CHAPTER 4: TECHNICAL DRAWING

Unit of learning code: ENG/CU/EI/CC/04/4/A.

Related Unit of Competency in Occupational Standard: Prepare and interpret Technical Drawings.

4.1 Introduction to the unit of learning

This unit covers the competencies required to prepare and interpret technical drawings. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, orthographic drawings of components and Electrical drawings.

4.2 Summary of Learning Outcomes

1. Use and maintenance of drawing equipment and materials
2. Produce plane geometry drawings
3. Produce solid geometry drawings.
4. Produce and orthographic drawings
5. Produce Electrical drawings

4.2.1 Learning Outcome 1: Use and Maintenance of Drawing Equipment and Materials

4.2.1.1 Introduction to the learning outcome

To use and maintain drawing equipment and materials one is required to identify and care the equipment and materials as per the manufacturer's instructions and work place procedures and also use personal protective Equipment (PPEs)

4.2.1.2 Performance Standard.

1. Drawing equipment are identified and gathered according to task requirements
2. Drawing equipment are identified and gathered according to task requirements
3. Drawing equipment are used and maintained as per manufactures instructions
4. Drawing materials are used as per workplace procedures
5. Waste materials are disposed in accordance with workplace procedures and environmental legislations
6. Personal Protective Equipment is used according to occupational safety and health regulations

4.2.1.3 Information Sheet

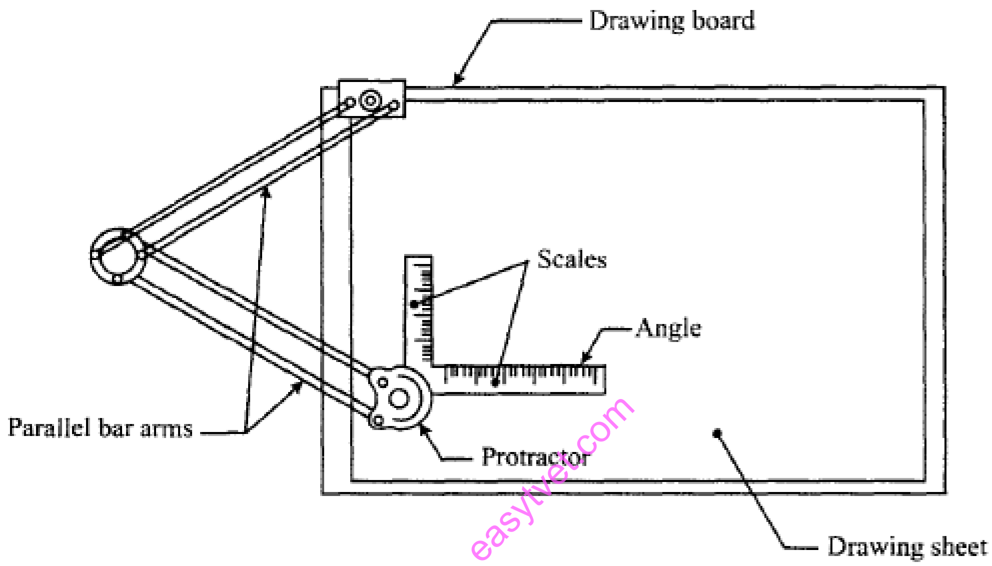
Drawing instruments

Drawing board

Until recently drawing boards used are made of well-seasoned softwood of about 25 mm thick with a working edge for T-square. Nowadays mini-draughters are used instead of T-squares which can be fixed on any board. The standard size of board depends on the size of drawing sheet size required.

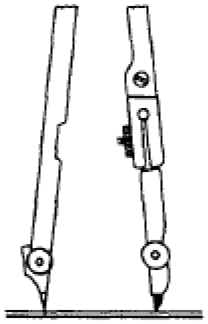
Mini-Draughter

Mini-draughter consists of an angle formed by two arms with scales marked and rigidly hinged to each other. It combines the functions of T-square, set-squares, scales and protractor. It is used for drawing horizontal, vertical and inclined lines, parallel and perpendicular lines and for measuring lines and angles

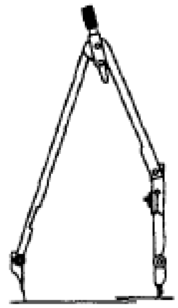


Instrument box

1. Compasses, Dividers and Inking pens. What is important is the position of the pencil lead with respect to the tip of the compass. It should be at least I mm above as shown below because the tip goes into the board for grip by 1 mm.



Sharpening and position of compass lead



Position of the lead leg to draw larger circles

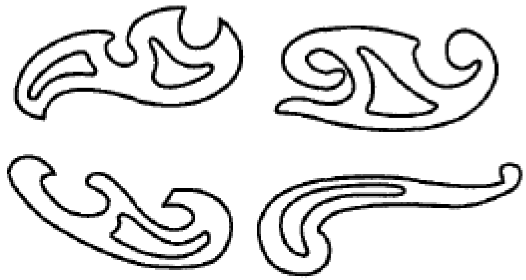
Set of Scales

Scales are used to make drawing of the objects to proportionate size desired. These are made of Wood, steel or plastic. BIS recommends eight set-scales in plastic/cardboard with designations.

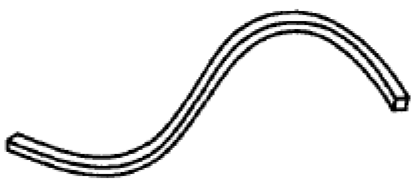
French Cures

French curves are available in different shapes shown below. First a series of points are plotted along

the desired path and then the most suitable curve is made along the edge of the curve. A flexible curve consists of a lead bar inside rubber which bends conveniently to draw a smooth curve through any set of points.



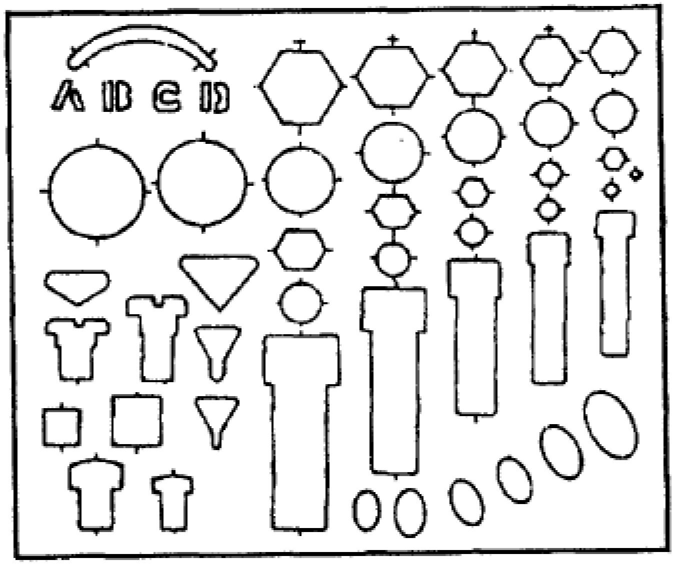
(a) French curves



(b) Flexible curve

Templates

These are aids used for drawing small features such as circles, arcs, triangular, square and other shapes and symbols used in various science and engineering fields.



Pencils

Pencils with leads of different degrees of hardness or grades are available in the market. The hardness or softness of the lead is indicated by 3H, 2H, H, HB, B, 2B, 3B, etc. The grade HB denotes medium hardness ofl ead used for general purpose. The hardness increases as the value of the numeral before the letter H increases. The lead becomes softer, as the value of the numeral before B increases.

HB- Soft grade for Border lines, lettering and free sketching

H- Medium grade for Visible outlines, visible edges and boundary lines

2H - Hard grade for construction lines, dimension lines, leader lines, extension lines, Centre lines, hatching lines and hidden lines.

Proper care and maintenance.

It is essential to take proper care of the drafting tools, materials, and equipment. Below are some tips to properly use and take care of them.

a) Avoid dropping your tools and equipment.
b) Never use measuring tools in cutting paper
c) Wipe off the surface and edges of triangles and T-squares.
d) Sharpen and store your pencils properly after use
e) Find or create and organizer where you can hang your measuring tools.
f) Have a separate container for making tools.
g) Keep your drawing sheets in a plastic tube to protect them from a dust and dirt.
h) Never lend or borrow drafting tools and materials if may.

4.2.1.4 Learning Activities

1. Identified and gathered drawing equipment according to task requirements.
2. Identified and gathered drawing materials according to task requirements
3. Used and maintained drawing equipment as per manufacturer's instructions
4. Used drawing materials as per Workplace procedures
5. Disposed waste materials in accordance with workplace procedures and environment legislations.
6. Used personal protective equipment according to occupational safety and health regulation

4.2.1.5 Self-Assessment

1.3 Name and give uses of Five drawing instruments.

1.4 What are the proper care and maintenance of drawing instruments.

4.2.1.6 Tools, Equipment, Supplies and Materials

a. Drawing room

b. Drawing instruments e.g., T-squares, set squares, drawing sets
c. Drawing tables
d. Pencils, papers, erasers
e. Masking tapes

4.2.1.7 References

K.Venkata Reddy Engineering Drawing 2nd Edition

S.K Bhattacharya Electrical Engineering Drawing 2nd Edition

Kenneth Morling Geometric and Engineering Drawing 3rd Edition.

4.2.1.8 Response for Self-assessment

1

i. Divider-used to equally divide a line or space by trials and error.
ii. Protractor-It is a semi-circular tool used to measure or layout angle/arc.
iii. Compass- draws large arcs and circles in pencil or pen point.
iv. T-square-guides in drawing parallel horizontal lines
v. French curve-it is used as a guide in drawing irregular curved lines.

2

a. Avoid dropping your tools and equipment
b. Never use measuring tools in cutting paper
c. Wipe off the surface and edges of triangles and T-squares.
d. Sharpen and store your pencils properly after use
e. Find or create and organizer where you can hang your measuring tools.

4.2.2 Learning Outcome 2: Produce Plane Geometry Drawings

4.2.2.1 Introduction to the learning outcome

To produce plane geometry drawing one is required to understand; types of lines in drawings, Construction of geometric forms, Construction of different angles, Measurement of different angles and Bisection of different angles and lines

4.2.2.2 Performance Standard

1. Different types of lines used in drawing and their meanings are identified according to standard drawing conventions Different types of geometric forms are constructed according to standard conventions
2. Different types of angles are constructed according to principles of geometry
3. Different types of angles are measured using appropriate measuring tools
4. Angles are bisected according to standard conventions
5. Freehand sketching of different types of geometric forms, tools, equipment, diagrams is conducted

4.2.2.3 Information Sheet

Plane geometry is the geometry of figures that are two-dimensional, i.e., figures that have only length and breadth. There are an endless number of plane figures but we will concern ourselves only with the more common ones – the triangle, the quadrilateral and the better-known Polygons

Definition of terms

Geometry –the shape of the object, represented as views from various angles.

Dimensions-the size of part, expressed in accepted unit

Material-represents what the component is made from.

Finish- specifies the surface quality.

Types of lines.

- Continuous thick line

This line is used to display the outline and edges of the main drawing, does with a pencil soften than HB.

- Continuous thin line

This line is basically used for dimension, extension, projection and leader line. A harder pencil should be used, such as a 2H pencil.

- Continuous thin line free hand line

This line is used to show short break or irregular boundaries.

- Continuous thin zigzag line

This line is used to show long break.

- Dashed line

This line is used to shown hidden edges of the main object

- Chain thin line long dotted

This line is used to represent the centre line for circles and arcs

- Chain thin with thick ends

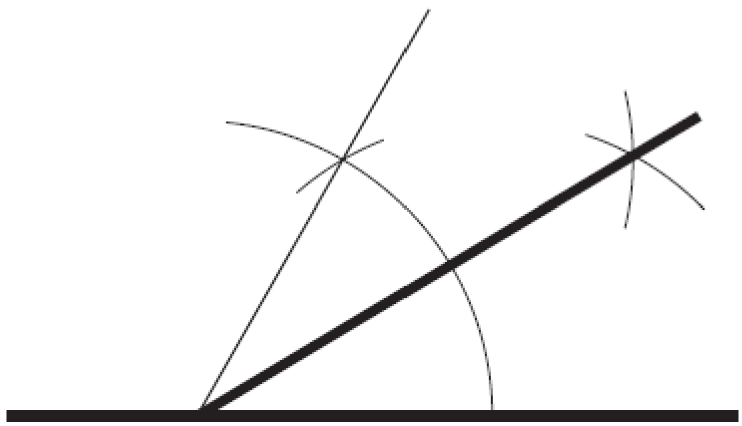
This line is used to represent the location of a cutting plane

- Long thin dashed and double short dashed lines

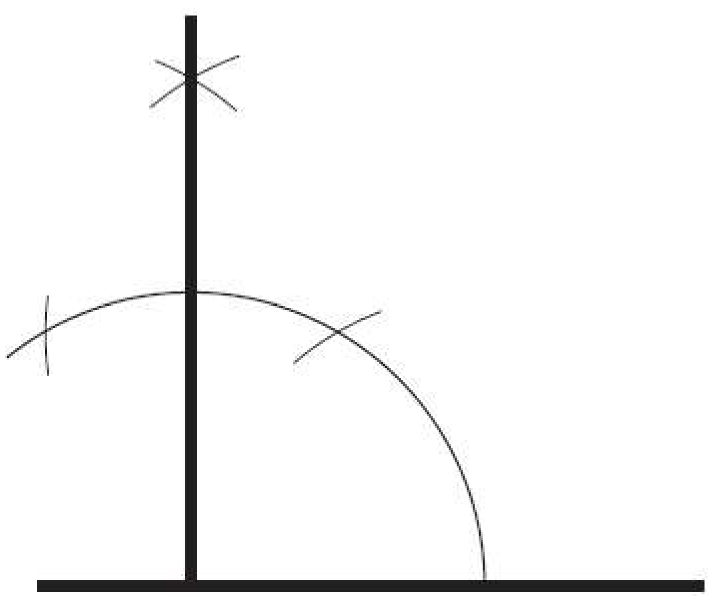
This line is located in front of cutting planes, outlines of adjacent parts, censorial lines, and to state centre of gravity.

Types of Angles

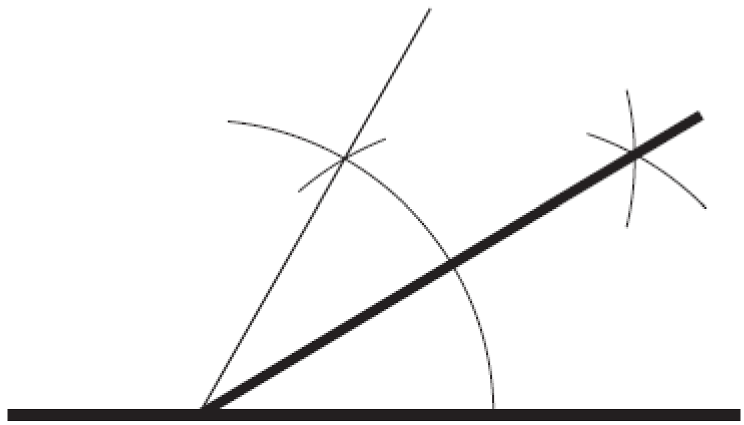
To construct 600



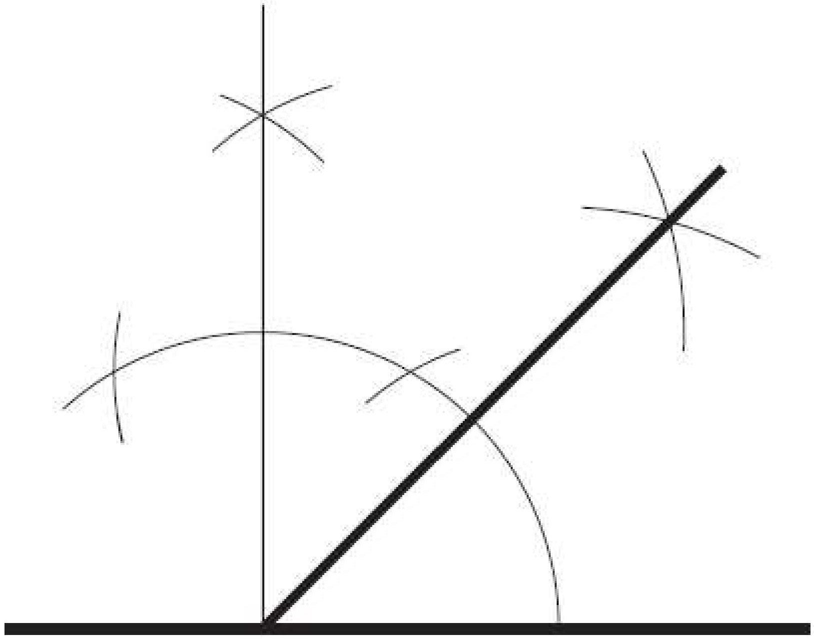
To construct 90^0



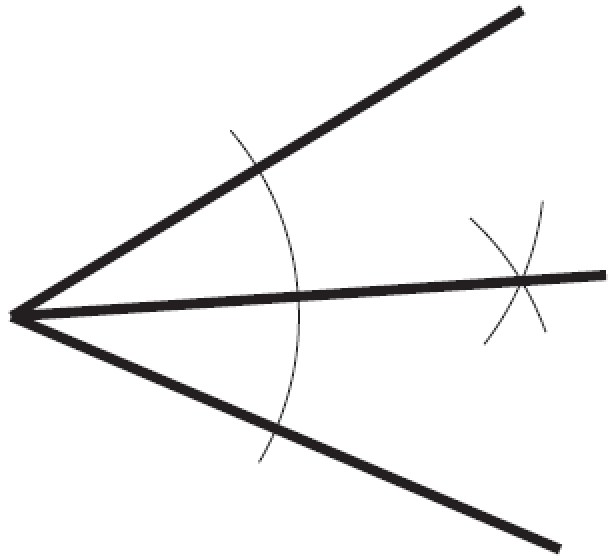
To construct 30^0



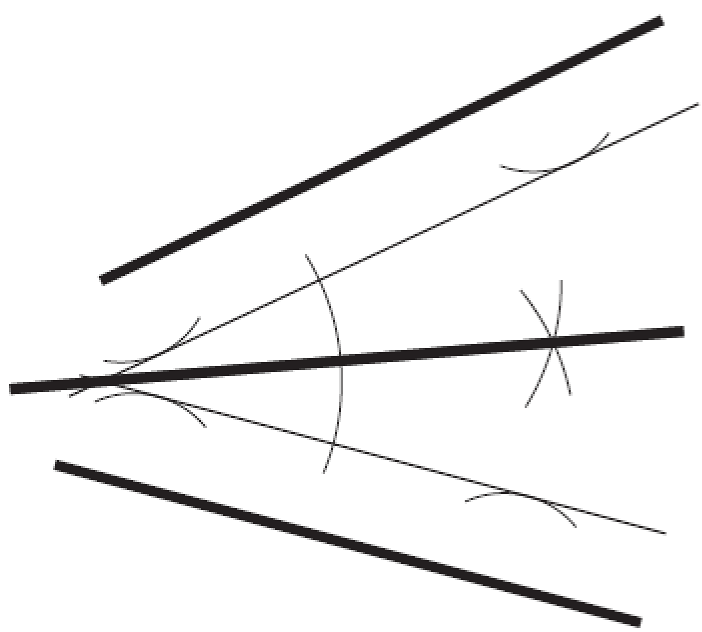
To construct 45^0



To bisect an angle



To bisect an angle formed by two converging lines



4.2.2.4 Learning Activities

1. Identified different types of lines used in drawing and their meanings according to standard drawing conventions Constructed different types of geometric forms according to standard conventions
2. Constructed different types of angles according to principles of geometry
3. Measured different types of angles using appropriate measuring tools
4. Bisected angles according to standard conventions

4.2.2.5 Self-Assessment

1. Name any five types of lines
2. Bisect 300 angle
3. Construct a parallel line

4.2.2.6 Tools, Equipment, Supplies and Materials

- Drawing room
- Drawing instruments e.g., T-squares, set squares, drawing sets
- Drawing tables
- Pencils, papers, erasers
- Masking tapes

4.2.2.7 References

K.Venkata Reddy Engineering Drawing 2nd Edition

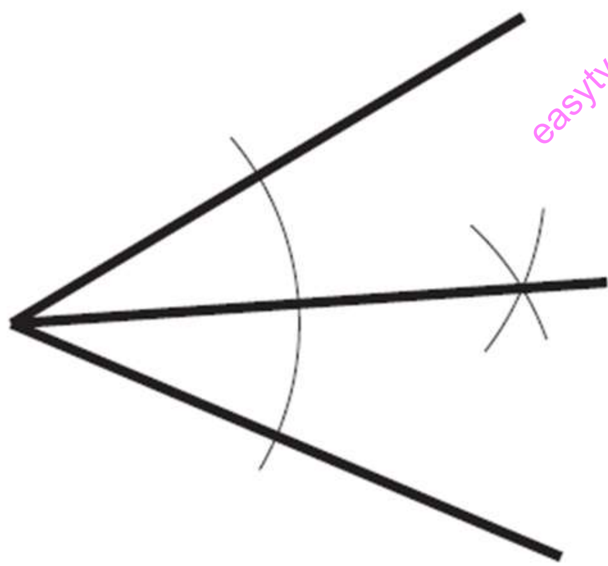
S.K Bhattacharya Electrical Engineering Drawing 2nd Edition

4.2.2.8 Response to Self-Assessment

1. Types of lines

- Continuous thick line
- Continuous thin line
- Dashed line
- Chain thin line long dotted
- Chain thin with thick ends

2.



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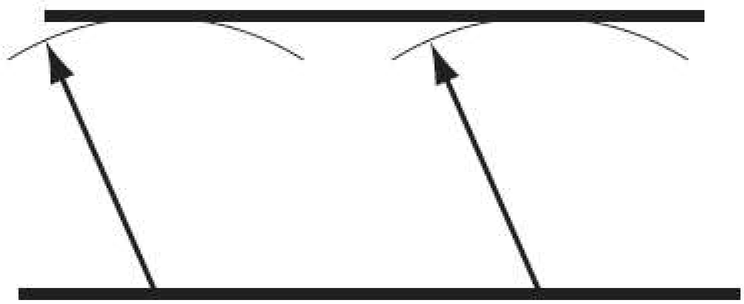


4.2.3 Learning Outcome 3: Produce Solid Geometry Drawings

4.2.3.1 Introduction to the learning outcome

To produce solid geometry drawings, one is required to understand; Interpretation of sketches and drawings of patterns, Sectioning of solids and Development and interpenetrations of solids.

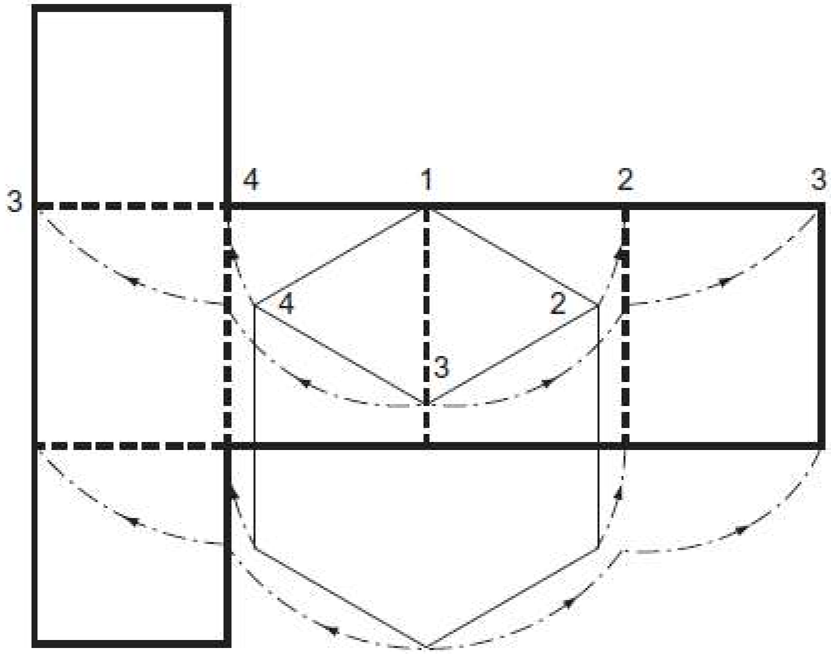
4.2.3.2 Performance Standard

1. Drawings of patterns are interpreted according to standard conventions
2. Patterns are developed in accordance with standard conventions
3. Patterns are assembled as per standard conventions
4. Pattern assembly is interpreted as per standard conventions.

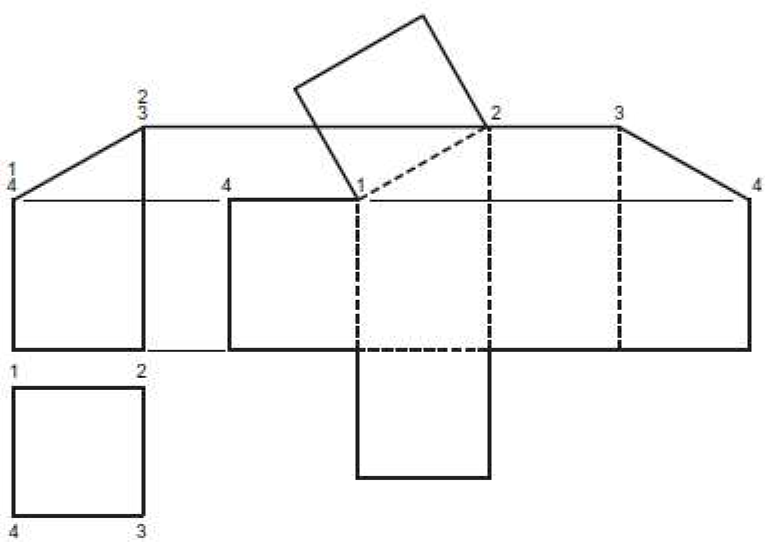
4.2.3.3 Information Sheet

Prism

The prism below shows how a square prism is unfolded and its development obtained. Note that where there are corners in the undeveloped solid, these are shown as dotted lines in the development.



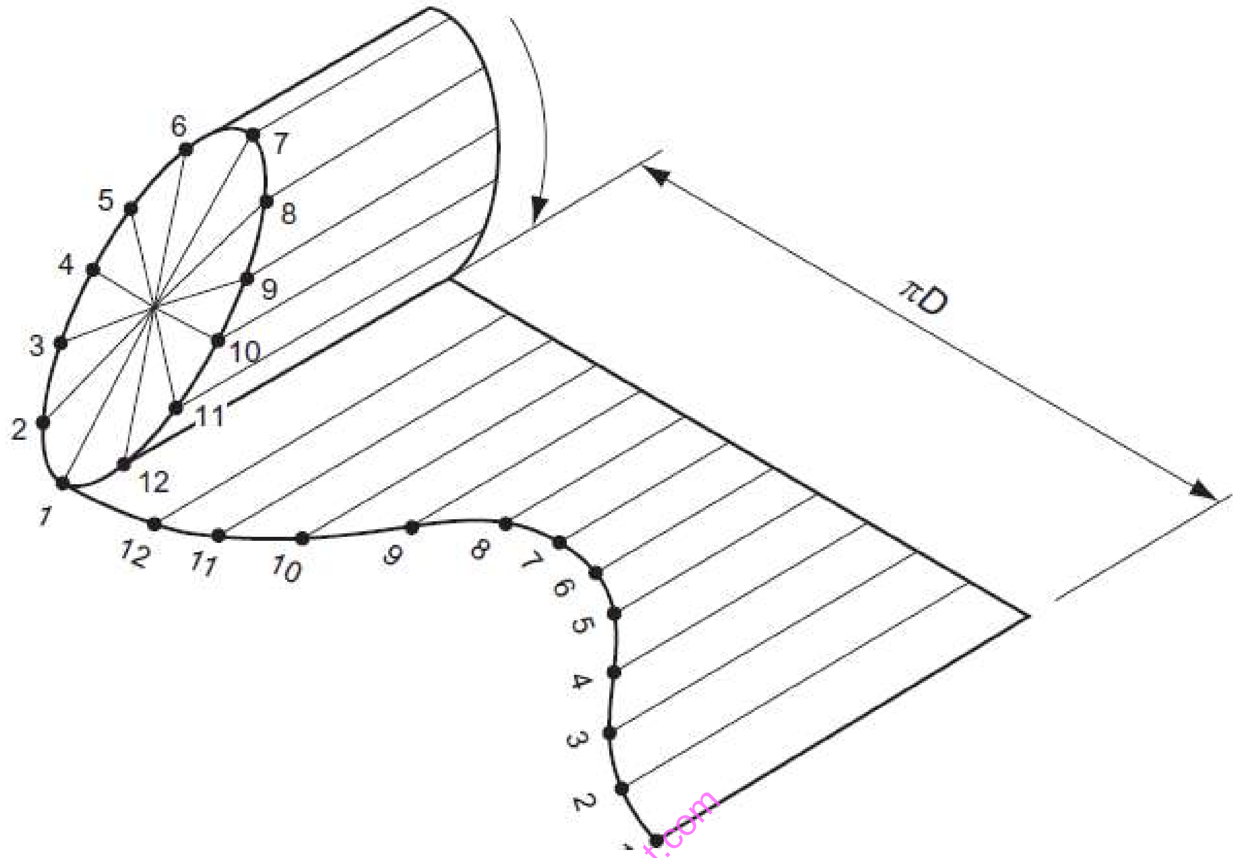
To develop a square prism with an oblique top.



Cylinders

If you painted the curved surface of a cylinder and, while the paint was wet, placed the cylinder on a flat surface and then rolled it once, the pattern that the paint left on the flat surface would be the development of the curved surface of the cylinder.

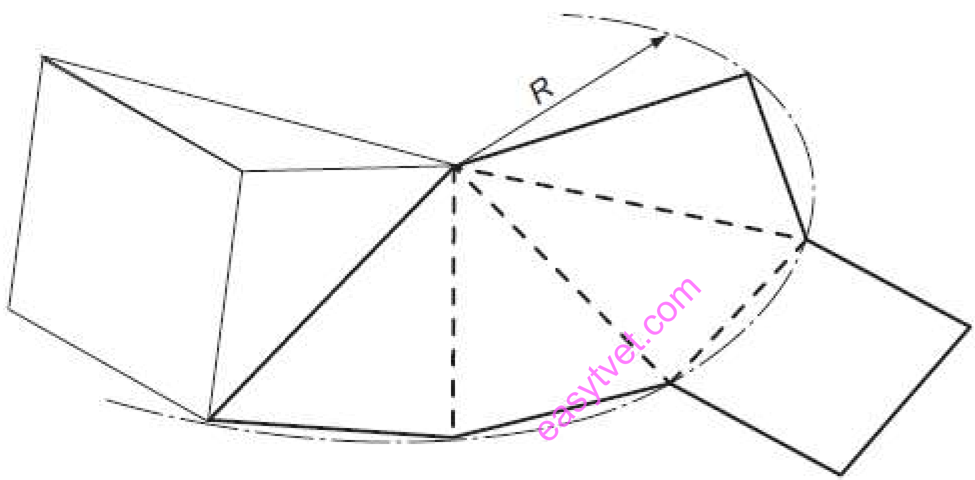
Figure below shows the shape that would evolve if the cylinder was cut obliquely at one end. The length of the development would be π D , the circumference. The oblique face has been divided into 12 equal parts and numbered. You can see where each number will touch the flat surface as the cylinder is rolled.



Pictorial view of the development of a cylinder.

Pyramids

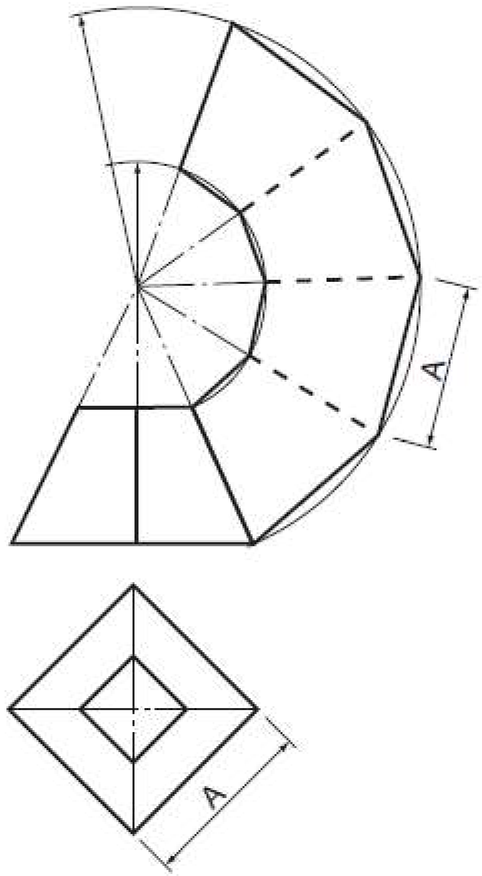
Figure below shows how the development of a pyramid is found. If a pyramid is tipped over so that it lies on one of its sides and is then rolled so that each of its sides touches in turn, the development is traced out. The development is formed within a circle whose radius is equal to the true length of one of the corners of the pyramid



R = True length of a corner of the pyramid

To develop the sides of the frustum of a square pyramid

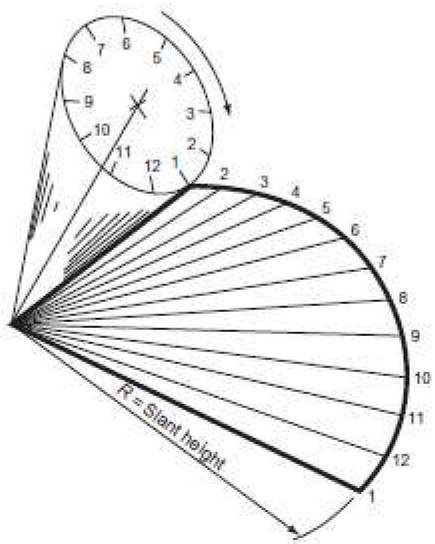
The true length of a corner of the pyramid can be seen in the FE. An arc is drawn, radius equal to this true length, centre the apex of the pyramid. A second arc is drawn, radius equal to the distance from the apex of the cone to the beginning of the frustum, centre the apex of the cone. The width of one side of the pyramid, measured at the base, is measured on the plan and this is stepped round the larger arc four times



Cones

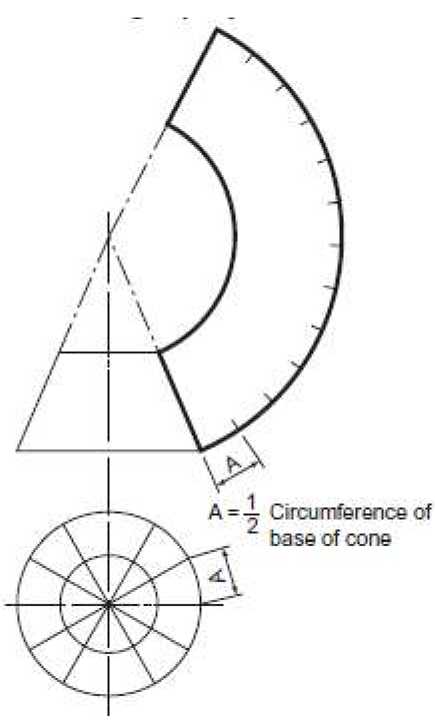
Figure below shows how if a cone is tipped over and then rolled it will trace out its development. The development forms a sector of a circle whose radius is equal to the slant height of the cone. The length of the arc of the sector is equal to the circumference of the base of the cone. If the base of the cone is divided into 12 equal sectors that are numbered from 1 to 12,

the points where the numbers touch the flat surface as the cone is rolled can be seen.



To develop the frustum of a cone.

The plan and elevation of the cone are shown below. The plan is divided into 12 equal sectors. The arc shown as dimension A is 1/12 of the circumference of the base of the cone.



4.2.3.4 Learning Activities

- Interpreted drawings of patterns according to standard conventions
- Developed patterns in accordance with standard conventions
- Assembled patterns as per standard conventions
- Interpreted pattern assembly as per standard conventions.

4.2.3.5 Self-Assessment

1. Develop the frustum of a cone that has been cut oblique
2. Develop the sides of a hexagonal frustum if the top has been cut obliquely

4.2.3.6 Tools, Equipment, Supplies and Materials

- Drawing room
- Drawing instruments e.g., T-squares, set squares, drawing sets
- Drawing tables
- Pencils, papers, erasers
- Masking tapes

4.2.3.7 References

K.Venkata Reddy Engineering Drawing 2nd Edition

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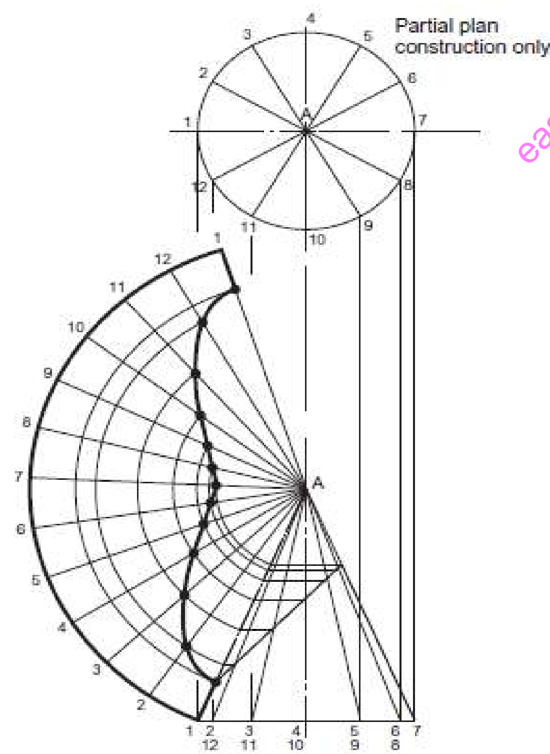
4.2.3.8 Response to self-assessment

1.

Third angle projection



4.2.4 Learning Outcome 4: Produce Orthographic Drawings

4.2.5.1 Introduction to the learning outcome

To produce orthographic drawings, one is required to understand; Meaning of pictorial and orthographic drawings, meaning of symbols and abbreviations, Drawing and interpretation of orthographic elevations, Dimensioning of orthographic elevations, Sectioning of views and Assembly drawing.

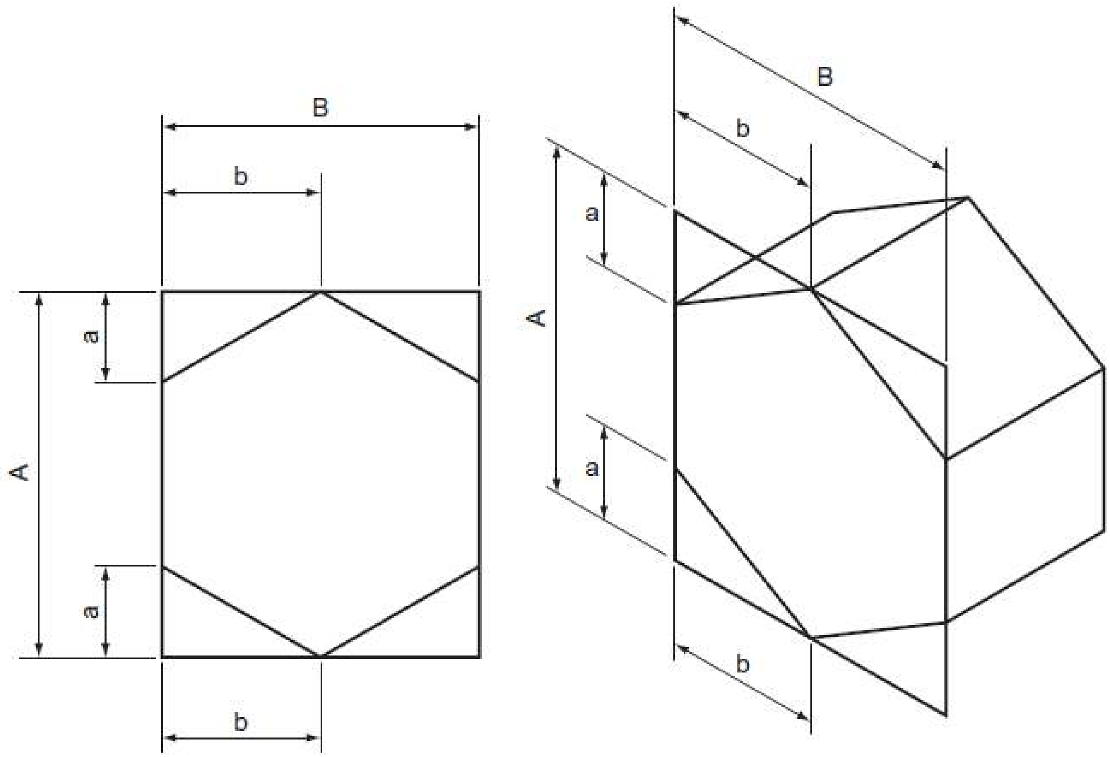
4.2.5.2 Performance Standard

1. Symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions
2. First and third angle orthographic drawings are produced and interpreted in accordance with the standard conventions
3. Orthographic elevations are dimensioned in accordance with standard conventions
4. Isometric drawings are produced and interpreted in accordance with standard conventions
5. Assembly drawing is produced and interpreted in line with the operating standards

4.2.5.3 Information Sheet

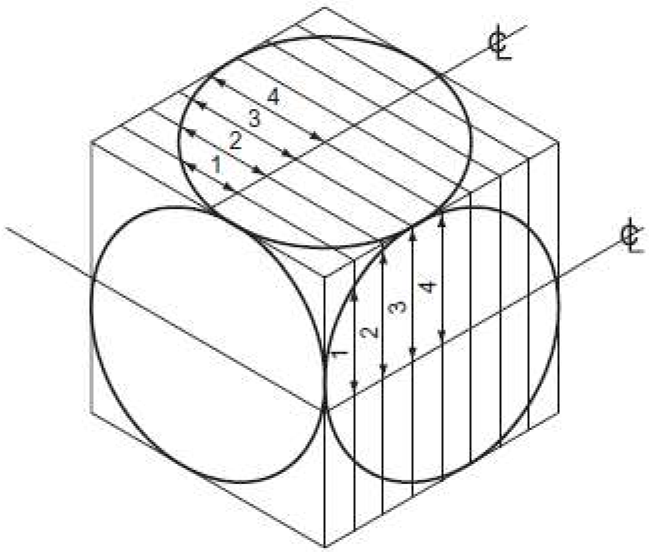
Engineering drawings are always drawn in orthographic projection. For the presentation of detailed drawings, this system has been found to be far superior to all others. The system has, however, the disadvantage of being very difficult to understand by people not trained in its usage. It is always essential that an engineer be able to communicate his ideas to anybody, particularly people who are not engineers, and it is therefore an advantage to be able to draw using a system of projection that is more easily understood. There are many systems of projection and this book deals with three: isometric, oblique and orthographic projections. Isometric and oblique projections present the more pictorial view of an object.

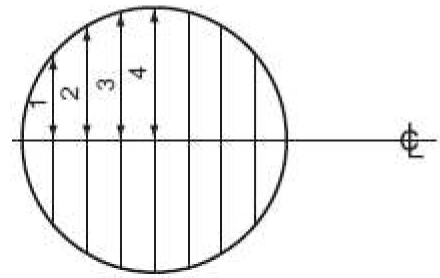
An isometric drawing of a regular hexagonal prism.



Circles and Curves Drawn in Isometric Projection

All of the faces of a cube are square. If a cube is drawn in isometric projection, each square side becomes a rhombus. If a circle is drawn on the face of a cube, the circle will change shape when the cube is drawn in isometric projection. Figure below shows how to plot the new shape of the circle.



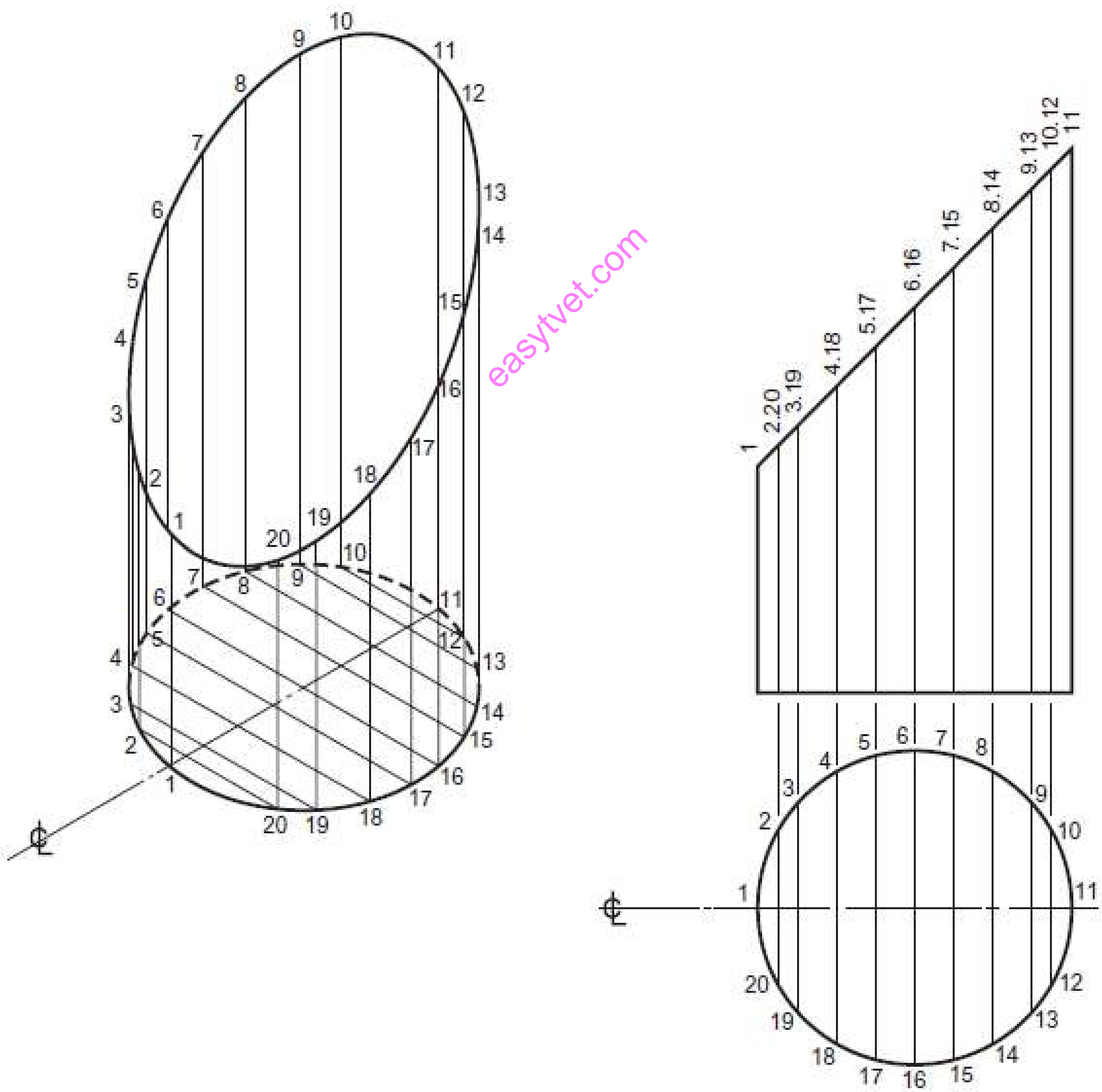


The circle is first drawn as a plane figure, and is then divided into an even number of equal strips. The face of the cube is then divided into the same number of equal strips. Centre lines are added and the measurement from the centre line of the circle to the point where strip 1 crosses the circle is transferred from the plane drawing to the isometric drawing with a pair of dividers. This measurement is applied above and below the centre line. This process is repeated for strips 2, 3, etc.

The points that have been plotted should then be carefully joined together with a neat freehand curve.

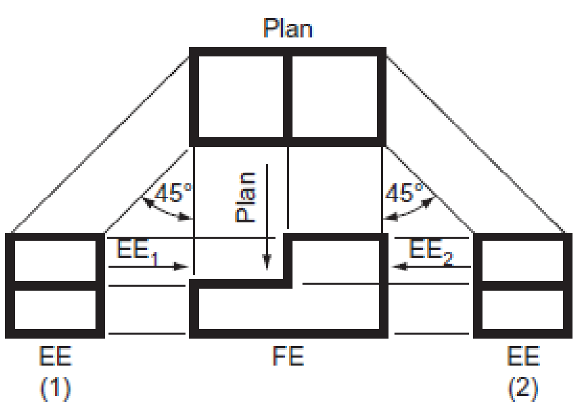
Cylinder cut obliquely.

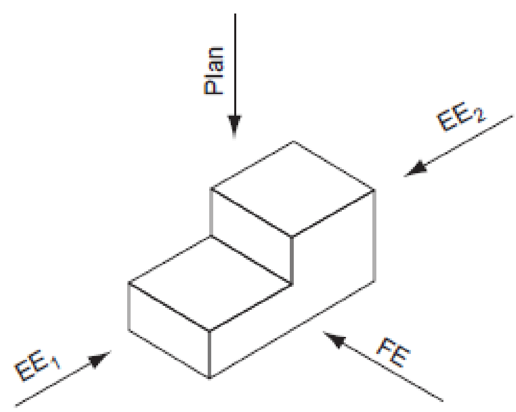
Figure below shows a cylinder cut at 45 °. Two views of the cylinder have to be drawn: a plan view and an elevation. The plan view is divided into strips and the positions of these strips are projected onto the elevation. The base of the cylinder is drawn in isometric projection in the usual way. Points1 to 20, where the strips cross the circle, are projected vertically upwards and the height of the cylinder, measured from the base with dividers is transferred for each point in turn from the elevation to the isometric view. These points are then carefully joined together with a neat freehand curve.



Third angle orthographic projection

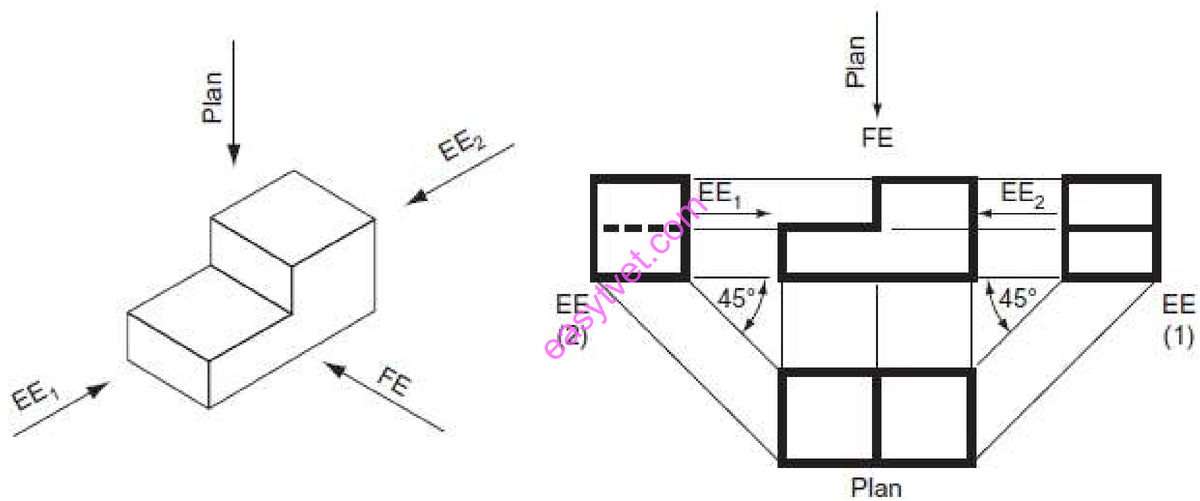
Figure below shows the same shaped block drawn in third angle projection. First draw the view obtained by looking along the arrow marked FE. This gives you the FE. Now look along the arrow marked EE 1 (which points from the left) and draw what you see to the left of the FE. This gives you an EE. Now look along the arrow marked EE 2 (which points from the right) and draw what you see to the right of the FE. This gives you another EE. Now look down onto the block, along the arrow marked ‘ plan ’ and draw what you see above the FE. This gives the plan and its exact position is determined by drawing lines from one of the EE at 45 ° .Note that with third angle projection, what you see from the left you draw on the left, what you see from the right you draw on the right and what you see from above you draw above.





First angle orthographic projection

Figure below shows the same block drawn in first angle projection. Again, first draw the view obtained by looking along the arrow marked FE. This gives the FE. Now look along the arrow marked EE 1 (which points from the left) and draw what you see to the right of the FE. This gives you an EE. Now look along the arrow marked EE 2 (which points from the right) and draw what you see to the left of the FE. This gives you another EE. Now look down on the block, along the arrow marked ‘ plan ’ and draw what you see below the FE. This gives the plan and its exact position is determined by drawing lines from one of the EE at 45 °.



4.2.5.4 Learning Activities

1. Identified symbols and abbreviations and their meaning interpreted according to standard drawing conventions
2. Produced first and third angle orthographic drawings and interpreted in accordance with the standard conventions
3. Dimensioned orthographic elevations in accordance with standard conventions
4. Produced isometric drawings and interpreted in accordance with standard conventions
5. Produced and interpreted assembly drawing in line with the operating standards

4.2.5.5 Self-Assessment

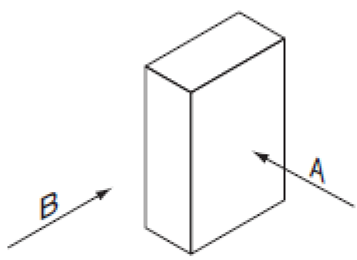
1. Figure below shows the following views of a rectangular prism, drawn in first angle projection with the prism tilted at 45 ° in the FE.

A FE looking along arrow A.

An EE looking along arrow B.

A plan.

An AP showing the cross-sectional shape of the prism.



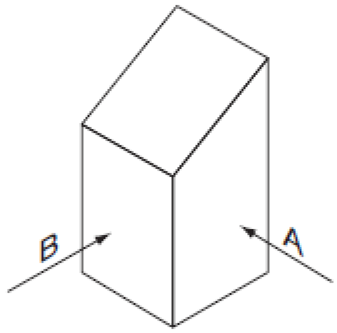
2. Figure below shows the following views of a square prism drawn in third angle projection. The top of the prism has been cut obliquely at 30 °.

A FE looking along arrow A .

An EE looking along arrow B .

A plan.

An AP projected from the FE at 30 ° .



4.2.5.6 Tools, Equipment, Supplies and Materials

- Drawing room
- Drawing instruments e.g. T-squares, set squares, drawing sets
- Drawing tables
- Pencils, papers, erasers

Masking tapes

4.2.5.7 References

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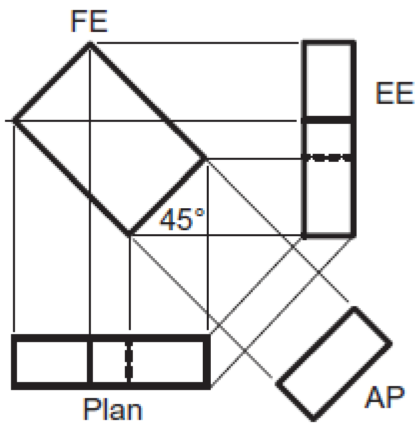
S.K Bhattacharya Electrical Engineering Drawing 2nd Edition

4.2.5.8 Response to self-assessment

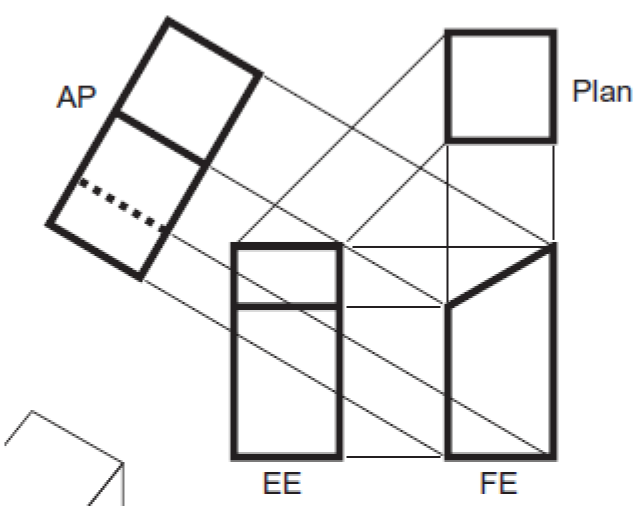
1.7

First angle projection



1.8

Third angle projection



4.2.5 Learning Outcome 5: Produce Electrical Drawings

4.2.5.1 Introduction to the learning outcome

To Produce Electrical drawings, one is required to have knowledge on; Electrical symbols and abbreviations, meaning of electrical drawings, drawing of electrical diagrams and Interpretation of electrical drawings.

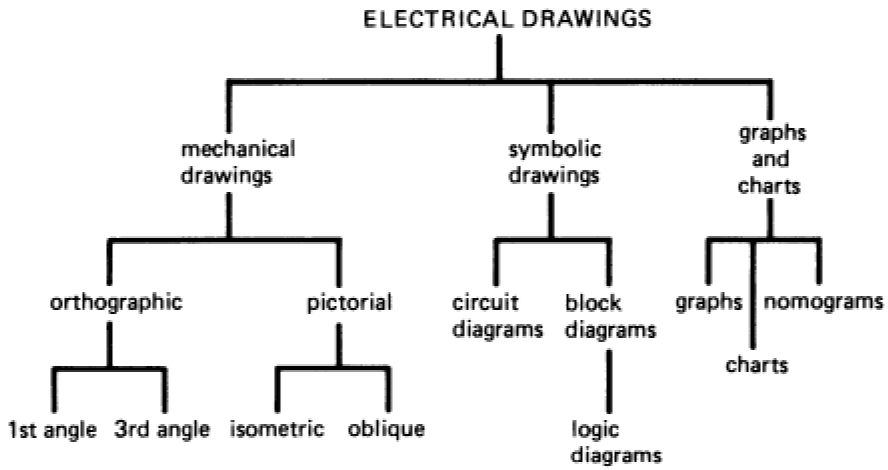
4.2.5.2 Performance Standard

1. Electrical symbols and abbreviations are identified and their meaning interpreted according to BS 3939
2. Electrical diagrams and drawings are developed as per established standards
3. Electrical drawings are produced in accordance with BS 3939
4. Electrical drawings and diagrams are interpreted as per established standards

4.2.5.3 Information Sheet

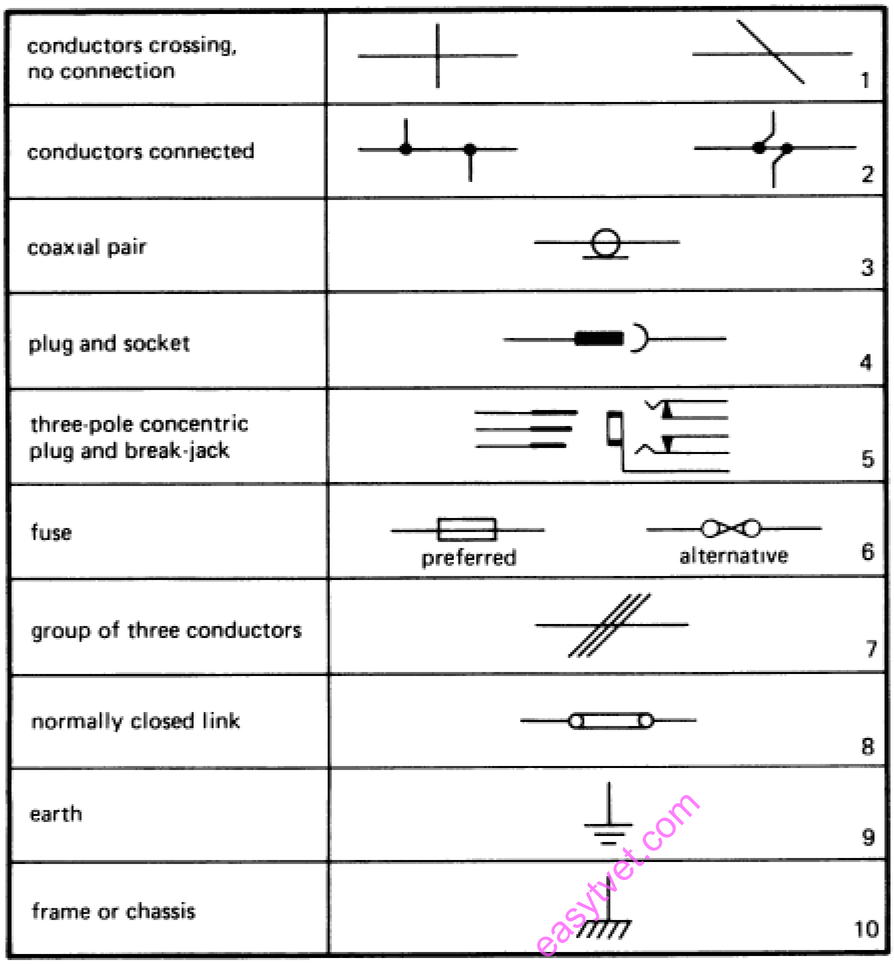
Types of Electrical drawing

Many kinds of drawing are used in electrical engineering in order to record different categories of information. Technicians and technician engineers may have to produce only some of these types of drawing, but they will need to understand all of them, and be able to extract information from them. Circuit diagrams show the way in which the components in an electrical or electronic system are connected together. When reading or drawing circuit diagrams it is important to remember two points.

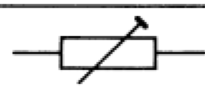
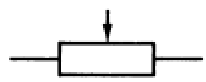
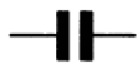


(l) The symbol used to represent each component depends only on its function, and has no relation to its shape, size or electrical rating. (2) The symbols are placed on the drawing to make the diagram as clear and easy to follow as possible. Their position bears no relationship to the layout of the components in the corresponding equipment. In view of the increase in international trade in electrical apparatus it is important to adhere wherever possible to internationally standard methods of drawing circuit diagrams. This is because much British equipment is exported all over the world, and in particular electronic apparatus may be made in one country, sold in another, and require servicing in a third. Unfortunately there is not complete uniformity in the component symbols used in all countries but the various national standards are steadily being brought into agreement with the international standards recommended by the International Electro-technic Commission set up for this purpose. The British standard for symbols is BS 3939: Symbols for electronics and electrical diagrams.

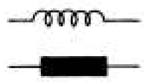
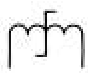
Symbols for connection and connectors



Symbols for resistors and capacitors.

Component	*Symbol*	*Ref.*
basic resistor		R 1
permitted alternative		R 2
variable resistor		R 3
variable resistor — preset		R 4
voltage divider with moving contact		R 5
capacitor		C 6
polarised electrolytic capacitor		C 7
variable capacitor		C 8

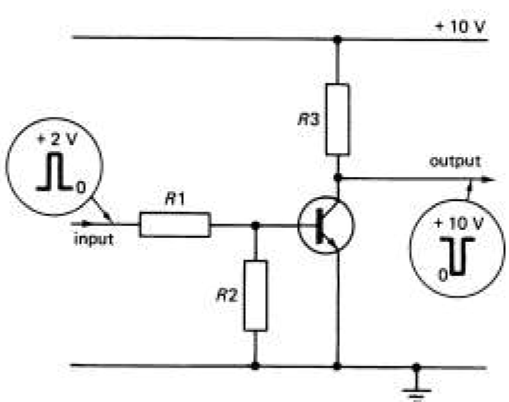
Symbols for inductors and transformers

Component	*Symbol*	*Ref.*
basic symbol for winding of inductor or transformer		L 1
alternative, non-preferred		L 2
inductor with ferromagnetic core		L 3
two-winding transformer		T 4
variable inductor, preset with ferromagnetic core		L 5
inductor with saturable core		L 6
three-phase power transformer star-delta connection		T 7

DRAWING CIRCUIT DIAGRAMS

Although some circuit diagrams are prepared as a re~rd of a particular product, the majority are in: tended as working drawings. These will be used for manufacturing the equipment they describe, commissioning, or maintaining it. The main purpose, then, of the drawing is to communicate to the reader the details of the circuit and the way in which it functions. Consequently, when preparing the diagram a very important factor is the clarity with which it shows the circuit's function. This must be given priority over a symmetrical appearance or a uniform spacing of symbols through the drawing. The following points help to make the drawing easy to read. (1) The main signal path should run from left to right. Inmost electronic equipment one or more inputs and outputs can be identified and this layout is easy to implement. It becomes more difficult with some electrical drawings; and power-station diagrams, for example, are often drawn with the main busbars near the top of the drawing and the various feeds in and out drawn at right angles, that is, vertically up and down the diagram. (2) D.C. power supply lines should be drawn horizontal, the most positive line being at the top of the page and the rest in order of their potential, the most negative being at the bottom. Where only one supply line is used this is sometimes drawn above the earth line even when negative to it. For a small diagram involving linear signals this procedure is acceptable, although not always easy to follow

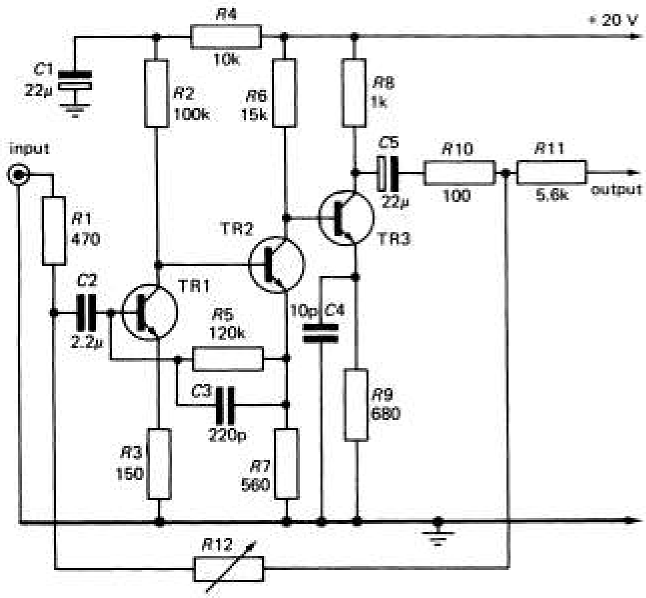
Transistor pulse amplifier



However, with pulse or digital circuits it becomes extremely confusing when fault-finding with an oscilloscope. This is because oscilloscopes are always built so that a positive-going signal moves the beam upwards. Thus in figure above, with no input signal the transistor base is at the same potential (earth) as the emitter and so the collector current is very small and the collector rises to the same potential as the supply line, + 10 V. A positive-going signal, if the resistors are properly chosen, will drive the base into conduction and saturate the transistor, causing it to conduct fully so that the collector voltage falls to near earth potential. The two waveforms show the signal which would be observed on an oscilloscope connected to input and output. It is much easier to relate these signals and their polarities if the positive line is at the top of the drawing, as shown, than if it were drawn below the earth line. On many maintenance manuals for apparatus concerned with pulse waveforms, for example television receivers and oscilloscopes, the wave forms to be expected at key points in the circuit are shown by the inset drawings. These are always drawn with a positive upwards convention to agree with the manner in which oscilloscopes deflect.

EXAMPLES OF CIRCUIT DIAGRAMS

Circuit diagram for a tape recorder Figure below shows a three-stage directly coupled amplifier which forms the first section of the recording chain for a tape-recorder. Since there are no inter-stage capacitors the stages are connected directly from collector to base and to simplify the layout each transistor is drawn higher on the page than the previous one. As there is a single amplifying signal path the input is on the left and the output on the right.



Circuit diagram for X-deflection amplifier of an oscilloscope

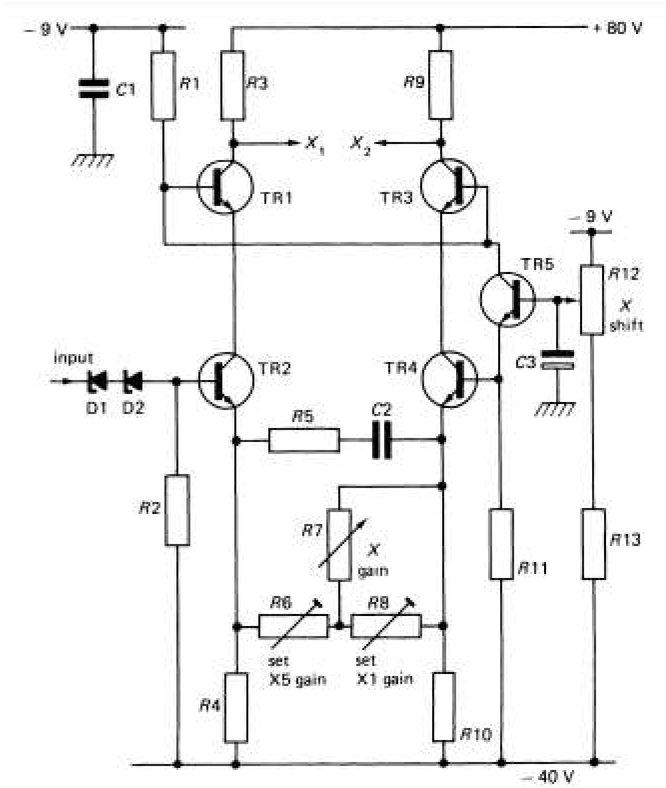
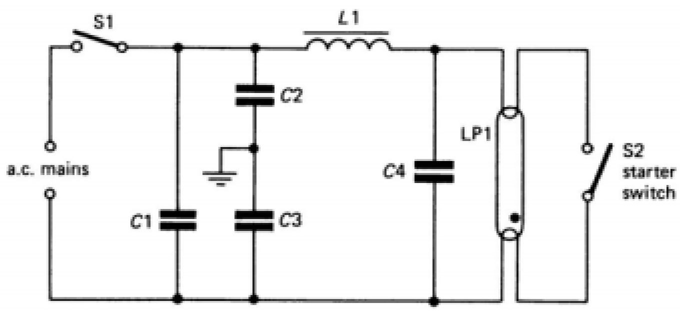


Figure above shows the X-deflection amplifier of an oscilloscope used for serv1cmg and fault-finding. The signal path here is somewhat more complicated as the single sawtooth input wave form must generate two push-pull output signals to drive the two X-deflection plates. The circuit has a degree of symmetry and comprises two transistors in each half of a 'long-tailed pair'. The two emitter electrodes ofTR2 and TR4 are coupled via R6 (preset) and R7 (the front panel 'X-gain' control). The two circuits R3, TRI, TR2, R4 and R9, TR3, TR4, RIO are identical and therefore they are drawn side by the side between the + 80 V and - 40 V lines. In this drawing the convention of positive supply line at the top and negative supply line at the bottom is followed with regard to the main + 80 V and - 40 V lines. The relative positions of the chassis and -9 V lines have however been altered to simplify the layout.

Circuit of fluorescent lamps



This is for a low-pressure fluorescent lamp. Whereas a filament lamp circuit would include only an on-off switch and a lamp, a fluorescent tube requires a power factor correction capacitor Cl , a ballast choke Ll, R.F. interference suppression capacitors C2, C3 and C4, and a starter switch S2. The layout is arranged with the a.c. mains input on the left to agree with the normal convention.

4.2.5.4 Learning Activities

1. Identified electrical symbols and abbreviations and their meaning interpreted according to BS 3939
2. Developed electrical diagrams and drawings as per established standards
3. Produced electrical drawings are in accordance with BS 3939
4. Interpreted electrical drawings and diagrams as per established standards

5.2.5.5 Self-Assessment

1. Name types of Electrical drawing
2. Draw the symbols for a complete semiconductor's devices

1.2.5.6 Tools, Equipment, Supplies and Materials

- Drawing room
- Drawing instruments e.g. T-squares, set squares, drawing sets
- Drawing tables
- Pencils, papers, eraser
- Masking tapes

4.2.5.7 References

K.Venkata Reddy Engineering Drawing 2nd Edition

S.K Bhattacharya Electrical Engineering Drawing 2nd Edition

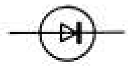
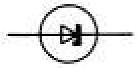
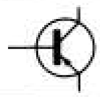
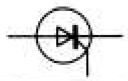
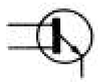
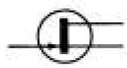
Kenneth Morling Geometric and Engineering Drawing 3rd Edition

4.2.5.8 Response for self-assessment

1. Mechanical drawing

Symbolic drawing

Graphic and charts

Component	Symbol	Ref.
p-n diode		D_1
zener diode		D_2
p-n-p transistor		TR_3
n-p-n transistor, can connected to collector		TR_4
cathode-controlled thyristor		CSR_5
unijunction transistor with *p*-type base		TR_6
junction-gate FET with *n*-type channel		TR_7
depletion-type *n*-channel insulated-gate FET		TR_8
enhancement-type *n*-channel insulated-gate FET		TR_9

2

Symbols for complete semiconductors devices