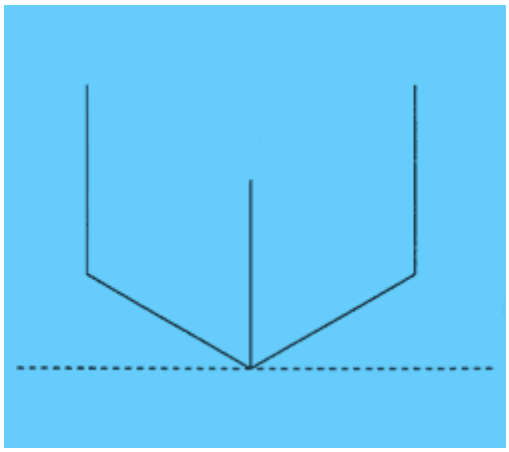




**1.** Draw the front vertical edge of the cube.

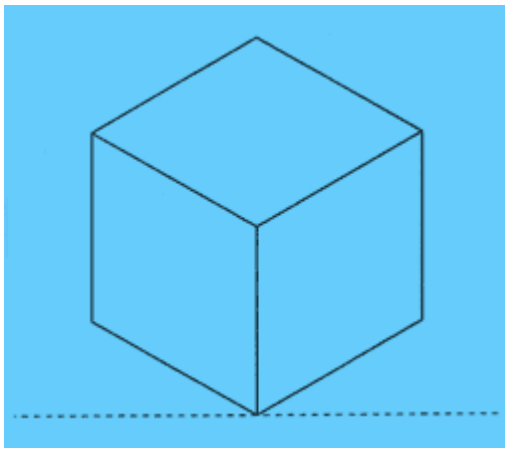



**2.** The sides of the box are drawn at 30 degrees to the horizontal to the required length.

**Note**: All lengths are drawn as actual lengths in standard isometric.



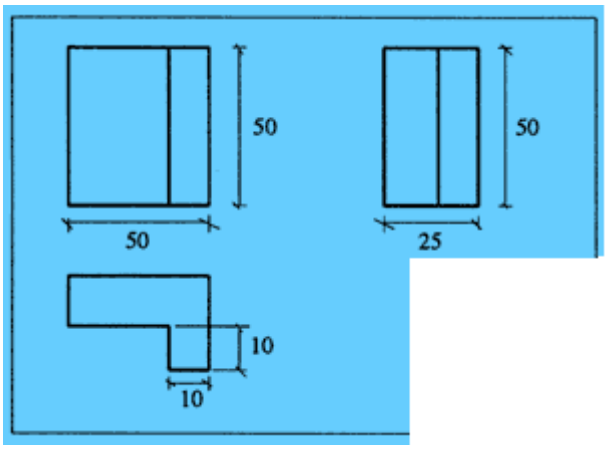
**3.** Draw in the back verticals.



**4.** Drawn in top view with all lines drawn 30 degrees to the horizontal.

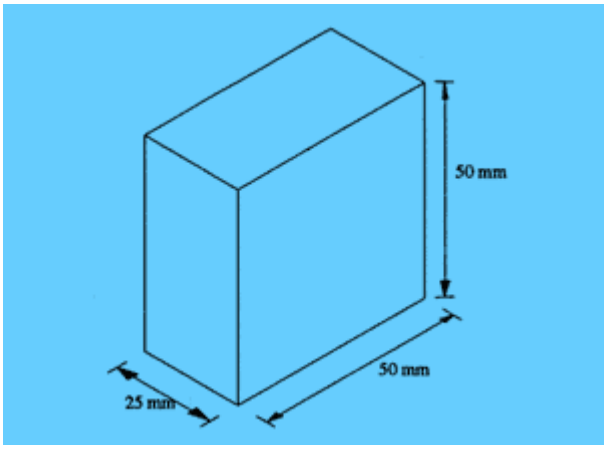
**Drawing more complicated shapes**

Initially when you first start using isometric it can be useful to use a simple box as a basic building block a guide to help you draw more complicated shapes.




This simple example shows you how you can use a box to help you accurately draw a more complicated shape.

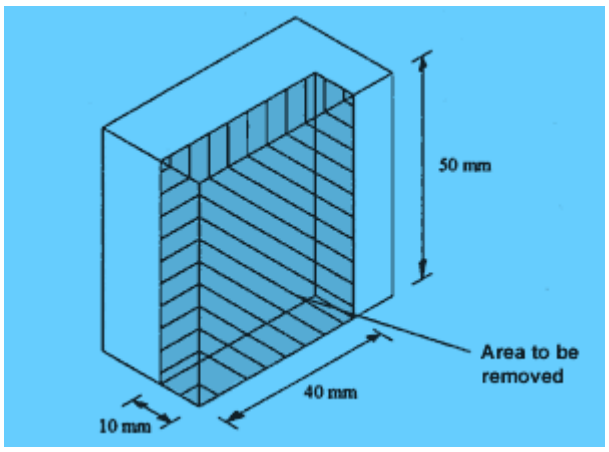
The object we are going to draw is L-shaped as illustrated by the engineering drawing (left).




The first step is to draw our guide box. This box is the size of the maximum dimensions. In this case, 50 mm long, 25 mm wide, and 50 mm high.

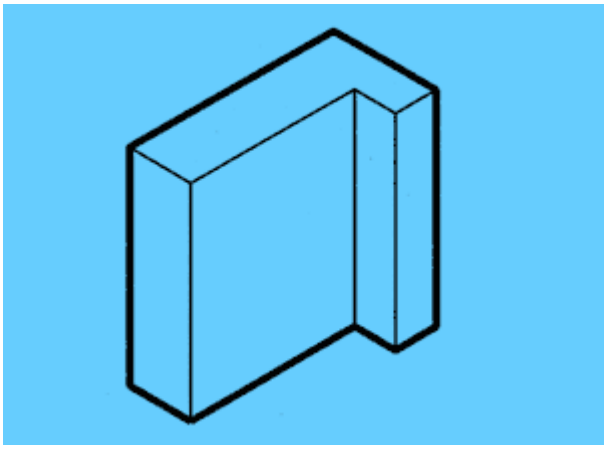
Draw the box in very lightly. When we have the final shape we can darken the lines.

**Outline of 'guide box'**




To get the L-shape we need remove an area from this box.

Draw a box 40 x 10 x 50 mm, the shape that needs to be removed from the box to create the shape we require.



Draw in the outline of the object using a heavier line.

Using this technique you can draw complex shapes accurately because you can use the guide box as a means to measure your engineering drawing views.

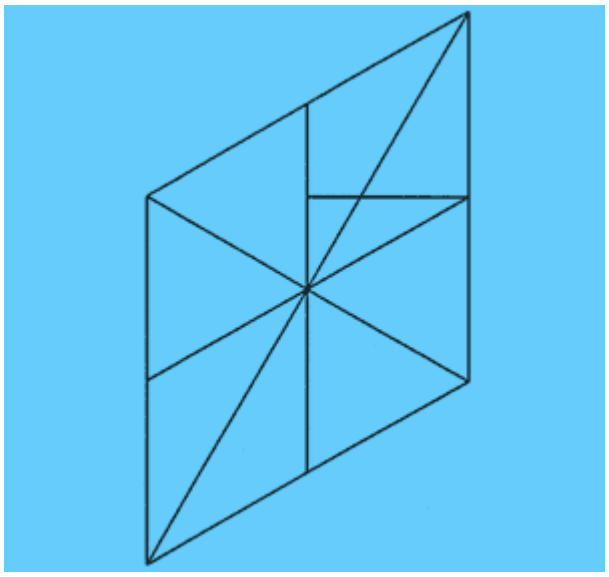
**The finished shape**

**Drawing circles in isometric**

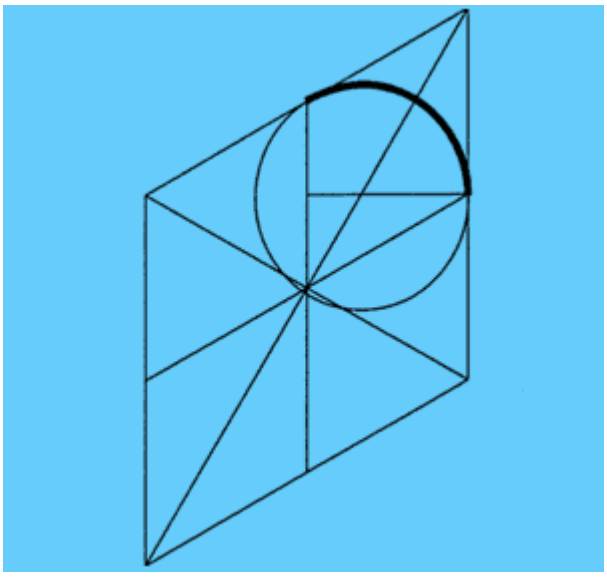
Circles in isometric don't appear circular. Instead they are skewed and are actually elliptical. There are several methods of constructing circles in isometric. By far the easiest method is to use an isometric circle template which can be bought from most good art shops. These templates contain a number of isometric circles of various sizes.

If you decide not to buy a template then you must construct a circle.

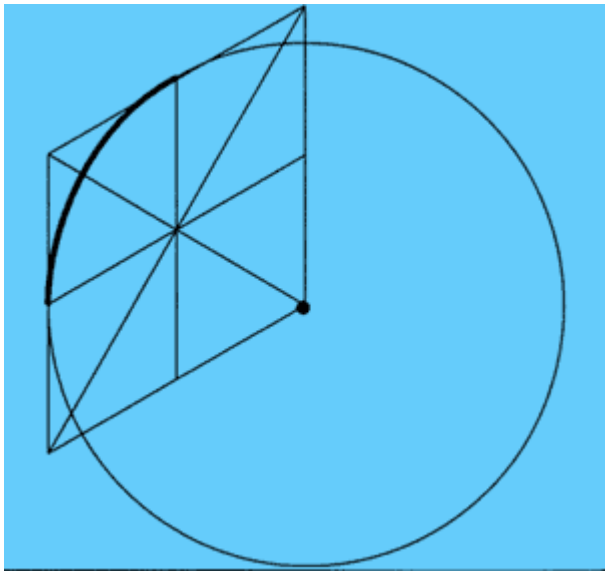
**Constructing an isometric circle**



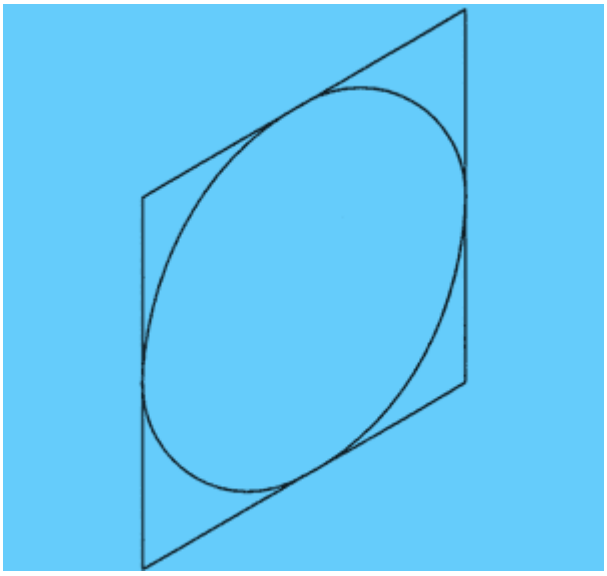
1. First draw an isometric square. Draw in the diagonals, a vertical and a line at 30 degrees from the midpoint of the sides as illustrated.



2. Place your compass point on the intersection of the horizontal line and the vertical line. Draw in a circle which touches the edges of the box



3. To draw the next section of the isometric circle place your compass point on the corner of the isometric 'square' and draw in the arc as illustrated.



4. Complete the circle using the appropriate techniques.

## LO 3.4 – Draw three principal views required for 2D representation

- Content/Topic 1 : **Draw three principal views required for 2D representation**

**Principal views**

- ✓ Front view
- ✓ Top view
- ✓ Side view

**Definition of projection**

Any kind of representation of an object on a paper, screen or similar surface by drawing or by photography is called the projection of that object

**TYPES OF ORTHOGRAPHIC PROJECTION (Presentations)**

- ✓ First angle projection
- ✓ Third angle projection

**First and third angle projection**

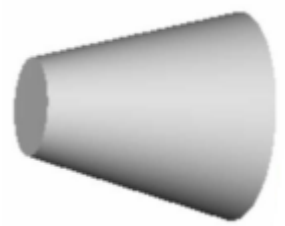
Theoretically, the object could be placed in any of the four quadrants. Engineering custom in the United States dictates the use of the third angle. This quadrant is used because the views, when revolved $90^0$ into the plane of the front view, are in their natural positions. In some countries the first angle projection is used for engineering drawing.

The difference between $1^{st}$ angle and third angle projection is that when $1^{st}$ angle projection is used and planes are revolved, the top view will be below the front view, and that the left side view will be to the right of the front view

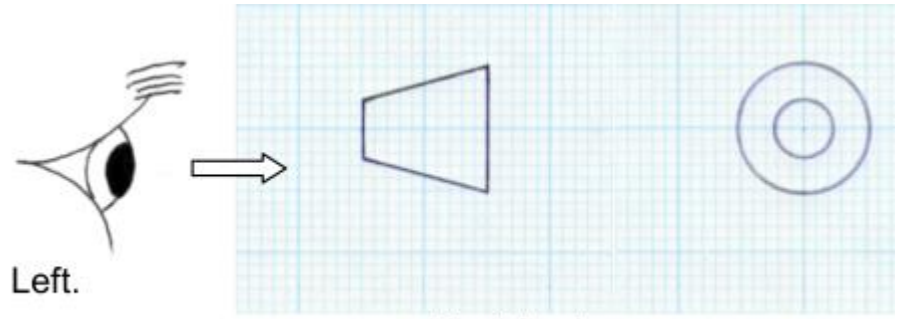
**Identifying the angle of projection**

On each orthographic drawing produced the symbol the method used has to be indicated on the drawing sheet. This is conventionally done by means of symbols.

Consider yourself looking at the following cone

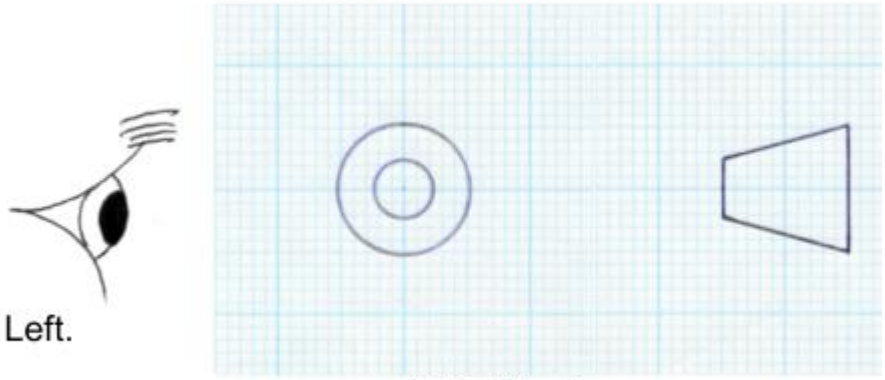


If you draw its front and left view and present it as in the figure below then your method of drawing will be **First Angle Projection**.




First Angle.

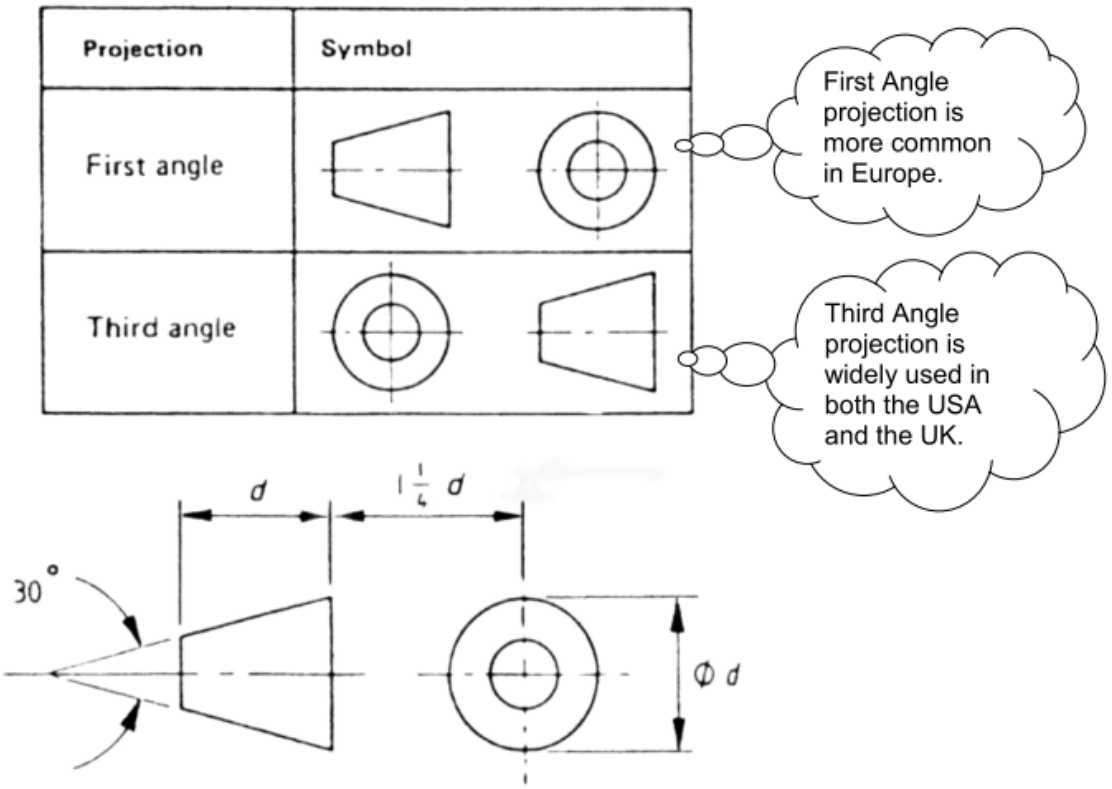
Once again if you draw its front and left view and present it as in the figure below then your method of drawing will be **Third Angle Projection**.




Third Angle.

There you are! You have got the international representation of objects in First and Third Angle Projection.

Both systems of projection, First and Third angle, are approved internationally and have equal status. The system used must be clearly indicated on every drawing, using the appropriate symbol shown in Figure below.

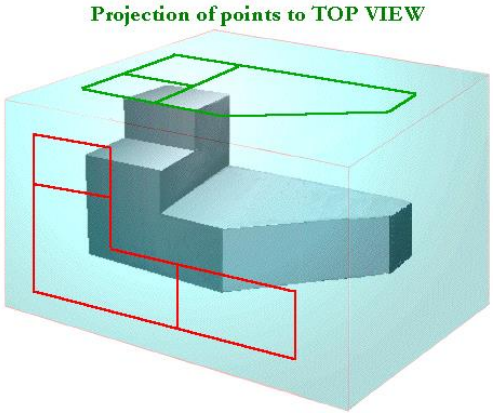



Projection system symbols and recommended proportions.

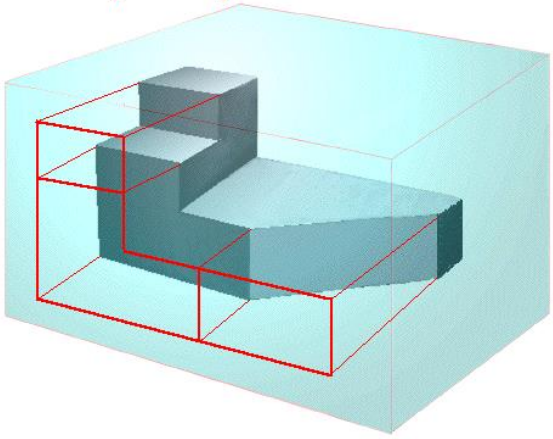
**TYPE OF VIEWS**

1. Front view or elevation
2. Rear view
3. Top view or plan
4. Bottom view
5. Right view
6. left view or Side view or
   Side elevation or profile view

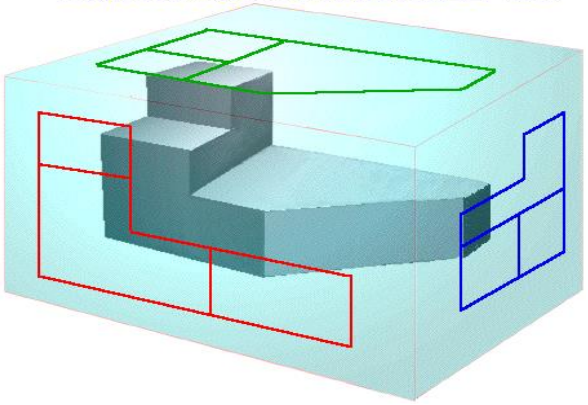
Now assume that the faces of the object are projected to the surfaces of the glass box that they are facing.



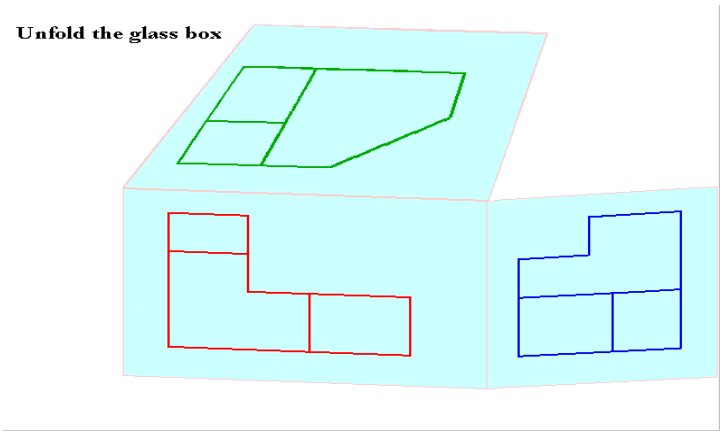
Projection of points to FRONT VIEW

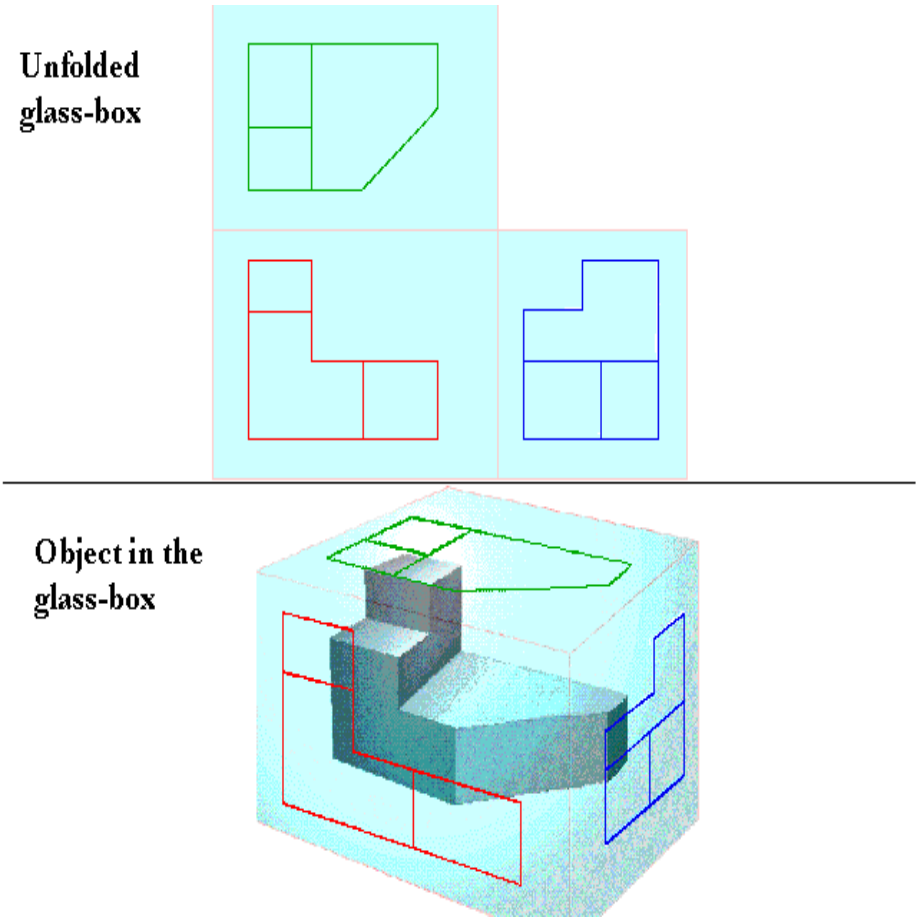


Projection of points to RIGHT SIDE VIEW



Now imagine that the glass box faces are unfolded

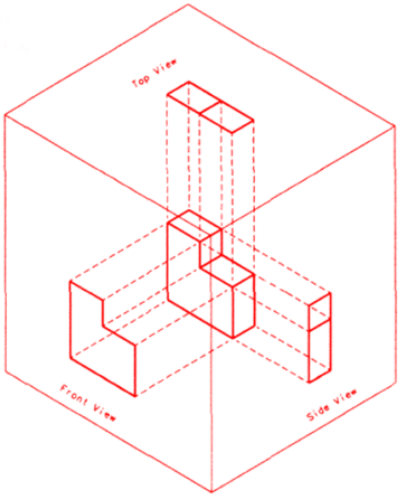





Then the following picture shows the Top, the Front and the Right view of the object.

**Example:**

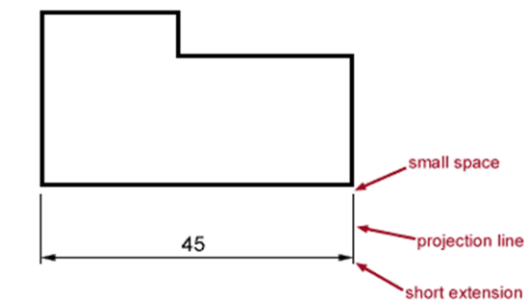
- Imagine the object is surrounded by a glass cube.
- Object surfaces are projected onto the faces.



## LO 3.5 – Apply dimensioning techniques on electrical objects according to the standards

- **Content/Topic 1 : Use of element for dimensioning**

A dimensioned drawing should provide all the information necessary for a finished product or part to be manufactured. An example dimension is shown below.

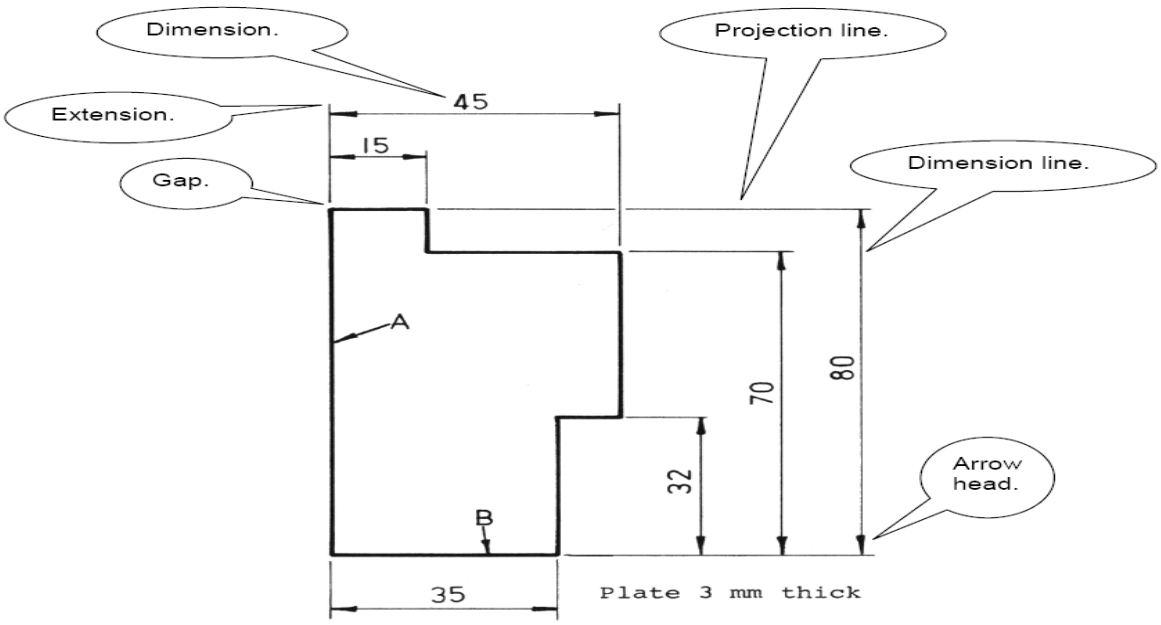



Dimensions are always drawn using continuous thin lines. Two projection lines indicate where the dimension starts and finishes. Projection lines do not touch the object and are drawn perpendicular to the element you are dimensioning.
All dimensions less than 1 should have a leading zero. i.e. .35 should be written as 0.35

**Element for dimensioning**

- ✓ Extension line
- ✓ Dimension Line
- ✓ Arrow Heads
- ✓ Leader line
- ✓ Dimension figures

- parallel dimensions, indicating the size of the plate
- edges **A** and **B** are being used as the reference edges
- minimum number of dimensions required are specified
- use of description of 'plate 3mm thick', so that no side view is required
- evenly spaced dimension lines



## LO 3.6 – Use drawing scales to reduce or enlarge electrical drawings

- Content/Topic 1: **Use drawing scales to reduce or enlarge electrical drawings**

**1. SCALES.**

The proportion by which we either reduce or increase the actual size of the object on a drawing is known as drawing to scale or simple scale.

The scale is actually a measuring stick, graduated with different divisions to represent corresponding actual distances according to some proportion, thus giving rapidity marking off distance on drawing. Numerically scales indicate the relation between the dimensions on the drawing and actual dimensions of the object.

The scales are either flat or triangular and the material used in their construction may be wood, celluloid, metal, etc.

In drawing, scale should not be selected arbitrarily, but standard recommended scales should be adopted as far as possible.

**Uses of scale**

The following are the main uses of scales in engineering practice

1. The scales are used to prepare reduced or enlarged size drawings
2. The scales are used to set off dimensions
3. The scales are used to measure distances directly.

**Sizes of scale**

**1. Full size scale**
The scale in which the actually measurements of the object are drawn to the same sizes on the drawing is known as full size scale. It is written on the stick as under

1:1 – drawing made to actual size

2. **Reducing scale**: The scale in which the actual measurements of the object are reduced to some proportion is known as reducing scale.

The standard reducing proportions are:

1:2 – Drawing made to one half of the actual size

1:5 – drawing made to one fifth of the actual size

1:10 – drawing made to one tenth of the actual size

1:20 – drawing made to one twentieth of the actual size

1:50 – drawing made to one-fiftieth of the actual size

1:100 – drawing made to one-hundredth of the actual size

3. **Enlarging scale**: the scale in which the actual measurements of the object are increased in some proportion is known enlarging scale. The standard proportion are:

2:1 – drawing made to twice the actual size

5:1 – drawing made to five times the actual size

10:1 – drawing made to ten times the actual size.

**Necessity**

- ✓ Drawings drawn with the same size as the objects are called full sized drawing.
- ✓ It is not convenient, always, to draw drawings of the object to its actual size. e.g. Buildings, Heavy machines, Bridges, Watches, Electronic devices etc.
- ✓ Hence scales are used to prepare drawing at:

- Full size
- Reduced size
- Enlarged size

# Learning Unit 4 – **Draw electrical diagrams**

## LO 4.1 – **Draw electrical symbols based on their meaning**

- Content/Topic 1 : **Draw electrical symbols based on their meaning**

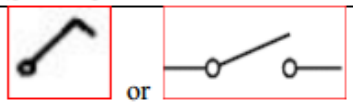
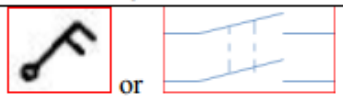
**General electrical symbols**

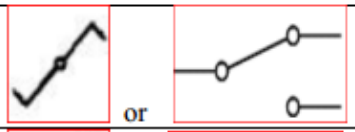
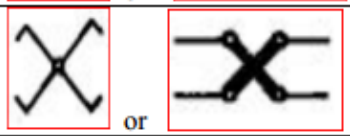
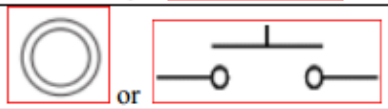
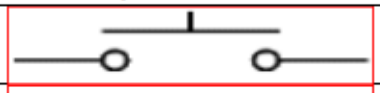
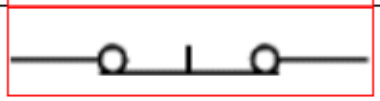
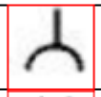
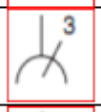
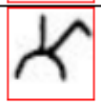
✓ **Power supply**

| | | |
|---|---|---|
|  | Voltage Source | Generates voltage |
|  | Current Source | Generates current. |
|  | AC Voltage Source | AC (alternate) voltage source |
|  | Generator | Electrical voltage is generated by mechanical rotation of the generator |
|  | Battery Cell | Generates constant voltage |

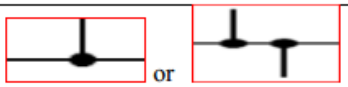
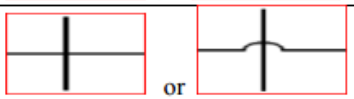
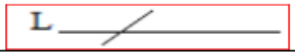
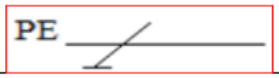
| | | |
|---|---|---|
|  | Battery | Generates constant voltage |
|  | Controlled Voltage Source | Generates voltage as a function of voltage or current of other circuit element. |
|  | Controlled Current Source | Generates current as a function of voltage or current of other circuit element. |

✓ **Switches and Sockets**

| **SWITCHES** | | |
|---|---|---|
| ***COMPONENT*** | ***SYMBOL*** | ***FUNCTION*** |
| One way switch |  or | An on-off switch allows current to flow only when it is in the closed (on) position. |
| Two pole switch |  or | |

| | | |
|---|---|---|
| Two way switch |  | A 2-way changeover switch directs the flow of current to one of two routes according to its position. |
| Intermediate switch |  | An intermediate switch directs the flow of current to two of two routes according to its position |
| Push button |  | Depend on type of push switch it will close or open the circuit when it is pressed. |
| Push switch (push to make) |  | A push switch allows current to flow only when the button is pressed. |
| Push switch ( push to break) |  | This type of push switch is normally closed (on),it is open (off) only when the button is pressed. |
| Outlet socket |  | Adapt external appliances to be supplied |
| Multi-outlet socket (three outlet socket) |   | Adapt more than one external appliances to be supplied (three appliances can be supplied ) |
| Outlet socket with switch |  | This help to switch of plugged appliance without plug it out |

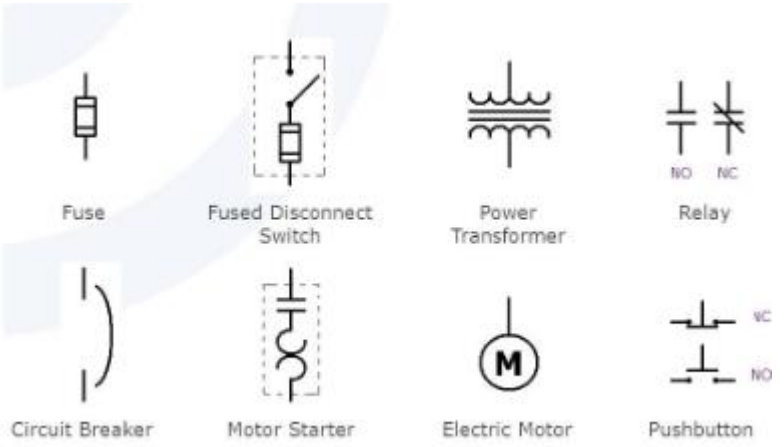
## ✓ Wires and Connections

| WIRES AND CONNECTIONS | | |
|---|---|---|
| ***COMPONENT*** | ***SYMBOL*** | ***FUNCTION*** |
| Wire |  | To pass current very easily from one part of a circuit to another |
| Wire joined / wire connected |  | A 'blob' should be drawn where wires are connected (joined). |
| Wire not joined/ wire not connected |  | In complex diagrams it is often necessary to draw wires crossing even though they are not connected. |
| Live wire |   | |
| Neutral wire |   | |
| Ground wire |   | |
| Fuse |  | A safety device which will 'blow' (melt) if the current flowing through it exceeds a specified value. |

| | | |
|---|---|---|
| | Electrical Wire | Conductor of electrical current |
| | Connected Wires | Connected crossing |
| | Not Connected Wires | Wires are not connected |

✓ **Fuses , Circuit breakers and other electrical power symbol**

| | | |
|---|---|---|
| | Fuse | The fuse disconnects when current above threshold. Used to protect circuit from high currents. |
| | Fuse | |

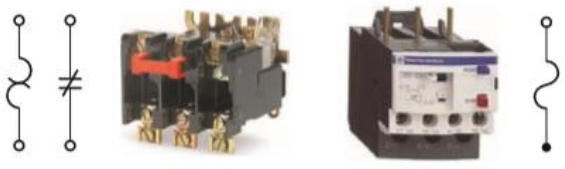




(a) Disconnect switch

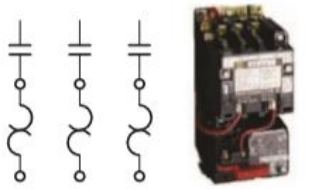


(b) Three-pole circuit breaker



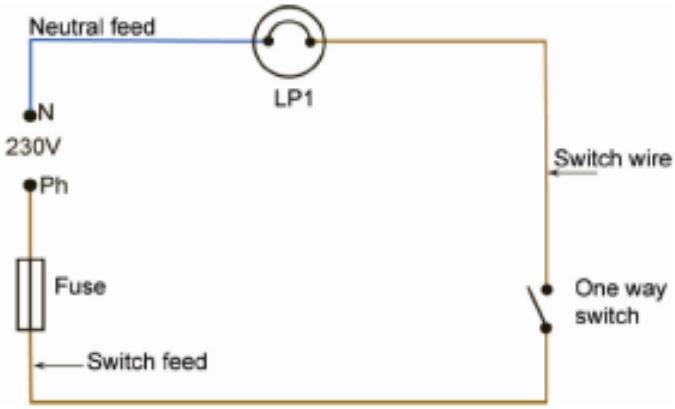

(c–d) Overload (OL) relays


(e–f) Fuses



(g) Three-phase magnetic motor starter

**Example of simple electrical circuit represented using symbols**




## LO 4.2 – Select types of electrical diagrams based on their intended uses

**Electrical diagrams**

Electrical diagrams are the drawing done by electrical technician in order to present the layout of the installation which is going to be done. These drawings present the required of materials to be used, how installation will work and the real connection of the whole installation on drawing.

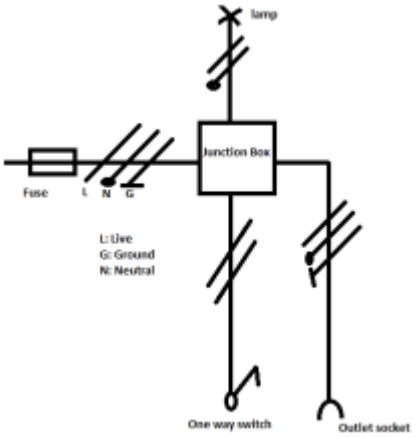
In electrical installations three types of diagrams are used, namely:

- Circuit diagram
- Wiring diagram
- Schematic diagram( Single line diagram)

- Content/Topic 1: Describe **Schematic diagram** (Single line diagram)

  **Introduction**

  Single line diagram is a diagram drawn using symbols. it help to outline the all required materials for electrical installation.




**Advantages of a schematic diagram**

- ✓ Shows the sizes and number of wires(3 of 2.5mm2)
- ✓ Specify the materials to be purchased.
- ✓ Specify the correct length of wires to be purchased.
- ✓ Gives a clear layout of the supply circuit.
- ✓ Shows the position of the various components in the circuit.

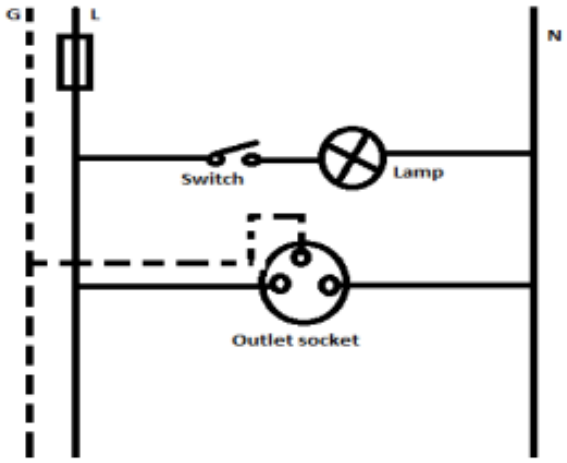
**Disadvantage of a schematic diagram**

- ✓ It is not explain the working of installation
- ✓ It is not also indicate the real connection of electrical installation

- Content/Topic 2: **Circuit diagram**

**Introduction**

A circuit diagram is a simplified wiring diagram. This is explanatory diagram meant for easy understanding the operation of an electrical circuit.




**Advantages**

- ✓ Easy understanding of circuit operation
- ✓ It facilitates easy fault tracing.

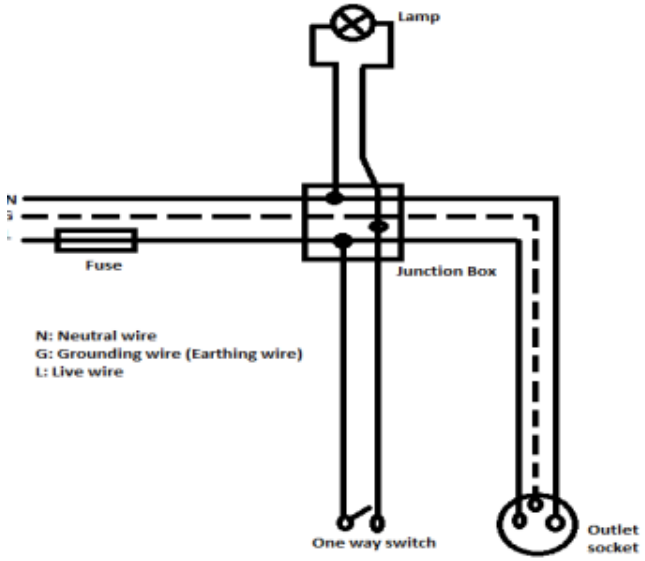
**Disadvantages**

- ✓ It is not indicate the real connection of electrical circuit.

- Content/**Topic 3: Wiring diagram**

**Introduction**

A wiring diagram shows the connection of installation or part of installation. It shows how the connection actually is made and also gives the layout.



**Advantages of a wiring diagram**

- ✓ To know the physical appearance of the installation and the components
- ✓ Helps make connections of the circuit easily.
- ✓ It facilitates easy connection

**Disadvantage**

- ✓ It is complicated to be done.

## LO 4.3 – Draw one line diagram of given installation

- Content/Topic 1 : Describe the purpose of one line diagram of given installation

The following are the Purpose of one line diagram of given installation:

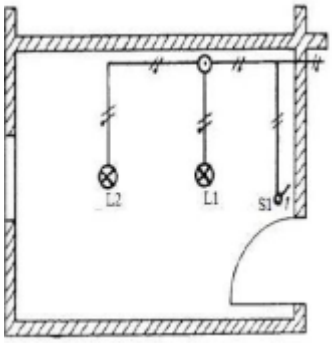
- **Interpreting the scope of a proposed installation of a power system**: The scope of the work is the area in an agreement where the work to be performed is described. The scope of the work should contain any milestones, reports, deliverables and end products that are expected to be provided by the performing party.
- **Serving as a basis to produce project drawings**: One line diagram of given installation serving as basis to produce projects drawing, shows more information about power, lighting and communication for an engineering project.
- **Analyzing power system problems**: Power system analyses are an essential part of electrical power system design, calculations and simulations are performed to verify that the electrical system, including the system components, are correctly specified to perform as intended, withstand expected stress and be protected against failures. One line diagram of given installation helps to analyze easily the problems in power system.
- **Determining which circuit interrupters must be opened to safely isolate electrical apparatus**: One line diagram of given installation helps to identify correct isolation point or device. Isolation has the purpose of protecting against electrical hazards. This barrier ensures that the electrical apparatus is safe by preventing electrical shocks and fire hazards.

- Content/Topic 2: Identify Characteristics of one line diagram of given installation

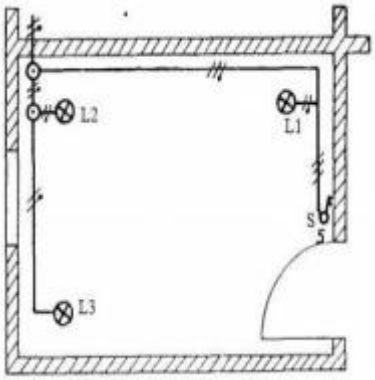
Characteristics of one line diagram of given installation:

- A one-line diagram uses Single lines
- Standard graphical symbols
- Standard nomenclature
- A one-line diagram shows the power path of an electrical circuit
- A one-line diagram shows the component devices

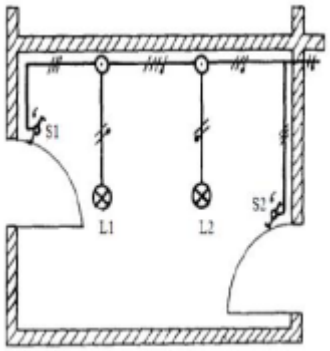
**One way switch circuit**



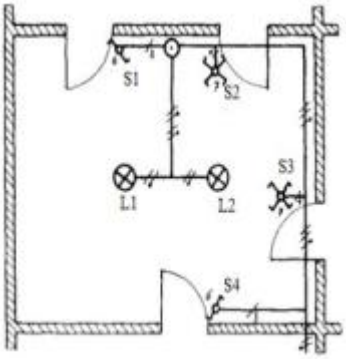

**One-way double direction**




**Two ways switch circuit**




**Intermediate switch circuit**



## LO 4.4 – Draw a schematic diagram of given installation

- Content/Topic 1 : Describe the purpose of one line diagram of given installation

- Purpose of schematic diagram

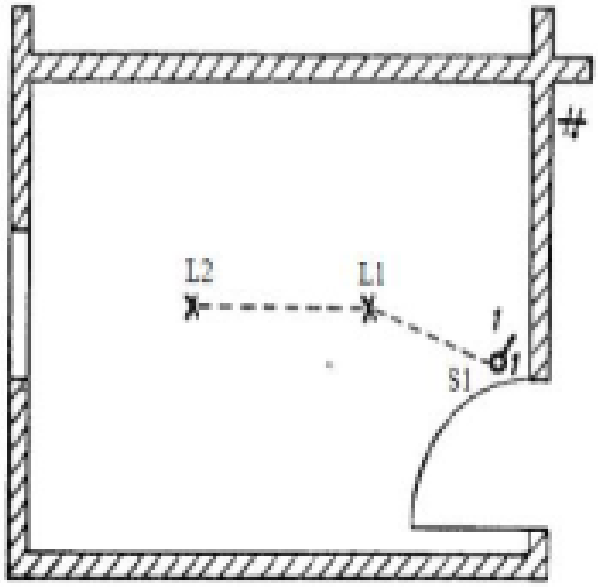
A schematic, or schematic diagram, is a representation of the elements of a system using abstract, graphic symbols rather than realistic pictures. A schematic usually omits all details that are not relevant to the key information the schematic is intended to convey, and may include oversimplified elements in order to make this essential meaning easier to grasp.

The schematic diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram is used to trace the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts. The schematic diagram is the most useful of all the diagrams in learning overall system operation

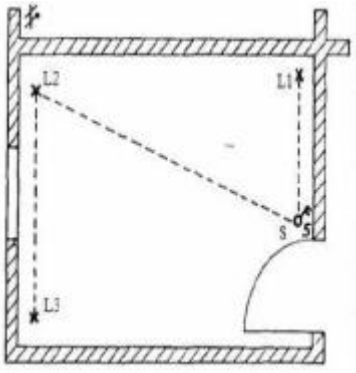
- **Characteristics**

✓ Using standardized symbols
✓ Show all terminals and connections of functional devices

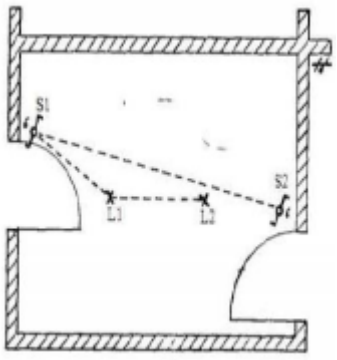
**One way switch circuit**



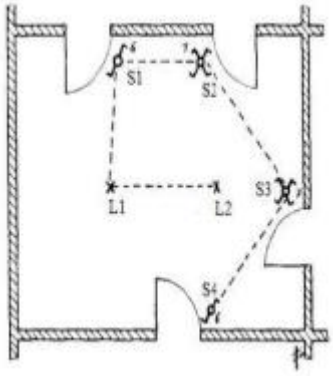

**One-way double direction**



**Two ways switch circuit**




**Intermediate switch circuit**




## LO 4.5 – Draw a wiring diagram of given installation

- Content/Topic 1 (From Curriculum)

- Purpose of wiring diagram

A wiring diagram is a simplified conventional pictorial representation of an electrical circuit .It shows the components of the circuit as simplified shapes , and the power and signal connection s between the devices.

A wiring diagram is created to facilitate communication between the people designing an electrical system and the people implementing it. It can also serve to support safety regulators confirming the installation has been properly designed and implemented, and provides service personnel with information about how the installation should have been implemented.

- **Characteristics**

✓ **Show physical locations**: a area , a structure or group of structure s) or an area within a site where something was , is or will be located

✓ **Standardized and non standard symbols are used**: It shows the components of the circuit as simplified shapes and how to make the connections between the devices , the electrical symbols are required to do the electrical drawing

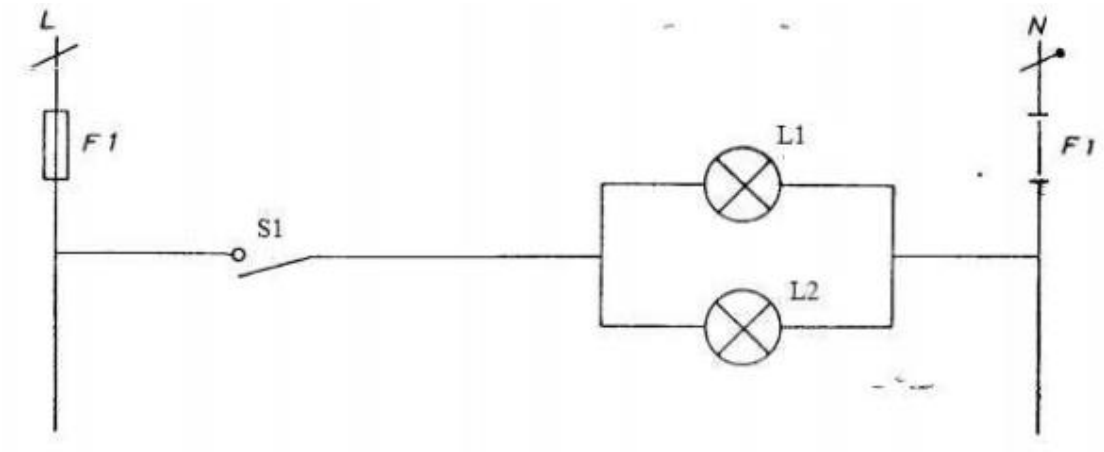
✓ **Multiple conductors are shown**: In wiring diagram the conductors connection are shown clearly

✓ **Representation of a conductor is labeled**: A label helps to provide complete information regarding the product. It includes caution in use and care to be taken while using it.

**Types of switches and lighting circuits**

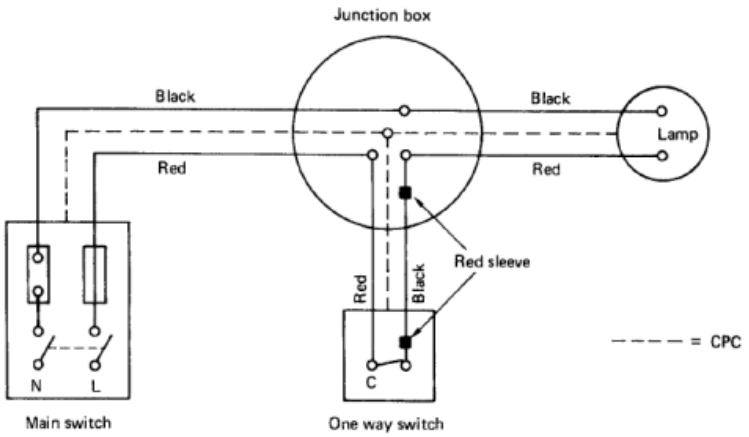
**One way switch circuit**

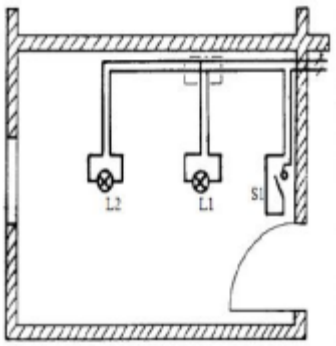
A one way switch is connected with a wiring to control a lamp or lamps from only one position.
If require several lamps connected in series or in parallel may be controlled from one switch.



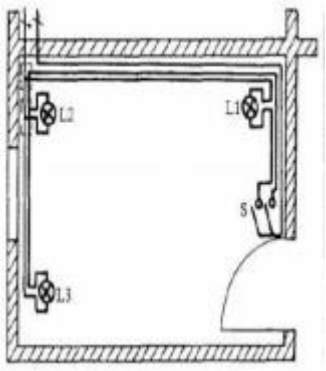

F: Circuit breaker
L: Live wire
N: Neutral wire
L1, L2: Lamps
S1: One way switch

**One way switch circuit**

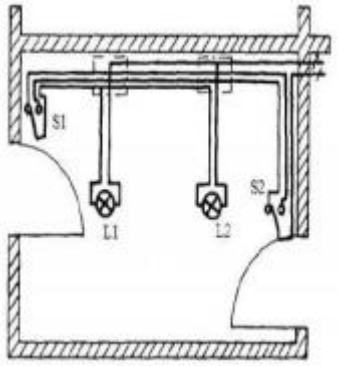


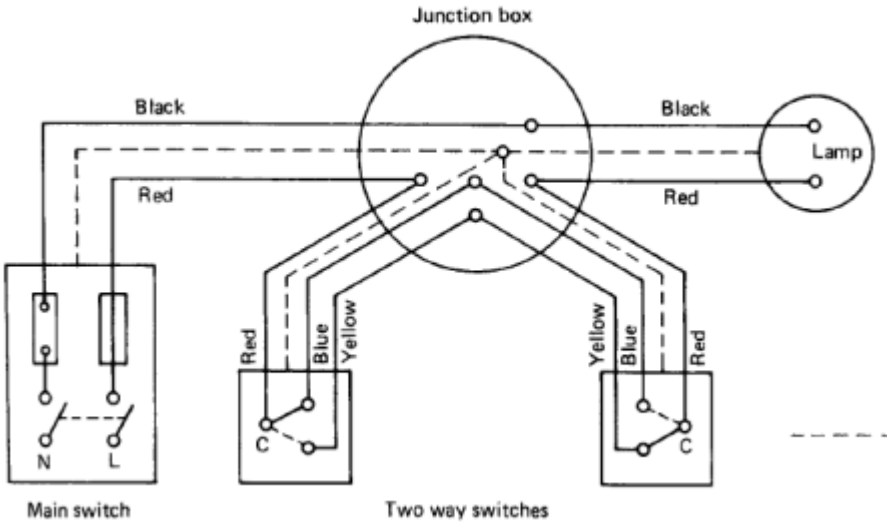




**One-way double direction**

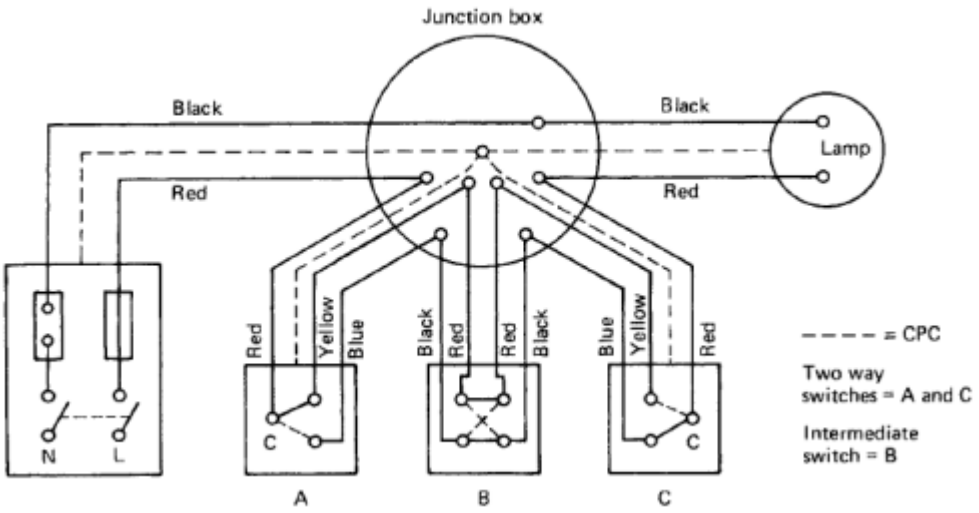


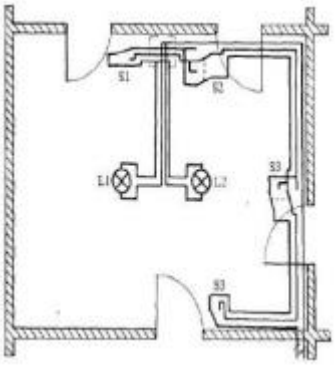

**Two ways switch circuit**




**Intermediate switch circuit**



## LO 4.6 – Draw a layout/installation/architectural plan diagram of given installation

- Content/Topic 1 : **– Draw a layout/installation/architectural plan diagram of given installation**
- Purpose of architectural plan

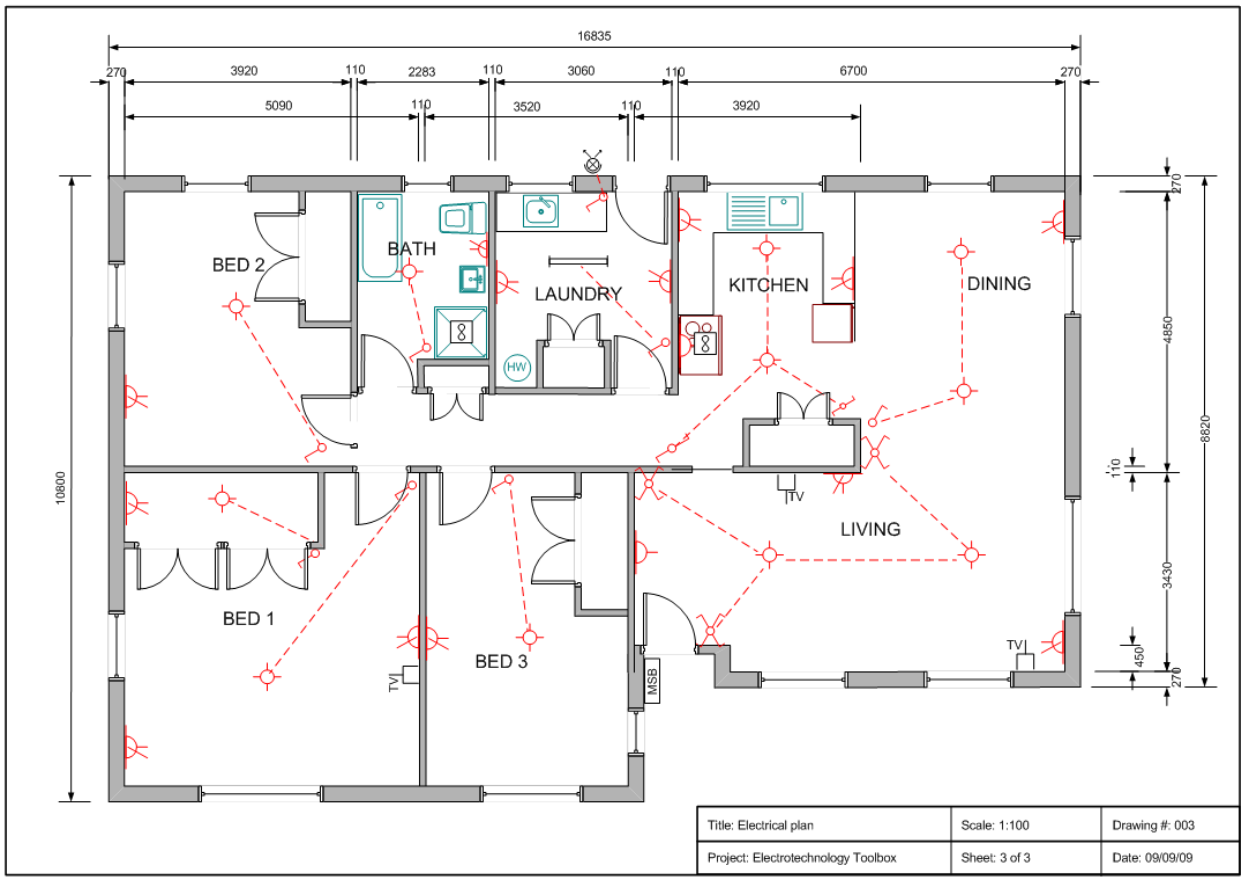
Architectural drawings are used by architects and others for a number of purposes to develop a design idea into a coherent proposal, to communicate ideas and concepts, to assist a building contractor to construct it based on design intent, as record of the design.

- **Characteristics**

✓ More technical details: The four basic elements of the architecture are point, line, plane and volume
✓ Correct geographical location: architects say design is influenced by the physical attributes of a location, like its climate, topography and site features.

Architectural plan of a house is simple their top view when that house are cut through it middle for example, you draw it by looking it through it top without it upper part. it like to draw floor house with it repartition.

**Basic symbol of architectural plan of a house**




This makes the electrical plan to be read and analyzed easily. Also this kind of installation will be a communication tool between designer and person who is supposed to the make the house installation.

## LO 4.7 – Draw a bloc diagram of given installation.

- Content/Topic 1 : **Draw a block diagram of given installation**

**Block Diagrams**

A block diagram is a very simple diagram in which the various items or pieces of equipment are represented by a square or rectangular box. The purpose of the block diagram is to show how the components of the circuit relate to each other and, therefore, the individual circuit connections are not shown. Figure below shows the block diagram of a space heating control system.

- Purpose of a block diagram

The purpose of the block diagram is to show how the components of the circuit relate to each other and, therefore, the individual circuit connections and show sequence of function link

- Characteristics of a block diagram

A block diagram is a visual representation of a system that uses simple , labeled blocks that represent single or multiple items ,entities or concepts, connected by lines to show relationships between them by using squares and rectangles

- Parts of a block Diagram

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks

- Data element
- Operators elements
- Control  Flow element

**Example of block diagram**

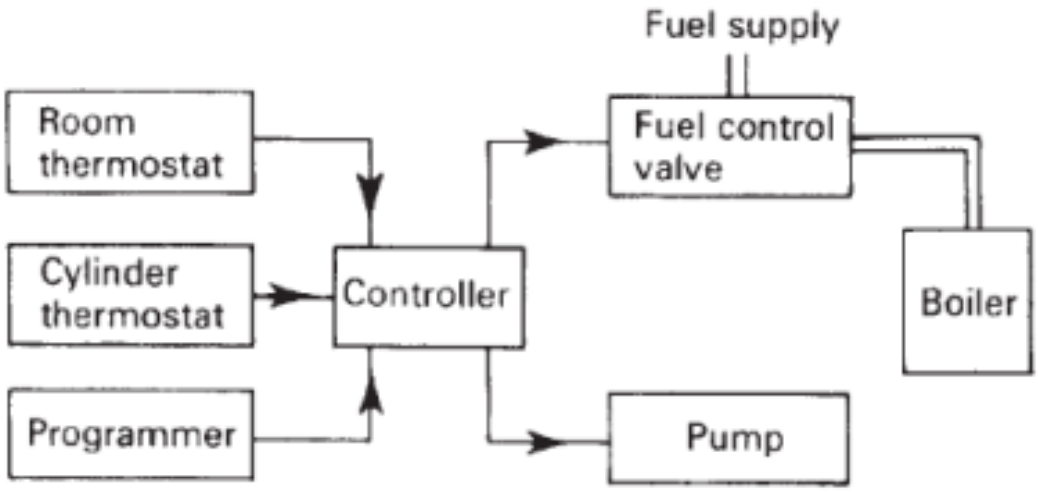



**Figure:** Block diagram of space heating control system

## LO 4.8 – Draw a layout/installation/architectural plan diagram of given installation

- Content/Topic 1: **Use Electrical CAD software**

**Use Electrical CAD software**

**Proper identification of CAD user interface**

**• Introduction to CAD**

**Computer-aided design** (**CAD**) is the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to:

- increase the productivity of the designer
- improve the quality of design,
- improve communications through documentation, and
- create a database for manufacturing

CAD output is often in the form of electronic files for print, machining, or other manufacturing operation.

**CAD interface**

Ribbon Interface, Project tab ,Project Tools panel ,Other Tools panel ,Troubleshooting panel ,Schematic tab ,Quick Pick panel ,Insert Components panel ,Edit Components panel ,Insert Wires/Wire Numbers panel ,Edit Wires /Wire ,Other Tools panel , Power Check Tools panel ,Panel tab , Insert Component Footprints panel , Terminal Footprints panel , Edit Footprints panel , Other Tools panel , Conduit Tools panel , Reports tab ,Schematic panel ,Miscellaneous panel, Import/Export Data tab ,Import panel , Export panel ,Conversion Tools tab ,Tools panel ,Schematic panel ,Attributes panel ,Symbol Builder tab ,Edit panel ,Help panel ,Toolbars to Ribbons, Main Electrical toolbar ,Main Electrical toolbar ,Panel Layout toolbar ,Conversion toolbar ,Conduit Marker

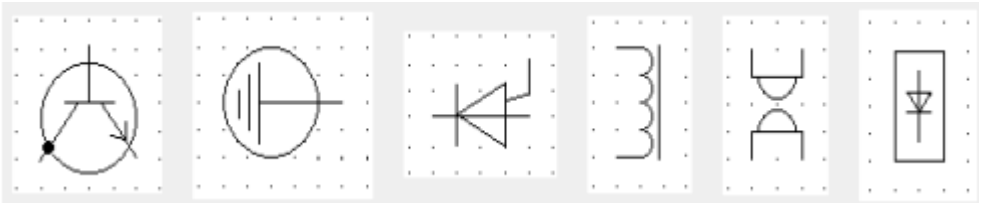
**Apply CAD in electrical drawing**

Symbol Preview Guide

- **Standard-based drafting and libraries**

**IEC symbols**

IEC 60617 contains graphical symbols for use in electro technical diagrams. All the parts (Ed. 2 or 3) of the previously published IEC 60617 have been incorporated into this database that currently includes some 1900 symbols. The database is the official source of IEC 60617



- Selector Switches , Illuminated Selector Switches , Fuses and Transformers , Circuit Breakers and Disconnects , Relays and Contacts , Latch Relay Coils ,Time Delay Relays ,OFF Delay Timers , Motor Control , Pilot Lights . all the symbols of are shown on computer

**Proper management of projects in Electrical CAD**

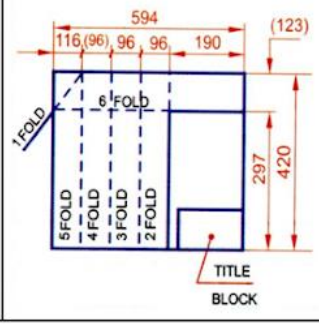
Overview of projects By using CAD software draw the Use recently opened projects Trainer Francois wants to install his house which is composed with 2 rooms and 1corridor of
3 doors and an electric bell located outside. The installation must be wired as follow:
**Room1:** - One way switching 2 lamps
- One socket outlet
**Room2:** - Two-Pole, One-way switching 2 lamps: one is located in the room and other outside of the room.
**Corridor (3doors):** - First two-way switch is on door number 1.
- Second two-way switch is on door number 3.
- Intermediate switch is placed on door number 2 between the 2 two-way switch in order to facilitate **on** or **off** in different position. (Use 1 lamp in a Corridor).
- An electric bell is commanded by Push Button located on the Gate to inform the presence of someone.
**You as Technician make schematic diagram of the installation.**

## LO 4.9 – File electrical diagrams and charts for future use

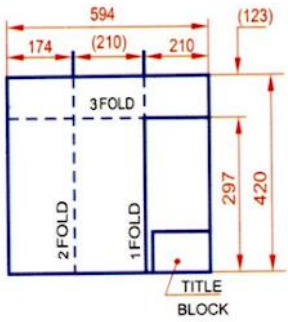
Content/Topic 1: Fold a drawing sheet

In Engineering Graphics, all the drawings are drawn in drawing sheets usually A2 and A3. After completing the drawing, the drawing sheet should be folded properly. There are two methods of folding of drawing sheets. The first method is intended for drawing sheets to be filed or bound, while the second method is intended for sheets to be kept individually in filing cabinet. The Method-I for folding the sheets is shown in the table below.

**Method-I for folding drawing sheet**

| SHEET DESIGNATION | FOLDING DIAGRAM | LENGTHWISE FOLDING | CROSSWISE FOLDING |
|---|---|---|---|
| A2<br>420 x 594 |  |  |  |

**Method-II for folding drawing sheet**

| SHEET DESIGNATION | FOLDING DIAGRAM | LENGTHWISE FOLDING | CROSSWISE FOLDING |
|---|---|---|---|
| A2<br>420 x 594 |  |  |  |

Whatever be the method of folding the drawing sheet, the title block should appear at the right bottom of the sheet finally. As per IS:SP 46-1988, the folding methods for A2 drawing sheet for engineering students should be the Method-II which is shown in the table above. This method is easy when compared with the Method-I but remember, practise is your best friend.

**Folding large format technical drawings**

There are basically two ways to handle large format drawings: roll them or fold them. Folding has a number of advantages:

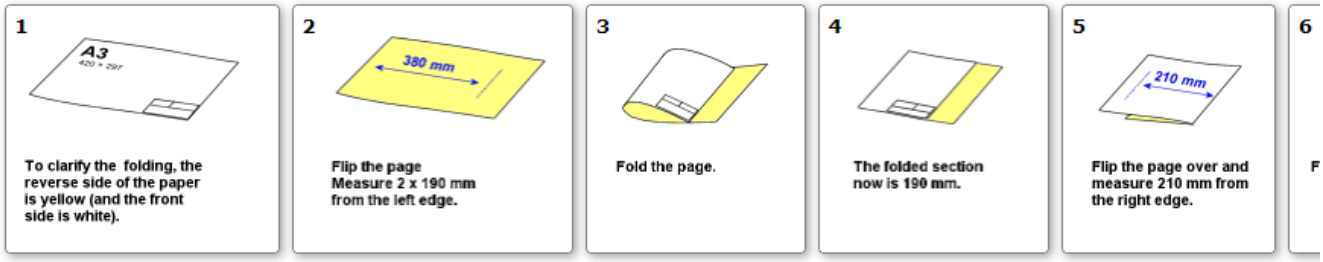
- a folded drawing is easier to archive and takes less space
- a set of folded drawings is conveniently organized in a ring binder or file folder, easy to slip in a briefcase to bring along to meetings
- a set of folded drawings in a binder/folder can be paged through without unfolding, because the title block is always visible in the lower right corner
- once you have flipped through the drawings and found the one you wish to view (or present), a folded drawing is easily unfolded to its full size without first needing to remove it from the binder/folder
- a folded drawing, put in an envelope, is cheaper to sent (by post) than a rolled-up drawing in a cardboard tube

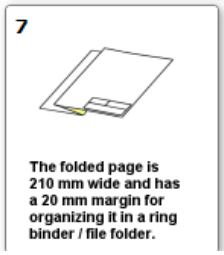
There is a catch: you need to fold the drawings correctly. The folding procedure that I present here conforms to the DIN 824 standard, based an "A" paper sizes. Each page folds to A4. I present only how to fold A3, A2 and A1 (we currently do not use larger paper sizes in our company, so I have no experience with them).

DIN 824 only specifies dimensions, of which there are quite a few. The advantage of my stepwise procedure is that you only need to remember three dimensions: the size of A4 format, being 210 × 297 mm, and the width of many folded sections, which is 190 mm. These values are not very critical, if you remember A4 as 21 by 30 cm that will be fine. In the drawings, you often see the doubled values: I measure 380 mm to create a folded section of 190 mm, but I think it is self-explanatory.

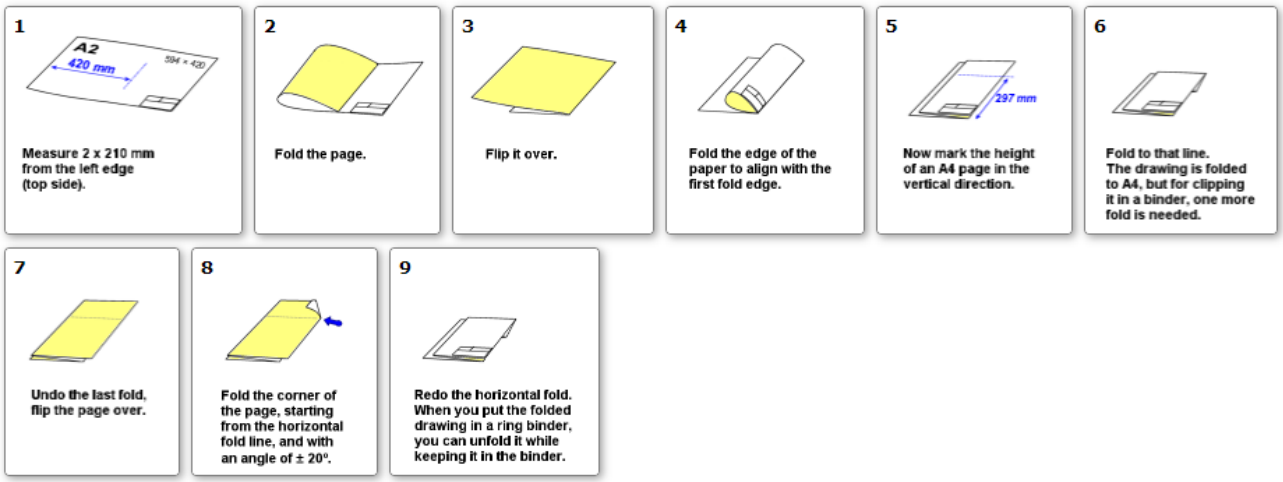
Real paper for technical drawings is typically white on both sides, but to better present the folding, I pretend to use paper that is white on top and yellow on the bottom side.

*A3*

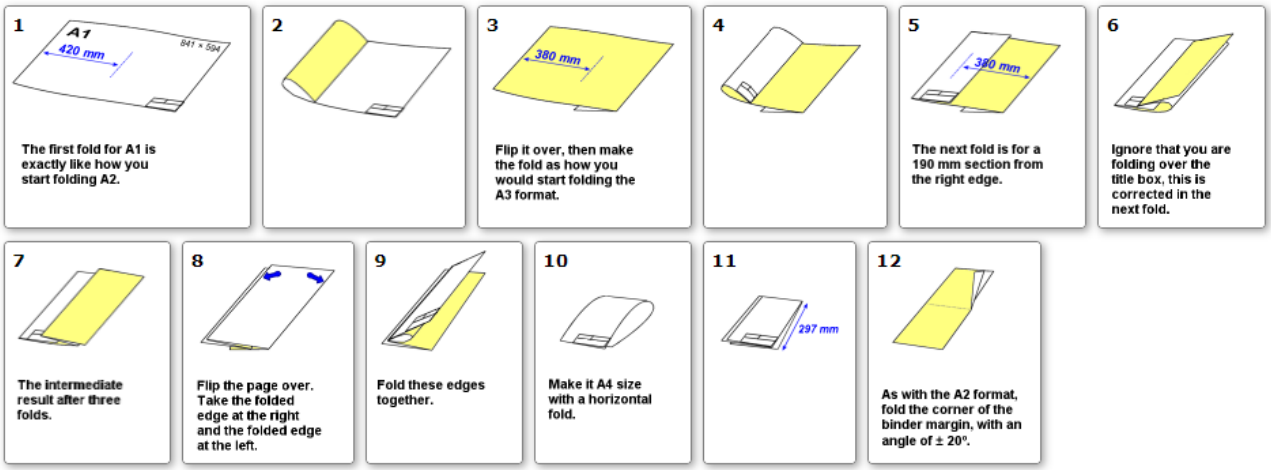


*A2*




*A1*




***Oversized paper***

When handling oversized paper, sometimes called A3+, A2+ and A1+, the easiest way out is to fold them to oversized A4 . If that is not acceptable, as a first step, fold away the right or top margin of the drawing, to approximate the width/height of A3, A2 or A1. For A3+ and A1+, you only have to fold the *top* margin (to approximate the height of A3 and A1 respectively); there is no need to also fold the right margin for A3+ and A1+. Likewise, for A2+ you only fold the *right* margin; you do not need to also fold the top margin.

For example, when folding A2+ with a size of 610 × 430 mm (instead of 594 × 420 mm), fold roughly 15 mm of the right edge of the drawing, so that the new size becomes 595 × 430 mm. Then proceed with the standard way to fold A2.

## Content/Topic 2: Arrangement of document

Arrangements are plans and preparation

- ✓ Chronological (by date)

Chronology is the arrangement of events by time or a timeline of events, Chronological order refers to sorting events, items or really anything by some sort of time or date sequence

- ✓ Numeric (Assigned number)

A system for organizing record through the use of numbers that appears on the materials or a system to classify materials using numbers as headings.

- ✓ Alphabetical (Alphabetical order)

Order files alphabetically according to their indexed name. The general rule for filing alphabetically is to arrange items in order from A (First) to Z(Last)

- ✓ Alpha numeric(letter and number)

If you add numbers to the names, then the order would be alphanumeric. The definition of alphanumeric is something that contains letters and numbers

**Reference(s):**


1. David Andelson(2006)Technical drawing
2. http://www.mhhe.com/primis/online/
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