Solar PV System Installation and Maintenance

Level-III

Learning Guide -30

Unit of Competence	**Prepare Working Drawing**
Module Title	**Preparing Working Drawing**
LG Code	**EIS PIM3 M08 LO1 LG-30**
TTLM Code	**EIS PIM3 TTLM 0920v1**

LO1: -Determine Drawing requirements

ADRA ETHIOPIA

Instruction Sheet	Learning Guide30

This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Checking & interpreting drawing requirements
- Sourcing information from Customer specifications and different sources.
- Planning Scope of drawing including layout, and resources

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: -

- Check and interpret drawing Requirements and purposes from work order.
- Source required information from workshop manuals, customer specifications, product suppliers, and designers or similar.
- Plan scope of drawing including layout, additional required information and resources.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet	Checking & interpreting drawing requirement

1.1. Introduction/ Overview of Drawing

A drawing is a graphic representation of an object, or a part of it, and is the result of creative thought by an engineer or technician. When one person sketches a rough map in giving direction to another, this is graphic communication. Graphic communication involves using visual materials to relate ideas. Drawings, photographs, slides, transparencies, and sketches are all forms of graphic communication.

A technical person can use the graphic language as powerful means of communication with others for conveying ideas on technical matters. However, for effective exchange of ideas with others, the engineer must have proficiency in (i) language, both written and oral, (ii) symbols associated with basic sciences and (iii) the graphic language. Engineering drawing is a suitable graphic language from which any trained person can visualize the required object. As an engineering drawing displays the exact picture of an object, it obviously conveys the same ideas to every trained eye. Hence, an engineer should posses good knowledge, not only in preparing a correct drawing but also to read the drawing correctly. This module is expected to meet these requirements. The study of machine drawing mainly involves learning to sketch machine parts and to make working and assembly drawings. This involves a study of those conventions in drawings that are widely adopted in engineering practice.

1.2. Classifications of Drawing

1.2.1. Machine Drawing

It is pertaining to machine parts or components. It is presented through a number of orthographic views, so that the size and shape of the component is fully understood. Part drawings and assembly drawings belong to this classification. An example of a machine drawing is given in Fig. 1.1.

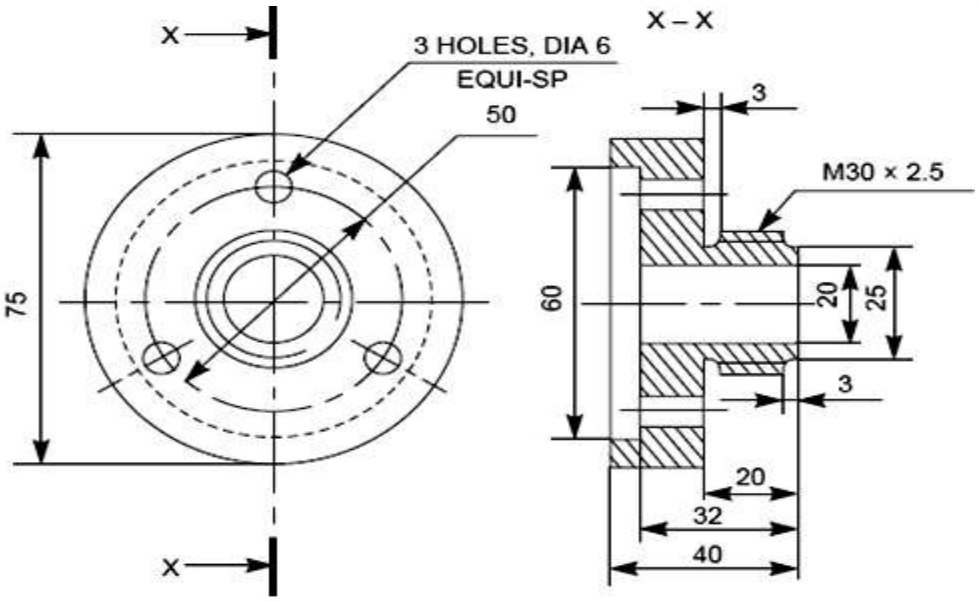


Figure 1.1 Machine Drawing

1.2.2. Production Drawing

A production drawing, also referred to as working drawing, should furnish all the dimensions, limits and special finishing processes such as heat treatment, honing, lapping, surface finish, etc., to guide the craftsman on the shop floor in producing the component. The title should also mention the material used for the product, number of parts required for the assembled unit, etc. Since a craftsman will ordinarily make one component at a time, it is advisable to prepare the production drawing of each component on a separate sheet. However, in some cases the drawings of related components may be given on the same sheet. Figure 1.2 represents an example of a production drawing.

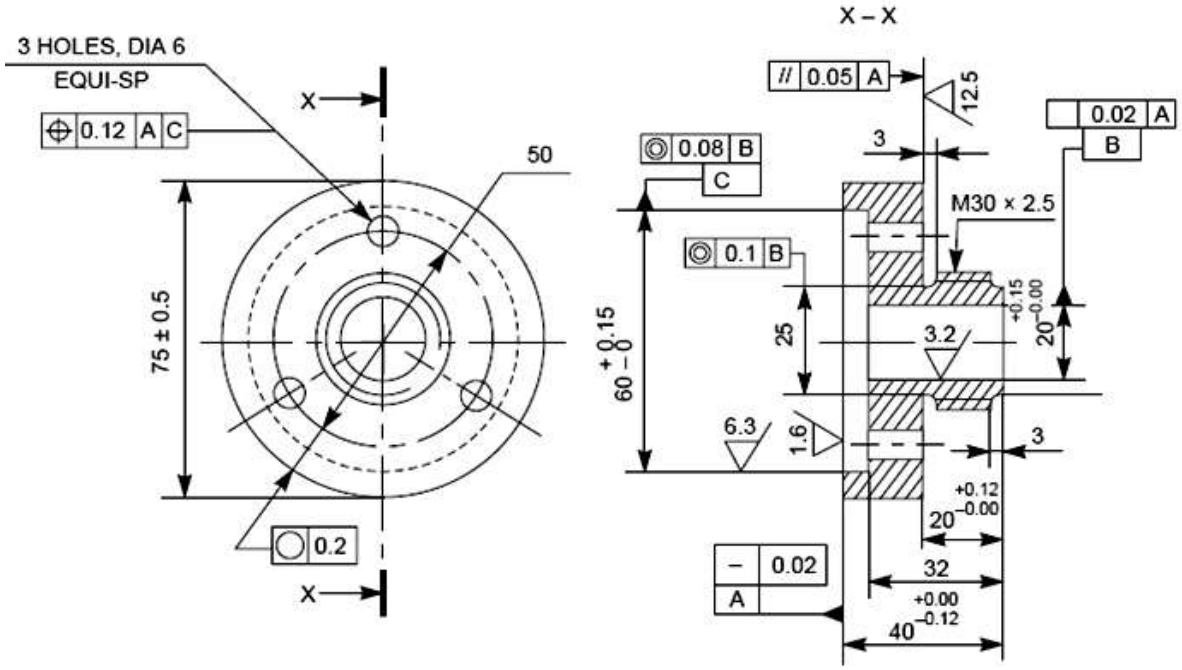


Figure 1.2. Production Drawing

1.2.3. Part Drawing

Component or part drawing is a detailed drawing of a component to facilitate its manufacture. All the principles of orthographic projection and the technique of graphic representation must be followed to communicate the details in a part drawing. A part drawing with production details are rightly called as a production drawing or working drawing.

1.2.4. Assembly Drawing

A drawing that shows the various parts of a machine in their correct working locations is an assembly drawing (Fig. 1.3). There are several types of such drawings.

- **Design Assembly Drawing**

When a machine is designed, an assembly drawing or a design layout is first drawn to clearly visualize the performance, shape and clearances of various parts comprising the machine.

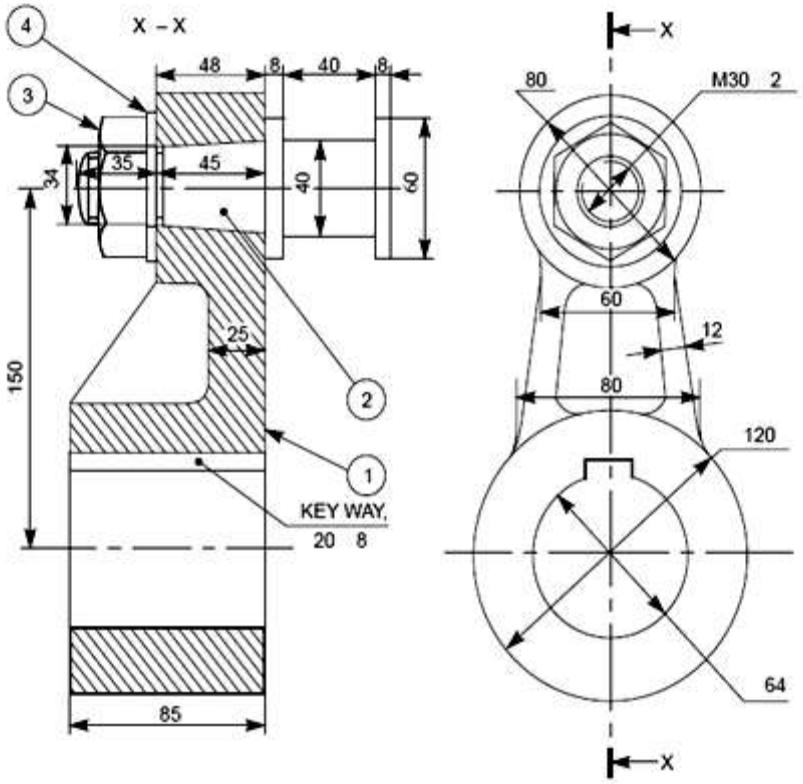
- **Detailed Assembly Drawing**

It is usually made for simple machines, comprising of a relatively smaller number of simple parts. All the dimensions and information necessary for the construction of such parts and for the assembly of the parts are given directly on the assembly

drawing. Separate views of specific parts in enlargements, showing the fitting of parts together, may also be drawn in addition to the regular assembly drawing.

- **Sub - Assembly Drawing**

Many assemblies such as an automobile, lathe, etc., are assembled with many pre-assembled components as well as individual parts. These pre-assembled units are known as sub-assemblies. A sub-assembly drawing is an assembly drawing of a group of related parts, that form a part in a more complicated machine. Examples of such drawings are: lathe tail-stock, diesel engine fuel pump, carburetor, etc.



Parts List

Part No.	Name	Material	Qty
1	Crank	Forged Steel	1
2	Crank Pin	45C	1
3	Nut	MS	1
4	Washer	MS	1

Figure1.3. Assembly Drawing

- **Installation Assembly Drawing**

On this drawing, the location and dimensions of few important parts and overall dimensions of the assembled unit are indicated. This drawing provides useful information for assembling the machine, as this drawing reveals all parts of a machine in their correct working position.

- **Assembly Drawing for Catalogue**

  Special assembly drawings are prepared for company catalogues. These drawings show only the pertinent details and dimensions that would interest the potential buyer. Figure 1.4 shows a typical catalogue drawing, showing the overall and principal dimensions**.**

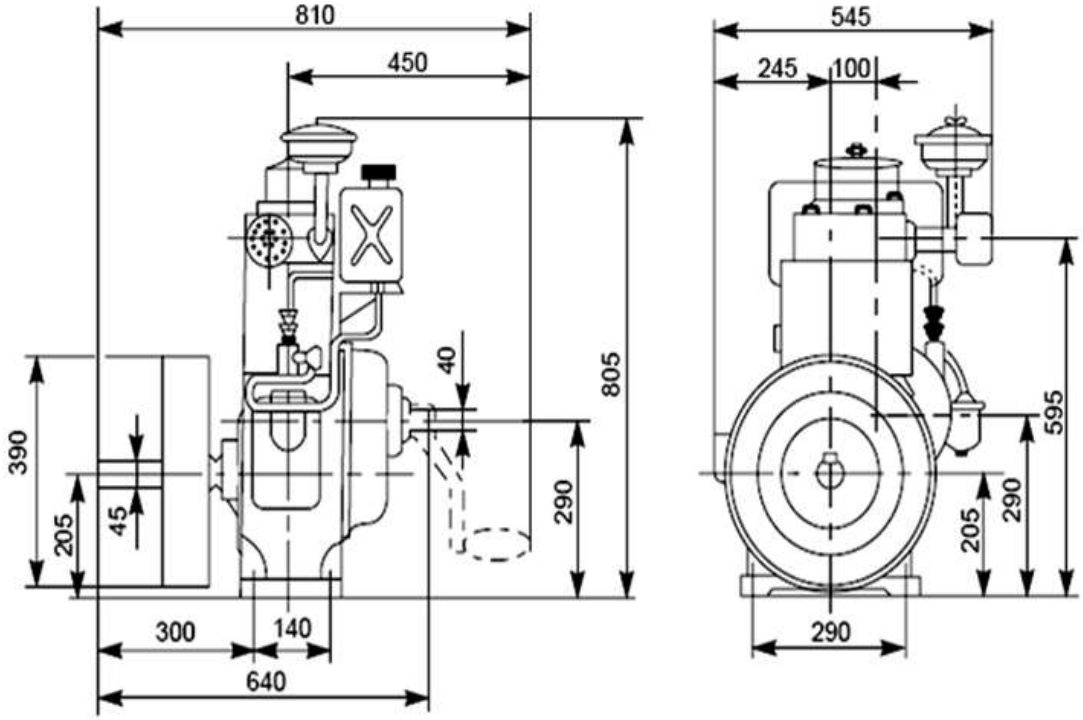
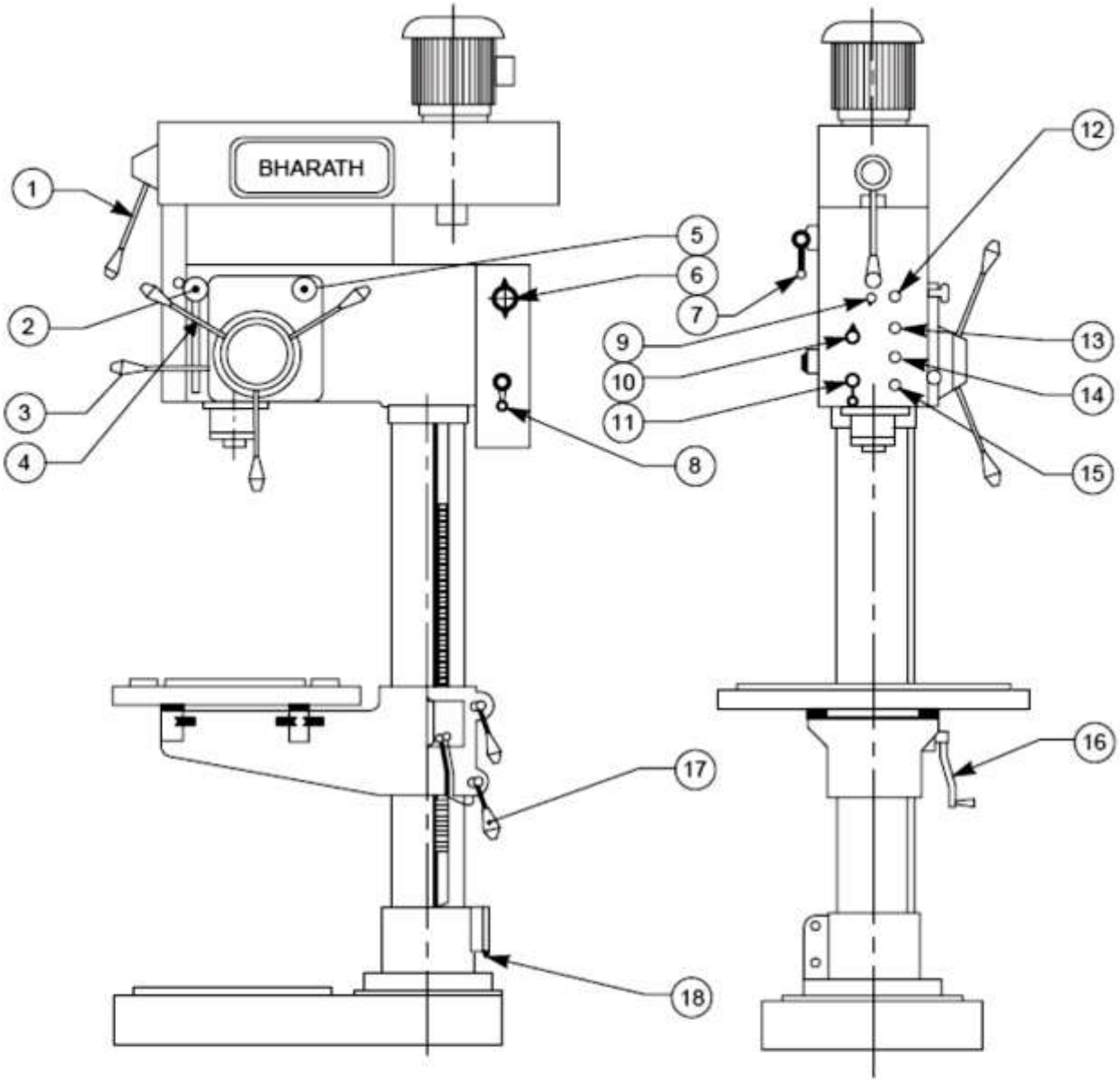


Figure1.4. Catalogue Drawing

- **Assembly Drawing for instruction manual**

These drawings in the form of assembly drawings are to be used when a machine, shipped away in assembled condition, is knocked down in order to check all the parts before reassembly and installation elsewhere. These drawings have each component numbered on the job. Figure 1.5 shows a typical example of such a drawing**.**



Speed change lever (1)
Depth adjusting knob (2)
Mech. feed engagement lever (3)
Hand feed lever (4)
Feed change knob (5)
Switch for tapping (6)
Gear shifting lever (7)
Main switch (8)
Lamp switch (9)
Selector switch (10)
Forward/reverse switch (11)
Pilot lamp (12)
Feed disengagement push button (13)
Start push button (14)
Emergency stop (15)
Elevating handle (16)
Clamping handle (17)
Supply inlet (18)

Fig. 1.5 Assembly drawing for instruction manuals

- **Exploded Assembly Drawing**

In some cases, exploded pictorial views are supplied to meet instruction manual requirements. These drawings generally find a place in the parts list section of a company instruction manual. Figure 1.6 shows drawings of this type which may be easily understood even by those with less experience in the reading of drawings; because in these exploded views, the parts are positioned in the sequence of assembly, but separated from each other**.**

- **Machine Shop Drawing**

Rough castings and forgings are sent to the machine shop for finishing operation (Fig. 1.8). Since the machinist is not interested in the dimensions and information of the previous stages, a machine shop drawing frequently gives only the information necessary for machining. Based on the same principle, one may have forge shop drawing, pattern shop drawing, sheet metal drawing, etc.

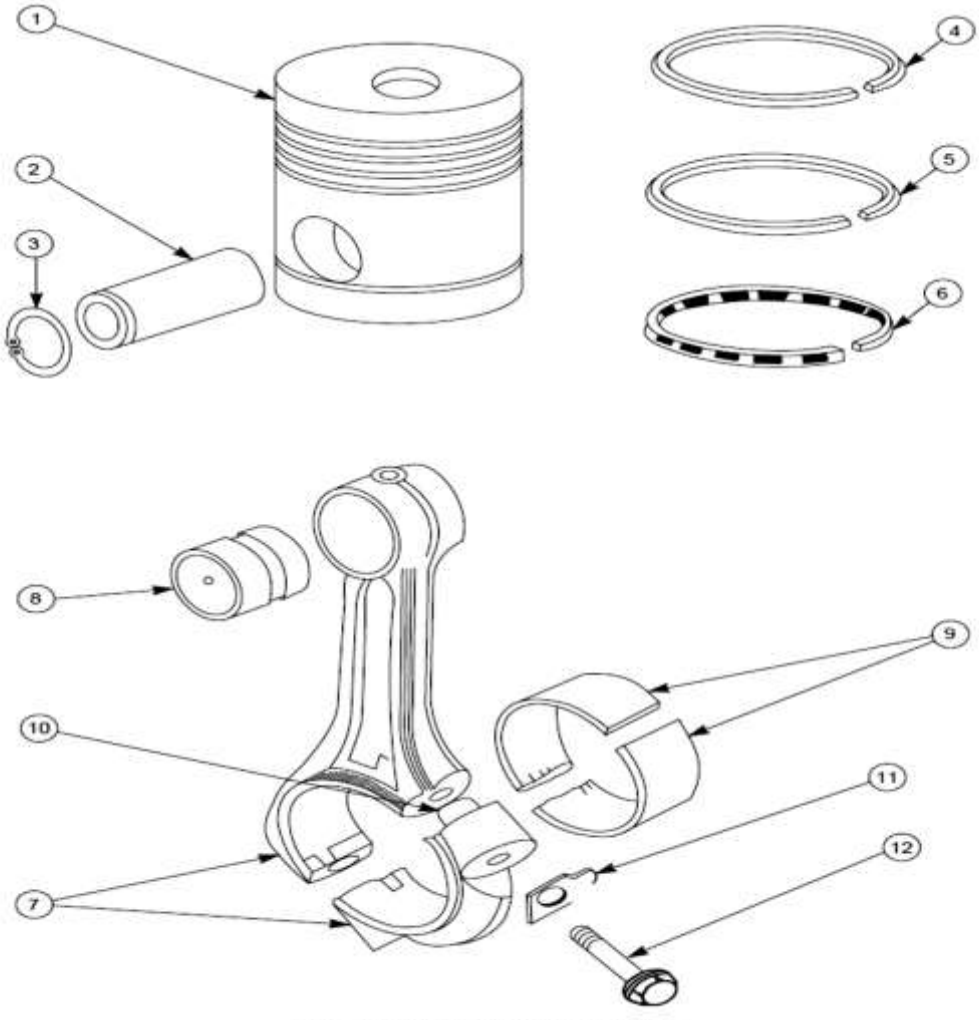


Fig. 1.6 Exploded assembly drawing

Figure 1.7 Machine Shop Drawing

1.2.5. Sectional Drawing

- **Sectional View**

An engineering drawing has the function of showing shape and size of an object clearly and completely. In certain cases, however, the representation in views is not sufficient. Many objects have internal shapes which are so complicated in nature that it is virtually impossible to show their true shape without employing numerous confusing hidden lines.

View (**a**) (b) Representation of the intersection

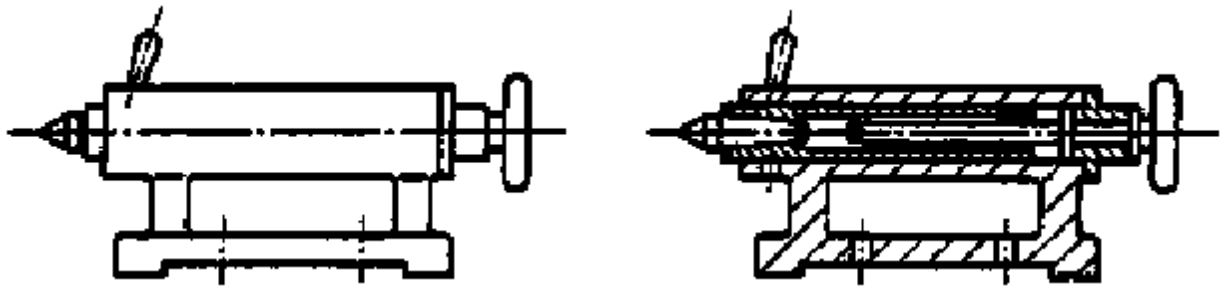


Figure 1.8. Sectional View

The solution of the problem is the use of one or more sectional views: One imagines the object cut by passing a cutting plane through it so that the internal shape is

revealed. The purpose of a sectional view is to show the internal shape of an object. In this way, the dimensions of the internal shape can be applied to visible edges. By passing a cutting plane (e.g. a saw or a knife) that portion of the object is removed which obstructs the view into the interior.

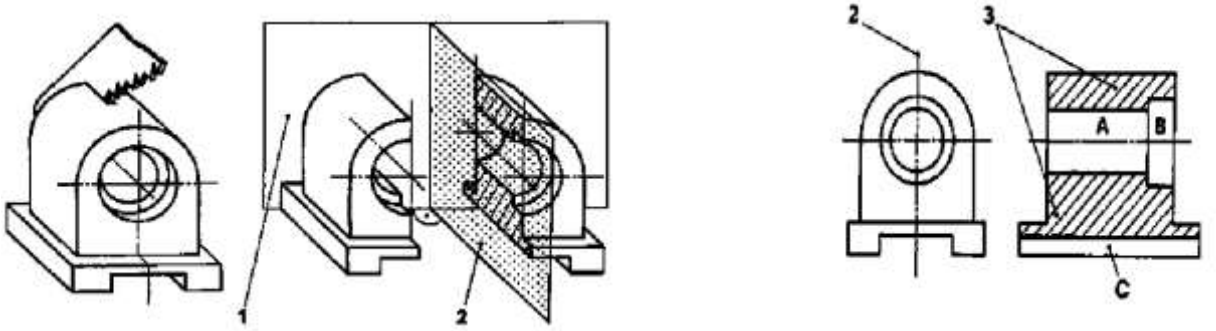


Figure1.9.1 Drawing plane

To produce a section view a cutting plane is passed through the part (figure a). The cutting plane is removed and the two halves are drawn apart (figure b) exposing the interior detail. A section view obtained by passing the cutting plane fully through the object is called a full section. In the front view the cutting plane appears as a line called a cutting-plane line. The arrows at the ends of the cutting-plane line indicate the direction of sight for the section view. To obtain the section view the right half of the front view is only imagined to be removed. The cross-hatched areas of the section view are those portions that are in actual contact with the cutting plane.

A correct front view and section view are shown in figure (a) and figure (b). All visible edges and contours behind the cutting plane should be shown. Section views are used primarily to replace hidden lines so as a rule hidden lines should be omitted in section views (figure d). A section-lined area is always completely bounded by a visible outline, never by a hidden line as in figure (e). Section lines in a section view must be parallel and at the same angle and direction (figure f).

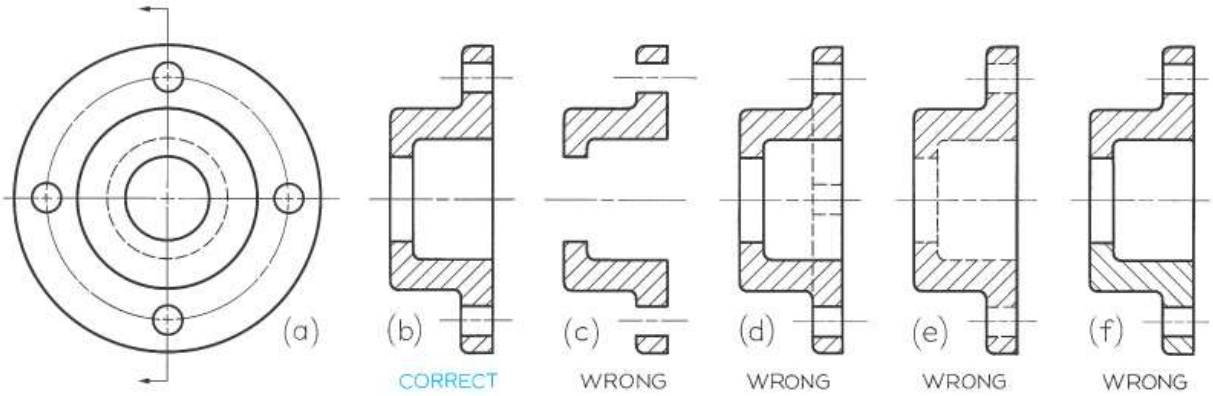


Figure: 1.10. (a) And (b) shows front view and section view

Shading with thin solid lines at an angle of 45 is the general hachure which is used irrespective of the material.

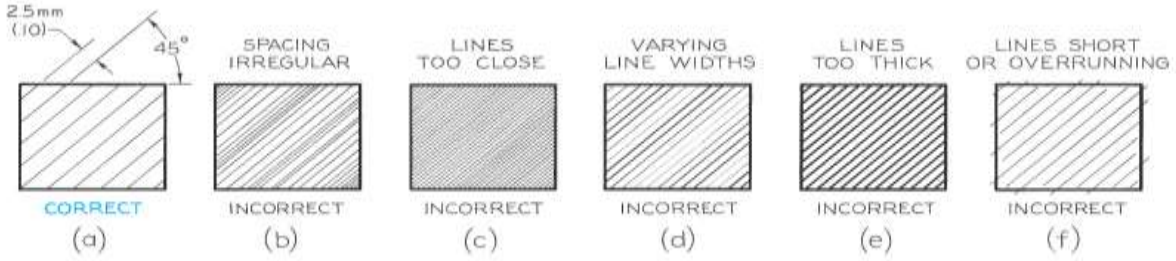
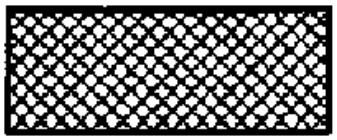
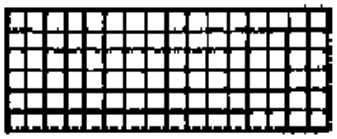
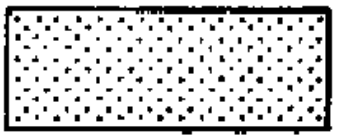
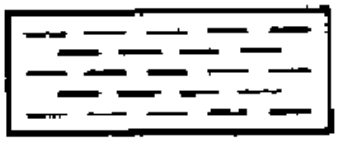


Figure1. 11. Shading with thin solid lines (Hatching)

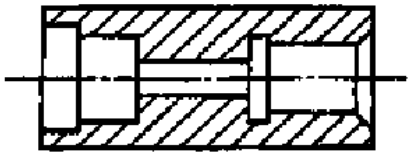
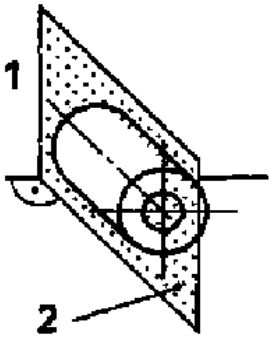
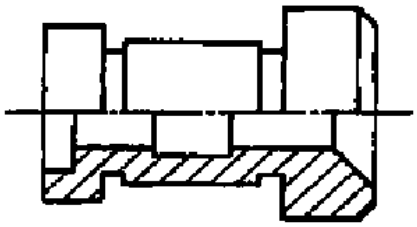
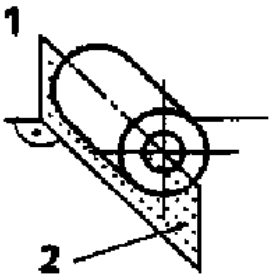
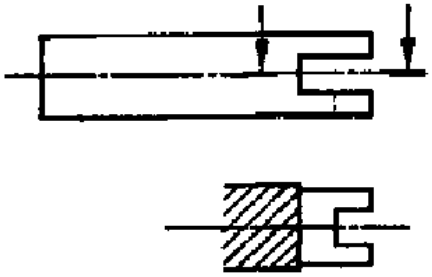
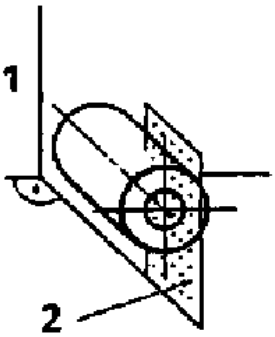
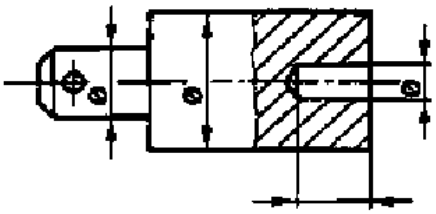
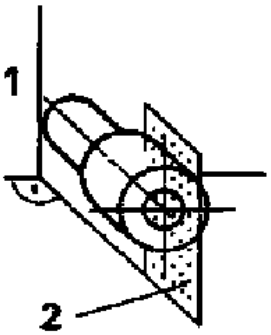
Table1.1. Shading Characterizing of material

Material	Shading characterising the material
Metal	
Plastics, rubber, felt, leather, filler, material	
Wood (cross–grained wood, other wood)	
Glass and the like	
Reinforced concrete	
electrical windings	
Sintered materials	
Liquids	
Porcelain, marble, slate	

- **Types of Sectional View**

Table1.2. Types of Sections

1 Drawing plane, 2 Cutting plane

Type of section	Explanations	Applications	Principle
Full sectional view	Objects with intricate internal shapes. Symmetric or non–symmetric or prismatic or cylindrical.		
Half section	Objects with intricate internal and external shapes; usually symmetric, prismatic or cylindrical		
Partial section	An internal partial shape is to be made visible but a full section is not necessary. It would not show more. Cutting line indicated by arrows.		
Broken–out section	This section is used to show only a desired feature of the object. A full section is not necessary or not permitted (shafts, pins, rivets). The view must be shown completely because of other features of the object.		

To obtain a sectional view, a cutting plane is assumed to be passed through the part (a). This cuts the part in two halves. The cutting plane is then removed, and the two halves are drawn apart, exposing the interior construction. In (b), the direction of sight is towards the left half. The section view will be in the position of a right side view.

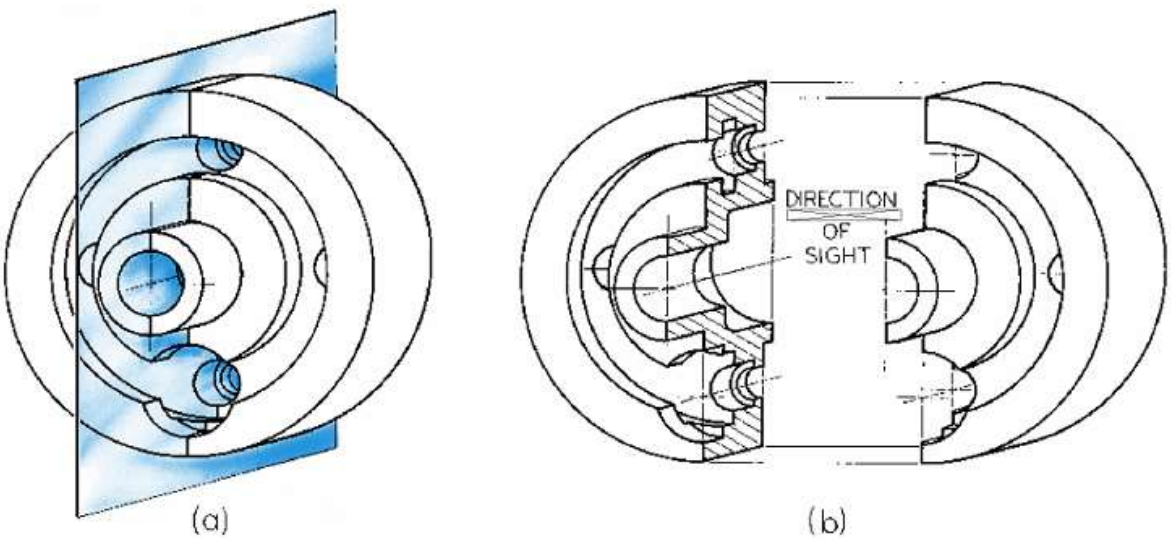


Figure1.12: Sectional View

Cutting Plane Line

- The cutting plane line is a thick dark line which uses one of the special patterns shown.
- The cutting plane line can be left out when it is obvious where it must lie from the appearance of the section itself

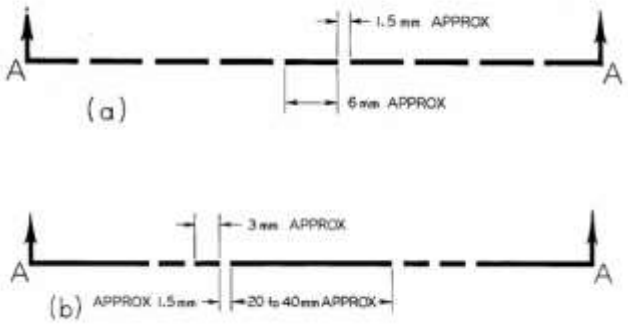


Figure 1.13: Cutting Plane Line

Cutting Plane in Sectional Views

- The cutting plane is indicated in a view adjacent to the sectional view. In this view, the cutting plane appears edgewise as a line, called the cutting plane line.

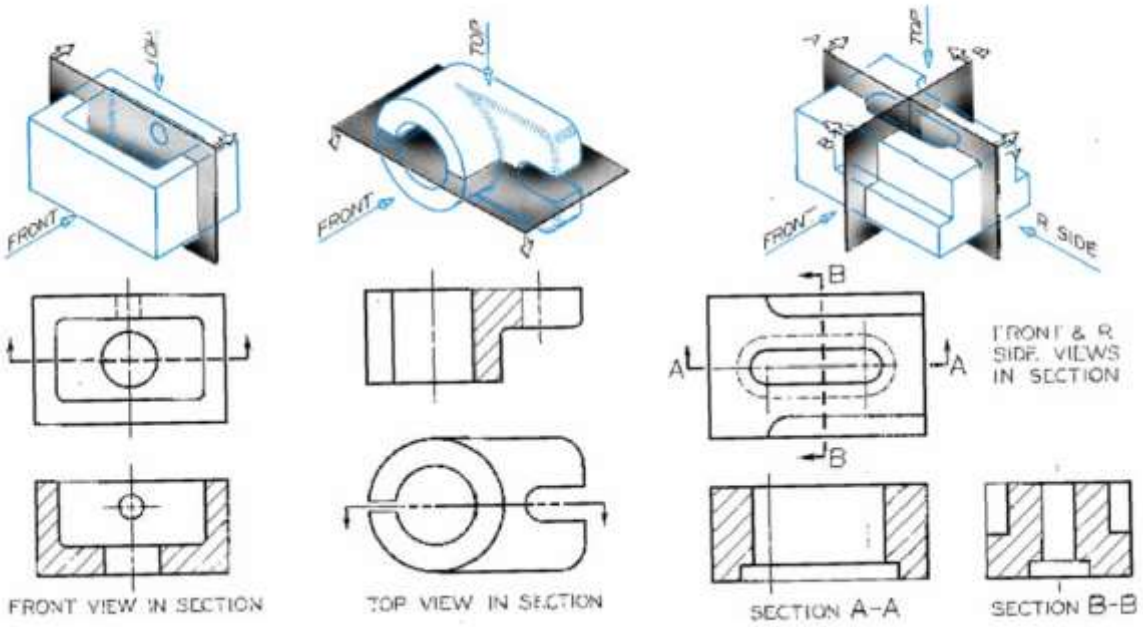


Figure 1.14: Cutting plane lines

Self-Check-1	Choice Test

Test I: Multiple Choice Questions

Directions: Choose the correct Answer (each question have 2 pts)

1. It is pertaining to machine parts or components and also presented through a number of orthographic views, so that the size and shape of the component is fully understood.

   a. Assembly Drawing b. Working Drawing c. Machine Drawing d. all

2. _____ also referred to as working drawing, should furnish all the dimensions, limits and special finishing processes such as heat treatment, honing, lapping, surface finish, etc., to guide the craftsman on the shop floor in producing the component.

   a. Sectional Drawing
   b. Production Drawing
   c. Assembly Drawing
   d. Machine Drawing

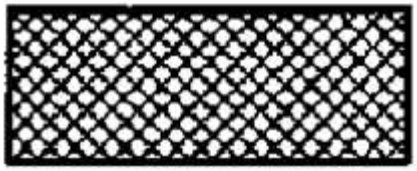
3. For effective exchange of ideas with others the engineer, must have proficiency in

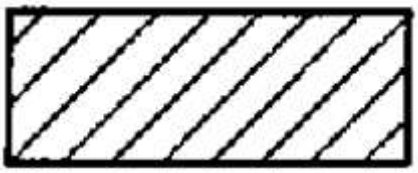
   a. Language, both written and oral.
   b. Symbols associated with basic science
   c. The graphic language
   d. All of above

4. A drawing that shows the various parts of a machine in their correct working locations.

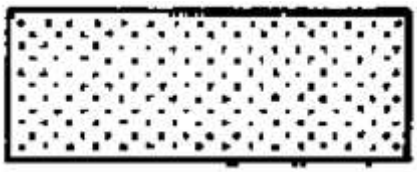
   a. Detail Drawing
   b. Assembly Drawing
   c. Sectional Drawing
   d. Production drawing

5. Which of shading Characterizing represents metal?

a. 

c. 

b. 

d. 

Note: Satisfactory rating –5 points and above

Unsatisfactory- below 5 points

Information Sheet-2	Sourcing of required information from workshop manuals, customer specifications,

2.1. Introduction to Blue Print Reading

In many ways, learning to read a drawing is the same as learning to read a language. Blueprint is the common name of the copies taken from an original drawing, usually drawn on a tracing paper. The copies may be obtained by way of reprographic processes.

For blueprint reading and understanding the drawing, one must have a thorough knowledge of the principles of drawing and orthographic projections. The knowledge of various manufacturing processes and the sequence of operations required to obtain the finished shape, intended by the designer, also helps in interpreting the drawings.

In this contentthe examples chosen help providing guidelines to enable trainee to understand the shape and size of a component in the case of component drawings.and also its location, in the case of assembly drawings. While reading the drawings, the details such as shape, size, through dimensions, notes and material to be used, and additional notes to the workman on machining, surface finish, tolerances, etc., are to be noted carefully.

2.2 General Information

First you have to collect general information about your customer, which you need to prepare a quote. But you also need to know exactly where the location is and if there is an internet connection. The internet connection is important in case you plan to run or monitor the system remotely. You need to collect:

- Name and address of the customer
- Location of PV power plant (GPS Coordinates, Altitude, photo)
- Internet connection (type, costs, accessibility)

The best tool to get the exact location are tools like Google maps.

2.3 Building and Roof Drawings and Pictures

In order to plan the PV system, one needs to know not only where to mount the modules, but also where to mount or place the inverter and the batteries, how to

connect the system to existing electrical installations and generators and where to mount the equipment. Pictures of the following have to be taken and copied in the site survey form:

- Building
- Roof
- Access to the roof
- installation location (roof)
- cable path
- relevant wiring situation
- Electricity meter
- Electricity meter cabinet
- Electricity meter (type name)
- Existing electricity supply (batteries, generator…)

Please describe the present situation of the building (type of building, number of floors, usage, electricity installation) as focusing on the existing electrical installation in a few words.

2.4 Location and Size of the Roof/side for the PV system

One has to document with a little drawing the area dedicated for the PV system. Solar modules could be mounted on a roof, on a pole or even get ground mounted. This drawing will be the basis for the planning on how and where to install the PV system. It is always good to make some drawing, even additionally to pictures. Here it is always good to have as much information as possible relevant for the PV system. Where is which tree, is it a deciduous tree or a conifer, what else can put shadow on the PV array. Such a drawing should include the following data Included in the drawing:

- Roof area (with attention to the orientation)
- Usable area for the PV system (situate the middle of the PV system at the coordinate origins, additional photos can be taken)
- Chimney, antenna, satellite systems
- Near lying buildings (approximate distance and height)
- Trees (approximate distance and height)
- Freestanding cables (i.e. electricity or telephone lines)

- Other shading sources: building projections, etc...

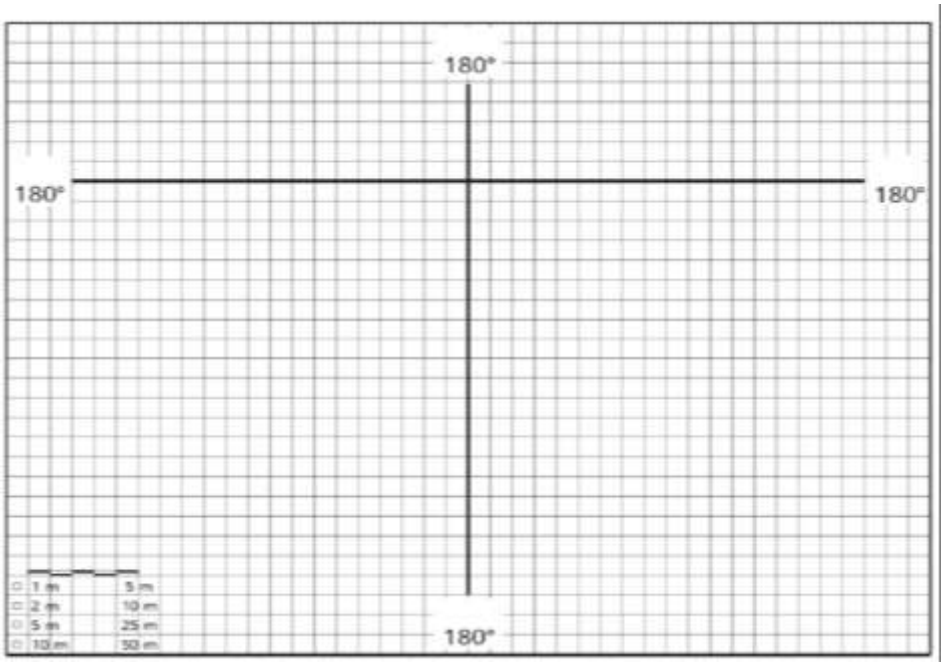


Fig1: Template to draw site

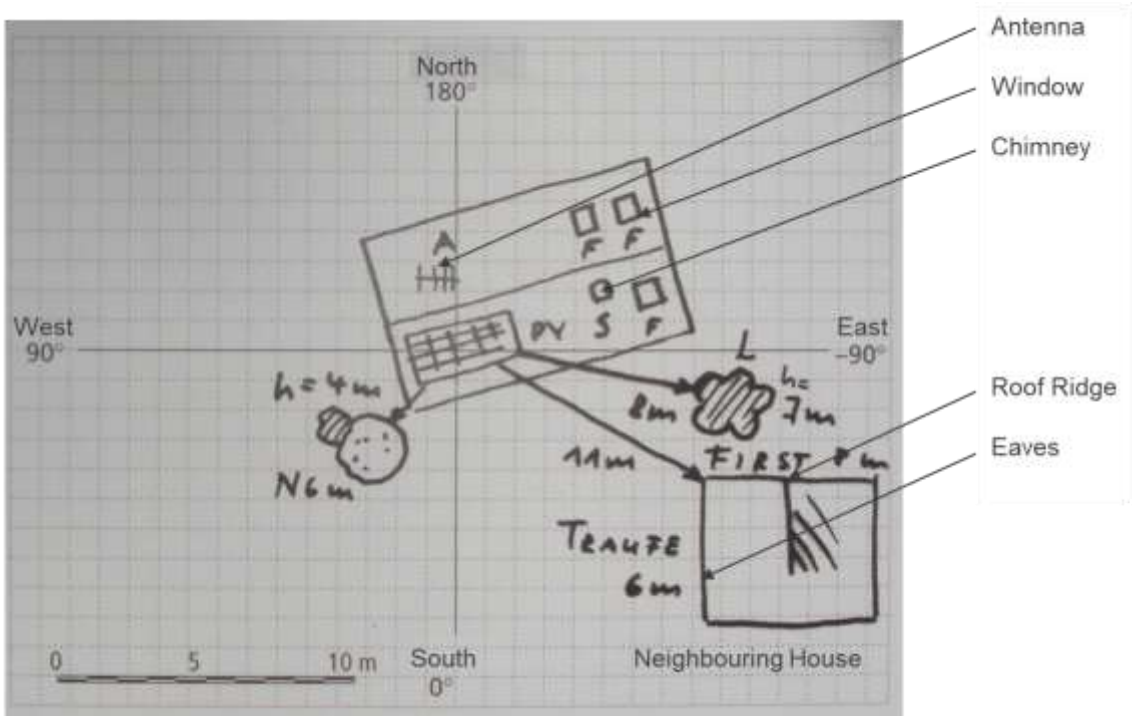


Fig2: Example for a site drawing

Additionally, the following information has to be documented in the site survey form:

- Mounting area (pitched roof, flat roof, open space, other)
- Describe if there is an existing mounting frame
- Describe if there is a roof area available for the PV system
- Describe the Shading (Is there any other building, tries, etc. which shades the roof area?)
- Describe any further information relevant information.

2.5 Roof structure, Roof Covering and Roof Waterproofing

When you can mount the PV system on the roof you need a detailed description of the roof, as you need to plan how to mount the PV array on the roof. The following paragraphs give you more background information on why and what is important to document. They are taken from [Mayfield, 2010, chapter 5, page 85] and adapted for Africa by the authors. How much physical space is available for the installation? Typically, PV systems are installed on the roofs of buildings or on free land space. Your task during the site survey is to make sure the space available will suffice for the client's desired PV system. Your client may have an idea of where he wants the array to go, but it's your job to make sure a better alternative doesn't exist.

The area you have your eyes on may be the same as someone else. Always verify that other plans don't exist for the space you want to use, such as plans for solar thermal collectors or skylights. Here are some additional structural and mechanical questions that you should ask if the array will likely be mounted to a roof:

- **What are the dimensions and shape of the roof area available?**

Takingthe dimensions of the roof area you plan to install on will help you sketch out the roof later when you're ready to plan how the array will be arranged on the roof. During the site-survey process, you also need to identify obstructions (such as plumbing vents, chimneys, and attic vents) on the roof as well as their locations.

- **What condition is the roof material in, and how old is the roof covering?**

Placing an array on a roof that will need to be replaced in a few years doesn't make a lot of sense. If a reroof is in order, suggest it be done now and be sure to work

closely with the client and the roofer to coordinate phases of the project so you can continue with the PV system design and installation in a timely fashion.

- **What's the roof framing like?**

The roof's framing plays an important role. Most modern homes and commercial buildings tend to have roof framing that's adequate for a PV array mounted parallel to the roof so long as a single layer of lightweight roofing material (such as composition cement fiber shingles or wood shake) is used as the roof covering. Why? Becausethe roofs of modern homes are designed to handle multiple lightweight roof layers. As long as onlyone layer is present, adding the weight of a PV array will be less than the structure's limitations.

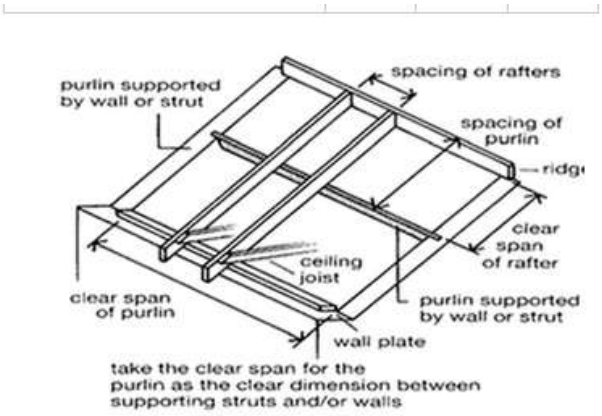
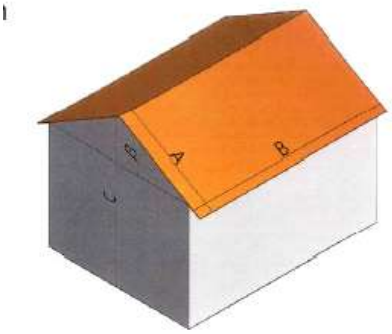
It is always recommended to involve a structural engineer to evaluate the roof foryou and outline any changes you need to make to safely support thearray. Make sure this consultation happens as early as possible in thesystem design process.
Note: Simple huts in uniform settlements or rural areas are often not suitable to carry any extra load. In this case pole or ground mounting is the only way to install a PV array.

- **What are the dimensions and spacing of the roof framing?**

Some buildingshave lumber, similar to residential roofs; others use very large wood supportmembers; and some use steel supports. Consequently, you shouldtake the time to verify the roof structure in order to properly attach thearray in any system that's being installed on a commercial roof. You have to identify the roof type, used material and dimensioning. Always do your best to verify the roof framing composition and orientationwhen conducting your site survey. Be sure to carefully evaluate rafters that are over spanned — a situationwhere the rafter has too much space between vertical support members.

Different spans are allowed based on lumber type and roof-loadingrestrictions, but as a general rule, if the rafters have a span of more than 2 meters between supports, you should investigate the need for adding supportby consulting a structural engineer.After roofs, ground mounts are the most popular type of racking system.

The site survey form will help you to collect all information as described by Mayfield above.

	
Roof height A:	
Roof width B:	
Height Attica D (if existing):	
Building height C:	
Slope of the roof β:	
Roof orientation: 0° (North), 90° (East), 180 (South), 270° (West)	
Roof inclination β: 0° (Horizontal) to 90° (Vertical)	
Rafter size:	
Rafter cm wide / high/length in cm	
Spacing of rafters in cm:	
Amount of rafters:	
Tile/Brick material*:	
Tile/ Brick size in cm:	
Roof age in years: Please indicate if correct figure or estimated	

Clay, concrete, fibre cement, concrete, roofing paper, reinforce concrete, fibre cement, Hollow concrete blocks, gravel, Reed, bitumen, others

Please note all information you can get in the form an ask if there are any drawings available.

Self-Check-2	Written test

I. **Multiple Choice Questions**

Directions: Choose the correct Answer (each question have 2pts)

1. _____ is the common name of the copies taken from an original drawing, usually drawn on a tracing paper. The copies may be obtained by way of reprographic processes.

   a. Drawing **b.** Blue print **c.** detail drawing d. all

2. For blueprint reading and understanding the drawing, one must have a thorough knowledge of.
   a. The principles of drawing
   b. Orthographic projections
   c. various manufacturing processes
   d. All of the above

II. Say true if the statement correct or say false if the statement is wrong

1 A drawing will be the basis for the planning on how and where to install the PV system.

2 The most important tool for a site survey is your camera, or nowadays your smart phone.

Note: Satisfactory rating –2 points and above Unsatisfactory – below 2points

You can ask you teacher for the copy of the correct answers.

Information Sheet-3	planning Scope of drawing

1.1. Introduction

The drawings prepared by any technical person must be clear, unmistakable in meaning and there should not be any scope for more than one interpretation, or else litigation may arise. In a number of dealings with contracts, the drawing is an official document and the success or failure of a structure depends on the clarity of details provided on the drawing. Thus, the drawings should not give any scope for misinterpretation even by accident. It would not have been possible to produce the machines/automobiles on a mass scale where a number of assemblies and sub-assemblies are involved, without clear, correct and accurate drawings. To achieve this, the technical person must gain a thorough knowledge of both the principles and conventional practice of drawing. If these are not achieved and or practiced, the drawings prepared by one may convey different meaning to others, causing unnecessary delays and expenses in production shops.

1.2. Items required for drawing

Drawing board
Drawing sheet (element of title block)
T- Square , Set Squares
Compass,
Divider
Scales
Protractor
Drawing Sheet Layout

French curves
Drawing pencils
Eraser
Drawing clip/pin/adhesive tape
Sharpener
Duster, etc

Standard layouts of drawing sheets are specified by the various standards organizations. This is the layout of a typical sheet, showing the drawing frame, the microfilm camera alignment marks, a typical title block, parts list and revision table:

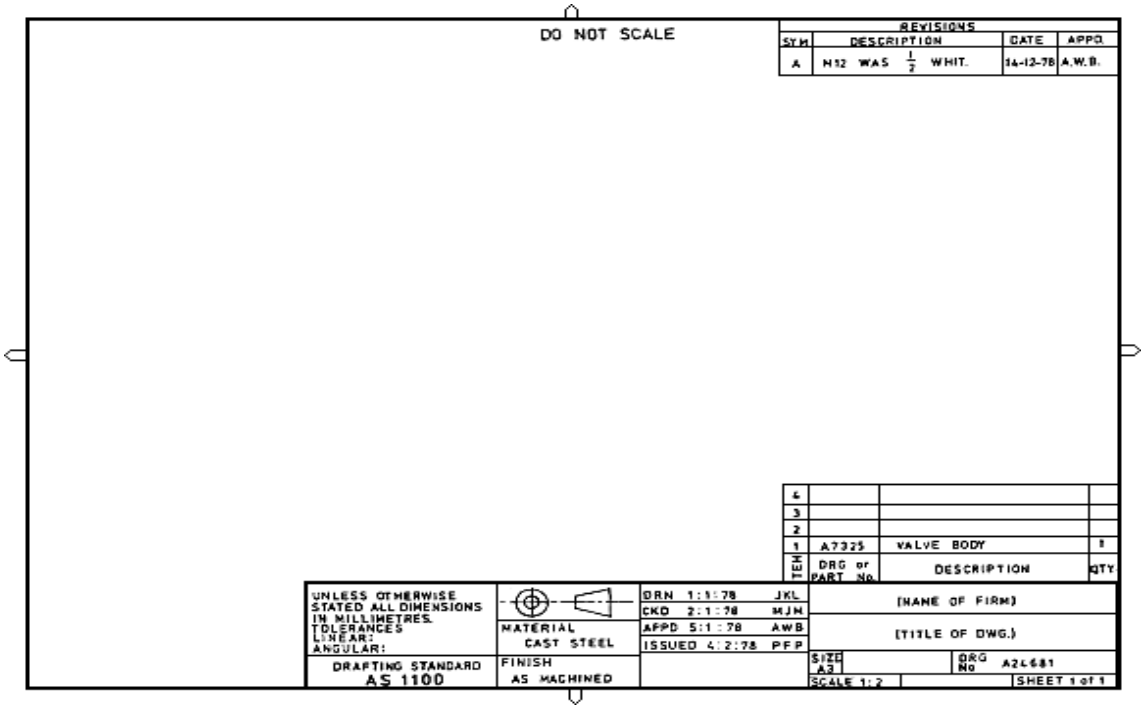


Table 1:Drawing Frames with No Filing Margin

Paper size	Border width(MM)		Dimensions of Drawing frame(MM)	
	Left &right	Top &bottom	Width	height
A0	28	20	1133	801
A1	20	14	801	566
A2	14	10	566	400
A3	10	7	4003	283

- **Title Block**

The title block is normally placed in the bottom right of the drawing frame, and it should contain the following information:

- ✓ the name of the company or organization
- ✓ the title of the drawing
- ✓ the drawing number, which is generally a unique filing identifier
- ✓ the scale
- ✓ the angle of projection used, either first or third, generally shown symbolically
- ✓ the signature or initials of the draftsman, checker, approving officer, and issuing officer, with the respective dates
- ✓ Other information as required.

- **Material or Parts List**

If the drawing contains a number of parts, or if it is an assembly drawing, a tabulated parts list is attached to the bottom right of the drawing frame, just above the title block.

The parts list should give the following information:

- ✓ the part number
- ✓ the part name
- ✓ the quantity required
- ✓ material specifications
- ✓ the drawing number of each individual part
- ✓ other applicable information

When the parts list is very large a separate drawing sheet may be used for the parts list alone.

Self-Check -3	Multiple Choice

Test I: Multiple Choice Questions

Directions: Choose the correct Answer (each question have 2.pts)

1. Which one of the following is the scope of a Drawing?
   a. Give information clear unmistakable in meaning
   b. Give clarity of details provided on the drawing
   c. Avoiding misinterpretation of drawing
   d. All of above

2. Which information is contained in Title block?
   a. the name of the company or organization
   b. the title of the drawing
   c. the drawing number,
   d. the scale
   e. the angle of projection used, either first or third
   f. All of above

3. Which information is contained in Part list?
   a. the part number
   b. the part name
   c. the quantity required
   d. material specifications
   e. the drawing number of each individual part
   f. All of the above

Note: Satisfactory rating –2 points and above Unsatisfactory – below 2points

List of reference materials

1- BOOKS

2- Machine drawing, therd edition,DR.KL.Narayana, Dr. M.A. Veluswami

3- Text book of engineering drawing,K.VENKATA Reddy,second edition,BS.Pabilication

4. KHURMI R S AND GUPTA J. K (1979). A Text Book of Machine Design, ISN 81-219-0501-x, Published by Sc and Company ltd

Solar PV System Installation and Maintenance

Level-III

Learning Guide -31

Unit of Competence	**Prepare Working Drawing**
Module Title	**Preparing Working Drawing**
LG Code	**EIS PIM3 M08 LO2 LG-31**
TTLM Code	**EIS PIM3 TTLM 0920v1**

LO2: - Produce drawings in third angle projection, including auxiliary views, sections and assemblies

Instruction Sheet	Learning Guide

This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Performing detail drawings.
- Determining dimensions of various components
- Applying appropriate drawing symbols
- Performing third angle projection layouts drawings
- Performing auxiliary view drawing
- Using correct conventions for different drawings.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: -

- Perform detail drawings.
- Determine dimensions of various components
- Apply appropriate drawing symbols
- Perform third angle projection layouts drawings
- Perform auxiliary view drawing
- Use correct conventions for different drawings.

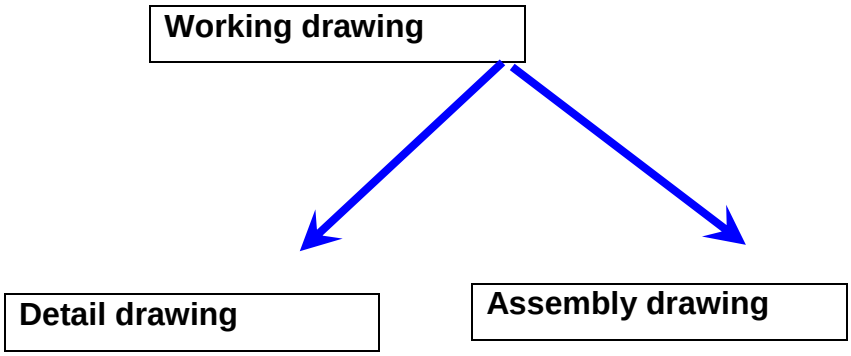
Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information sheet 1	Performing detail drawings

1.1. Introduction

Working drawing is a set of drawing used during the work of making a product.



1.2. Detail drawing

Detail drawings provide a detailed description of the geometric form of a part of an object such as a building, bridge, tunnel, machine, plant, and so on. They tend to be large-scale drawings that show in detail parts that may be included in less detail on general arrangement drawings.

Detail drawings may be used to demonstrate compliance with regulations and other requirements, to provide information about assembly and the junctions between components, to show construction details, detailed form, and so on, that would not be possible to include on more general drawings. They may include dimensions, tolerances, notation, symbols and specification information, but this should not duplicate information included in separate specifications as this can become contradictory and may cause confusion. They may consist of two-dimensional orthogonal projections showing plans, sections and elevations and may be drawn to scale by hand, or prepared using Computer Aided Design(CAD)software. However, increasingly, building information modeling(BIM) is being used to create detailed three-dimensional representations of buildings and their components.

Detail drawings may be confused with ‘detailed design drawings’ which might describe the drawings produced during the detailed design stage, (sometimes referred to as 'developed design' or 'definition').Detailed design is the process

developing the design so that it is dimensionally correct and co-ordinated, describing all the main components of the building and how they fit together. Not all drawings produced during this stage will necessarily be detail drawings. Detail drawing is a multi-view representation of a single part with dimensions and notes. Detail drawing conveys the information and instructions for manufacturing the part.

1.2.1. **Information in detail drawing**

- General information ---------- Title block
- Part' s information
  - ✓ Shape description----------Object's
  - ✓ Size description---------- views
  - ✓ Specifications---------- Notes
- **GENERAL INFORMATION**
  - ✓ Name of company
  - ✓ Title of drawing (usually part's name)
  - ✓ Drawing sheet number
  - ✓ Name of drafter, checker
  - ✓ Relevant dates of action (drawn, checked, approved etc.)
  - ✓ Revision table
  - ✓ Unit
  - ✓ Scale
  - ✓ Method of projection

- **PART' S INFORMATION**
  - ✓ Shape
    - **Orthographic drawing**
    - **Pictorial drawing**
  - ✓ **Size**
    - **Dimensions** andTolerances
  - ✓ **Specifications**
    - **Part number, name, number required**
    - **Type of material used**
    - **General notes**
    - **Heat treatment**

- **Surface finish**
- **General tolerances**

Placing an information

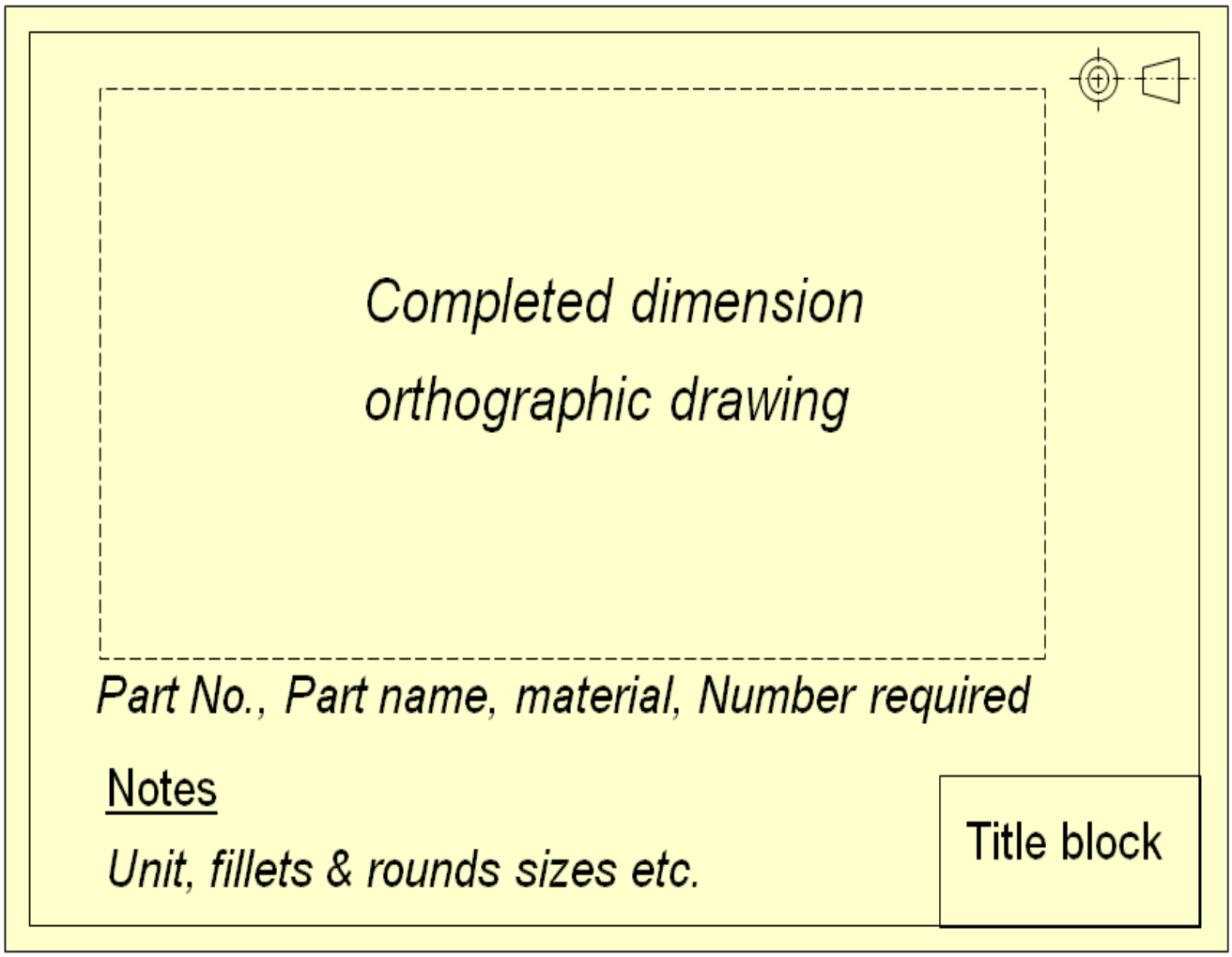


Fig 1: place an information

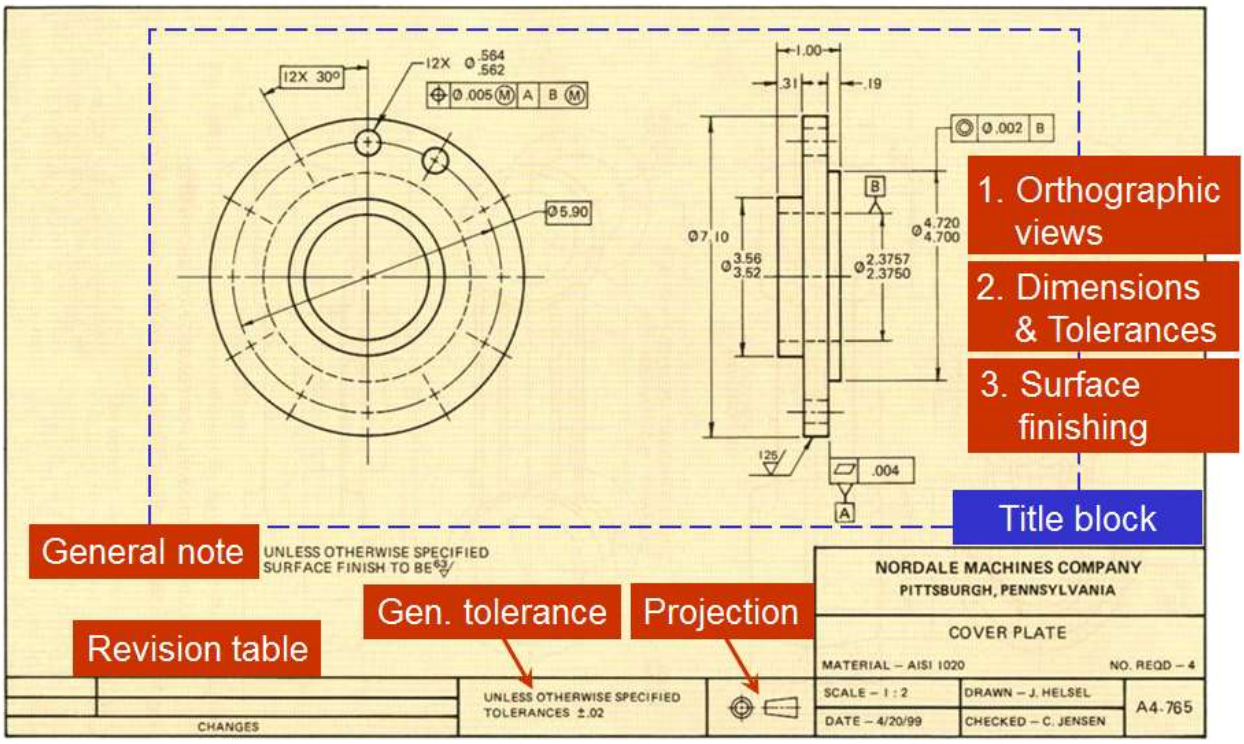


Fig 2: detail drawing a

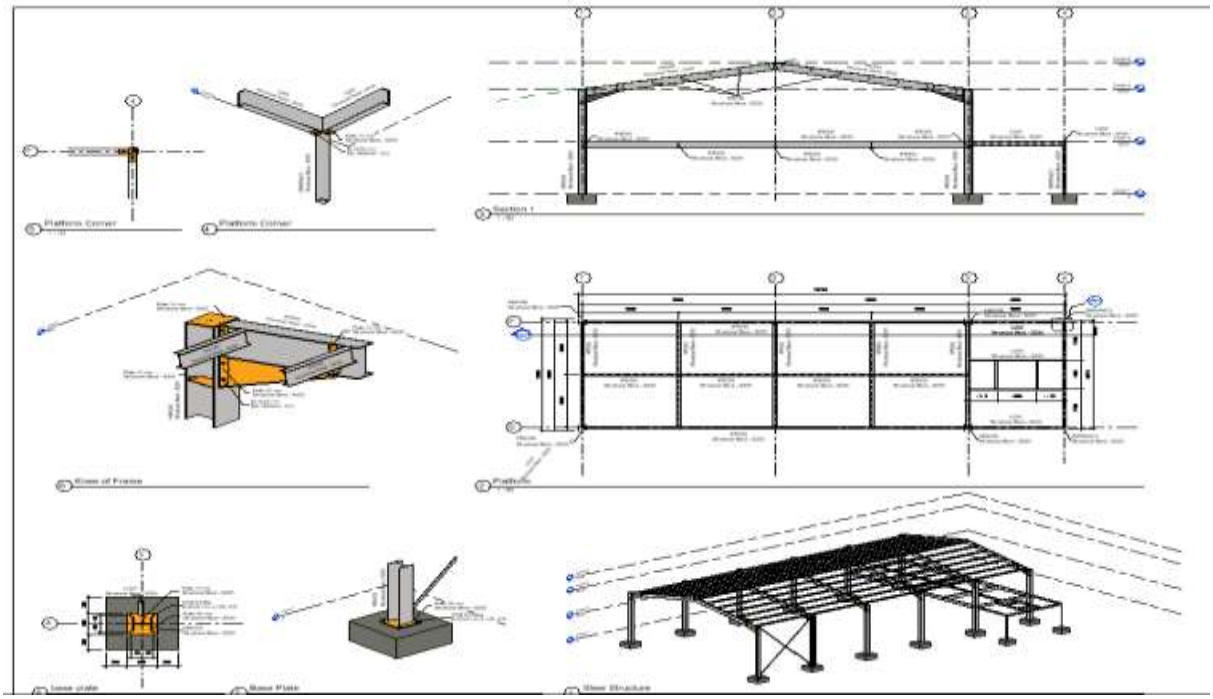


Fig 2: detail drawing b

1.2.2. **Assembly drawing** is a drawing of various parts of a machine or structure assembled in their relative working positions. Can be used to represent items that consist of more than one component They show how the components fit together and may include, orthogonal plans, sections and elevations, or three-dimensional views, showing the assembled components, or an exploded view showing the relationship between the components and how they fit together. They may be used to show how to assemble parts of a kit such as furniture, how to assemble a complex part of a building(an assembly), or to show the relationship between a number of details. The location of assemblies may be shown on general arrangement drawings, or sometimes on detail drawings. The components that form the assembly may be shown shop drawings that allow their fabrication. Assembly drawings may include instructions, lists of the component parts, reference numbers, references to detail drawings or shop drawings, and specification information. However, they should not duplicate information provided elsewhere, as this can become contradictory and may cause confusion. They may also include dimensions, notation and symbols. It is important that these are consistent with industry standards so that their precise meaning is clear and can be understood.

- **Assembly drawing** conveys
  - ✓ Completed shape of the product.
  - ✓ Overall dimensions.
  - ✓ Relative position of each part.
  - ✓ Functional relationship among various components.

- **TYPES OF ASSEMBLY DRAWING**
  - ✓ Exploded **assembly drawings**

  The parts are separately display, but they are aligned according to their assembly positions and sequences.
  - ✓ **General assembly drawings**

  All parts are drawn in their working position
  - ✓ **Detail assembly drawings**

  All parts are drawn in their working position with a completed dimensions.

EXPLODED ASSEMBLY

Pictorial representation

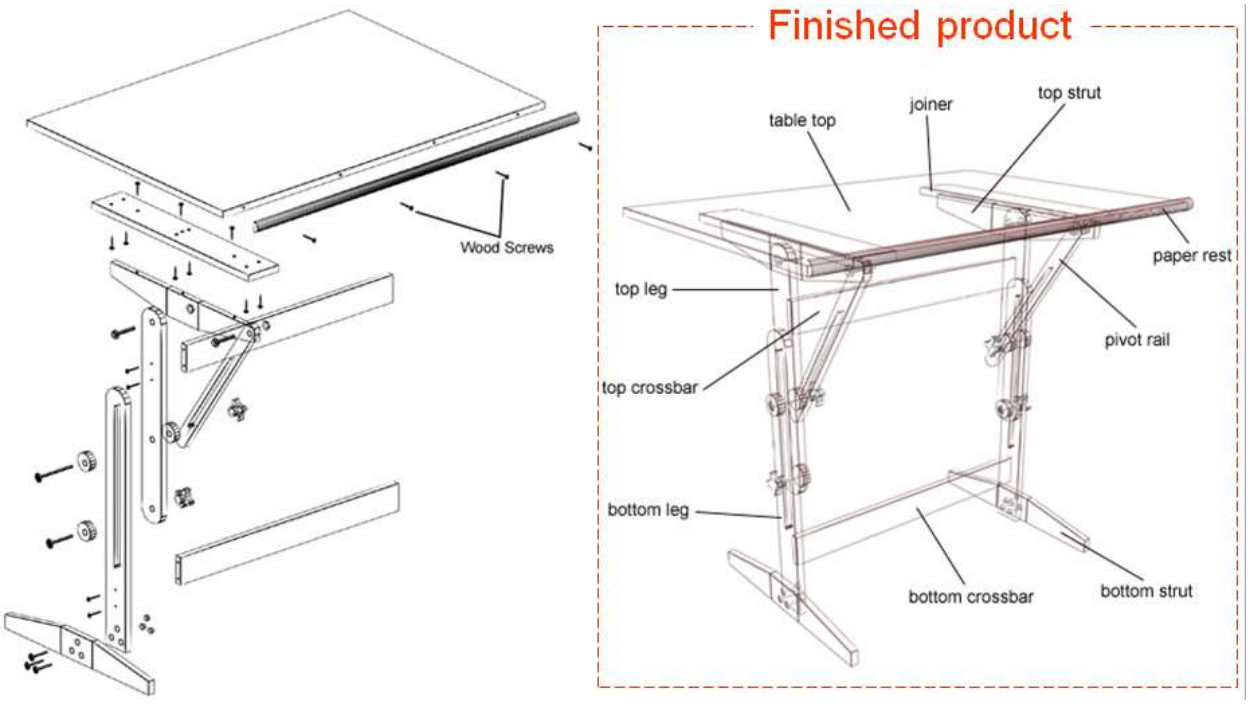


Fig 3: Exploded assembly pictorial representation

Orthographic representation

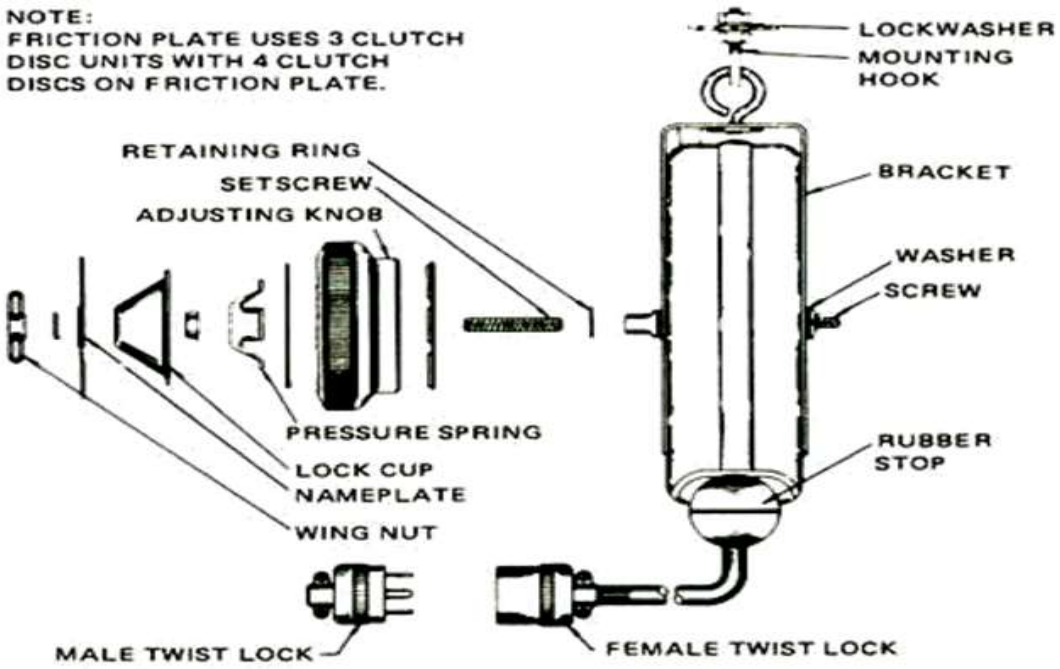


Fig 4: Orthographic representation

1.3. General assembly

Pictorial

Orthographic

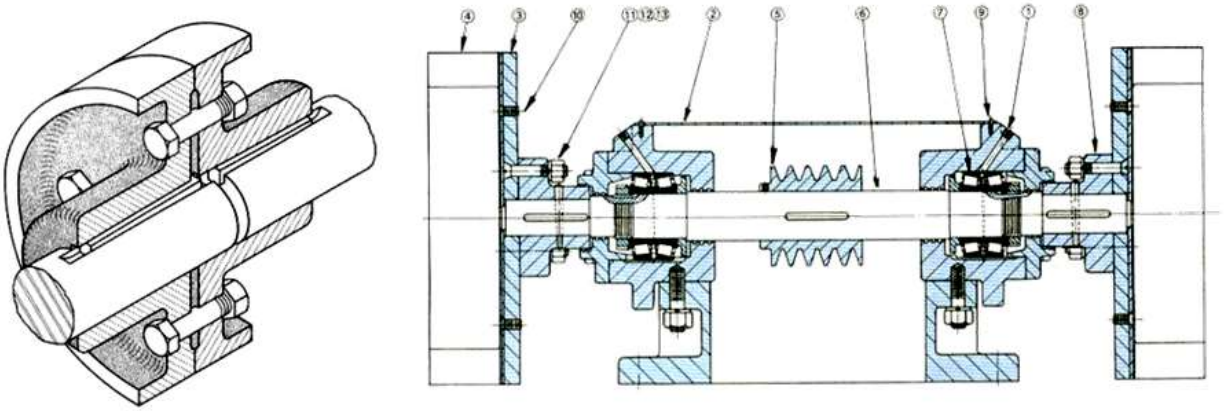


Fig 5: GENERAL ASSEMBLY a

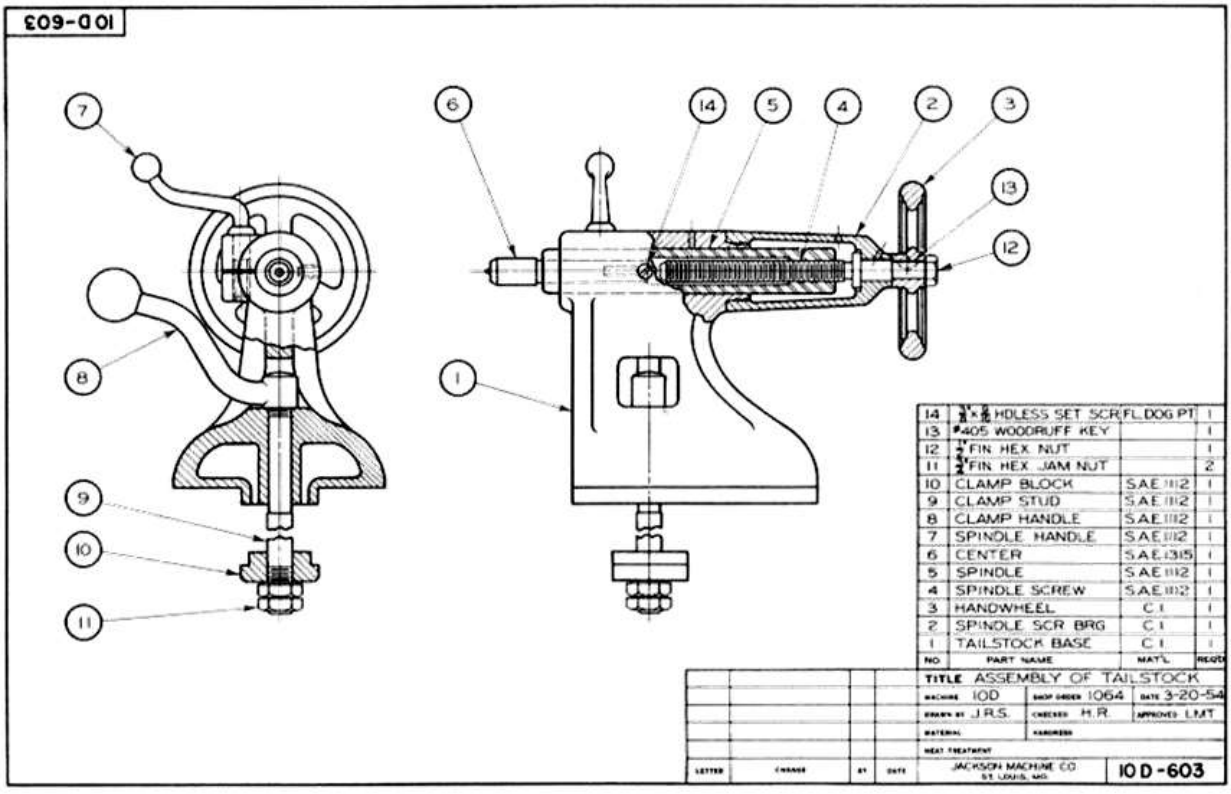


Fig 5: GENERAL ASSEMBLY b

1.4. Detailed assembly

(Working-drawing assembly)

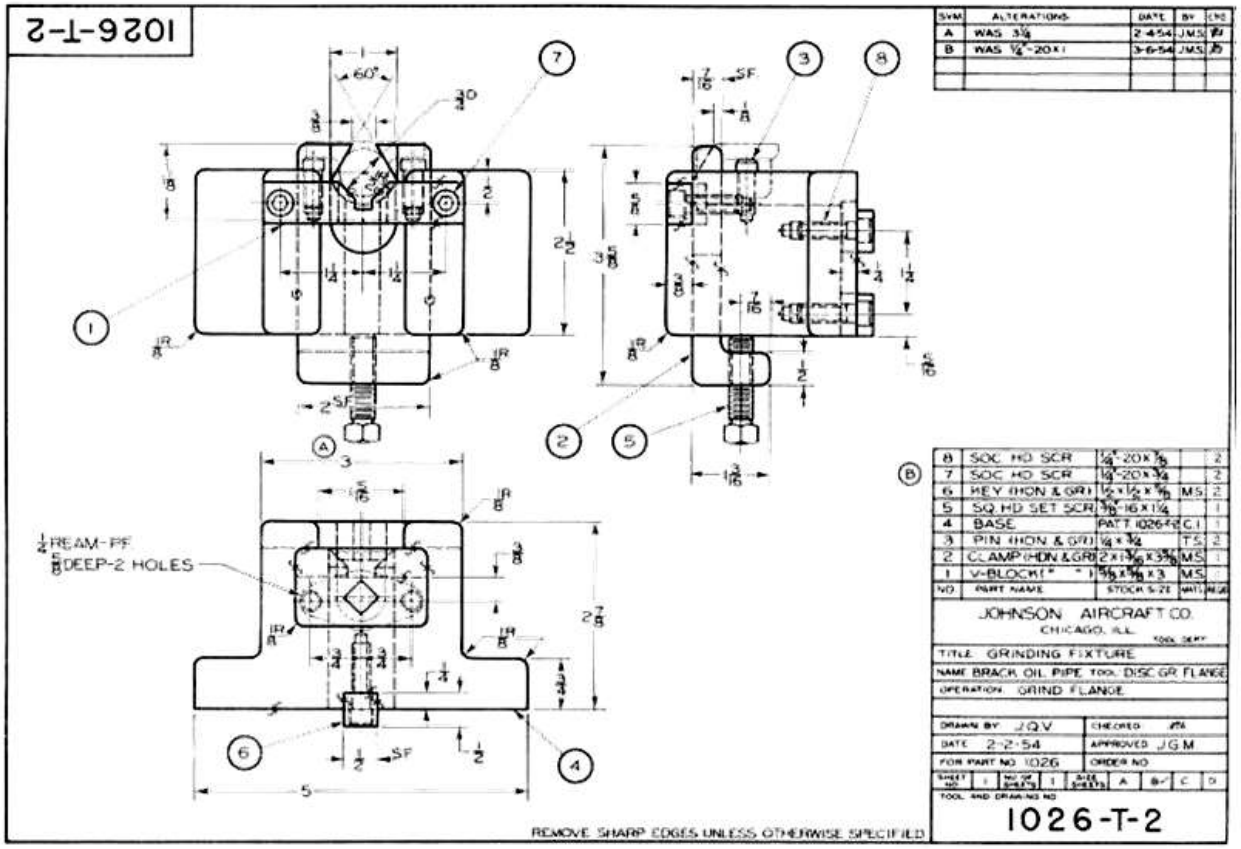


Fig 6: Working-drawing assembly

1.5. required information in general assembly drawing

- **All parts, drawn in their operating position**
- **Part list (or bill of materials, BOM)**
  - ✓ Item number
  - ✓ Descriptive name
  - ✓ Material, MATL.
  - ✓ Quantity required (per a unit of machine), QTY
- Leader lines with balloons around part numbers
- Machining and assembly operations and critical dimensions related to operation of the machine**.**

Placing an information

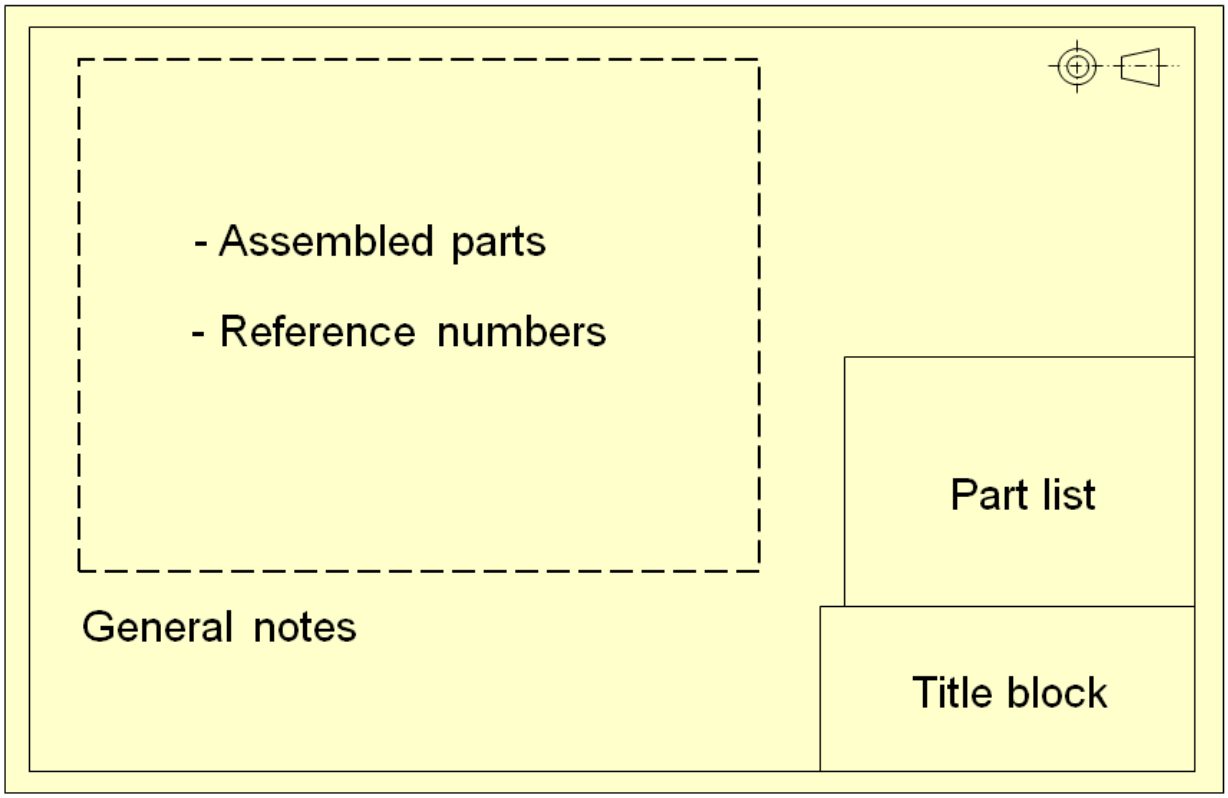


Fig 7: placing an information

Steps to create assembly drawing

1. **Analyze** geometry and dimensions of all parts in order to understand the assembly steps and overall shape of device or machine.
2. Select an appropriate view.
3. Choose major parts, i.e. parts that have several parts assembled on.
4. Draw a view of **major parts** according to a selected viewing direction.
5. Add detail view of the remaining parts at their working positions.
6. Apply **section technique** where relative
7. Positions between adjacent parts are needed to clarify.
8. Add **balloons**, **notes** and **dimensions** (if any).
9. Create BOM

- **General practice**

The **number of views** can be one, two, three or more as needed, but it should be **minimum**. A good **viewing direction** is that represents all (or most) of the parts assembled in their working position.

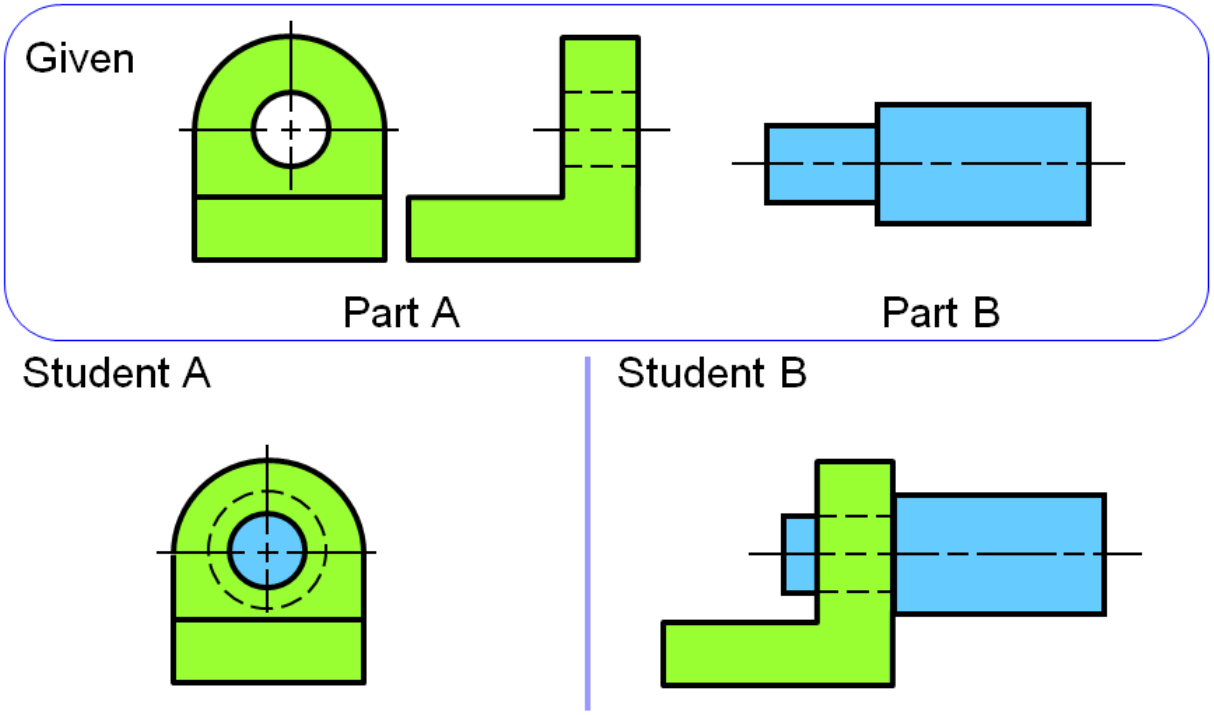
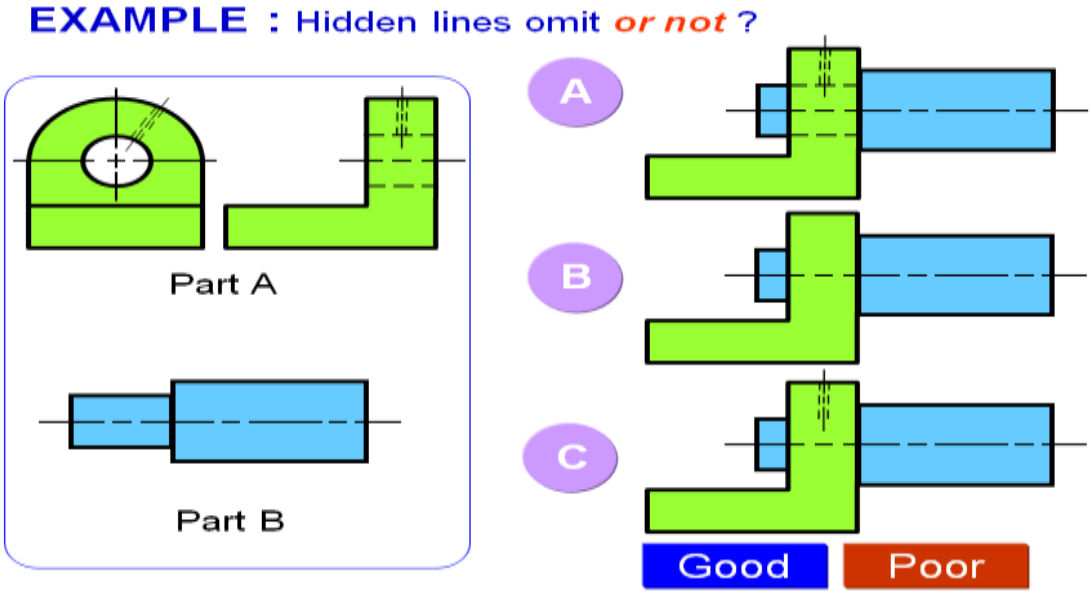


Fig 8: view for assembly drawing a

Hidden lines usually **omit** unless they are absolutely necessary to illustrate some important feature that the reader might otherwise miss.



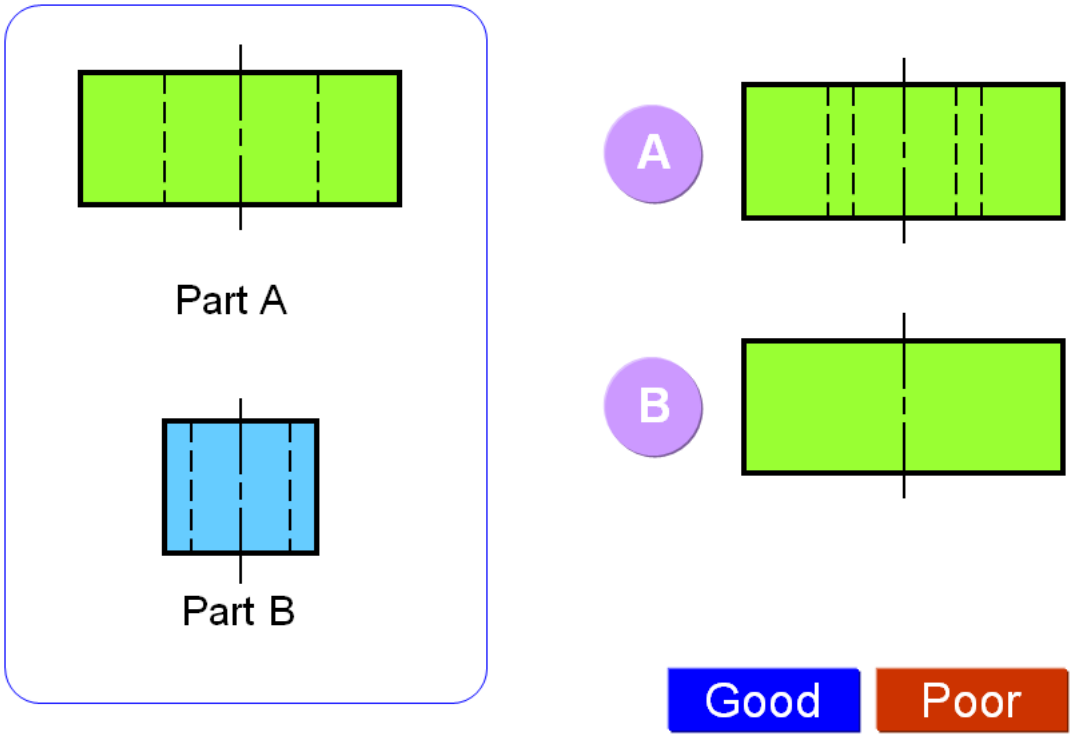


Fig 9: view for assembly drawing b

Self-check 1	Written test

Say true if the statement is write, say false if the statement is wrong

1. Working drawing is a set of drawing used during the work of making a product.
2. Detail drawings may be used to demonstrate compliance with regulations and other requirements.
3. Assembly drawing conveysCompleted shape of the product.
4. Assembly drawing All parts, drawn in their operating position

Information sheet 2	Determining dimensions of various components

2.1. Introduction

The purpose of dimensioning is to provide a clear and complete description of an object. A complete set of dimensions will permit only one interpretation needed to construct the part. Dimensioning should follow these guidelines.

- Accuracy: correct values must be given.
- Clearness: dimensions must be placed in appropriate positions.
- Completeness: nothing must be left out, and nothing duplicated.
- Readability: the appropriate line quality must be used for legibility.

2.2. Definitions

- Dimension line is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end.

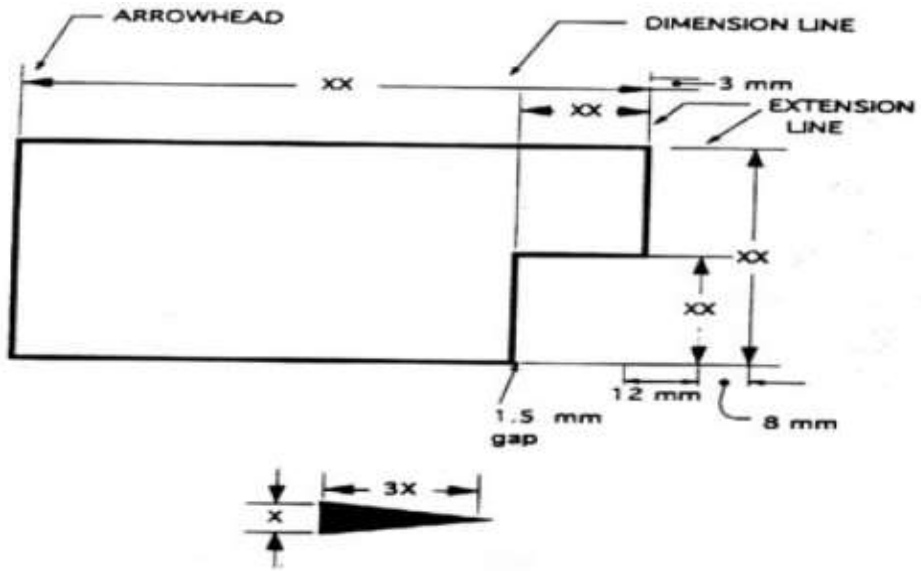


Fig 1: Dimension drawing

- An arrowhead is approximately 3 mm long and 1 mm wide. That is, the length is roughly three times the width.
- An **extension line** extends a line on the object to the dimension line. The first dimension line should be approximately 12 mm (0.6 in) from the object. Extension lines begin 1.5 mm from the object and extend 3 mm from the last dimension line.
- A leader is a thin line used to connect a dimension with a particular area

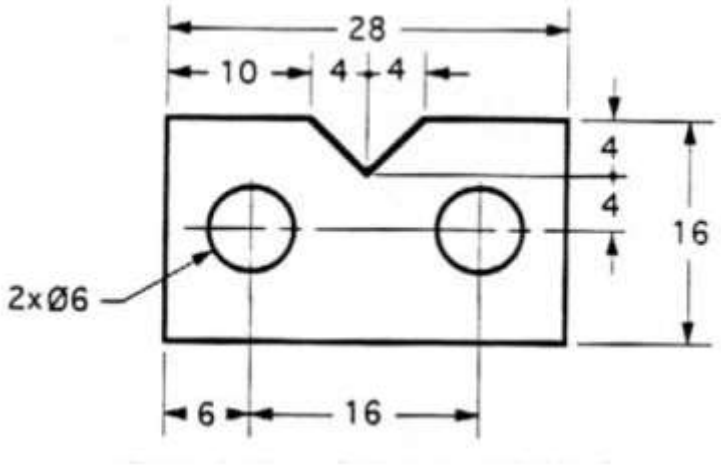


Fig 2: Example drawing with a leader

A leader may also be used to indicate a note or comment about a specific area. When there is limited space, a heavy black dot may be substituted for the arrows, as in figure 8.1. Also in this drawing, two holes are identical, allowing the "2x" notation to be used and the dimension to point to only one of the circles.

2.2.1. Steps in Dimensioning

There are two basic steps in dimensioning objects, regardless of the type of object. STEP 1: Apply the size dimensions. These are dimensions, which indicate the overall sizes of the object and the various features, which make up the object. STEP 2: Apply the location dimensions. Location dimensions are dimensions, which locate various features of an object from some specified datum or surface.

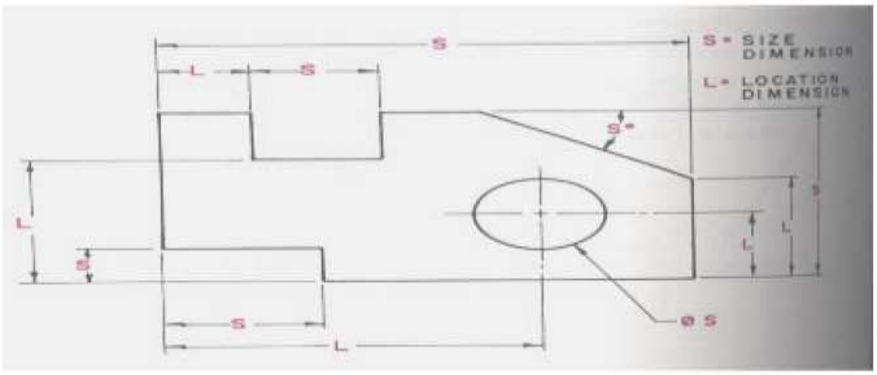


Fig 3: Dimensioning

2.2.2. Where to Put Dimensions

The dimensions should be placed on the face that describes the feature most

clearly. Examples of appropriate and inappropriate placing of dimensions are shown in figure

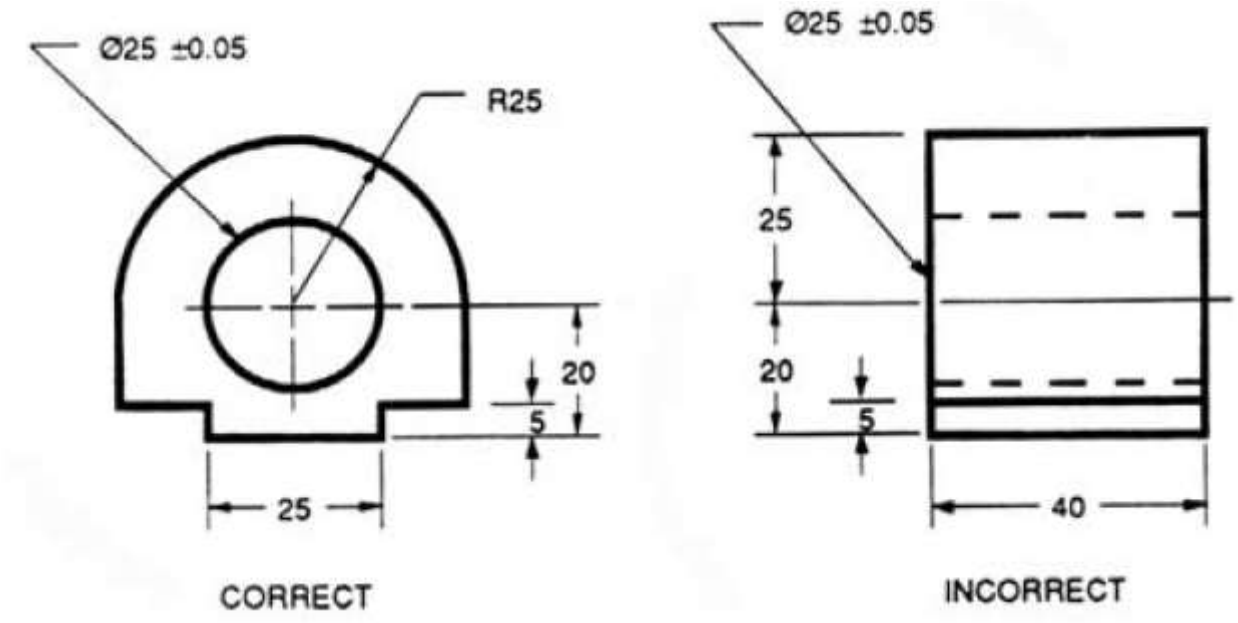


Fig 4: example of appropriate and in appropriate dimensioning

2.3. Dimensioning

In order to get the feel of what dimensioning is all about, we can start with a simple rectangular block. With this simple object, only three dimensions are needed to describe it completely figure. There is little choice on where to put its dimensions.

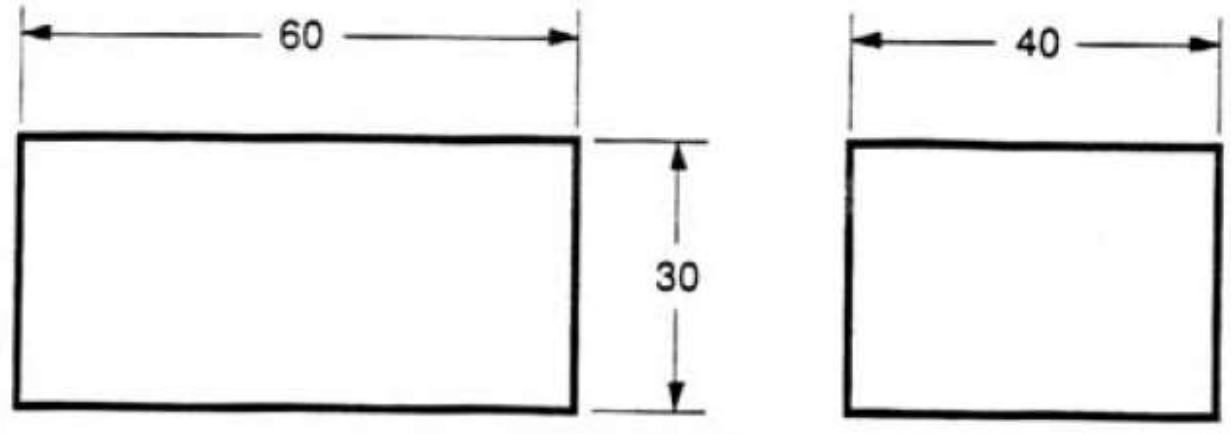


Fig 5: simple object

We have to make some choices when we dimension a block with a notch or cut out figure. It is usually best to dimension from a common line or surface. This can be called the datum line of surface This eliminates the addition of measurement or machining inaccuracies that would come from "chain" or "series" dimensioning. Notice how the dimensions originate on the datum surfaces. We chose one datum surface in figure 9.6, and another in figure 9.7. As long as we are consistent, it makes no difference. (We are just showing the top view).

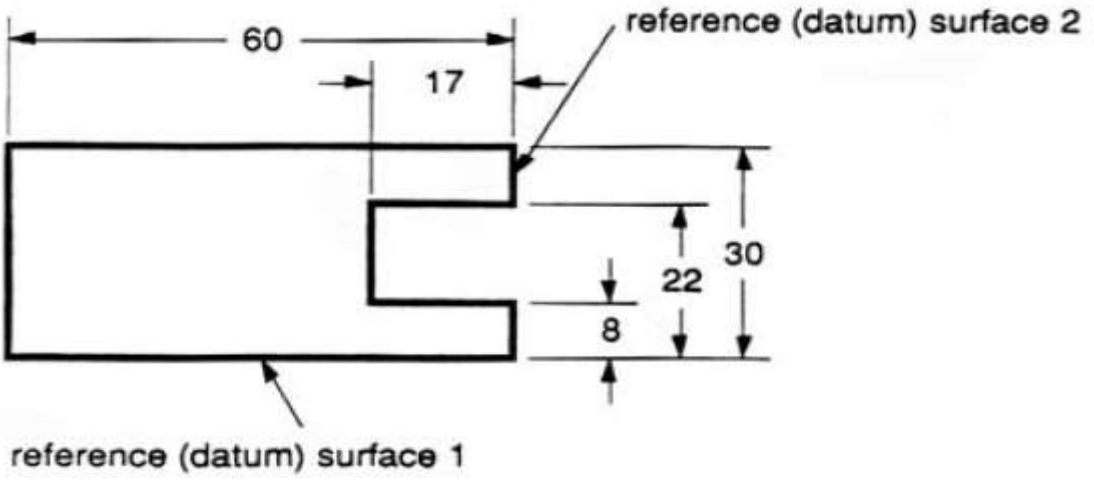


Fig 6: Surface datum example

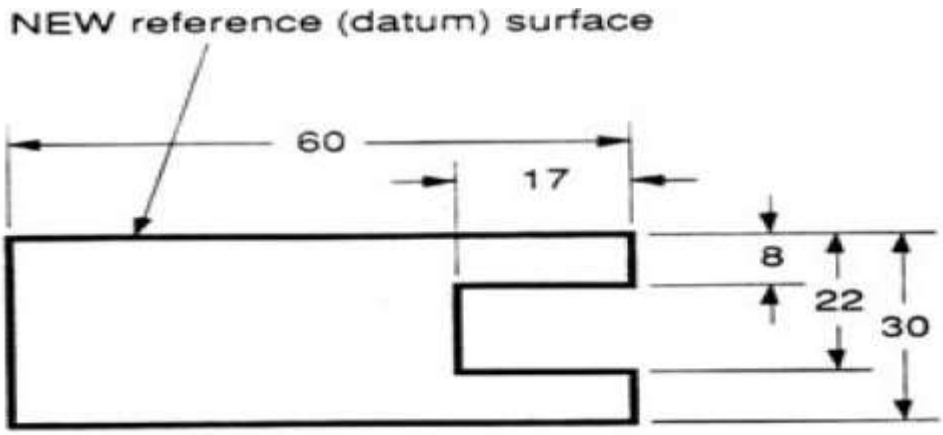


Fig 7: surface datum example

In figure 8 we have shown a hole that we have chosen to dimension on the left side of the object. The Ø stands for "diameter".

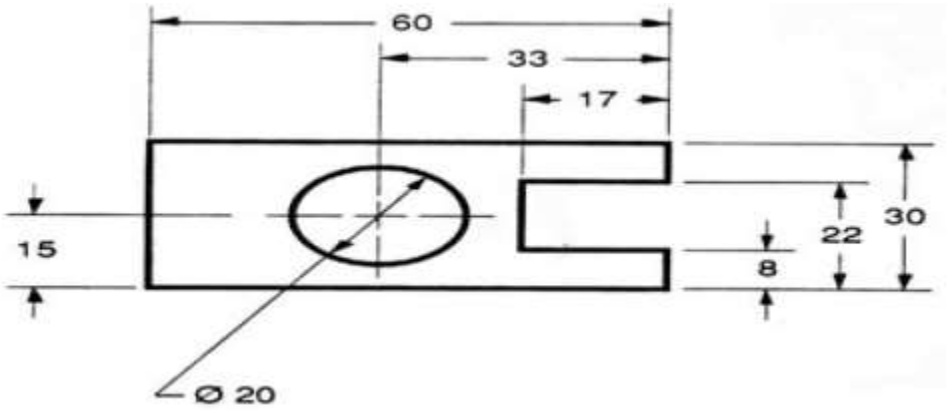


Fig 8: a directly dimensioned hole

When the left side of the block is "radiuses" as in figure 9, we break our rule that we should not duplicate dimensions. The total length is known because the radius of the curve on the left side is given. Then, for clarity, we add the overall length of 60 and we note that it is a reference (REF) dimension. This means that it is not really required.

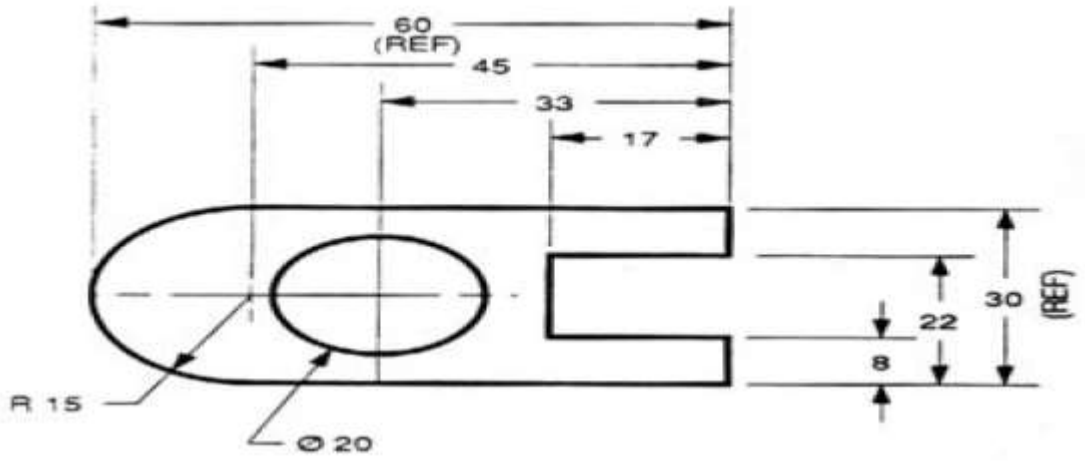


Fig 8: a directly dimensioned hole

Somewhere on the paper, usually the bottom there should be placed information on what measuring system is being used (e.g. inches and millimeters) and also the scale of the drawing.

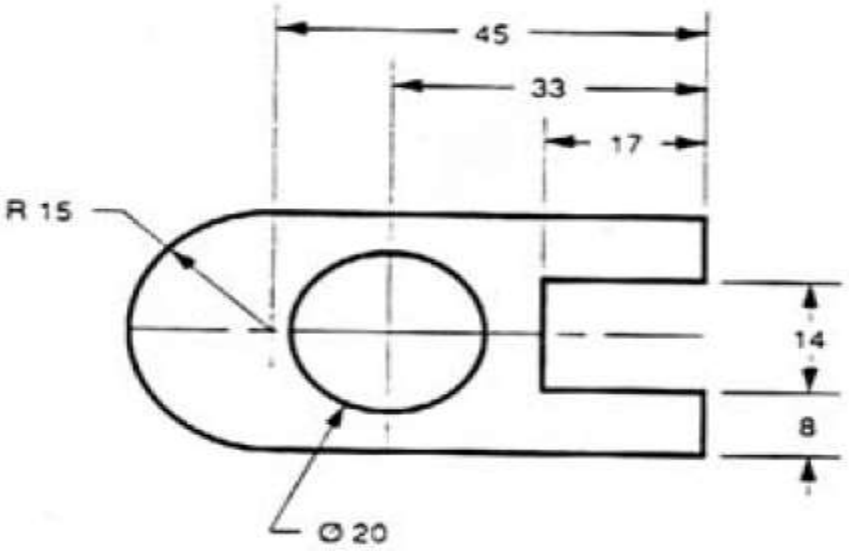


Fig 9: example of a directly dimensioned hole

This drawing is symmetric about the horizontal centreline. Centrelines (chain-dotted) are used for symmetric objects, and also for the centre of circles and holes. We can dimension directly to the centreline, as in figure 9.10. In some cases this method can be clearer than just dimensioning between surfaces.

Self-check 2	Written exam

Say true if the statement is correct, say false if the statement is wrong

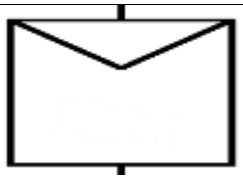
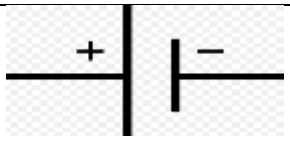
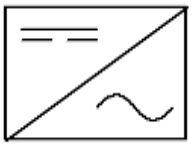
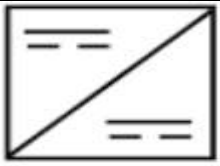
1. The purpose of dimensioning is to provide a clear and complete description of an object.
2. Dimensioning should follow the guidelines ofAccuracy correct values must be given.
3. Dimension line is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end.
4. An extension lineextends a line on the object to the dimension line.

Information sheet 3	Applying appropriate drawing symbols

3.1. Introduction

An electronic symbol is a pictogram used to represent various electrical and electronic devices or functions, such as wires, batteries, resistors, and transistors, in a schematic diagram of an electrical or electronic circuit. These symbols are largely standardized internationally today, but may vary from country to country, or engineering discipline, based on traditional conventions. Electrical symbols virtually represent the components of electrical and electronic circuits. This article shows many of the frequently used electrical symbols for drawing electrical diagrams. Though these standard symbols are simplified，the function descriptions can make you understand clearly.

Table 1: electrical symbol

Solar panel	
Battery	
Inverter	
Solar charge controller	
DC- direct current	
AC- alternating current	

Terminal Strip	11 12 13 14	Neon Lamp	H
Start Button (spring return)	I S	Relay Contacts	K
Stop Button (spring return)	O S	Contactor or Relay Coil	K
Non Automatic Return		Contactor Main Contacts	KM
Emergency Stop (Mushroom Head) (Latching)	O S	Normal Open Auxillary Contact on KM3	KM3
Selector Switch 3 Position	S	Normally Closed Auxillary Contact On KM4	KM4
Float switch		Resettable Thermal Overload Auxiliary Contacts	R F
Signal Lamp	H	Thermal Overload Relay Elements	F
Incandescent Signal Lamp	H		

Fig 1: Electrical symbols

Sl. No.	*Name of Component*	*Electrical Symbols*
1.	Push Button Normally Open NO, S = Start Normally Closed NC. O = Off	S O
2.	Push Button with one NO and one NC contact operated together (1 NO + 1 NC)	OR
3.	Three phase induction motor (Squirrel cage)	M

Fig 2: electrical symbols

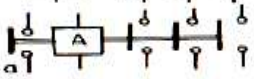
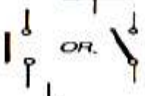
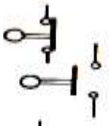
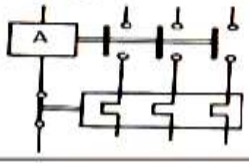
Sl. No.	Name of Component	Electrical Symbols
4.	Slip ring induction motor	
5.	Electrically operated 3-pole contactor with power contacts (three phase supply contacts) or main contacts only	
6.	Electrically operated contactor with main (three phase or power contacts) and auxiliary (control circuit) contacts	
7.	Coil of a electromagnetic relay contactor	
8.	Auxiliary contact Normally Open (NO)	
9.	Auxiliary contact Normally Closed (NC)	
10.	Two-way contactor	
11.	Limit Switch contact Normally Closed	
12.	Limit Switch Contact Normally Open	
13.	NO + NC Limit Switch Operated together	
14.	Signal Lamp	
15.	Contactor with thermal overload relay in all the three poles (phases)	

Fig 3: Electrical symbols

Motor Controllers Symbols (Western Format)

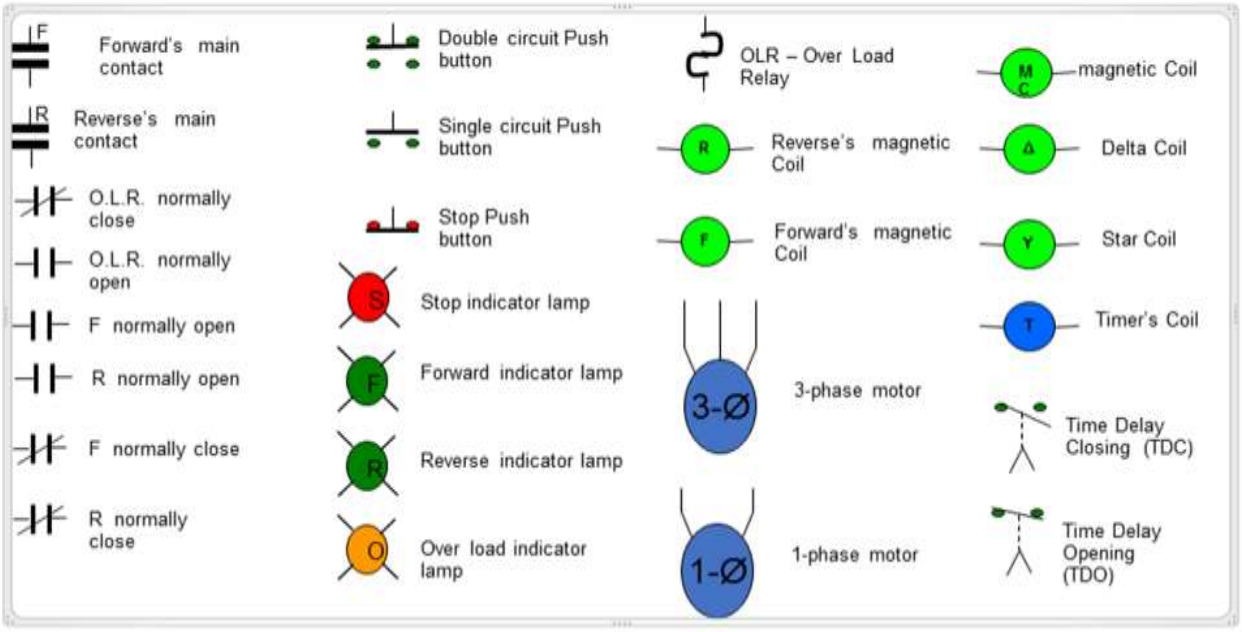


Fig 4: western motor control symbols

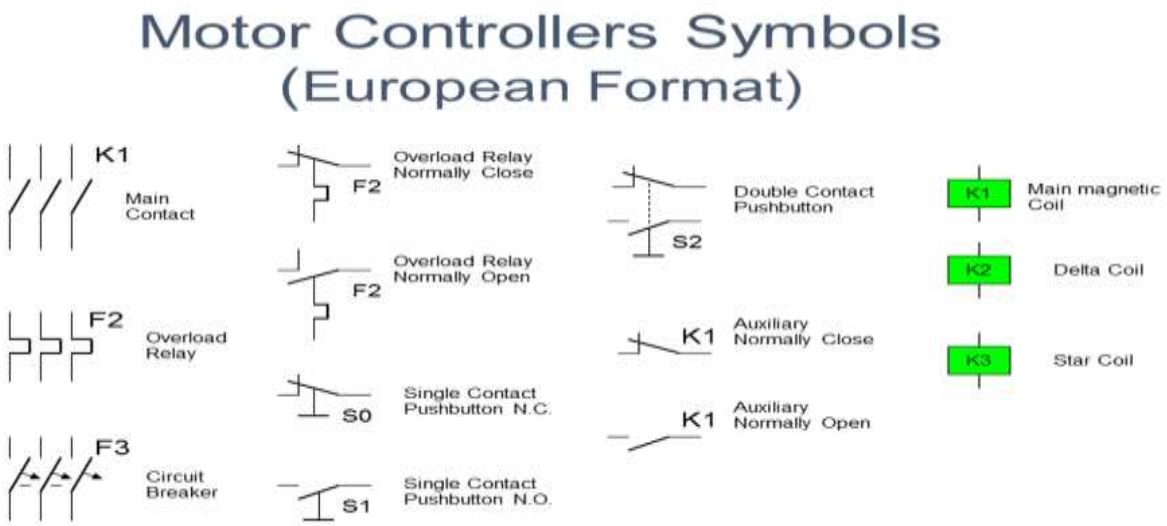


Fig 5: European motor control symbols

Self-check 3	Written test

Say true if the statement is correct, say false if the statement is wrong

1. An electronic symbol is a pictogram used to represent various electrical and electronic device or functions.
2. Electrical symbols virtually represent the components of electrical and electronic circuits.

4.1. Introduction

Third Angle projection is a method of orthographic projection which is a technique in portraying a 3D design using a series of 2D views. 3rd Angle project is where the 3D object is seen to be in the 3rd quadrant. It is positioned below and behind the viewing planes, the planes are transparent, and each view is pulled onto the plane closest to it. The front plane of projection is seen to be between the observer and the object.

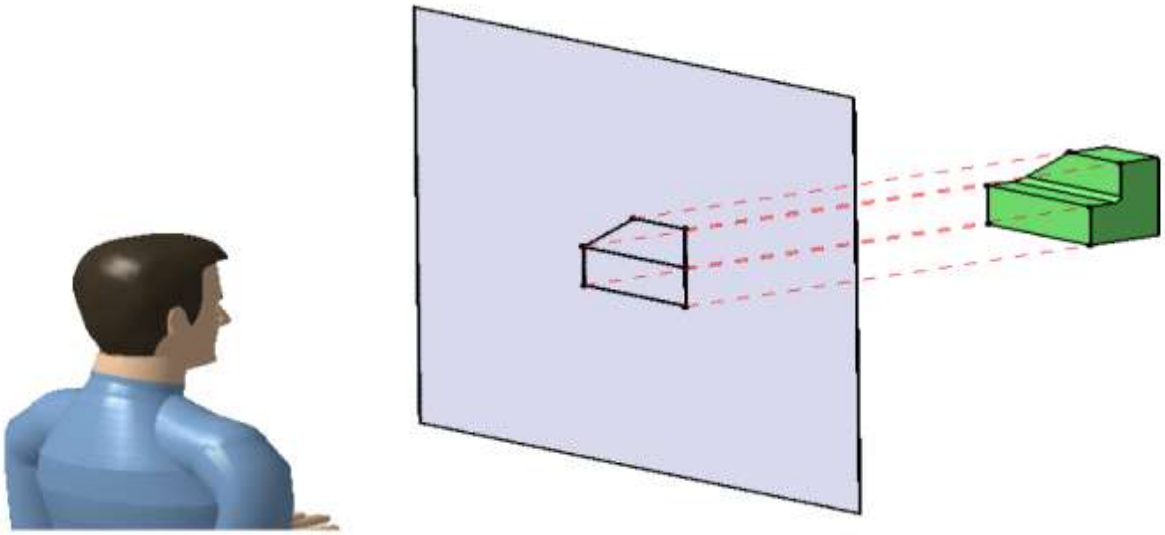


Fig 1: Third angle projection

The images below show the projection of the object on a 3D box surrounding the object. The box is then gradually unfolded to then present a series of 2D views in the 3rd Angle projection as viewed by the observer.

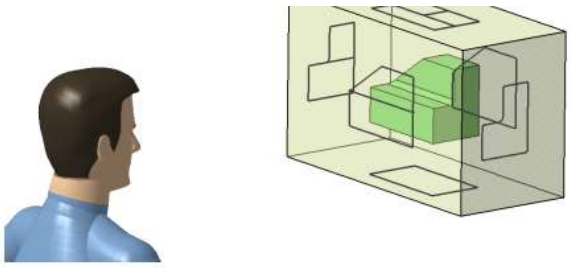


Fig 2: Projection of the object on a 3D box

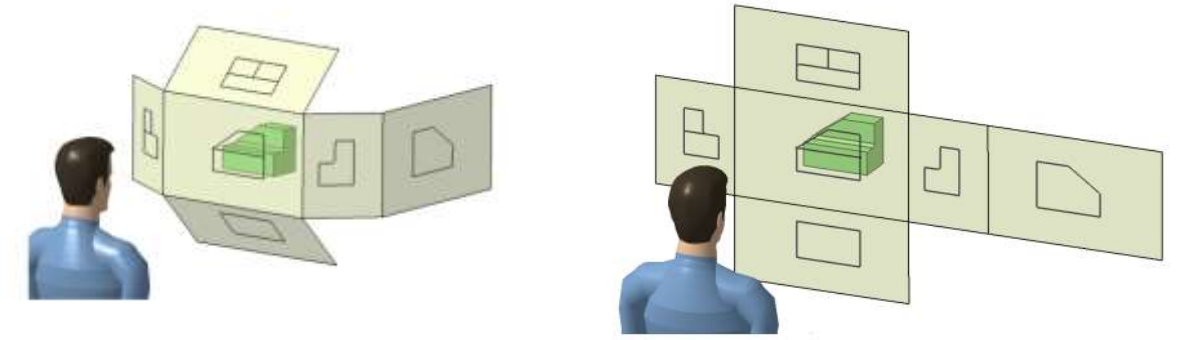


Fig 3: a series of 2D views in the 3rd Angle projection

- The following demo shows this in motion:

The views below show the same object in first an Isometric 3D view then the corresponding 2D 3rd Angle projection views in the specific alignment. The annotations on the 2D views show how the Top and Left views are aligned to the front view.

- ✓ The front view, is a drawing of the block, as if you are looking directly at the front of the object.
- ✓ The side view, is a drawing of the block, when it has been rotated so that one of its sides is now directly in view.
- ✓ The plan view, is a 'birds eye' view, from above.

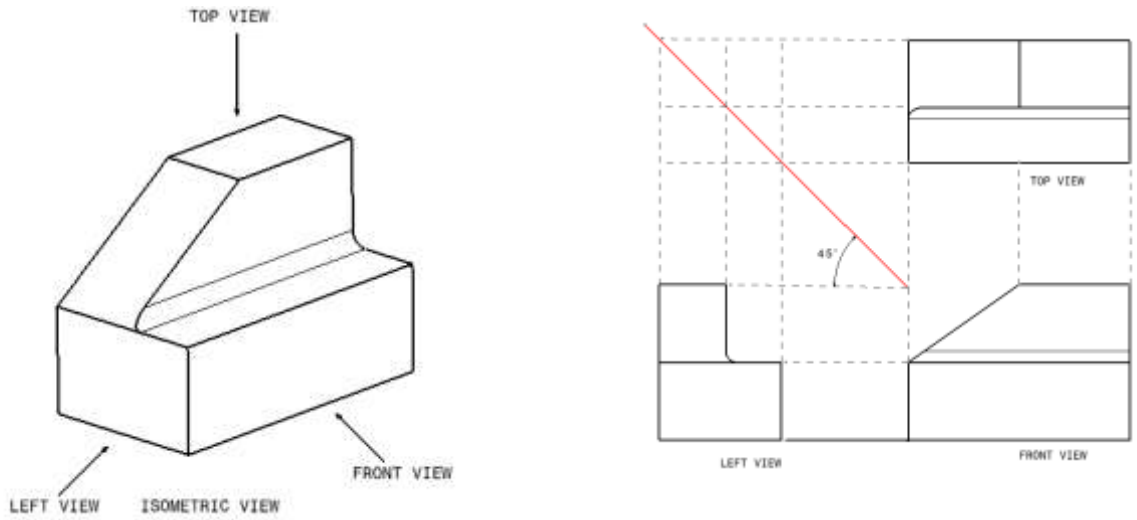


Fig 4: same object in first an Isometric 3D view

The 3rd Angle projection symbol shows the orientation of a cone in the 3rd Angle projection.

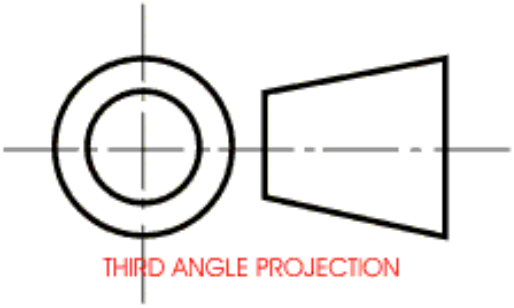


Fig 5: Third angle projection

4.2. Steps used to create an orthographic projection

The following steps take you through the creation of an orthographic projection.

- Choose a front view. This is the view that shows the most about the object.
- Decide how many views are needed to completely describe the object. If you are unable to determine which views will be needed, draw the standard views (front, top and right side).
- Draw the visible features of the front view.
- Draw projectors off of the front view horizontally and vertically in order to create the boundaries for the top and right side views.
- Draw the top view. Use the vertical projectors to fill in the visible and hidden features.
- Project from the top view back to the front view. Use the vertical projectors to fill in any missing visible or hidden features in the front view.
- Draw a 45° projector off of the upper right corner of the box that encloses the front view.
- From the top view, draw projectors over to the 45° line and down in order to create the boundaries of the right side view.
- Draw the right side view.
- Project back to the top and front view from the right side view as needed.

- Draw center lines where necessary.

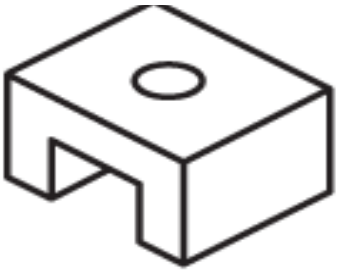


Fig 6: Designed object

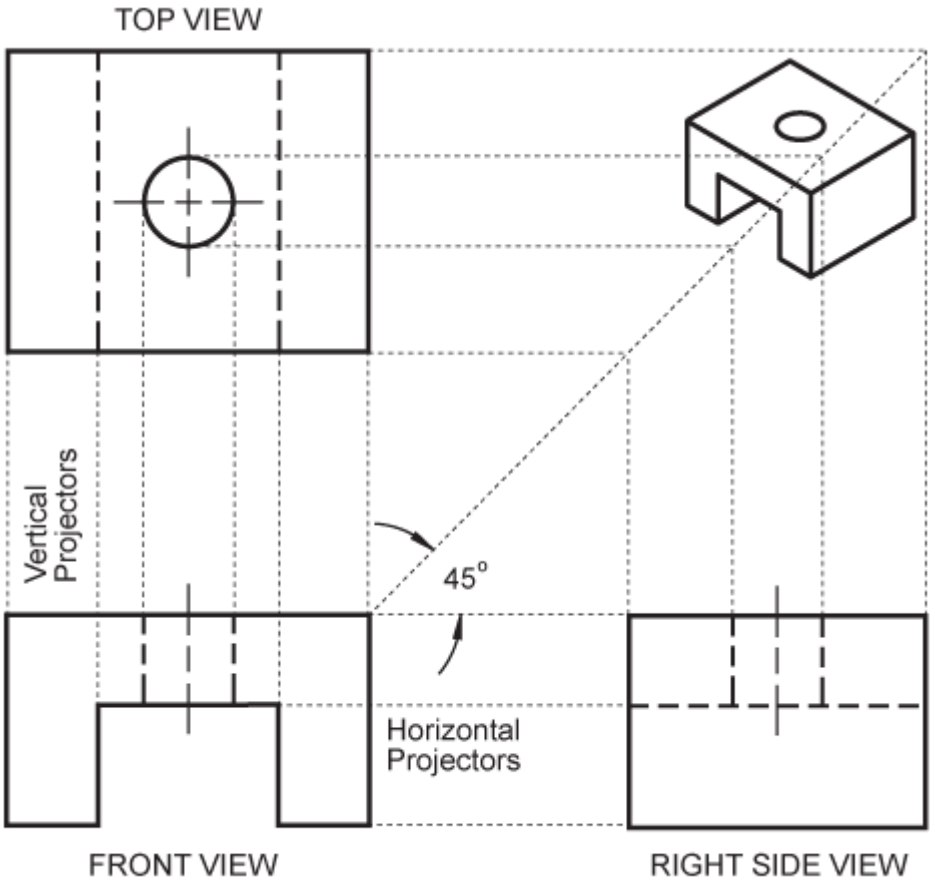


Fig 7: Orthographic projection

4.3. OBJECT REPRESENTATION

- Axonometric projection
- Multi view projection

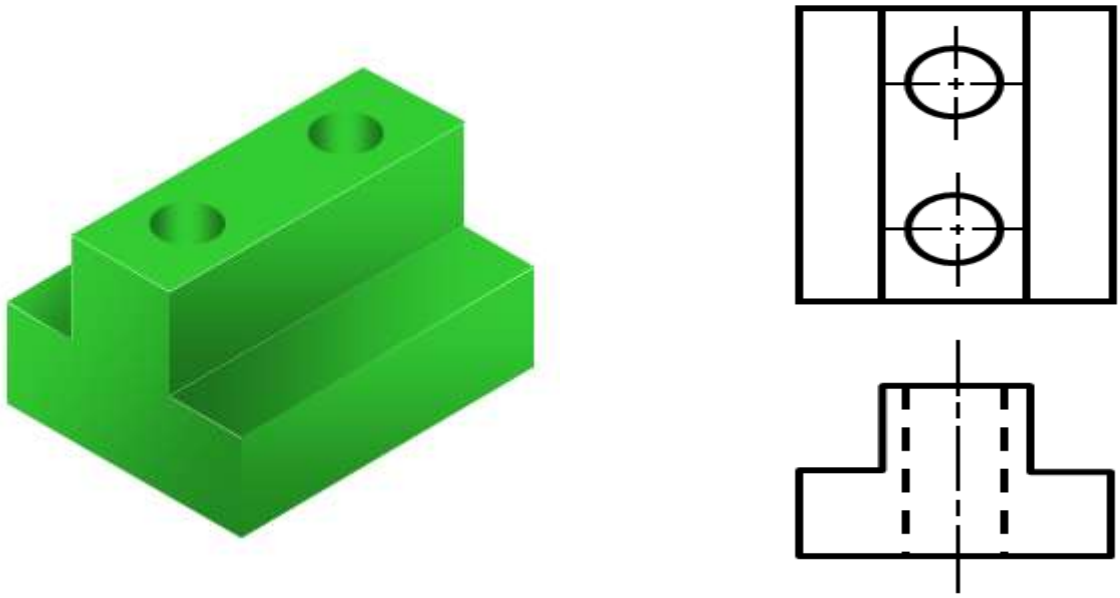


Fig 8: Axonometric projection

4.4. MULTIVIEW PROJECTION

Three principle dimensions of an object can be presented only **two in each view.**

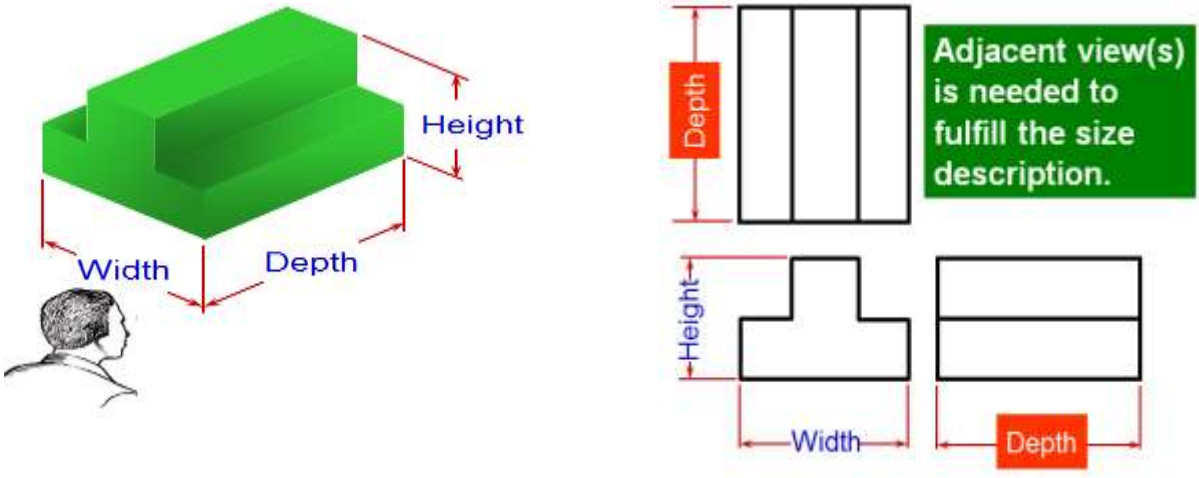


Fig 9: Multi view projection

4.4.1. To obtain multi view representation of an object

- Revolve the object with respect to observer.
- The observer move around theobject.

Revolve the object

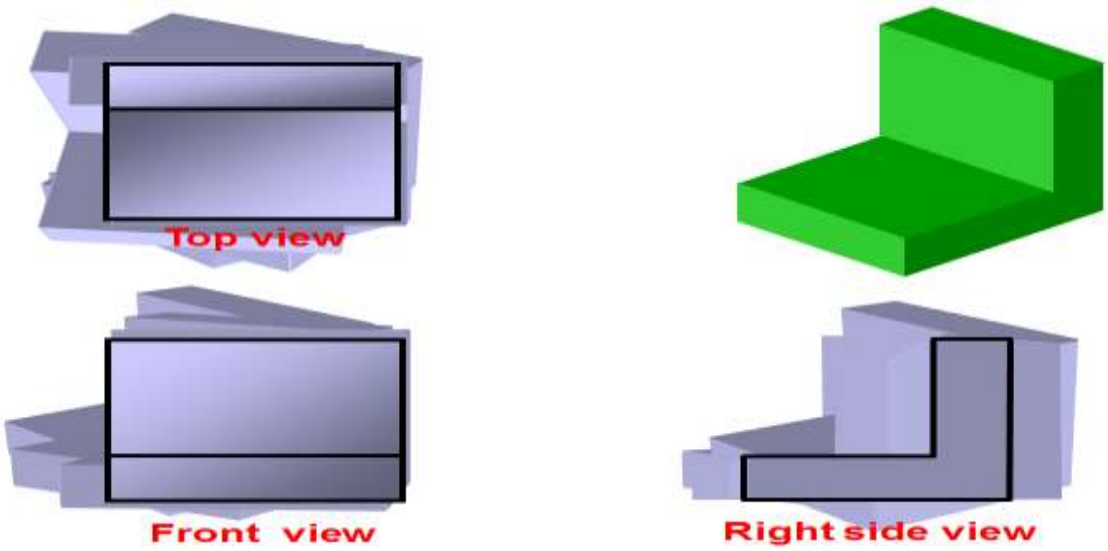


Fig 10: Multi view projection of an object

Observer move around

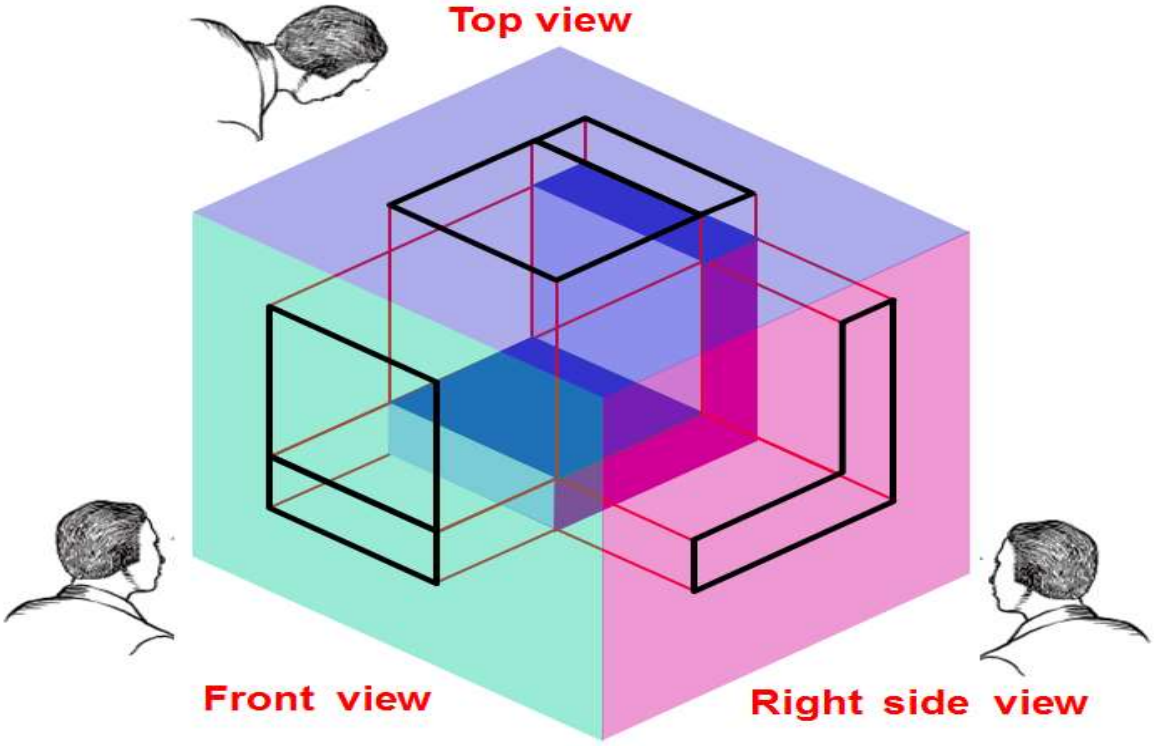


Fig 11: observer move around

4.5. Projection of object

The views are obtained by projecting all object features to the picture plane.

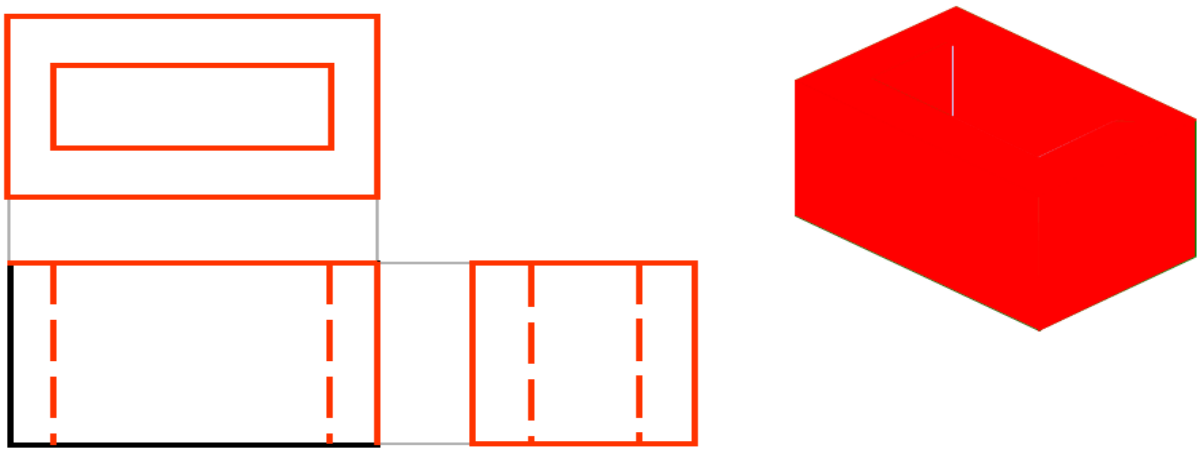


Fig 12: projection of object a

- **Projection of object**

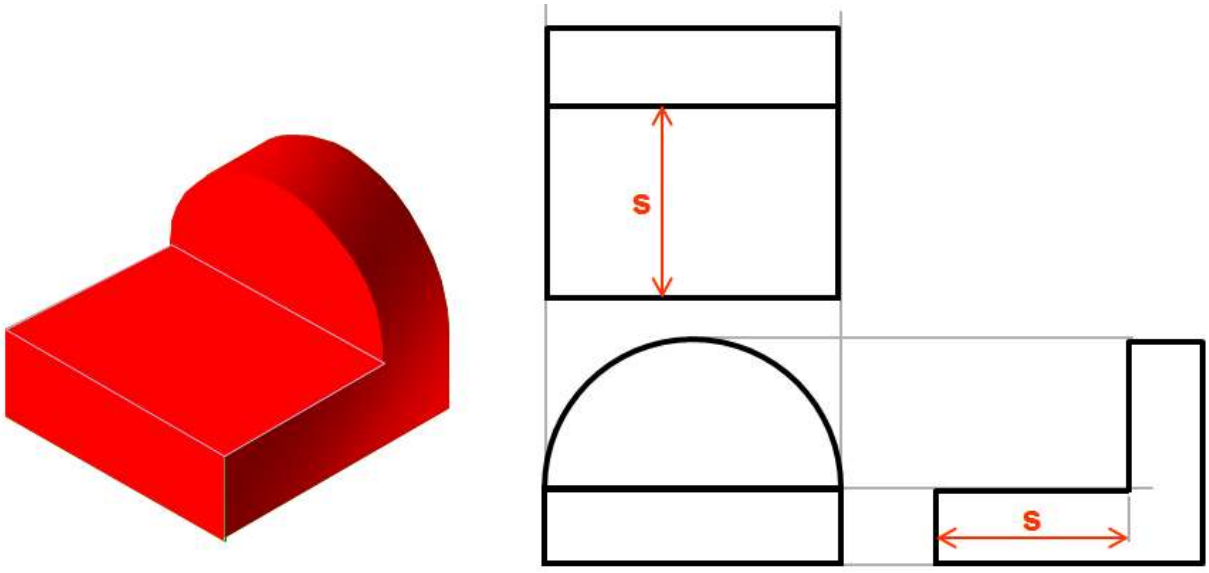


Fig 13: projection of object b

Self-check 4	Written test

Say true if the statement is correct, say false if the statement is wrong

1. Third Angle project is where the 3D object is seen to be in the 3rd quadrant
2. Third Angle projection is a method of orthographic projection
3. The front plane of projection is seen to be between the observer and the object.

Information sheet 5	Performing auxiliary view drawing

5.1. Auxiliary Views

- Front view auxiliaries
- Top auxiliaries
- Side view auxiliaries
- Sketching auxiliary view

When an object has a slanted or inclined surface, it usually is not possible to show the inclined surface in an orthographic drawing without distortion. To present a more accurate description of any inclined surface, an additional view, known as an auxiliary view, is usually required. An auxiliary view is simply a “helper” view, which shows the slanted part of the object as it actually is. It turns or projects the object so that the true size and shape of the surface (or surfaces) are seen as they actually are. Auxiliary views are commonly found on many types of industrial drawings.

- Front View Auxiliaries

There are three basic types of auxiliary views. In the first type, the auxiliary view is projected from the front view of a three view (orthographic) drawing. In the second and third types of drawings, the auxiliary views are projected from the top and side views. Here is a front view auxiliary of a simple object with an inclined surface.

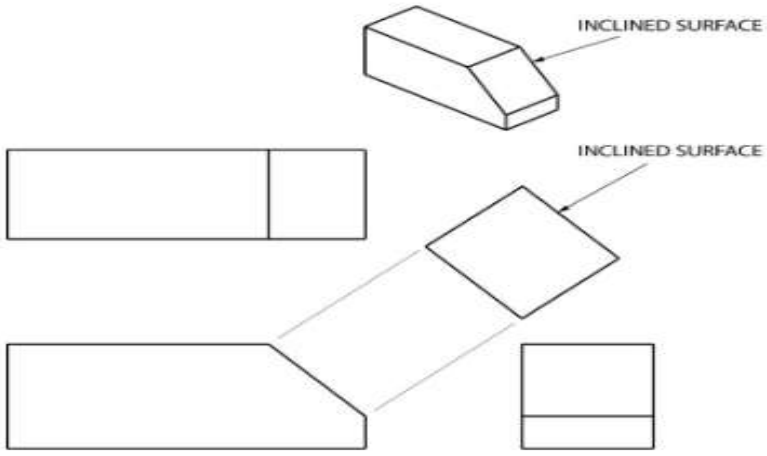


Fig 1: front view auxiliary

Notice that the projection lines are perpendicular to the slanted surface of the first view, and that only the slanted surface of the object is shown in the auxiliary view. ·

The rest of the object is omitted, however, for clarification portions of the adjacent· surfaces are sometimes shown. Also, notice that the slanted surfaces of the top and side views are shortened because of distortion, whereas the surface of the auxiliary view is true or actual size.

To sketch an auxiliary view, you begin with orthographic. Views of the object and add projection lines perpendicular (90˚) to the slanted surface, adding a reference line any convenient distance from the view with the slanted surface.

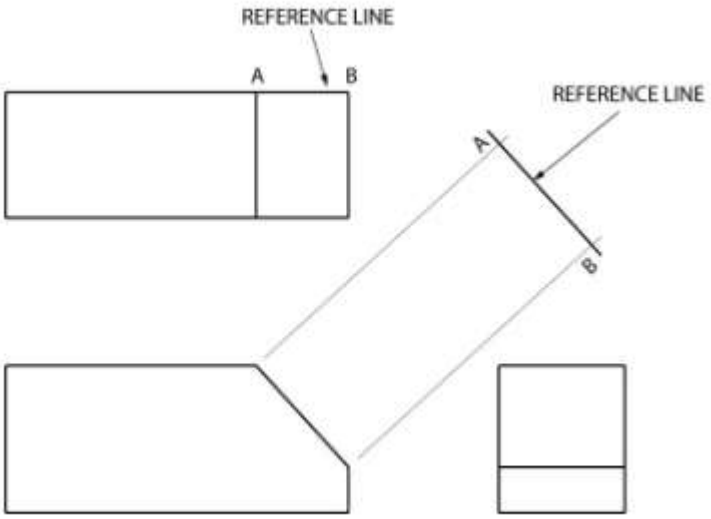


Fig 2: front view auxiliary

Next, the distance CB on the auxiliary view is made the same length as the related distance in one of the orthographic views; in this example it's the side view. This completes the auxiliary view.

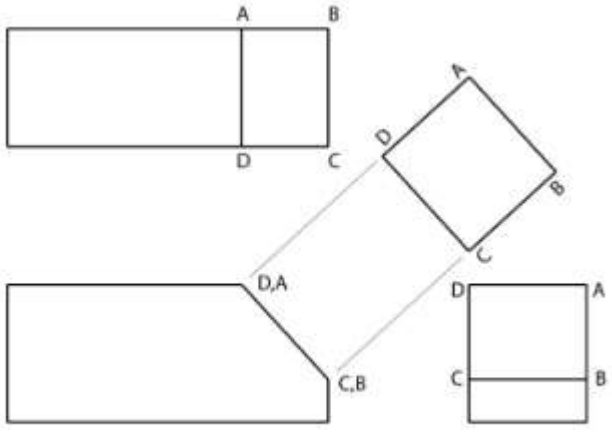


Fig 3: front view auxiliary

- **Top View Auxiliaries**

A top view auxiliary is developed in the same way as a front view auxiliary, except that the auxiliary is projected from the top view. Whether the auxiliary view is to be projected from the front, top, or side view depends on the position of the object, or which surface of the object is slanted. In this example, the top view is slanted. Therefore the auxiliary view must be protected from the top view. Again, notice how the angled surfaces shown in the front and side views are not shown in true length.

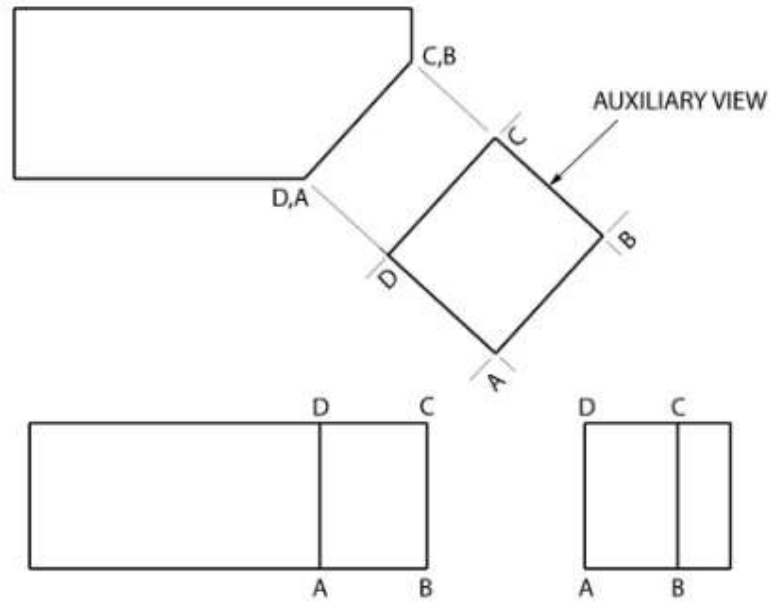


Fig 4: Top View Auxiliaries

- **Side View Auxiliary**

Side view auxiliaries are drawn in the same way as front and top view auxiliaries. Again, where the auxiliary view is to be projected depends upon the position of the object or which surface of the object is slanted.

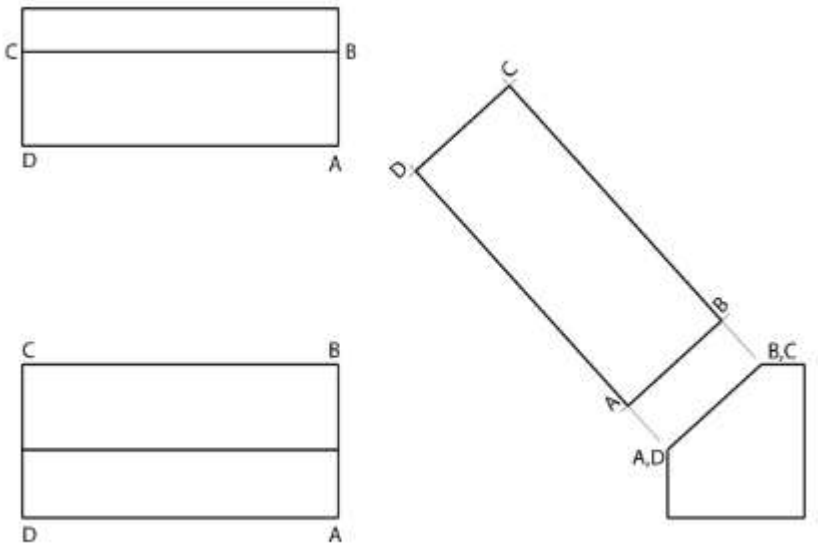


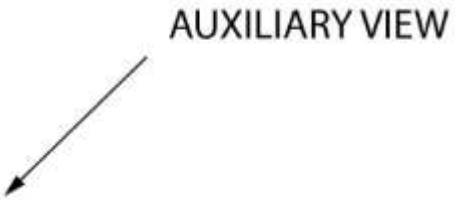
Fig 5: Side View Auxiliary

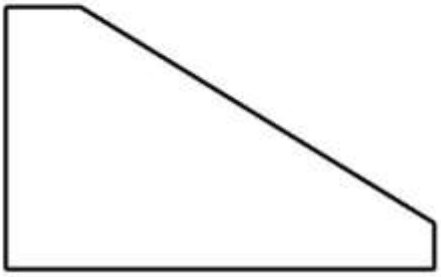
Obviously, these are very basic auxiliary view examples and are presented to introduce you to the concept of auxiliary views. As objects with inclined surfaces become more complex, auxiliary views provide a means of presenting objects in their true size and shape.

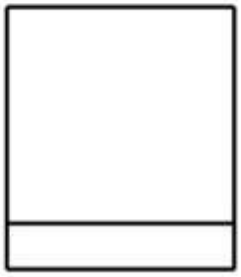
- **Sketching Auxiliary Views**

The following problems require and auxiliary view to be complete. Sketch the auxiliary views required in the spaces provided.

Drawing practice 1







Self-check 5	Written test

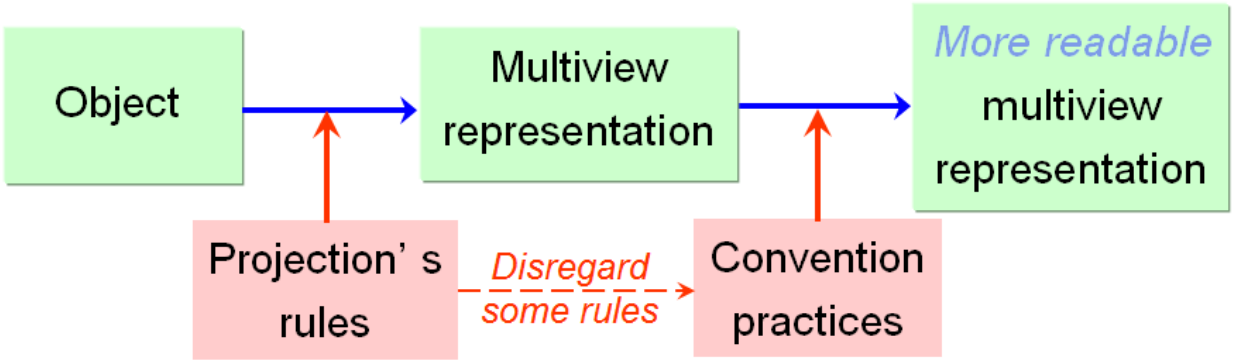
Say true if the statement is correct, say false if the statement is wrong

1. the slanted surface of the object is shown in the auxiliary view
2. In the second and third types of drawings, the auxiliary views are projected from the top and side views.
3. To sketch an auxiliary view, you begin with orthographic.

Information sheet 6	Using correct conventions for different drawings.

6.1 Definition

Convention is a commonly accepted practice whichdisregardsome strict rules of orthographic projection



EXAMPLE: Already met convention practice

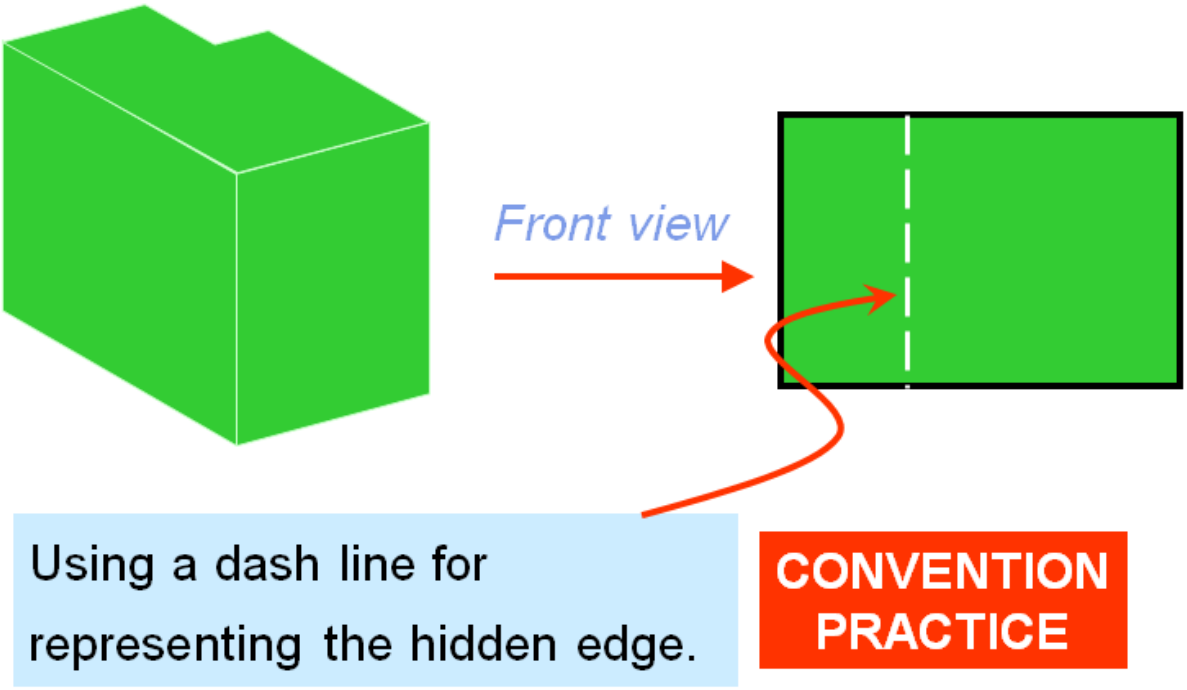


Fig 1: using dash line for representing edge.

6.2 Purpose of convention practice

- To improve the clarity of a drawing
- To facilitate the dimensioning
- To reduce the drafting effort
- To save or efficiently use a drawing space

6.3 Types of convention practice

- Alternate position of side view
- Incomplete view
- Incomplete side view
- Partial view
- Half view
- Local view
- Aligned view
- Enlarged view
- Non-existing intersection line
- Intersection : Hole on a cylinder

6.4 Conventional Lines

Each line on a technical drawing has a definite meaning and is drawn in certain ways. There are certain conventional lines recommended by American Standard Association. According to the standard," three widths of line, thick, medium, and thin are recommended exact thickness may vary according to the size and type of drawing.

There should also be a distinct contrast in the thickness of different kinds of lines, particularly between the thick lines and thin lines. In technical drawings, make construction lines so light that they can barely be seen, with a hard sharp pencil such as 4H to 6H. For visible lines, hidden lines, and other "thick" lines use relatively soft pencils, such as F or H. All thin lines except construction line must be thin, but dark. They should be made with a sharp medium grad pencil, such as H or 2H.

Self-check 6	Written test

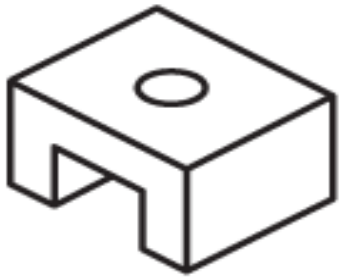
Say true if the statement is correct, say false if the statement is wrong

1. Convention is a commonly accepted practice whichdisregardsome strict rules of orthographic projection
2. Purpose of convention practice is to improve the clarity of a drawing.
3. All thin lines except construction line must be thin, but dark.

Operation sheet 1	Methods to create**orthographic projection**

The following steps take you through the creation of an orthographic projection.

1. Choose a front view. This is the view that shows the most about the object.
2. Decide how many views are needed to completely describe the object. If you are unable to determine which views will be needed, draw the standard views (front, top and right side).
3. Draw the visible features of the front view.
4. Draw projectors off of the front view horizontally and vertically in order to create the boundaries for the top and right side views.
5. Draw the top view. Use the vertical projectors to fill in the visible and hidden features.
6. Project from the top view back to the front view. Use the vertical projectors to fill in any missing visible or hidden features in the front view.
7. Draw a 45° projector off of the upper right corner of the box that encloses the front view.
8. From the top view, draw projectors over to the 45° line and down in order to create the boundaries of the right side view.
9. Draw the right side view.
10. Project back to the top and front view from the right side view as needed.
11. Draw center lines where necessary.

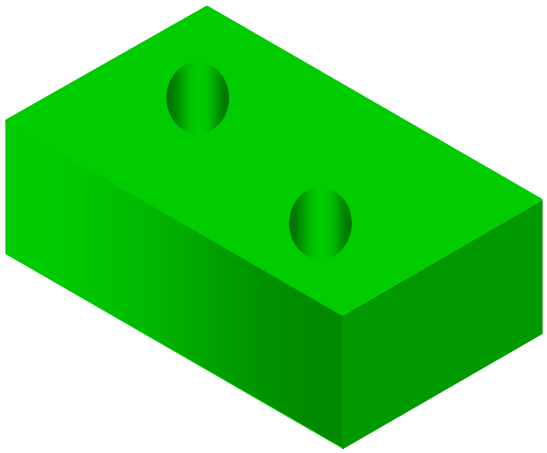


Operation sheet 2	Demonstration

Method of Dimensioning for the following designed object

STEP 1: Apply the size dimensions.

STEP 2: Apply the location dimensions.



LAP Test	Practical Demonstration

Instructions: Given necessary materials, tools and measuring instruments you are required to perform the following tasks within 2 hour.

Task 1:

Your instructor will give you designed project and you will create orthographic projection

Task 2: Your instructor will give you designed project and you will make a dimension.

List of reference materials

1. **Engineering drawing ©2005 by Wuttet Taffesse, Laikemariam Kassa haramay university**

Solar PV System Installation and Maintenance Level-III

Learning Guide -32

Unit of Competence	**Prepare Working Drawing**
Module Title	**Preparing Working Drawing**
LG Code	**EIS PIM3 M08 LO3 LG-32**
TTLM Code	**EIS PIM3 TTLM 0920v1**

LO3: -Issue and/or file drawing

Instruction Sheet	Learning Guide 32

This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Issuing the drawing
- Filing drawings

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: -

- Issue drawing according to workplace procedures.
- File drawing according to workplace procedures.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1	Issuing the drawings

1.1 Introduction

By itself, any single paper item or book would seem easy to store and simple to preserve. However, most collections present challenges based simply on their size and the number of items they contain. When combined with considerations about storage space, storage methods, and shelving, the challenges of storing one item among many become complex.

Storage and handling methods have a direct impact on the useful life of drawings and the accessibility of information. Damage to drawings can be avoided by preventing overcrowded, careless, or haphazard storage conditions. Chemically unstable and improperly fitting shelving and storage enclosures accelerate the deterioration of drawing they are intended to protect. Normal use causes wear, but inexpert and rough handling can quickly lead to extensive damage to drawings requiring expensive repair or replacement. The longevity of drawings can be extended significantly by putting into practice the guidelines discussed here.

Photocopying or Scanning Bound Volumes drawing are often unnecessarily damaged during copying photocopy machines and flatbed scanners encourage pressing the binding flat in order to get a good image. Overhear scanners are better for public use because they allow a book page to be copied with the drawing open less than 180 degrees.

Copying or scanning of drawings is done by staff members (if the materials are particularly fragile). If materials are stable and an overhead scanner is available, researchers can be trained to make their own copies. Digital cameras can also be used with the proper policies in place. For guidance in using digital cameras in special collections and archives, see “Capture and Release”: Digital Cameras in the Reading Room at http://www.oclc.org/research/publications/ library/2010/2010-05.pdf.

Issuing Drawings

Issuing is the process of moving drawing from storage or rooms to drawing production. The correct quantity of drawing must be issued to meet estimated guest demand. This process must be carefully controlled to minimize product misuse.

Importance of effective issuing should there be some relationship between the quantity of drawing and the quantity of drawing removed from storage areas?

Self-Check -1	Multiple Choice

Test I: Multiple Choice Questions

Directions: Choose the correct Answer (each question have 2.pts)

Directions: Answer all the questions listed below. Use the Answer sheet provided in the space provided

1. Storage and handling methods have a direct impact on the useful life of drawings and the accessibility of information. The drawing must stored by their type.

   A. True B. false

2. _____ is the process of moving drawing from storage or rooms to drawing production.

   A. Issuing B. Catalog C. documenting D. All

3. Copying or scanning of drawings is done by staff members only.

   A. true B. false

Note: Satisfactory rating –2 points and above

Unsatisfactory – below 2 points

Information Sheet 2	Filing drawings

2.1. Filing and handling Approved drawing/ blueprints

The method of folding prints depends upon the type and size of the filling cabinet and the location of the identifying marks on the prints. It is best to place identifying marks at the point of prints when you file them vertically (upright), and at the bottom right corner when you file them flat. In some cases, construction prints are stored in rolls. Blueprints are valuable permanent records. However, if you expect to keep them as permanent records, you must handle them with care. Here are a few simple rules that will help.

- Keep prints out of strong sunlight; they fade.
- Do not allow prints to become wet or smudged with oil or grease. Those substances seldom dry out completely, and the prints can become unreadable.
- Do not make pencil or crayon notations on a print without proper authority. If you are instructed to mark a print, use a proper colored pencil and make the markings a permanent part of the print. Yellow is a good color to use on a print with a blue background (blueprint).
- Keep prints stored in their proper place. If you receive prints that are not properly folded, refold them correctly.

With this article, we will review various types and methods of Blueprint Storageand Large Document Storage. We'll provide points for you to consider before making a purchase of any Blueprint Storage Box, Blueprint Storage Cabinet, Blueprint Storage Bags, or Blueprint Storage Rack. We understand that storing your Blueprints safely and securely is important, and that you want to have them organized for quick and easy reference and retrieval. When seeking Blueprint/hard copy of completed drawing Storage Solutions, you must first start by considering how many sheets and plan sets you have that you want to store. And, then consider how your collection will grow in the future. Will you have some storage solutions that offer quick retrieval but less protection? For example; a Blueprint Mobile Stand (also known as a Blueprint Stands, Blueprint Racks, and Hanging Stands) that is located near the people that use the plans the most. Basic starting points to consider when seeking to organize your Blueprint Storage

would be; do you want flat storage, rolled storage, permanent storage, or locked storage. Rolling up drawings takes time, but it does allow for them to be stood up on end beside a workers desk. Corrugated Upright Roll Files and Wire Upright Roll Files offer quick access to rolled drawings right beside workers desk. Something else you should consider is the investment in blueprints you or your company has. Some prints from CAD files that were printed on a CAD Plotter can be reproduced (printed again and again) easily, even if you have a disaster such as a fire. As long as the drawing data is backed up by your computer network administrator, you should be fine. But, what if your drawings have notes, or have been hand-drawn, or what if they were the only available original drawings. Your drawings may have many hours invested in them and as a result make the documents become very valuable and not easily replaced. Many Universities and Plants have the problem of having only originals that are available and once these documents are gone, they are lost forever. In these cases, we recommend a secured Plan Room with fire suppression (possibly not of the water type since water would ruin your documents. We recommend learn more about fire suppression systems which is outside the scope of this document), and we recommend Steel Flat Files that secure the drawings and add a level of protection. Some Blueprint Cabinets even offer fire protection as one of their features. You would need to read more about what each cabinet has to offer and how these levels of protection work.

In summary, we have touched on various points of which you should consider before you make a purchase of a Blueprint Storage Solution. We would even recommend possibly getting a meeting together within your company to discuss what each user would want.

2.2. Storing

There are several blueprint storage options to organize maps, plan drawings and other large format documents. Drafting Steals offers an entire line of storage options. Use Safco & Mayline Cabinets to safely store a vast number of maps, blue prints and other papers flat in minimal space. At the job site organize and quickly retrieve plans off racks and remove out of tubes and upright files. Protection of plans during transportation is important; we have blue print bags and document protectors to help

protect valuable drawings. We have organized storage option in categories to make it easier to navigate. If you run into a problem, can't figure out what you need, don't hesitate to email or call us.

- **Storing Documents**

As a document storage company, Ardington Archives have built up over 20 years' experience managing our client's archive and storage requirements. We work closely with our clients to ensure best working practices and therefore provide guidance on storing documents prior to depositing at our facilities. Below are the 10 top tips for storing documents on site:

- **Store documents in a stable environment**

Paper will deteriorate if kept in places which are too humid, too hot, too light and which allow uncontrolled access to pests (e.g. insects) and pollutants. In practice, typically bad places in which documents are often stored include basements (too humid and a danger of pests) or lofts (too hot in summer, too light and a danger of pests).

- **Ensure documents are stored securely against theft.** Three key elements are involved in protecting your documents against theft:
- The physical security of the building: use good quality locks and metal doors, put bars on any windows, maintain an up to date alarm system, and regularly check the building for any weaknesses or possible points of unauthorized entry.
- Controlling who is allowed into the document store: specify who is authorized to enter it and on what basis, monitor compliance with this, and do not allow visitors to have unsupervised access to the store.
- Maintaining confidentiality regarding the location, identity and content of the document store – or, to put it simply, do not draw attention to the fact that particular documents are kept in a particular place.
- Keep documents away from the risk of fire. Storing documents in any place which is (a) liable to become very hot at certain times, or(b) exposed to direct sunlight, carries with it a risk of fire. Lofts with large plastic skylights are particularly dangerous in this regard.
- Do not allow food to be consumed or stored in the same space as your documents. Food and documents don't mix. The presence of even tiny traces of food will attract, sustain and promote the proliferation of pests such as insects and rodents which are more than capable of doing serious damage to your records.
- Catalogue the contents of each archive box. Cataloguing the contents of each box in which you are storing documents is undeniably a tedious task. However, having in your possession a proper index to the contents of your boxes allows you to find particular documents quickly and will save you from the tedious task of opening up box after box to find that one file or document you just know is 'in there somewhere'.
- Create a searchable storage space. If you simply stack 100 boxes in a room without troubling to sort them into different locations or categories, you are likely to experience trouble finding individual boxes in the future. The best approach isto label boxes individually and catalogue the contents on a searchable index.

- Label boxes properly. Even if you have properly catalogued each box, it is still important to ensure that each has on it a clear, prominent and sufficiently descriptive label, which identifies the box within your catalogue.
- Allow sufficient access space in the document store. Space is always at a premium in any company, so it is always tempting to cram as much in as possible. However, while all ‘dead space’ should be filled, it is important to remember to leave enough space in the right places so that the boxes can be accessed without unnecessary loss of time and without compromising applicable regulations (particularly those pertaining to health and safety and fire safety).
- Use strong boxes. Flimsy boxes tend to be cheap, which is certainly a point in their favors, however they also have a tendency to collapse, tear or burst either when being moved or over a long period of storage. The consequences of this caninclude loss or damage to documents. More typically, they sag and collapse when stored in stacks over a long period, with the result that the contents have to be re boxed in sturdier boxes – a lab our and materials expense that could have been avoided.
- Do not over fill boxes. When filling up an archive box with documents and files, it is always tempting to try to jam as much in as possible and then shove the lid on. The result is usually an unsightly bulge at the top. This can be ignored of course – up to the point when you try to stack the boxes. You then find that the stacks are horribly unstable because the surfaces of the boxes on which each box stands are not flat. It is also important not to under fill boxes – unless they are of particularly strong build – since the unfilled (and therefore unsupported) top section of each box may collapse under the weight of the boxes stacked above it.

- CATALOG this article provides guidelines on managing architectural drawings, to help non-specialist archivists who have responsibility for these ‘non-traditional’ archives. The article gives advice on appraisal, sorting and cataloguing of drawings, based on the experience of a number of specialists working in dedicated architecturalarchives in the UK and abroad. Useful cataloguing terms are provided and defined, including expressions used to describe the purpose of specific kinds of drawing. The article is illustrated by three case studies, demonstrating appropriate levels of cataloguing for different types of drawing. Reference is also made to British and international cataloguing standards. Future collecting is considered too, specifically the collecting of architectural records in electronic formats.

Self-Check -2	Multiple Choice

Test I: Multiple Choice Questions

Directions: Choose the correct Answer (each question have **2.pts**)

Directions: Answer all the questions listed below. Use the Answer sheet provided in the

1. The method of folding prints depends upon:
   A. the type of the filling cabinet
   B. the size of the filling cabinet
   C. the location of the identifying marks on the prints.
   D. None

2. Which of the following rules are important for keeping drawing?
   A. Do not allow prints to become wet or smudged with oil or grease
   B. Keep prints out of strong sunlight; they fade
   C. Do not make pencil or crayon notations on a print without proper authority
   D. Keep prints stored in their proper place
   E. All

Note: Satisfactory rating –1points and above **Unsatisfactory – below 0points**

List of Reference Materials

BOOKS

- Machine drawing, therd edition,DR.KL.Narayana, Dr. M.A. Veluswami
- Text book of engineering drawing,K.VENKATA Reddy,second edition,BS.Pabilication
- KHURMI R S AND GUPTA J. K (1979). A Text Book of Machine Design. ISN 81-219-0501-x, Published by Scand and Company ltd