Foundary Works

Level-II

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Acronyms

TTLM	Teaching training learning materials
ISO	International standard organization
LAP Test	learning activity performance test
TVT	Technical and vocational training

Introduction to the Module

In the field of foundry, Engineering drawing is a two dimensional representation of three dimensional objects. In general, it provides necessary information about the shape, size, surface quality, material, manufacturing process, etc. of the object. It is the graphic language from which a trained person can visualize objects.

An engineering drawing is a subcategory of technical drawings. The purpose is to convey all the information necessary for manufacturing a product or a part. Engineering drawings use standardized language and symbols. This makes understanding the drawings simple with little to no personal interpretation possibilities.

This module is designed to meet the industry requirement under the **Foundry Works Level II** occupational standard, particularly for the unit of competency: **Basic engineering detail drawings.**

This module covers the units:

- Concepts of drawing requirements.
- Produce detail drawing
- Engineering parts lists
- Complete drawing task

Learning Objective of the Module

- Determine concepts of drawing requirements.
- Produce detail drawing
- Prepare engineering parts lists
- Complete drawing task

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and

5. Read the identified reference book to get more knowledge and to-do.

Unit One: Concepts of Drawing Requirements

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Scope of drawing
- Project/work Requirement
- Drawing Equipment
- Examine drawing requirements for presentation
- Communication Requirements of drawing.

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

- Check scope and information requirements for drawing
- Interpret available information relevant to project requirements
- Prepare equipment required to complete work
- Examine requirements for presentation of drawings
- Confirm communication requirements during project work

1.1 Scope and Definition of Drawing

Engineering drawing is an international language; meaning that any drawing can be interpreted by professionals globally, Students desiring professions in the area of engineering, architectural, surveying and manufacturing should learn engineering Drawing. To provide visual guidelines as how to construct a product or structure. Therefore the trainees will also learn to create and analyze before the completion of their drawing. They are motivated to become critical thinkers, planners and evaluators of their own work. Engineering Drawing encourages, teamwork, communication, use to established methods with the field and those applied in problems solving. It boosts the self-esteem of Trainees after they have seen their finish work.

1.2. Project/Work Requirement

1.2.1. Representation and visualization

An artifact or system can be represented in a variety of ways. Engineering drawing is but one of the ways.

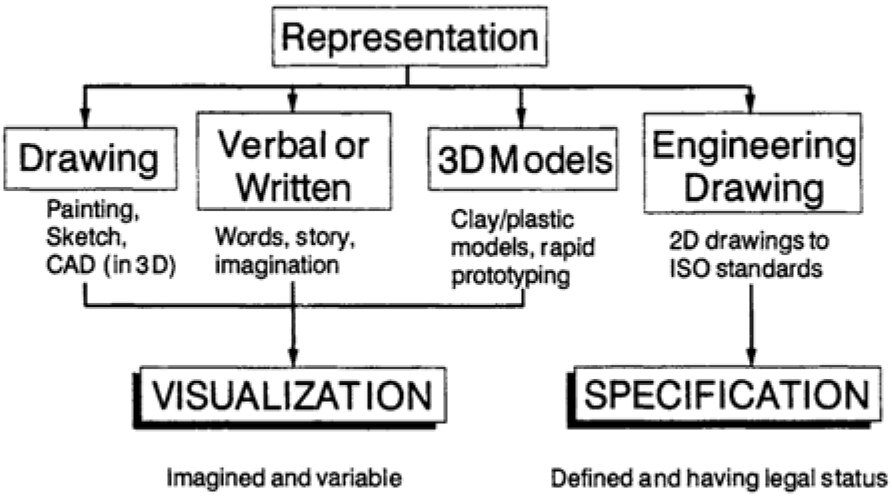


Figure 1. 1 Engineering drawing representation

The above figure shows some of the ways that products or systems can be represented. Verbal or written instructions take the form of words describing something. If the words take the form of a set of instructions for doing something, they are ideal. If the words are used to tell a story, then they can paint beautiful pictures in the imagination.

1.2.2 Representation and Specification of Drawing

Engineering drawing was the equivalent of a language. A language has to have a set of rules and regulations for it to operate correctly. There are two basic rules. The first is the word order that gives information on subject and object. The second is spelling, which gives information on the words themselves in terms of the spelling, i.e. the nouns, verbs, etc. Previously, the phrase described a perfectly feasible situation whereas it now describes an impossible situation. Thus, the word order gives information on which is the subject and which is the object. In engineering drawing, there are similarly two sets of rules. The second is concerning how the individual views are drawn using different line thicknesses and line types, which is the equivalent of a spelling within each individual word. The first set are the 'drawing layout rules', which define information concerning the projection method used and therefore the arrangement of the individual views and also the methodology concerning sections.

The second set of rules is the 'manufacturing rules', which show how to produce and assemble an artifact. This will be in terms of the size, shape, dimensions, tolerances and surface finish. The drawing layout rules and the manufacturing rules will together make a legal specification that is binding. Both sets of rules are defined by ISO standards. When a contractor uses these two sets of rules to give information to a subcontractor on how to make something, each party is able to operate because of the underpinning provided by ISO standards.

1.2.3 Requirements of Engineering Drawings

Engineering drawings need to communicate information that is legally binding by providing a specification. Engineering drawings therefore need to meet the following requirements:

Engineering drawings should be unambiguous and clear. For any part of a component there must be only one interpretation. If there is more than one interpretation or indeed there is doubt or fuzziness within the one interpretation, the drawing is incomplete because it will not be a true specification.

The drawing must be complete. The content of an engineering drawing must provide all the information for that stage of its manufacture. There may be several drawings for several phases of manufacture, e.g. raw shape, bent shape and heat-treated. Although each drawing should be complete in its own right, it may rely on other drawings for complete specification, e.g. detailed drawings and assembly drawings.

The drawing must be suitable for duplication. A drawing is a specification which needs to be communicated. The information may be communicated electronically or in a hard copy format. The drawing needs to be of a suitable scale for duplicating and of a sufficient scale such that if is micro-copied it can be suitable magnified without loss of quality.

Drawings must be language-independent. Engineering drawings should not be dependent on any language. Words on a drawing should only be used within the title block or where information of a non-graphical form needs to be given. Thus, there is a trend within ISO to use symbol in place of words.

Drawings need to conform to standards. The 'highest' standards are the ISO ones that are applicable worldwide. Alternatively standards applicable within countries may be used. Company standards are often produced for very specific industries.1

1.3 Equipment Required Completing Work

1.3.1 Description of drawing instruments and materials.

Drawing Table/Board

This has different dimensions that depend on the needs of a drafter. This should be a perfectly smooth flat board of soft wood or metal are made in such a way that it cannot warp or split. All angles should be perfectly true and smooth. The drawing board should be smooth and free from any hard particle.

Figure 1. 2 Drawing Table/Board

T-Square is especially useful when constructing accurate orthographic drawings or architectural drawings. A T-Square is normally used with a drawing board, set squares and clips. The common parts of a T-square are the head and the blade. The common materials to produce T-square are wood, plastic and metal. The substitute of a T-square is a slider which is shown on the figure upper right.

Figure 1. 3 T-Square

Parallel bar this bar will slides up and down the board to allow you to draw horizontal lines. Vertical lines and angles are made with triangles in conjunction with the parallel bar. The parallel bar is commonly found in architectural drafting offices because architectural drawings are frequently very large. Architects often need to draw straight lines the full length of their boards and the parallel bar is ideal for such lines.

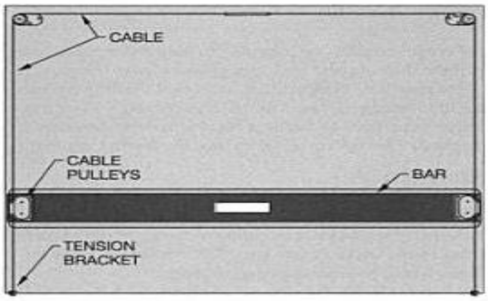


Figure 1. 4 Parallel bar

Set Squares The most common are 45 by 45 degrees and 60 by 30 degrees. When using set squares they should always used along with a T-Square. The Set-square rest on the straight edge of the T-Square and this ensures when the angle is drawn that it is accurate. Please see figure above.

Scale The architectural draftsman's scale is made in various lengths, but 12 -inch triangular scale will be found best for student use. This has in one face the normal full size division of the foot. The scale at which the drawing is to be made may depend upon three things: first the size of the paper on which the draftsman wishes to work; second the size of the building or detail to be drawn; third, the amount of detail that is desirable to show in the drawing.

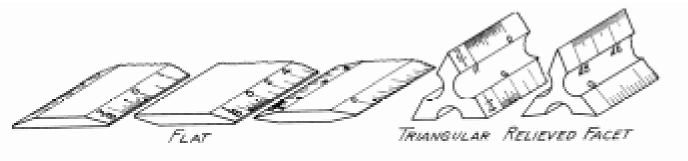


Figure 1. 5 Scales

A ruler is possibly one of the most important pieces of drawing equipment. Be remembered that the edge of a ruler is not guaranteed to have a perfectly straight edge unlike a good T-Square or set square. The recommended material for a ruler is a plastic but for cutting purpose, it is advisable to use a metal ruler. Recommended maximum dimension of a ruler is 12 inches and it is commonly known as one foot ruler.

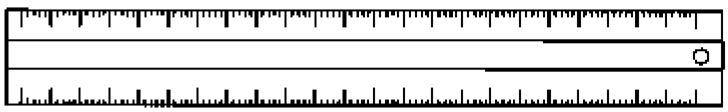


Figure 1. 6 Ruler

Paper sizes the rolls vary in width from 36 to 54 inches and contain a measurement from 10 to 50 yards. A 36 inch roll may be cut without waste into sheets 36 by 26, 26 by 18, 18 by 13, 13 by 9 by 6 1/2 inches.

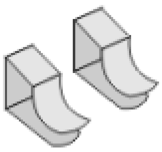
Table 1. 1 Paper sizes

SIZE (MILLIMETERS)			LETTER SIZE
WIDTH		LENGTH	
210	x	297	A4
297	x	420	A3
420	x	594	A2
594	x	841	A1
841	x	1189	A0

Tracing paper is a thin white transparent paper for general use where one drawing is to be made over another. But if ink was applied then you cannot use again. This material is recommended to use in preparation of plans and specifications.

Figure 1. 7 Tracing paper

Board clips they simply clip on to the board holding the paper firmly against the drawing board. You can choose either plastic or metal clips. Figure below shows the importance of a board clips.



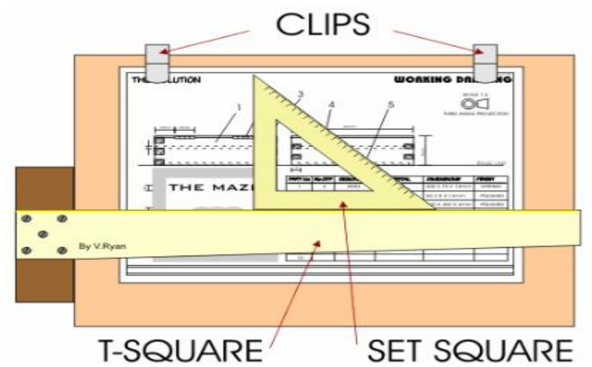


Figure 1. 8 Board clips

Drawing Pencils are a basic requirement of any graphics course. You need a number ranging from 2B to 2H. These letters refer to the hardness of the pencil lead. When sketching a soft lead such as 2B is can be used to produce quick drawings and shading.

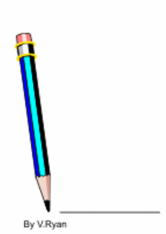


Figure 1. 9 Drawing Pencils

A refillable pencil is very convenient to use if you are constructing a drawing that needs a constant thickness of line. The refills are available in a range of thicknesses and either hard or soft leads. Disadvantages are that the refillable pencils are relatively expensive and so are the refills. Also, the leads tend to break more easily.

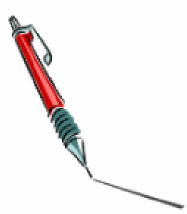


Figure 1. 10 Refillable pencil

Ink fountain pens often the pens can be bought with a variety of ‘nibs’ as a set. These can be used to draw / write in a vast range of styles. This type of writing is called ‘Calligraphy’. Ink pens are rarely used now as word processing software can be used to produce accurate styles of writing in a range of fonts.

Figure 1. 11 Ink fountain pens

A fine pen (color - normally black) produce accurate lines. Fine pens are available with various thicknesses of 'tips'.

Figure 1. 12 Fine pen

Eraser is a soft and consumable material. There are two kinds of it, an eraser for pencil and an eraser for ink pen.

Figure 1. 13 Eraser

Circle templates they are plastic with a number of accurate circles cut out. Small circles are difficult to draw using a traditional compass because the compass can easily slip on the paper. With a template, the circle diameter is selected and a sharp pencil is used to draw round the cutout circle. If this material is being used properly can produce precision on making circles but it is limited only for small diameter.

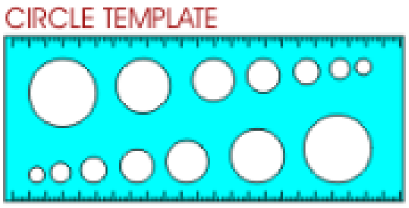


Figure 1. 14 Circle templates

Ellipse templates the description is similar to circle templates and this material can produce precise outcome for drawing ellipse / oval shapes accurately.

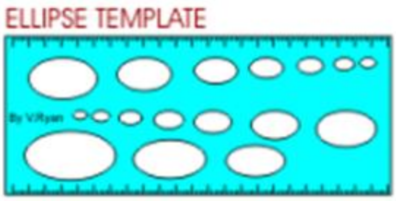


Figure 1. 15 Ellipse templates

French Curves are purchased in sets of three or four. These can be used in the same way as circle or ellipse templates. This will create an irregular curve shape.

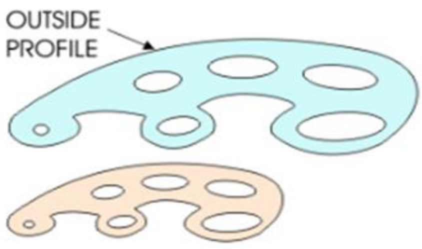


Figure 1. 16 French Curves

A compass is an absolute essential piece of equipment. It is well worth buying a good set which includes at least two compasses allowing the drawing of small and large circles. The drawing opposite is a 'bow' compass. This is very effective in making big diameter of a circle and curves.

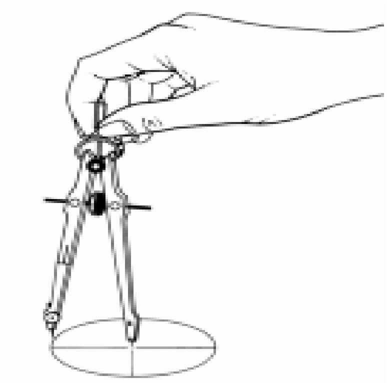
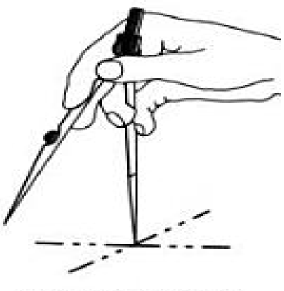


Figure 1. 17 Compass

Divider is looks like a compass but it differs with its uses. Both ends are pointed, not like a compass the other end has an attachment of a lead pencil.



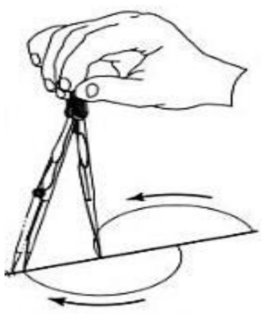


Figure 1. 18 Divider

Compass Adapter is an attachment of a compass and effective for inking process.

Figure 1. 19 Compass Adapter

A protractor is a typical protractor, a semi-circular piece of plastic with 180 degrees printed around its curve. This instrument is not advisable to draw curves. The purpose of these instruments is for determining angles only.

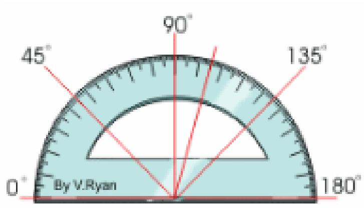


Figure 1. 20 A protractor

1.4 Examine requirements for presentation of drawings

1.4.1 Using measuring instruments

Measuring tools are instruments used to determine lengths and angles. They follow two systems. They are the US customary system and the International System (SI), commonly referred to as metric. US customary rulers and scales measure feet and inches. Smaller units are measured in fractions of an inch.

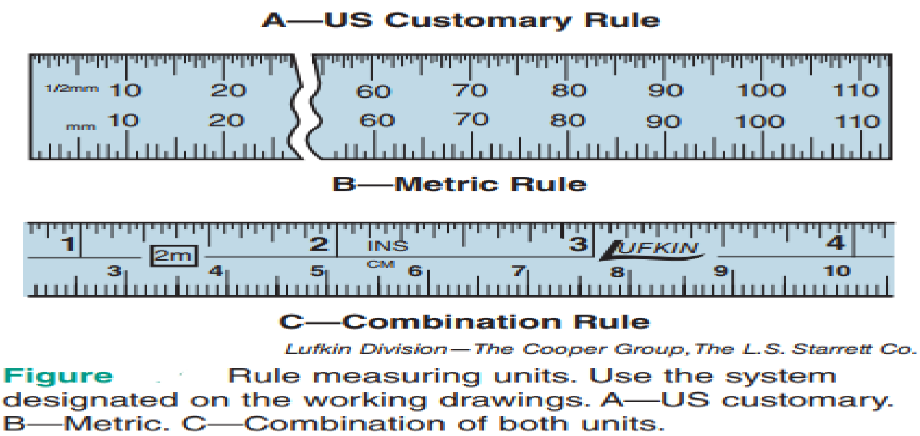


Figure 1. 21 Standard measuring instruments

Used to measuring the following instruments needed

- T-Square
- Set Squares
- Scale
- Protractor
- Divider
- Protractor

1.5. Communication Requirements of drawing

1.5.1 Communication skills

Communication: It is the process of

conveying feelings/ Information from:

One place to the other place or one person to the other person Communication is the main thing which separates the human beings from other living being

Figure 1. 22 Ways of communication

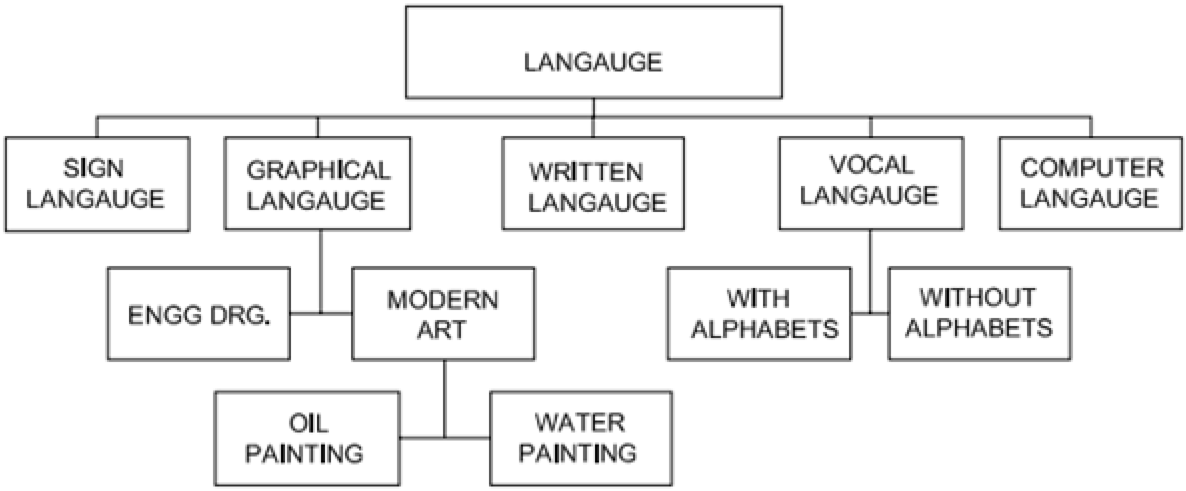


Figure 1. 23 Paths of communication

Limitations of sign language Information/feelings cannot be conveyed effectively Chances of misunderstanding the information / feelings both the communicator and the receiver to be present at the same place

Limitations of graphical language

Information /feelings can be conveyed effectively but still there are chances for imagination (communication gap) Viewer may image anything in his mind due to the absence of written language. Engineering drawing is a graphical language which also uses written language for effective communication.

Technical drawings allow efficient communication among engineers and can be kept as a record of the planning process. Since a picture is worth a thousand words, a technical drawing is a much more effective tool for engineers than a written plan. The technical drawing, on the other hand is not subtle, or abstract. It does not require an understanding of its creator, only on understanding of technical drawings. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specification.

1.5.2 Establishing relevant personnel.

The trainee will be tested for his skill, knowledge and attitude during the period of the unit of competence and at the end of the training program as notified by the collage registrar. Then, relevant personnel are instructor itself. By apply professional knowledge, core skills & performing the work. Assessment will be conducted using assessment criteria.

1.5.2.1 Relevant personnel May include, but is not limited to:

- Supervisor
- Technical personnel
- Manufacturers
- Definition of Supervision
- Suppliers
- Contractors
- Customers

"Supervision is getting the job done through others."

This classic definition of **supervision** states the relationship between supervisors, subordinates, and work. However, it doesn't explain how to be a delegator, a decision maker,

a coach, an instructor, a motivator, or most importantly, a leader. The skills of good supervision are new to most people when they are asked to lead for the first time. To be successful as a leader, the new supervisor needs to consider three broad areas:
Administrative:

The new supervisor is accountable for many organizational procedures that subordinates don't have to consider. These include daily reports, monitoring time and attendance, budgeting, work orders, transmitting management directives and bulletins, and a host of other types of information.

Technical:

New supervisors have demonstrated their proficiency in technical skills in order to be promoted to supervision. However, as a leader becomes more involved in supervision, the amount of time available for doing technical tasks decreases and the amount of time spent helping others increases. Supervisors eventually find themselves helping people with tasks that they themselves have never done.

Interpersonal:

Becoming an effective supervisor involves learning a whole set of leadership skills. Prior training both on the job and in school probably hasn't covered the interpersonal skills of leadership. New supervisors need to look to role models and mentors for tips on leadership behaviors. They also need to examine their own personal styles and consider the changes they need to make for their own growth and development. As an exercise in defining supervision, think about all the different tasks that are part of the supervisor's job. Make a list of these tasks on the next page and discuss them with your manager. Ask if you will actually be evaluated on how well or poorly you perform each task.

Supervisory Duties:

Planning and Organizing:

- Lay out the work and decide how to handle it.
- Processing the Work:
- Assign the work and supply what your employees need to get the job done.
- Controlling the Operation:

- Keep the work up to standards and check on costs and materials.
- Administering Rules:
- See that conduct and procedures are done according to the rules.
- Keeping People Informed:
- Talk with and listen to staff - up and down the line.
- Making Improvements:
- Find better ways for doing the work and solve job problems.
- Handling Personnel Matters:
- Administer leave time, benefits, pay, change of jobs, overtime, and other personnel functions.
- Training and Development:
- Break in new people, build morale, plan replacements.
- Monitoring Safety and Security:

Prevent trouble. Deal with accidents and illnesses. Safeguard equipment and supplies. Serving as Representative: Act for the group or the organization as required."

1.5.3 Manufacturers /Manufacturing Drawings/

Manufacturing drawings communicate engineers' ideas in a clear way and inform machine operators and production workers how a certain product is manufactured and assembled. They're greatly important in the production process, but, due to their highly detailed nature, they require a lot of time and attention. Because of this, many engineers and entrepreneurs take advantage of the manufacturing drawing services we offer here at Cad Crowd. Our freelancers are experts in this type of illustrative material and can assist you in creating informative manufacturing drawings that comply with international standards.

Self-Check – One

Part I - Choose the best answer.

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

1, which of not included about required for drawing.

A, Scales B, Protractor C, Drawing pencils D, wood pattern

2. ________ is a specialized ruler designed to facilitate the drafting and measuring of architectural drawings, such as floor plans and orthographic projections

A, protractor B, architect's scale C, Drafting Pencils

3.,________ is a graphical language which also uses written language for effective communication.

A, engineering drawing B, language C - none

Part II - True / False

Directions: Say True / False answer for the given question

1. T-Square is a technical drawing instrument used by draftsperson & It is first used to align the drafting paper on the drafting board or table

   A, true B, false

2. Engineering drawing hasn't a set of rules and regulations for it to operate correctly

   A, true B false

3. Technical is New supervisors have demonstrated their proficiency in technical skills in order to be promoted to supervision

   A, true B false

Part III – write Short answer

Directions - Give short answer to the following questions

1. What are the definitions of engineering drawing?

2. List down the basic requirements of engineering drawings?
3. Explain purpose of 3 or more drawing instrument must be needed engineering drawing?

Operation Sheet 1	**Communication Skills**

The techniques for identifying key information about communication skills;

3 key steps how to improve your communication skills

Step 1 -listen intently using your ears, hearing what the, person is saying, get a sense of What they are feeling

Step 2 -respond with phrases that relate to what that person is talking about .that is true b/c

Step 3- tell stories. Situation, action, results

Lap test	Communication skills

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8-12 hours.

Task 1: Identify key information about communication skills

Unit Two: Produce Detail Drawing

This unit to provide you the necessary information regarding the following content coverage and topics:

- Orthogonal plane
- Drawing conventions
- Drawing techniques
- Industry standards and symbols.

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

- Prepare drawings in orthogonal plane
- Require method of standard drawing conventions,
- Use drawing techniques according to work requirements
- Ensure industry standards and symbols

2.1 Orthogonal Plane

2.1.1 Definitions

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. Any medium that uses a graphic image to aid in conveying a message, instructions, or an idea is involved in graphic communication. One of the most widely used forms of graphic communication is the drawing. Technically, it can be defined as “a graphic representation of an idea, a concept or an entity which actually or potentially exists in life. Drawing is one of the oldest forms of communicating, dating back even farther than verbal communication. The drawing itself is a way of communicating all necessary information about an abstract, such as an idea or concept or a graphic representation of some real entity, such as a machine part, house or tools.

There are two basic types of drawings: Artistic and Technical drawings.

Artistic Drawings

Artistic Drawings range in scope from the simplest line drawing to the most famous paintings. Regardless of their complexity, artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist. In order to understand an artistic drawing, it is sometimes necessary to first understand the artist. Artists often take a subtle or abstract approach in communicating through their drawings, which in turn gives rise to various interpretations.

Technical Drawings

The technical drawing, on the other hand, is not subtle, or abstract. It does not require an understanding of its creator, only an understanding of technical drawings. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications.

2.1.2 Preparation of drawing

A. Types of Technical Drawings Technical drawings are based on the fundamental principles of projections. A projection is a drawing or representation of an entity on an imaginary plane or planes. This projection planes serves the same purpose in technical drawing as is served by the movie screen. A projection involves four components

- The actual object that the drawing or projection represents
- The eye of the viewer looking at the object
- The imaginary projection plane
- Imaginary lines of sight called Projectors

There are two broad types of projections, both with several sub classifications, are *parallel projection* and *perspective projection*.

Parallel Projection

Parallel Projection is a type of projection where the line of sight or projectors are parallel and are perpendicular to the picture planes. It is subdivided in to the following three categories: Orthographic, Oblique and Axonometric Projections.

Orthographic projections: are drawn as multi view drawings, which show flat representations of principal views of the subject.

Oblique Projections: actually show the full size of one view.

Axonometric Projections: are three-dimensional drawings, and are of three different varieties: Isometric, Diametric and Trimetric. Orthographic Oblique drawing Axonometric drawing

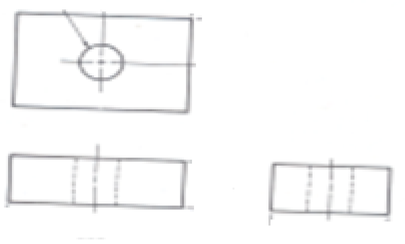


Table 2. 1 Orthogonal multi view drawing

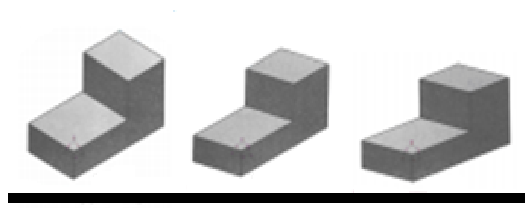


Table 2. 3 Oblique drawing

Table 2. 2 Axonometric drawing

Perspective Projection

Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object. There are three types of perspective projections: One point, Two-point and Three-point Projections.

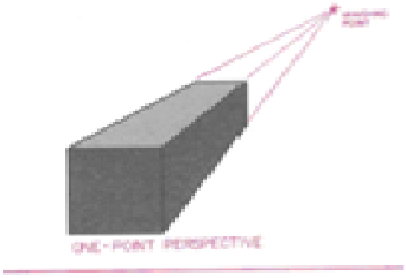


Table 2. 4 One point perspective drawing

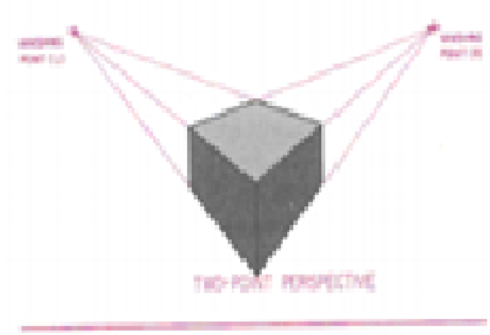


Table 2. 5 Two point perspective drawing

2.2. Drawing conventions

2.2.1 Introduction

Engineering drawings are to be prepared on standard size drawing sheets. The correct shape and size of the object can be visualized from the understanding of not only the views of it but also from the various types of lines used, dimensions, notes, scale, etc. To provide the correct information about the drawings to all the trainee, the drawings must be prepared, as the following certain standard practices.

2.2.2 Drafting principles to be applied in the preparation of drawing

Drawing sheet

Engineering drawings are prepared on drawing sheets of standard sizes.

Sheet size

Table 2. 6Drawing paper size

Designation	*Dimensions* (mm)
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297

For this Module, we use 210mm X 297mm sized paper or A4 for the assignments or class works. We have the following elements to be noticed over the format of our drawing paper:

- **Border line**: it is the peripheral heaviest lines which enclose all drawings.

- **Title Block**: It is a box where all information about the drawing such as drawn by, checked by, date, scale, title of drawing, drawing number and company name are specified.
- **Guide line**: is the lightest line used to guide the height of alphabets.
- **Thickness and types of lines**: Two thicknesses of lines are used in drawing practice. The ratio of the thick to thin line should not be less than 2:1. The thickness of lines should be chosen according to the size and types of lines depends up on type of the drawing from the drawing rang
- **Scale;** is the ratio of the linear dimension of an element of an object as represented in the drawing, to the real linear dimension of the same element of the object itself.
- **Drawing Space**: is an international standard used to all over the world

2.2.3 Use of correct sectioning technique

Ground rules for selection of views

Right hand side view should be used in preference to a left side view and a top view in preference to a bottom view.

Place the object to obtain the smallest number of hidden lines. When both views of an equal numbers of hidden lines exist, the right side view will be traditionally selected.

Precedence of lines

The following listed lines are the various types conventionally used over the world now a day;

Visible Lines – solid thick lines that represent visible edges or contours

Hidden Lines – short evenly spaced dashes that depict hidden features

- **Section Lines** – solid thin lines that indicate cut surfaces
- **Center Lines** – alternating long and short dashes

Dimensioning

Dimension Lines - solid thin lines showing dimension extent/direction

Extension Lines - solid thin lines showing point or line to which dimension applies

Leaders – direct notes, dimensions, symbols, part numbers, etc. to features on drawing

Cutting-Plane and Viewing-Plane Lines – indicate location of cutting planes for sectional views and the viewing position for removed partial views

Break Lines – indicate only portion of object is drawn. May be random "squiggled" line or thin dashes joined by zigzags.

Phantom Lines – long thin dashes separated by pairs of short dashes indicate alternate positions of moving parts, adjacent position of related parts and repeated detail

Chain Line – Lines or surfaces with special requirements

2.2.4 Identification of cutting plane

Cutting Plane

Section views show how an object would look if a cutting plane (or saw) cut through the object and the material in front of the cutting plane was discarded

Representation of cutting plane

According to drawing standards cutting plane is represented by chain line with alternate long dash and dot. The two ends of the line should be thick.

Full Section View

In a full section view, the cutting plane cuts across the entire object

Note that hidden lines become visible in a section view

Hatching

on sections and sectional views solid area should be hatched to indicate this fact. Hatching is drawn with a thin continuous line, equally spaced (preferably about 4mm apart, though never less than 1 mm) and preferably at an angle of 45 degrees.

(i) Hatching a single object

when you are hatching an object, but the objects has areas that are separated. All areas of the object should be hatched in the same direction and with the same spacing.

(ii) Hatching Adjacent objects

when hatching assembled parts, the direction of the hatching should ideally be reversed on adjacent parts. If more than two parts are adjacent, then the hatching should be staggered to emphasize the fact that these parts are separate.

2.2.5 Accurate line types

Lines

Lines of different types and thicknesses are used for graphical representation of objects. The types of lines and their applications are shown in below.

Table 2. 7 Types of lines and thickness

Line	*Description*	*General Applications*
A	Continuous thick	A1 Visible outlines
B	Continuous thin (straight or curved)	B1 Imaginary lines of intersection B2 Dimension lines B3 Projection lines B4 Leader lines B5 Hatching lines B6 Outlines of revolved sections in place B7 Short centre lines
C	Continuous thin, free-hand	C1 Limits of partial or interrupted views and sections, if the limit is not a chain thin
D	Continuous thin (straight) with zigzags	D1 Line (see Fig. 2.5)
E	Dashed thick	E1 Hidden outlines
G	Chain thin	G1 Centre lines G2 Lines of symmetry G3 Trajectories
H	Chain thin, thick at ends and changes of direction	H1 Cutting planes
J	Chain thick	J1 Indication of lines or surfaces to which a special requirement applies
K	Chain thin, double-dashed	K1 Outlines of adjacent parts K2 Alternative and extreme positions of movable parts K3 Centroidal lines

Thickness of lines

Two thicknesses of lines are used in drawing practice. The ratio of the thick to thin line should not be less than 2:1. The thickness of lines should be chosen according to the size and type of the drawing from the following range:0.18, 0.25, 0.35, 0.5, 0.7, 1, 1.4 and 2

It is recommended that the space between two parallel lines, including hatching, should never be less than 0.7 mm.

A visible line takes precedence over all other lines

0.70 mm

Hidden lines and cutting plane lines take precedence over center lines

0.35 mm

Center lines have lowest precedence

0.35 mm

2.2.6 Appropriate view positions

Method of projection

There are two types of projection methods in use today. These are:

- Third-angle projection is used in the United States, Canada, and in many other countries.
- First-angle projection is used mainly in Europe.

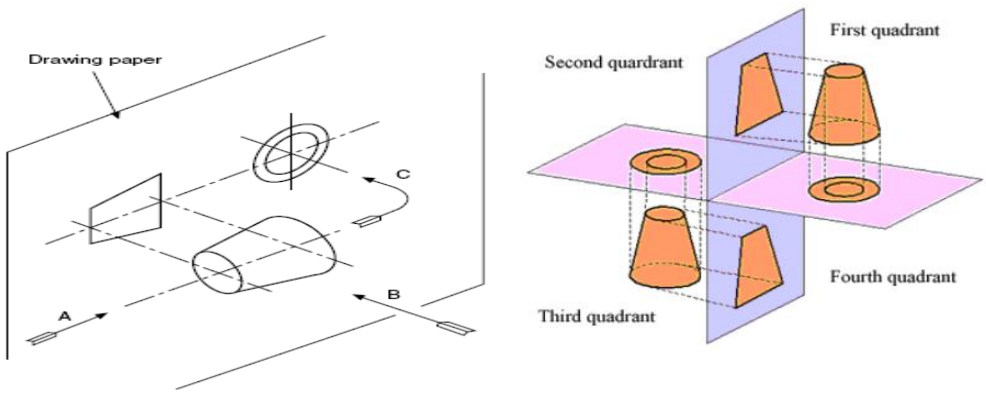


Table 2. 8 First angle projection

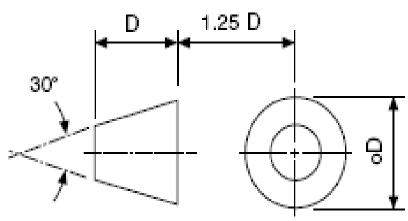


Table 2. 9 - Third angle projection

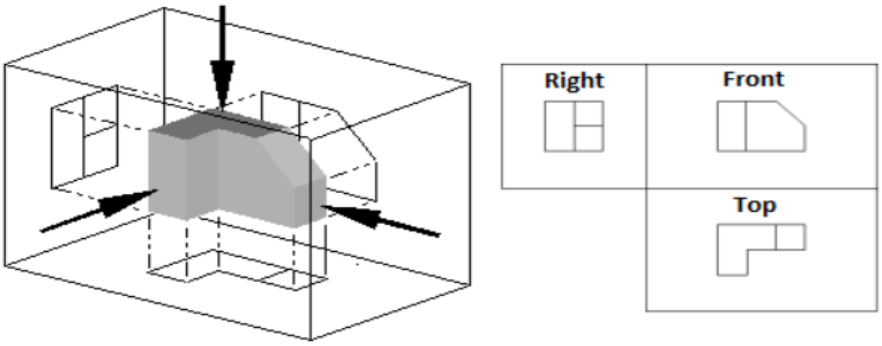


Table 2. 10 Symbolic representation for the third angle projection

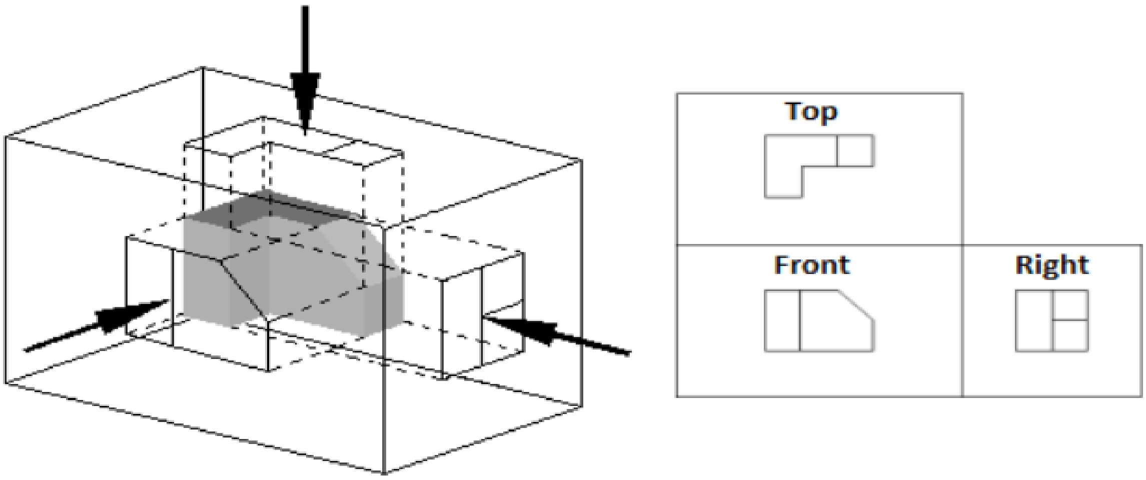


Table 2. 11Symbolic representation of third angle orthographic projection

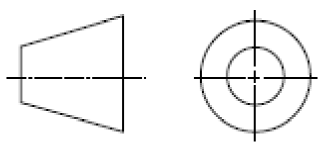
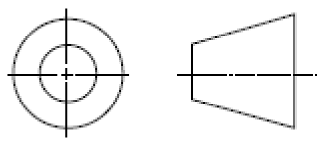
FIRST ANGLE PROJECTION	THIRD ANGLE PROJECTION
R.S.V F.V L.S.V T.V	T.V L.S.V F.V R.S.V
	

Table 2. 12 Comparison between 1st and 3rd angle projection

Orthographic projection:

Is a system of views of an object formed by projectors from the object perpendicular to the desired planes of projection.

Here we have three principal projection planes. That is to say:

- Horizontal projection plane (H)
- Frontal projection plane (F)
- Profile projection plane (P)

For example:

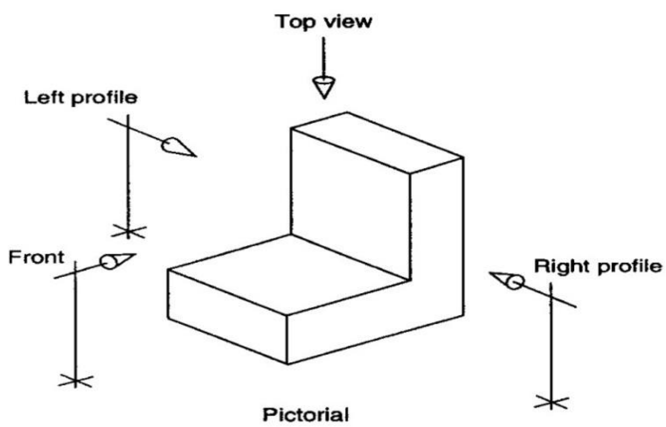


Table 2. 13 Orthographic projection

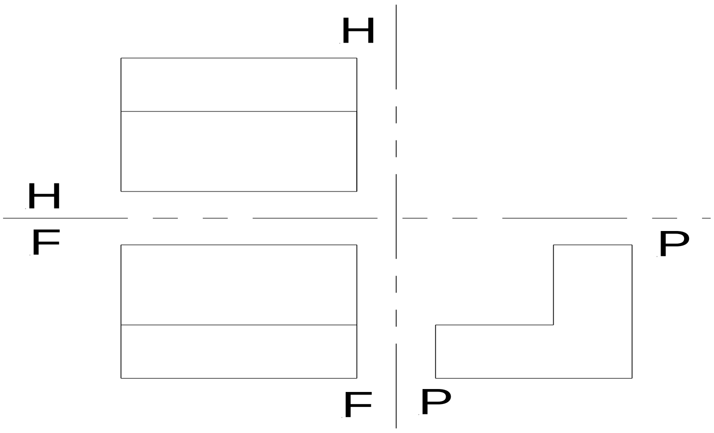


Table 2. 14 Orthographic projection (Multi-view drawing)

Choice & layout of views

Six principal views can be obtained for any object by using the principles of multi view drawing or orthographic projection which are the maximum views. Width dimension remains the same for top, front and bottom views. Whereas height is common for right side, front, left-side, and rear views.

Only views that are necessary for a clear and complete description should be selected. Because the repetition of information may tends to confuse the reader. So that, it is important to have a set of views that describe an object clearly.

Technical drawings usually include only the front, top and right side orthographic views because together they are considered sufficient to completely define an object's shape

2.2.7 Use of correct symbols

Symbols

Permit consistency in the way dimensions and tolerances are specified, and each symbol has a clearly defined meaning. Symbols take less time to apply on a drawing than would be required to state the same requirements with words. The symbols also require considerably less space.

The symbols are presented in two groups for easier use of this section as a reference. General dimensioning symbols are shown first. Some of these symbols are also used in tolerance specifications. The second sets of symbols are used for tolerances.

2.2.8 Use technique of the correct dimensioning

Dimensioning

A drawing of a component, in addition to providing complete shape description, must also furnish information regarding the size description. These are provided through the distances between the surfaces, location of holes, nature of surface finish, type of material, etc. The expression of these features on a drawing, using lines, symbols, figures and notes is called dimensioning.

General principle

Dimension is a numerical value expressed in appropriate units of measurement and indicated on drawings, using lines, symbols, notes, etc., so that all features are completely defined.

1. be placed outside As far as possible, dimensions should the view.
2. Dimensions should be taken from visible outlines rather than from hidden lines.
3. Dimensioning to a center line should be avoided except when the center line passes through the center of a hole.
4. Each feature should be dimensioned once only on a drawing.
5. Dimensions should be placed on the view or section that relates most clearly to the corresponding features.
6. Each drawing should use the same unit for all dimensions, but without showing the unit symbol.
7. No more dimensions than are necessary to define a part should be shown on a drawing.
8. No features of a part should be defined by more than one dimension in any one direction

Provision of a suitable number of views

Types of views

- Front View (FV) –Projected on VP
- Top View (TV) –Projected on HP
- Side View (SV) –Projected on PP

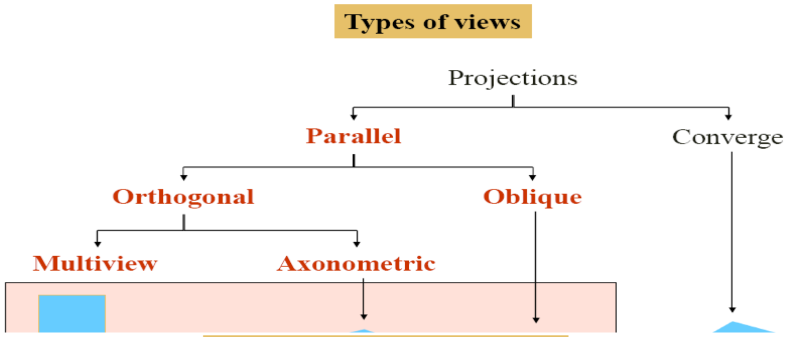
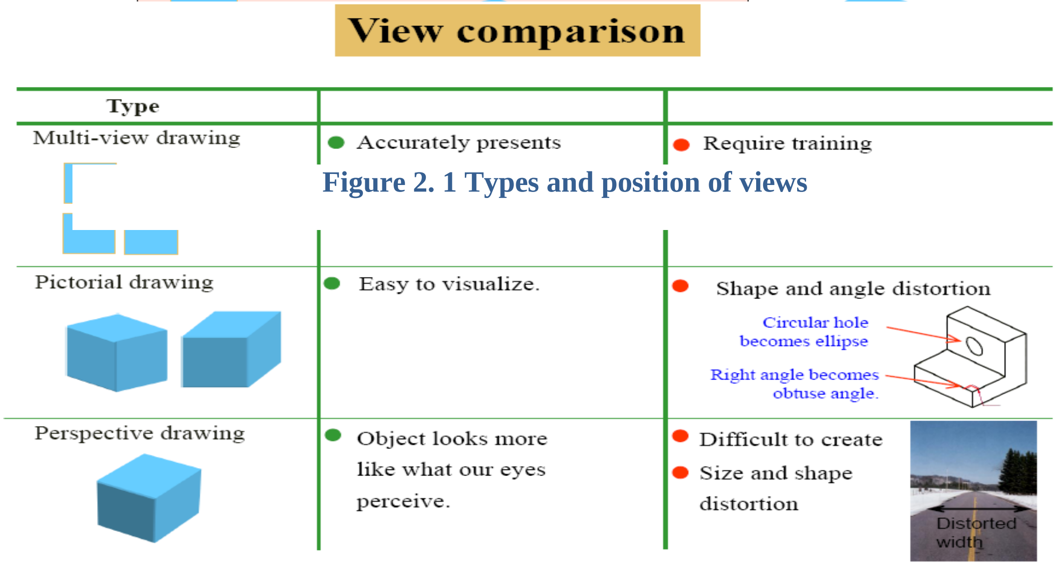


Figure 2. 1 Types and position of views



View comparison

Type		
Multi-view drawing	Accurately presents	Require training
Pictorial drawing	Easy to visualize.	Shape and angle distortion Circular hole becomes ellipse Right angle becomes obtuse angle.
Perspective drawing	Object looks more like what our eyes perceive.	Difficult to create Size and shape distortion Distorted width

Table 2. 15 View comparison

: There are three principal projection planes. That is to say

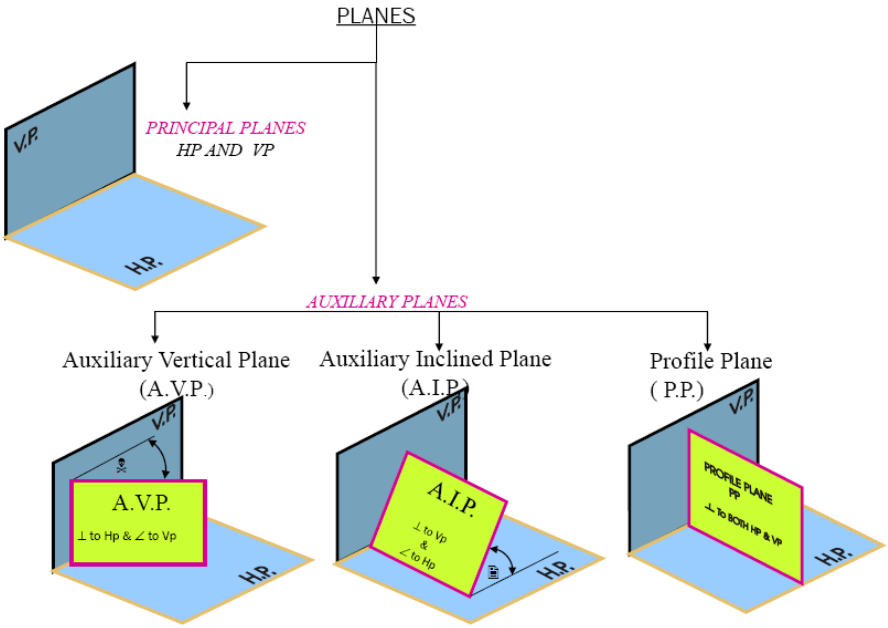


Table 2. 16 Pattern of Planes and Views (First angle Projection)

Orthographic projection could be defined as any single projection made by dropping perpendiculars to a plane. In short, orthographic projection is the method of representing the exact shape of an object by dropping perpendiculars from two or more sides of the object to planes, generally at right angles to each other; collectively, the views on these planes describe the object completely.

Descriptive geometry is basically the use of orthographic projection in order to solve for advanced technical data involving the spatial relationship of points, lines, planes, and solid shapes. The most common means of understanding these types of orthographic projection is The Glass Box method.

The Glass Box method,

Primarily for descriptive geometry problems, requires that the user imagine that the object, points, lines, planes etc are enclosed in a transparent "box". Each view of the object is established on its corresponding glass box surface by means of perpendicular projectors originating at each point of the object and extending to the related box surface. The box is hinged so that it can be unfolded on to one flat plane (the paper

The Six Principal Views

Let us surround the object entirely by asset of six planes, each at fight angles to each other. On these planes, views of the object can be obtained as is seen from the top, front, and right side, left side, bottom and rear. Think now of the six sides, or the plane of the paper. The front is already in the plane of the paper, and the other sides are, as it were, hinged and rotated in position as shown..

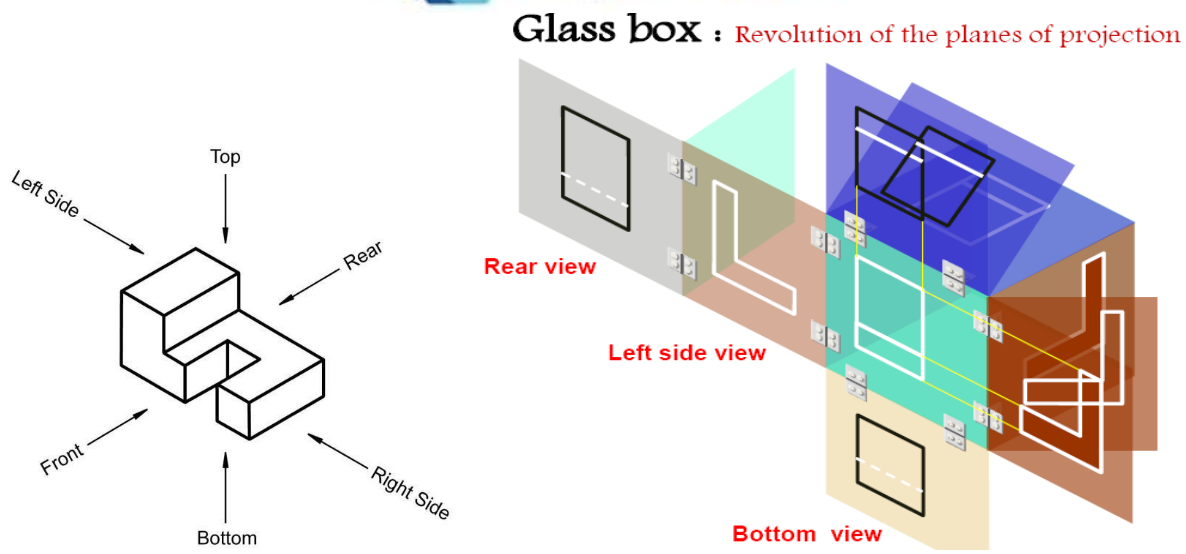


Table 2. 17 Glass box approch in six principal views

The projection on the frontal plane is the front view vertical projection, or front elevation, that on the horizontal plane, the top view, horizontal projection, or plan, that on the side, profile view, side view, profile projection, or side elevation. By reversing the direction of sight, a bottom view is obtained instead of a top view, or a rear view instead of a front view.

The 6 principal views are created by looking at the object, straight on, in the directions indicated

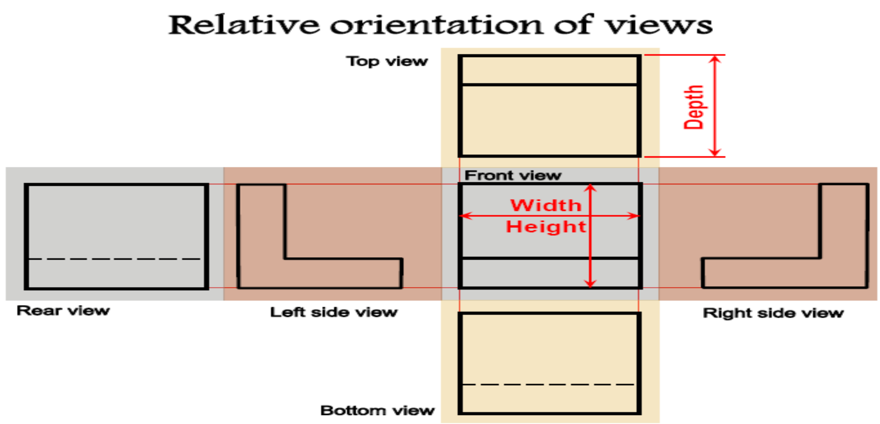


Table 2. 18 Six Principal Views

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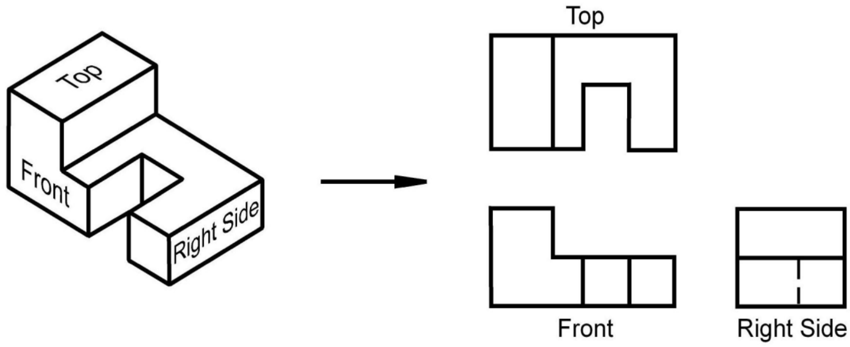


Table 2. 19 Orthographic projection = 2-D representation of a 3-D object

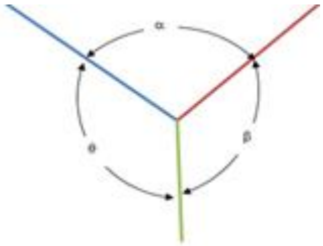
Axonometric projection:

Axonometric projection is a presentation of a design idea that is accurate and scientifically correct and can be easily understood by persons without technical training. It Is a three dimensional drawing which is named alternatively as Pictorial drawing. Depending on the angles found between the principal projection planes, we can sub divide it into: isometric, diametric and trimetric projection.

If $\alpha = \beta = \theta$ it is an isometric axonometric projection

If $\alpha \neq \beta = \theta$ it is dimetric axonometric projection

If $\alpha \neq \beta \neq \theta$ it is trimetric axonometric projection



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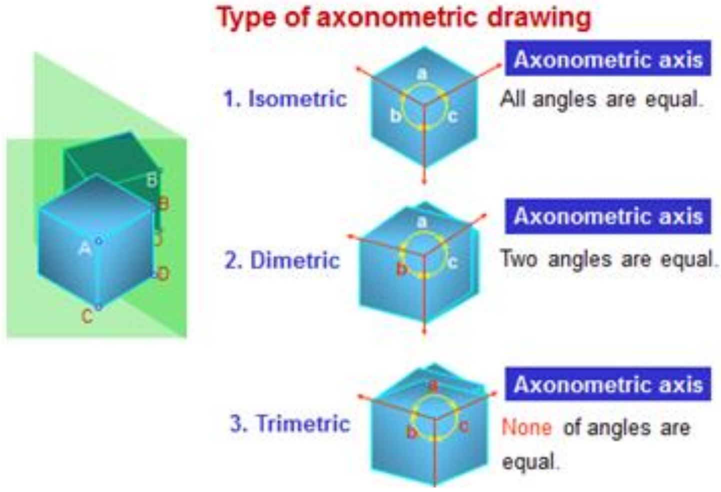


Table 2. 20Types of axonometric drawing

Isometric Drawing

The representation of isometric drawing is one of a family of three-dimensional views called pictorial drawings. In an isometric drawing, the object's vertical lines are drawn vertically, and the horizontal lines in the width and depth planes are shown at 30 degrees to the horizontal. When drawn under these guidelines, the lines parallel to these three axes are at their true scale) lengths. (Lines that are not parallel to these axes will not be of their true length. Any engineering drawing should show everything: a complete understanding of the object should be possible from the drawing. If the isometric drawing can show all details and all dimensions on one drawing, when all three angles are equal the drawing is classified as a isometric. For example angles A, B and C are equal and are 120^0.

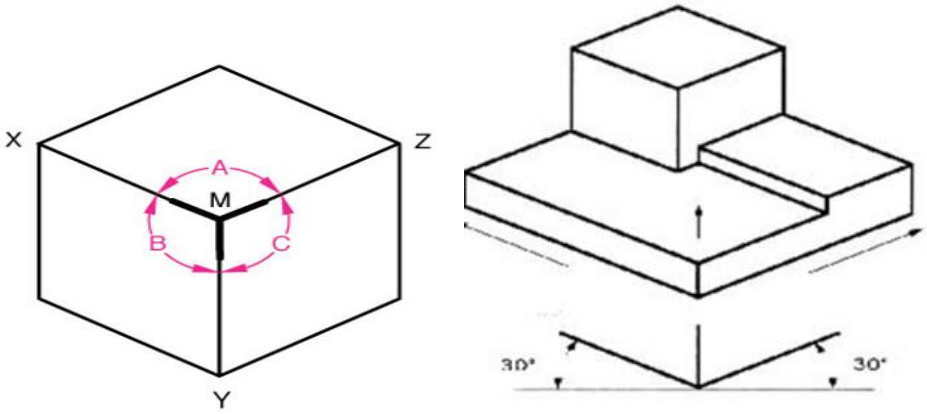


Table 2. 21 Isometric and Isometric drawing

Perspective

Pictorial drawings used to represent 3-D forms on 2-D media in a manner closest to how we perceive the objects with our eyes. Terms to be familiar with include horizon line (HL), ground line (GL), station point (SP), picture plane (projection plane), and vanishing point (VP). Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object. There are three types of perspective projections: One point, Two-point and Three-point Projections.

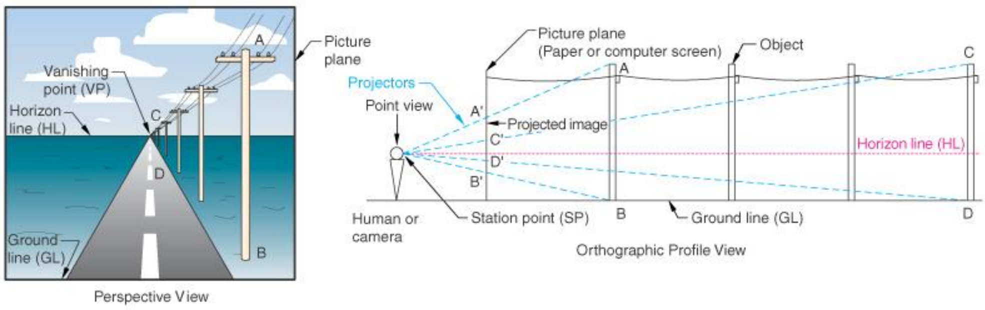


Table 2. 22 Perspective drawing

Exploded drawing

Exploded drawing is a diagram, picture, schematic or technical drawing of an object, that shows the relationship or order of assembly of various parts.

It shows the components of an object slightly separated by distance, or suspended in surrounding space in the case of a three-dimensional exploded diagram. An object is represented as if there had been a small controlled explosion emanating from the middle of the object, causing the object's parts to be separated an equal distance away from their original locations.

The exploded view drawing is used in parts catalogs, assembly and maintenance manuals and other instructional material.

The projection of an exploded view is usually shown from above and slightly in diagonal from the left or right side of the drawing. (See exploded view drawing of a gear pump to the right: it is slightly from above and shown from the left side of the drawing in diagonal.).

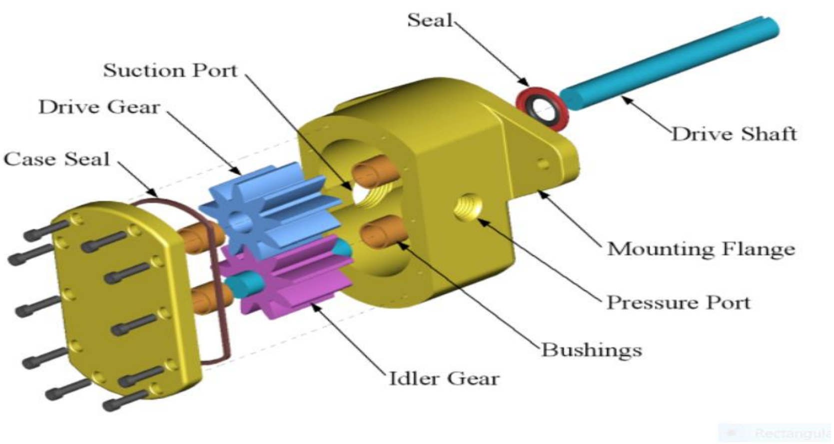


Table 2. 23 Exploded drawing

Hidden view technique

Hidden lines are not usually shown in isometric sketches unless they are needed to show a feature that would be unclear. Usually the orientation for the isometric drawing should be chosen so that hidden lines aren’t needed. Holes are assumed to go completely through the object unless their depth is indicated with a note or with hidden lines.

Use of correct scales

Scale

Scale is the ratio of the linear dimension of an element of an object as represented in the drawing, to the real linear dimension of the same element of the object itself. Wherever possible, it is desirable to make full size drawings, so as to represent true shapes and sizes. If this is not practicable, the largest possible scale should be used. While drawing very small objects, such as watch components and other similar objects, it is advisable to use enlarging scales.

Designation and Recommendation of scale

The complete designation of a scale should consist of the word Scale, followed by the indication of its ratio as:

SCALE 1 : 1 for full size,

SCALE × : 1 for enlarged scales,

SCALE 1 : × for reduced scales.

The designation of the scale used on the drawing should be shown in the title block.

Table 2. 24 Recommended scale

Category	*Recommended Scales*		
Enlarged scales	50:1	20:1	10:1
	5:1	2:1	
Full size			1:1
Reduced scales	1:2	1:5	1:10
	1:20	1:50	1:100
	1:200	1:500	1:1000
	1:2000	1:5000	1:10000

2.2.9 Neat presentation

Presentation of view

The different views of an object are placed on a drawing sheet which is a two dimensional one, to reveal all the three dimensions of the object. For this, the horizontal and profile planes are rotated till they coincide with the vertical plane. the view from the front, above and the left of an object.

Multi-view (orthographic) drawings Pictorial drawings are excellent for presenting easy-to-visualize pictures to the viewer, but there are some problems. The main problem is that these drawings cannot be accurately drawn to scale. Also, they cannot accurately duplicate exact shapes and angles. As this information can be essential, another form of drawing is used, one that has several names, including orthographic projection, third angle projection, multi-view projection, and working drawing. Each projection is a view that shows only one face of an object, such as the front, side, top, or back. These views are not pictorial.

Then the edges of the box are removed and you have a six-view orthographic drawing of the original object. These six views are called the six principal orthographic views. This view alignment is important and is always consistent in orthographic projection. You will seldom need to show views of all six sides of an object; usually it is sufficient to show just two or three. You should remember the names of these six views and understand how they are obtained in case you ever need to show an object that cannot be truly represented in two or

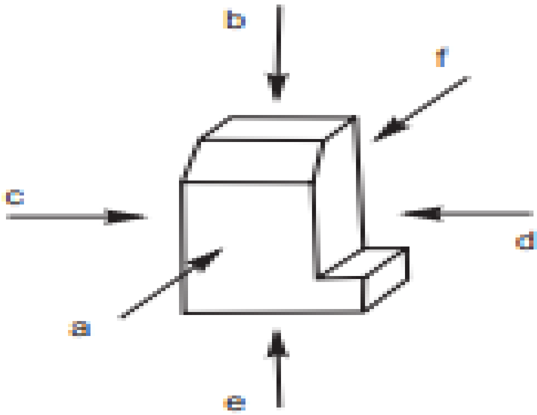


Table 2. 25Neat representation of the drawing

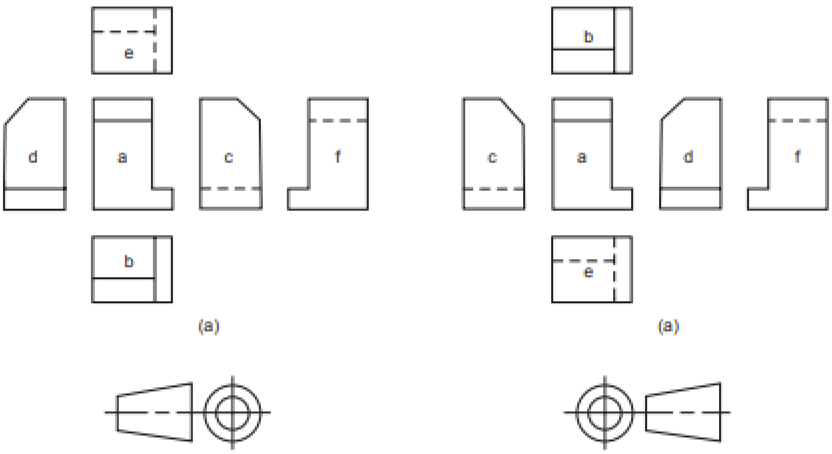


Table 2. 26 First and third angle projection

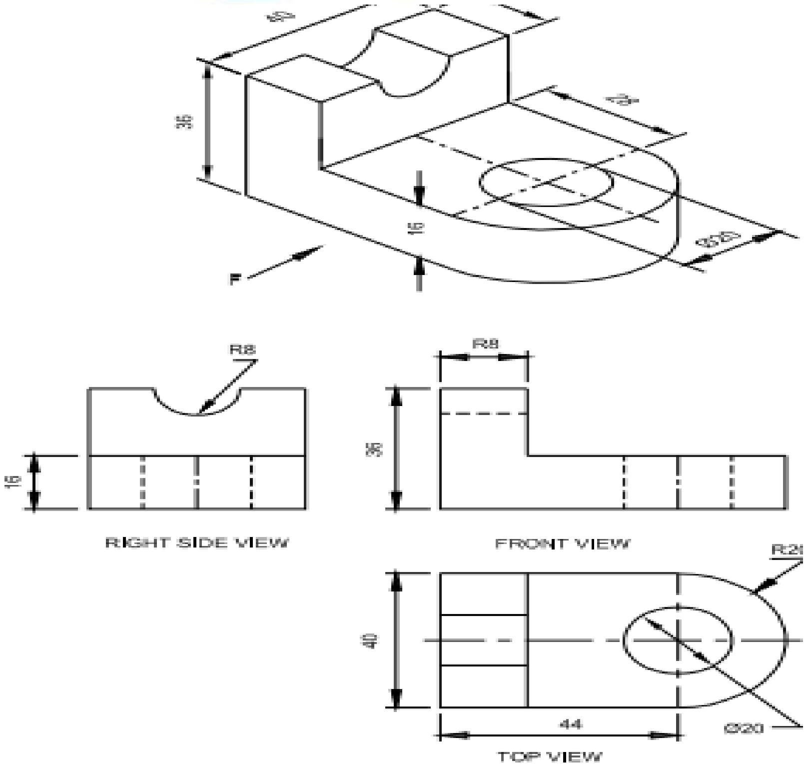


Table 2. 27 Orthographic view

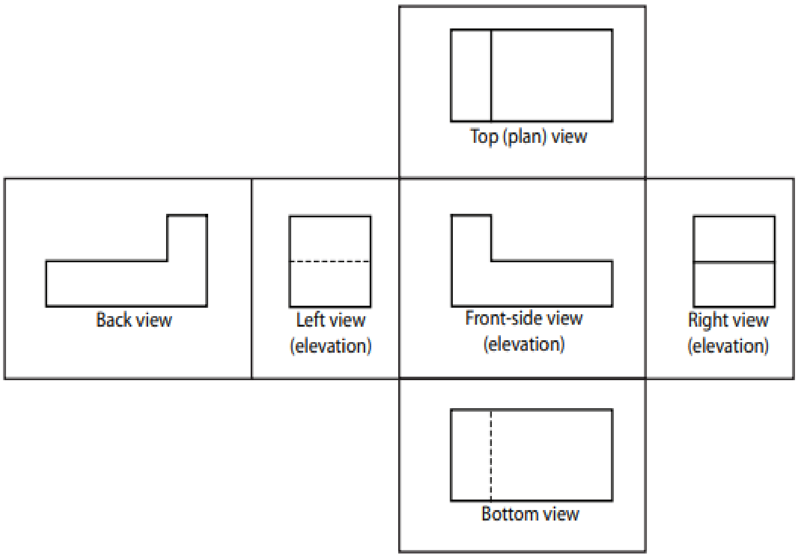


Table 2. 28 Glass box flattened out drawing

Orthographic projections are tools that allow us to represent three-dimensional objects with two-dimensional drawings.

2.3 Using drawing techniques

2.3.1 Orthogonal projection

Definition

Basically, Orthographic projection could be defined as any single projection made by dropping perpendiculars to a plane. In short, orthographic projection is the method of representing the exact shape of an object by dropping perpendiculars from two or more sides of the object to planes, generally at right angles to each other; collectively, the views on these planes describe the object completely.

Descriptive geometry is basically the use of orthographic projection in order to solve for advanced technical data involving the spatial relationship of points, lines, planes, and solid shapes. The most common means of understandingthese types of orthographic projection is *The* Glass Box method.

The *Glass Box method*, used primarily for descriptivegeometry problems, requires that the user imagine that the object, points, lines, planes etc are enclosed in a transparent "box". Each view of the object is established on its corresponding glass box surface by means of perpendicular projectors originating at each point of the object and extendingto the related box surface. The box is hinged so that it can be unfolded on to one flat plane (the paper).

The lines of sight representing the direction from which the object is viewed. represents a corner of the given object, has been projected on to the three primary image planes. Where itis intersects the horizontal plane (top image plane), it is identified as 1_H' when it intersects the frontal plane (front image plane), it is identified as 1_F, and where it intersects the profile plane (right side image plane), it is labeled

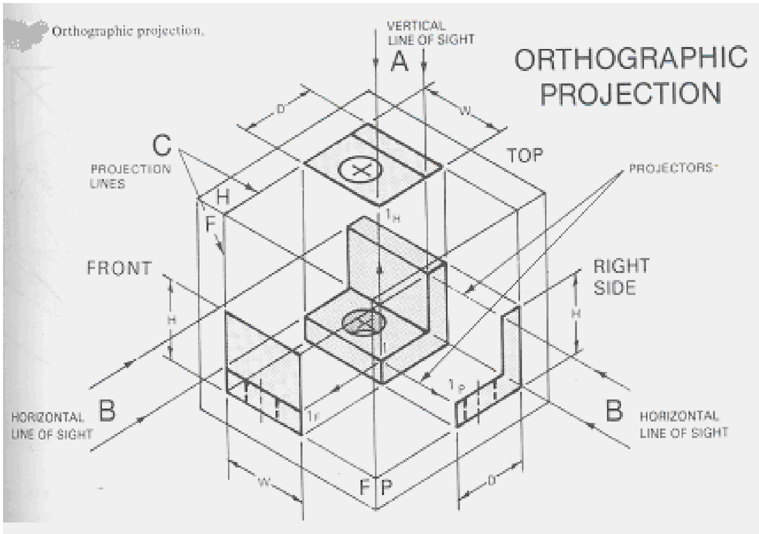


Table 2. 29 Glass box methods

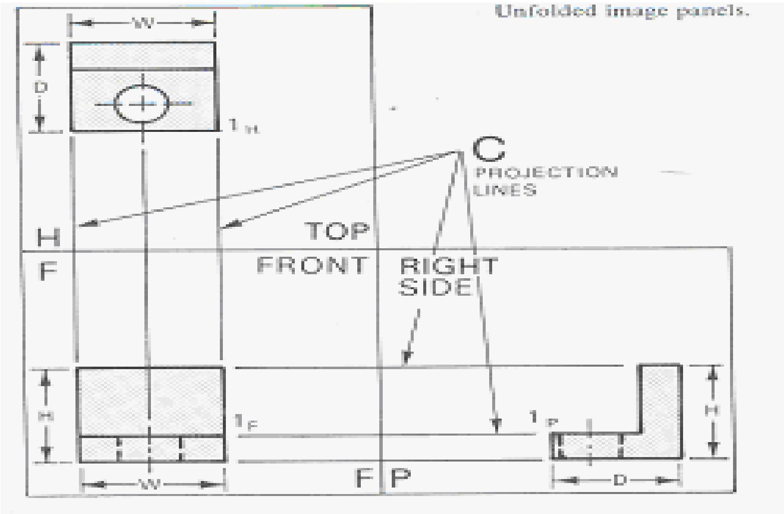


Table 2. 30 Orthographic projection of objects

Orthographic view

It is the picture or view or thought of as being found byextending perpendiculars to the plane from all points of the object. This picture, or projection on a frontal plane, shows theshape of the object when viewed from the front but it does not tell the shape or distance from front to real. Accordingly, more than one protection is required to describe the object.

If transparent plane is placed horizontally above the object,the projection on this plane found by extending perpendicularsto it from the object, will give the appearance of the object asif viewed from directly above and will show the distance from frontal plane. Then the *horizontal plane* is now rotated into coincidence with the *frontal plane*. Now again a third plane, perpendicular to the first two called *profile plane* are used to view an object from the side.

The Six Principal Views

Let us surround the object entirely by asset of six planes,each at fight angles to each other. On these planes, views of the object can be obtained as is seen from the top, front, and right side, left side, bottom and rear.

Think now of the six sides, or the plane of the paper. The frontis already in the plane of the paper, and the other sides are,as it were, hinged and rotated in position as shown. The projection on the frontal plane is the front view vertical projection, or front elevation, that on the horizontal plane, the top view, horizontal projection, or plan, that on the side, profileview, side view, profile projection, or side elevation. By reversing the direction of sight, a bottom view is obtained instead of a top view, or a rear view instead of a front view.

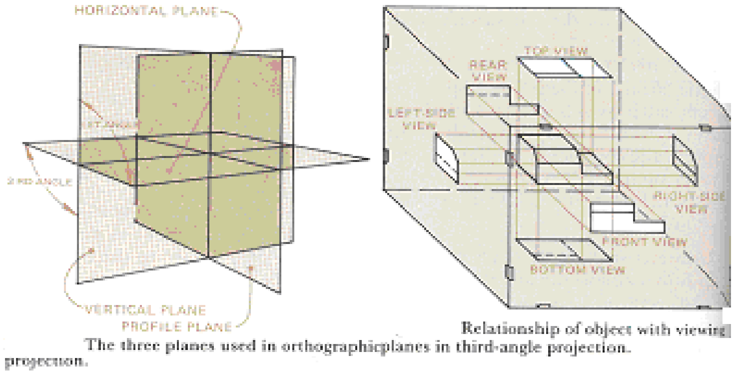


Table 2. 31 Six Principal Views

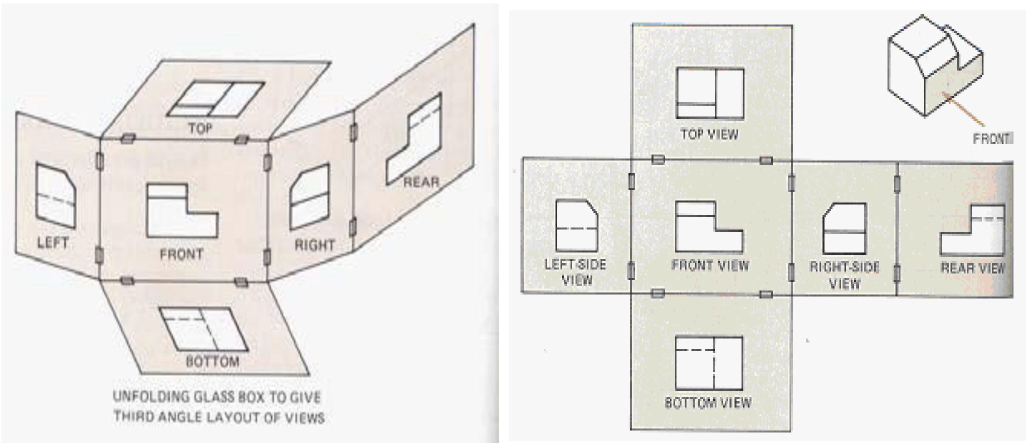


Table 2. 32 Principal Picture Planes

In actual work, there is rarely an occasion when all six principal views are needed on one drawing. All these viewsare principal views. Each of the six views shows two of the three dimensions of height, width and depth.

In general, when the glass box is opened, its six sides are revolved outward so that they lie in the plane of the paper.And each image plane is perpendicular to its adjacent image plane and parallel to the image plane across from it. Before it is revolved around its hinged fold line (reference line). *A fold line* is the line of intersection between any hinged (adjacent) image planes.

The left side, front, right side, and back are all elevation views.Each is vertical. The top and bottom planes are in the horizontal plane. But in most cases the top, front, and right sides are required.

Combination of views

The most usual combination selected from the six possible views consists of the top, front, and right side views some times the left- side view helps to describe an object more clearly then the light side view.

N.B: The side view of the front face of the object is adjacent tothe front view and the side view of a point will be at the same distance from the front surface as its distance fromthe front surface on the top view.

The six principal views of an object or the glass box have previously been presented in the type of orthographicprojection known as *Third Angle Orthographic Projectio*n. Thisform of projection is used throughout this lecture note and is primary form of projection found in all American Industry with the exception of some special cases in the architectural and structural fields.

The type of projection used in most foreign countries and on many American Structural and architectural drawings is called*First Angle Orthographic Projections.*

In this form of projection, the object is assumed to be in frontof the image plane. Each view is formed by projecting throughthe object and on to the image plane.

Classification of surfaces and Lines inOrthographic Projections

Any object, depending upon its shape and space position mayor may not have some surfaces parallel or perpendicular to the planes of projection.

Surfaces are classified according to their space relationship with the planes of projection i.e. *horizontal*, *frontal* and *profile surfaces*. When a surface is inclined to two of the planes of projection (but perpendicular to the third, the surface is said tobe *auxiliary or inclined* .It the surface is at angle to all three planes, the term *oblique or skew* is used

Although uniform in appearance, the lines on a drawing may indicate three different types of directional change on theobject. An edge view is a line showing the edge of a projection. An intersection is a line formed by the meeting of two surfaces where either one surface is parallel and one atan angle or both are at an angle to the plane of projection. A surface limit is a line that indicates the reversal of direction ofa curved surface.

Horizontal, Frontal and Profile Surfaces

The edges (represented by lines) bounding a surface may be in a simple position or inclined to the planes of projection depending up on the shape or position, the surface takes is name from the plane of projection. Thus, a horizontal line is a line in a horizontal plane; a frontal line is a line in a frontal plane; and a profile line is a line in a profile plane. When a lineis parallel to two planes, the line takes the name of bothplanes as horizontal frontal, horizontal- profile, or frontal – profile.

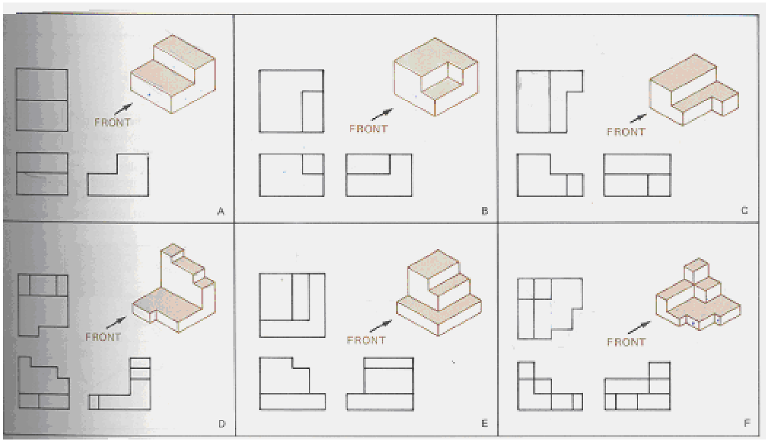


Table 2. 33 Examples of objects having parallel surfaces to the principal planes

Inclined Surfaces

An edge appears in true length when it is parallel to the plane of projection, as a point when it is perpendicular to the plane and shorter than true length when it is inclined to the plane. Similarly, a surface appears in trey shape when it is parallel tothe planes of projection, as alien when it is perpendicular to the plane, and fore shortened when it inclined to the plane. Anobject with its face parallel to the plans of projection as figure 5.12; a top, front, and right side surfaces are shown in true shape and the object edges appear either in true length or as points. The inclined surface of the object as figure 5.13 does not show true shape in any of the views but appears as an edge in front view. The front and rear edges of the inclined surface are in true length in the front view and fore shortened in the top and side views. The top and bottom edges of the inclined surface appear in true length in top and side views and as points in the front view.

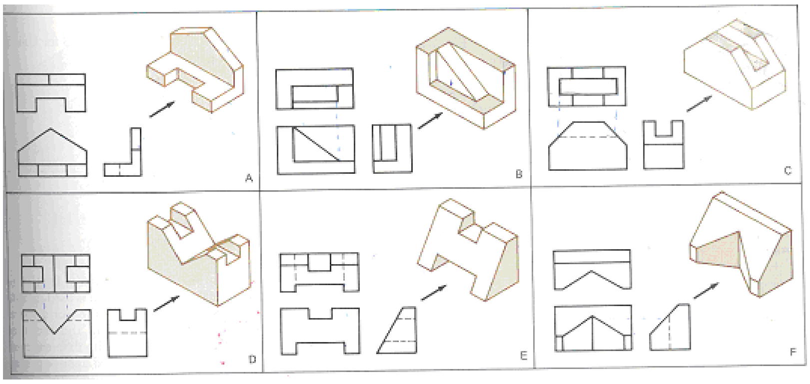


Table 2. 34 Examples of objects having inclined surfaces

Oblique Surfaces

A line that is not parallel to any plane of projection is called anoblique skew line and it does not show in true shape in any of the views, but each of the bounding edges shows interval length in one view and is fore shortened in the other twoviews,

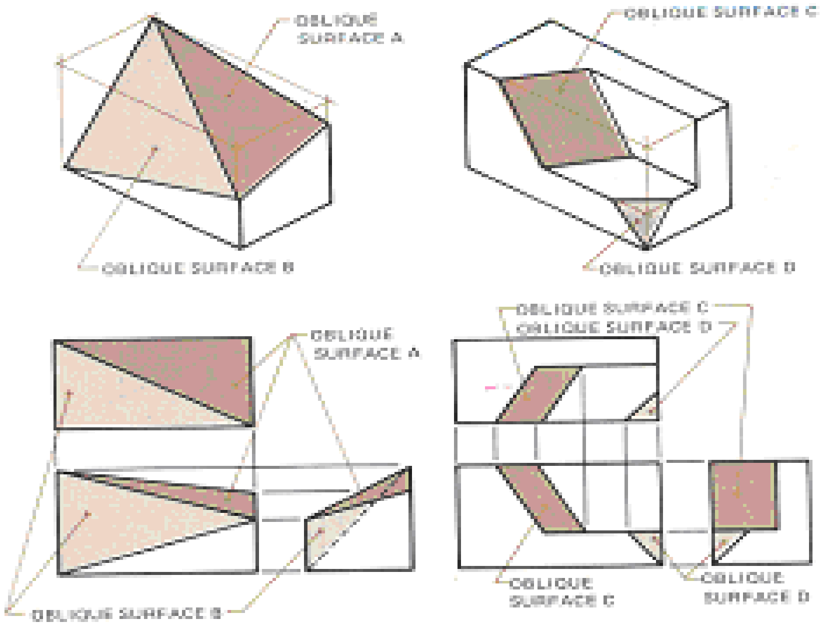


Table 2. 35 Examples of objects having oblique surfaces

Hidden Surfaces

To describe an object with complex internal features completely, a drawing should contain lines representing all theedges, intersections, and surface limits of the objects In any view there will be some parts of the object that cannot be seen from the position of the observer, as

they will be coveredby station of the object closer to the observer's eye. Theedges, intersections, and surface limits of these hidden parts are indicated by a discontinuous line called a dashed line. In
figure 2.31, the drilled hole that is visible in the top-side viewis hidden in the front and right side views, and there fore it is indicated in these views by a dashed line showing the hole and the shape as left by the drill.

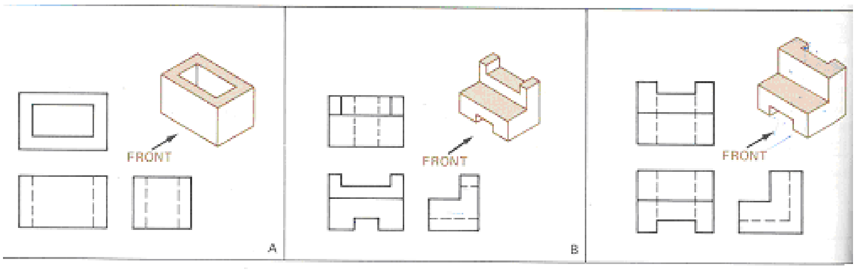


Table 2. 36 Examples of objects having hidden surfaces

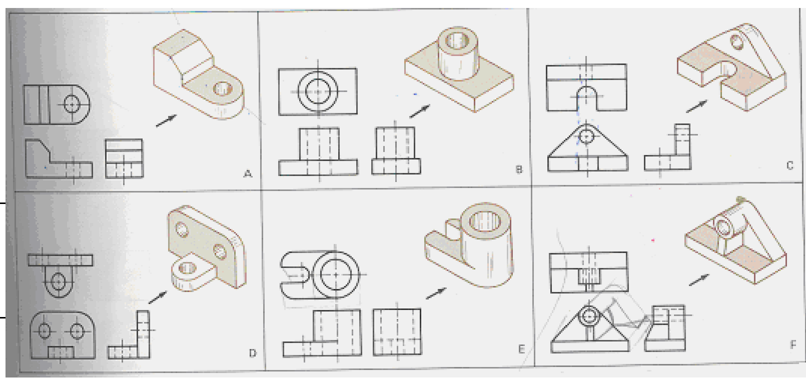
Particular attention should be paid to the execution of these dashed lines. It carelessly drawn, they appearance of a drawing. Dashed lines are drawn lighten full lines, of short dashes uniform in length with the space between there very short, about ¼ of the length of the dash. This view shows the shape of the object when viewed fromthe side and the distance from bottom to top and front to rear. The horizontal and profile planes are rotated in to the same plane as the frontal plane. Thus, related in the same plane, they give correctly the three dimensional shape of the object

Curved Surfaces

To represent curved surfaces in orthographic projections, center lines are commonly utilized. All the center lines, which are the axes of symmetry, for all symmetrical views are a part of views.

Every part with an axis, such as a cylinder will have the axis drawn as center line before the part is drawn.

Every circle will have its center at the intersection of two mutually perpendicular center lines. The standard symbol for center lines on finished drawings is afine line made up of alternate long and short dashes.



Precedence of lines

In any view there is likely to be a coincidence of lines. Hidden portions of the object may project to coincide with visibleportions Center lines may occur where there is a visible or hidden out line of some part of the object.

Since the physical features of the object must be represented full and dashed lines take precedence over all Table 2. 37 Examples of objects having curved surfaces ›osition, full lines take precedence over dashed lines. A full line couldcover a dashed line, but a dashed line could not cover a full line.

It is evident that a dashed line could not occur as one of the boundary lines of a view.

2.3.2 Sectioning

Introduction

Sections and sectional views are used to show hidden detail more clearly. They-are created by using a cutting plane to cut the object. A section is a view of no thickness and shows the outline of the object at the cutting plane. Visible outlines beyond the cutting plane are not drawn.

A sectional view, displays the outline of the cutting plane and all visible outlines which can be seen beyond the cutting plane.

Improve visualization of interior features. Section views are used when important hidden details

are in the interior of an object. These details appear as hidden lines in one of the orthographic principal views; therefore, their shapes are not very well described by pure orthographic projection.

Types of Section Views

• Full sections • Half sections • Offset sections

• Revolved sections • Removed sections • Broken-out sections

2.3.3 Sheet format

A / Sizes and layout of drawing sheets

- Drawing paper size
- Main article: Paper size

Sizes of drawings typically comply with either of two different standards, ISO (World Standard) or (American), according to the following tables:

ISO paper sizes (common)

Table 2. 38 Sheet format

ISO A Drawing Sizes (mm)	
A4	210 X 297
A3	297 X 420
A2	420 X 594
A1	594 X 841
A0	1189

Layout of drawing

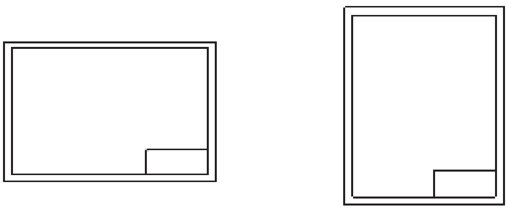
Title Block

The title block should lie within the drawing space such that, the location of it, containing the identification of the drawing, is at the bottom right hand corner. This must be followed, both for sheets positioned horizontally or vertically (Fig. 2.2).

The direction of viewing of the title block should correspond in general with that of the drawing. The title block can have a maximum length of 170 mm. Figure 2.3 shows a typical title block, providing the following information:

(*i*) Title of the drawing
(*ii*) Sheet number
(*iii*) Scale
(*iv*) Symbol, denoting the method of projection
(*v*) Name of the firm
(*vi*) Initials of staff drawn, checked and approved.

NOTE According to Bureau of Indian Standards, SP-46:1998, "Engineering Drawing Practice for Schools and Colleges", First angle projection is preferred.



(a) (b)

Fig. 2.2 Location of title block

Border line

Borders enclosed by the edges of the trimmed sheet and the frame, limiting the drawing space, should be provided with all sheet sizes. It is recommended that these borders have a minimum width of 20 mm for the sizes A0 and A1 and a minimum width of 10 mm for the sizes A2, A3and A4 (see Fig. below). A filing margin for taking perforations, may be provided on the edge, far left of the title block.

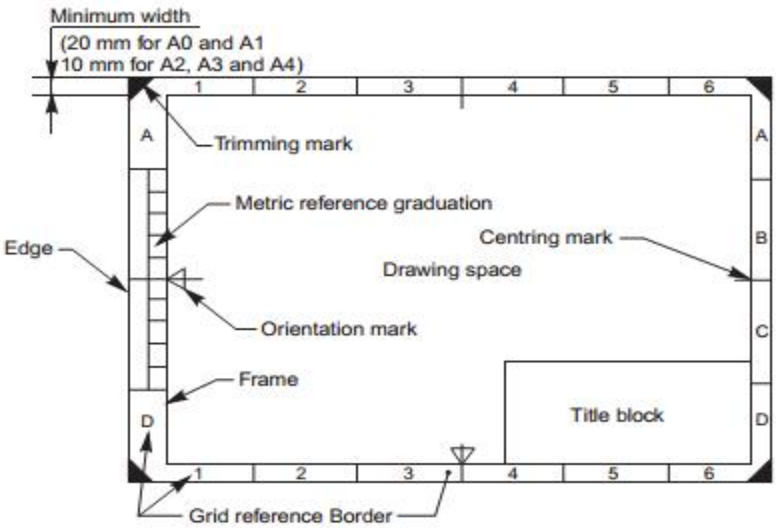


Table 2. 39 Sheet format

2.3.4 Dimensioning

Dimension

A drawing of a component, in addition to providing complete shape description, must also furnish information regarding the size description. These are provided through the distances between the surfaces, location of holes, nature of surface finish, type of material, etc. The expression of these features on a drawing, using lines, symbols, figures and notes is called dimensioning.

General principle

Dimension is a numerical value expressed in appropriate units of measurement and indicated on drawings, using lines, symbols, notes, etc., so that all features are completely defined.

1. As far as possible, dimensions should be placed outside the view.
2. Dimensions should be taken from visible outlines rather than from hidden lines.
3. Dimensioning to a center line should be avoided except when the center line passes through the center of a hole.
4. Each feature should be dimensioned once only on a drawing.
5. Dimensions should be placed on the view or section that relates most clearly to the corresponding features.

6. Each drawing should use the same unit for all dimensions, but without showing the unit symbol.

7. No more dimensions than are necessary to define a part should be shown on a drawing.

8. No features of a part should be defined by more than one dimension in any one direction

Method of execution

The elements of dimensioning include the projection line, dimension line, leader line, dimension

line termination, the origin indication and the dimension itself.. The following are some of the principles to be adopted during execution of dimensioning:

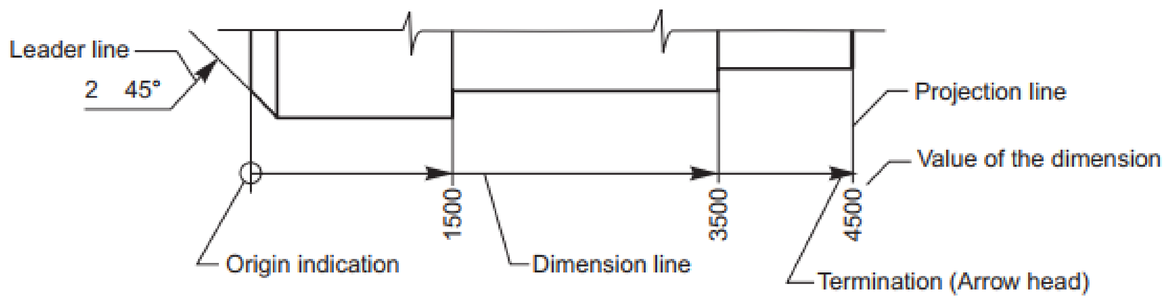


Fig. Elements of dimensioning

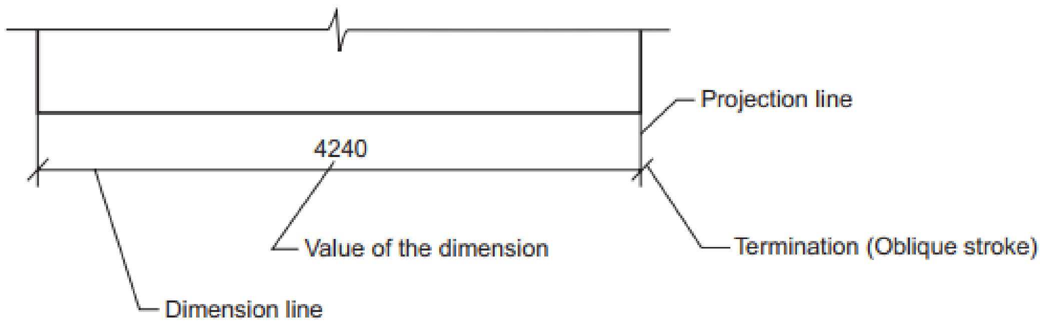


Table 2. 40 Dimensioning

1. Projection and dimension lines should be drawn as thin continuous lines.
2. Projection lines should extend slightly beyond the respective dimension lines.
3. Projection lines should be drawn perpendicular to the feature being dimensioned. Where necessary, they may be drawn obliquely, but parallel to each other However, they must be in contact with the feature.
4. Projection lines and dimension lines should not cross each other, unless it is un avoidable

5. A dimension line should be shown unbroken, even where the feature to which it refers, is shown broken

6. A center line or the outline of a part should not be used as a dimension line, but may be used in place of projection line

Methods of indicting dimension

Dimensions should be shown on drawings in characters of sufficient size, to ensure complete legibility. They should be placed in such a way that they are not crossed or separated by any other line on the drawing. Dimensions should be indicated on a drawing, according to one of the following two methods. However, only one method should be used on any one drawing.

METHOD–1 (Aligned System)

Dimensions should be placed parallel to their dimension lines and preferably near the middle, above and clear-off the dimension line. An exception may be made where superimposed running dimensions are used.

Dimensions may be written so that they can be read from the bottom or from the right side of the drawing.

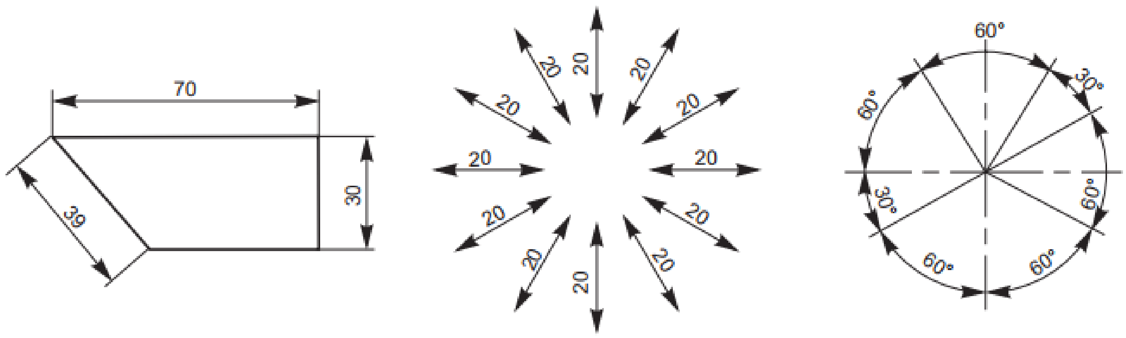


Table 2. 41Aligned dimensioning System

METHOD–2 (Uni-directional System)

Dimensions should be indicated so that they can be read from the bottom of the drawing only. Non-horizontal dimension lines are interrupted, preferably near the middle,

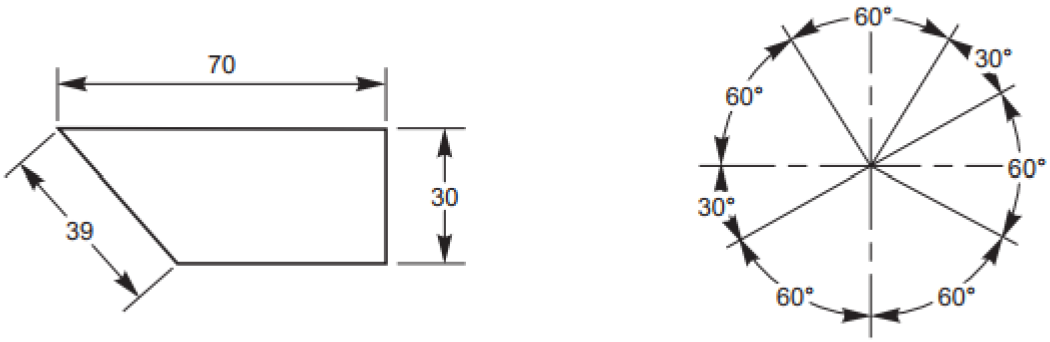


Table 2. 42 Uni-directional System

Dimensions can be, (*i*) above the extension of the dimension line, beyond one of the terminations,) or (*ii*) at the end of a leader line, which terminates on a dimension line, that is too short to permit normal dimension placement or (*iii*) above a horizontal extension of a dimension line, where space does not allow placement at the interruption of a non-horizontal dimension line.

Arrangement of dimensions

The arrangement of dimensions on a drawing must indicate clearly the design purpose. The following are the ways of arranging the dimensions.

Chain dimensions

Chains of single dimensions should be used only where the possible accumulation of tolerances does not endanger the functional requirement of the part

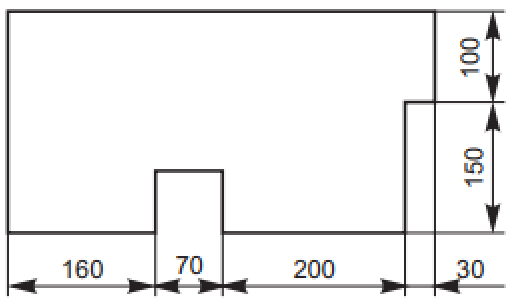


Table 2. 43 Chain dimensions

Parallel dimensions

In parallel dimensioning, a number of dimension lines, parallel to one another and spaced-out are used. This method is used where a number of dimensions have a common datum feature

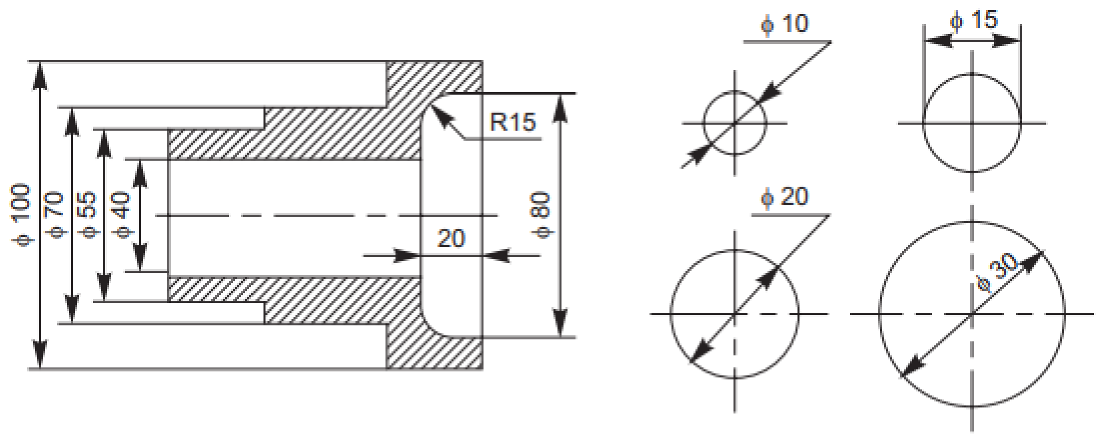


Table 2. 44 Parallel dimensions

2.3.5 Scale drawing

Scale

Scale is the ratio of the linear dimension of an element of an object as represented in the drawing, to the real linear dimension of the same element of the object itself. Wherever possible, it is desirable to make full size drawings, so as to represent true shapes and sizes. If this is not practicable, the largest possible scale should be used. While drawing very small objects, such as watch components and other similar objects, it is advisable to use enlarging scales.

Designation and Recommendation of scale

The complete designation of a scale should consist of the word Scale, followed by the indication of its ratio as:

SCALE 1 : 1 for full size,

SCALE × : 1 for enlarged scales,

SCALE 1 : × for reduced scales.

The designation of the scale used on the drawing should be shown in the title block.

2.4 Appling industry standards and symbols

Symbol sizes are shown in the figures as values proportional to the letter **'h'**. The letter 'h' represents the predominant character height on a drawing. If a symbol dimension is shown

As 1.5h, and the predominant character height on the drawing is to be 3mm, then the symbol dimension is 4.5mm (1.5 x 3mm). Symbol proportions defined in the standard are recommendations. Some companies find it desirable to vary from the recommended proportions for improved microfilm reproduction capability. Symbol proportions within a company, and certainly within a single drawing, should be consistent Symbols are not generally used in text or notes lists. Abbreviations and symbol names are used in text or notes.

General symbols

General symbols are used with dimensions to clarify the requirement defined by a dimension value and to minimize the number of words or abbreviations placed on a drawing.

Diameter:- A diameter symbol is placed in front of any dimension value that is a diameter.

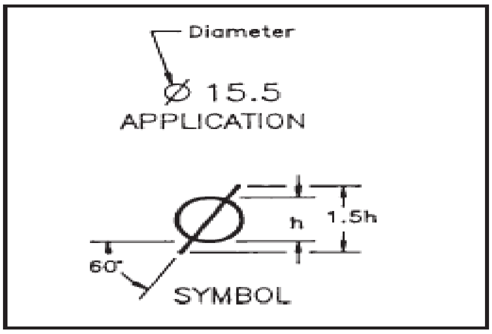


Table 2. 45 diameter symbol

Counter bore Symbol:- A counter bore symbol combined with a diameter symbol is placed in front of a specified counter bore or spot face diameter.

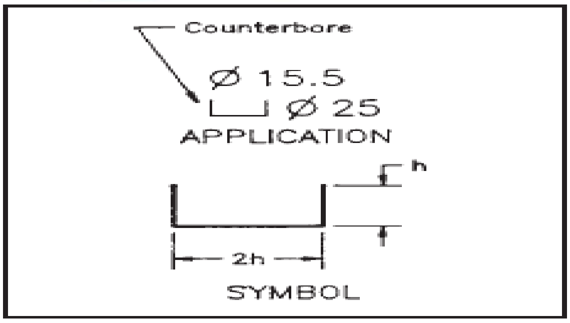


Table 2. 46 Counter bore Symbol

Depth:- A downward-pointing arrow is used for the depth symbol, and it is placed in front of the depth value in such applications as for counter bore and hole depths.

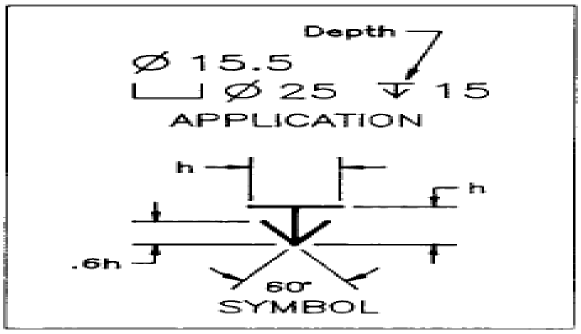


Table 2. 47 Depth symbol

Radius:- The letter R is placed in front of any value that indicates a radius dimension.

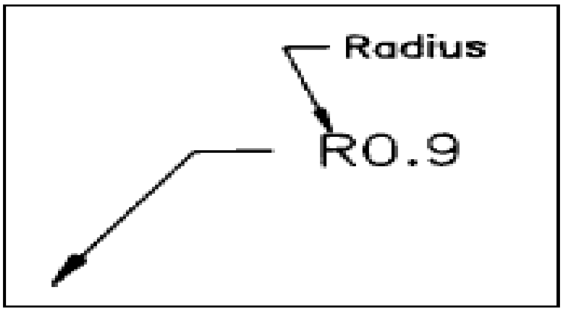


Table 2. 48 Radius symbol

Straightness:- A straight line is used to indicate a Straightness requirement. It is only applied in a feature control frame, and maybe used to control straightness of surface elements. It may also be used to control the straightness of an axis or center plane.

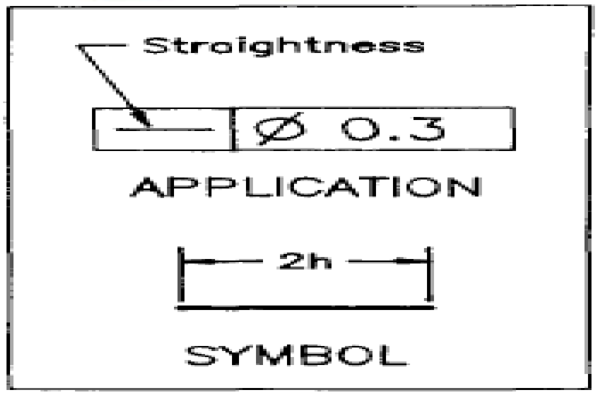


Table 2. 49 Straightness symbol

Flatness:- The flatness symbol appears as an oblique view of a square surface. See Figure 13. This symbol is used in feature control frames and is only used to control the form variations on flat features.

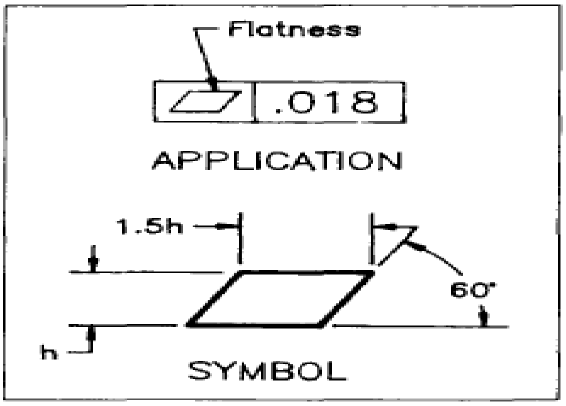


Table 2. 50 Flatness symbol

Circularity:- Circularity is indicated by a circle. It controls the amount of form error permitted on the surface of a circular feature at individual cross sections.

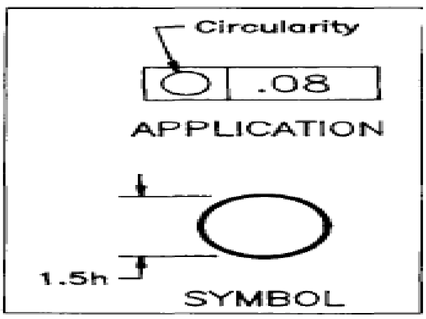


Table 2. 51 Circularity symbol

Cylindricity:- This symbol is a circle with two parallel lines drawn tangent to the circle. It is used to control the surface errors on a cylindrical feature. It simultaneously

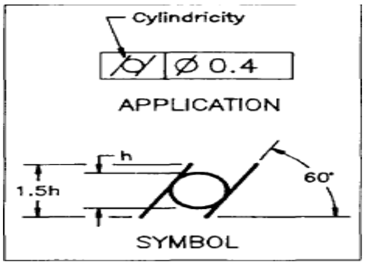


Table 2. 52 Cylindricity symbol

Parallelism:- Parallelism is indicated by two parallel straight line

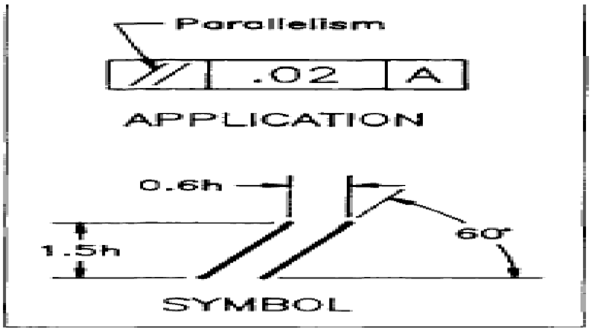


Table 2. 53 Parallelism

Perpendicularity – Perpendicularity is indicated by two perpendicular lines

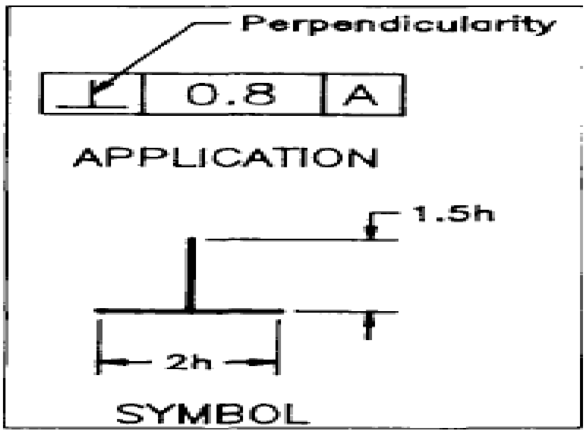


Table 2. 54Perpendicularity symbol

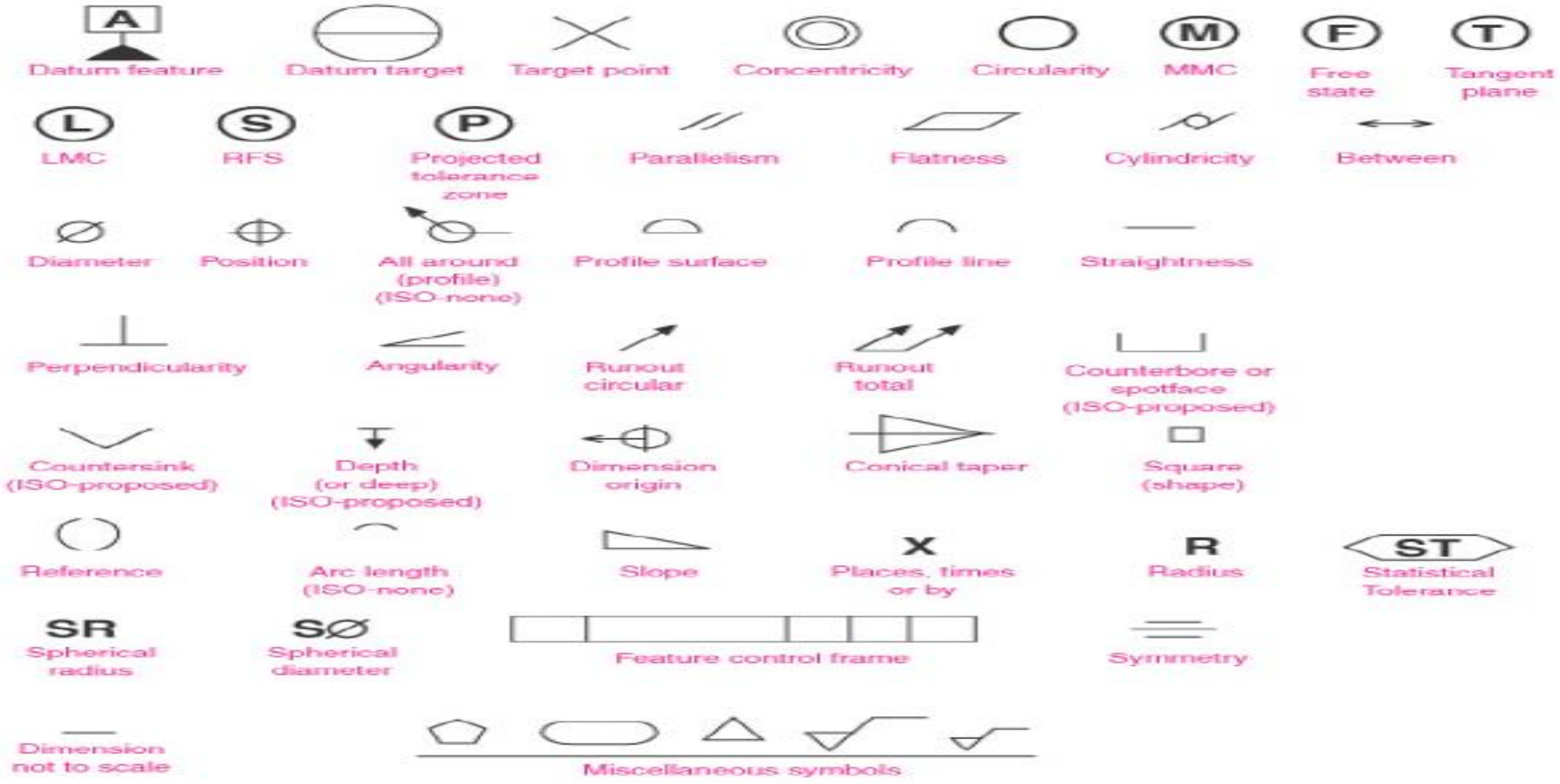
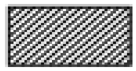
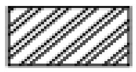
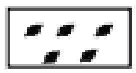
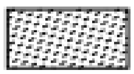
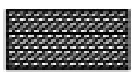
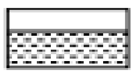
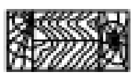
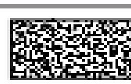
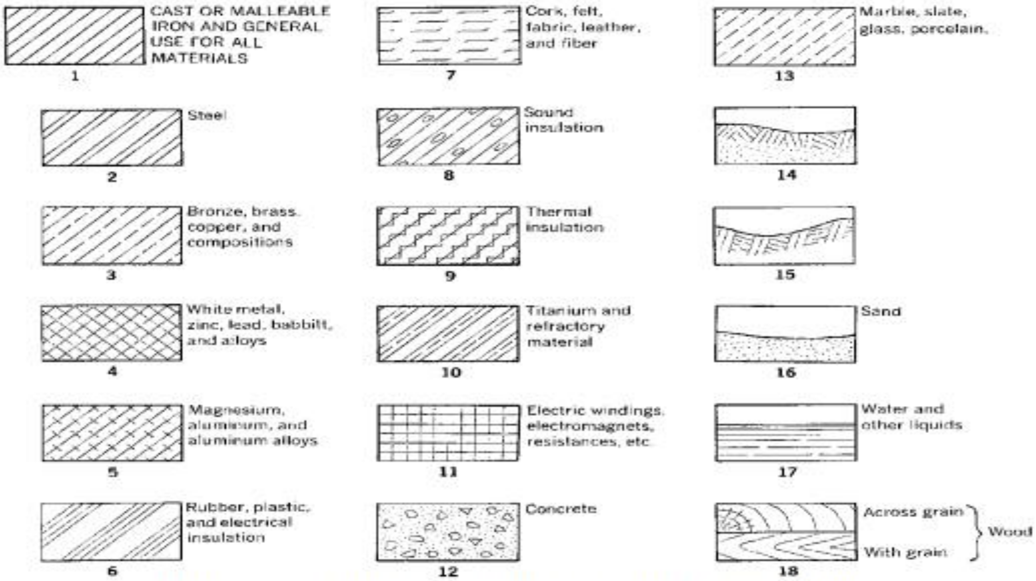


Figure 2. 2 Example of symbol

Table 2. 55Drawing symbols and standards

TYPE	CONVENTION	MATERIALS
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its alloy,etc
		Lead,Zinc Tin White-metal,etc.
Glass		Glass
Packing and Insulating materials		Porcelain, Stoneware, Marble,Slate etc
		Asbestos, Fibre, Felt, Syntehtic resin, Products, Paper, Cork, Linoleum, Rubber, Leather, Wax, insulating & Filling Materials etc
Liquid		Water, Oil, Petrol, Kerosen etc
Wood		Wood, Plywood etc
Concrete		Concrete



Hatch patterns by American National Standard Institute (ANSI).

Table 2. 56 Symbols representing the characteristics to be tolerance

Form of single features	Straightness	—
	Flatness	▱
	Circularity (roundness)	○
	Cylindricity	⌭
	Profile of any line	⌒
	Profile of any surface	⌓

Self-Check – Two

Part I - Choose the best answer.

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

1. ______ is built on 3 main axis namely the vertical axis and two 30 degrees axis from a horizontal line to the left and right of the vertical axis.

   A, Isometric drawing B, Orthographic drawing C, exploded view drafting D, none

2. ________is different types and thicknesses are used for graphical representation of objects.

   A, graph B, line C, point D, none

3. _____________is straight elements that have no width

   A. Lines B. Symbol C. Straight D, None

Part II - True / False

Directions: Say True / False answer for the given question

1. Precision is the degree of accuracy to ensure the functioning of not a part as intended

   A, true B, false

2. . Deviation is the algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

   A, True B, False

3. . Allowance is the dimensional difference between the maximum material limits of the mating parts, intentionally provided to obtain the desired class of fit

   A, True B, False

Part III - Short answer writing

Directions - Give short answer to the following questions

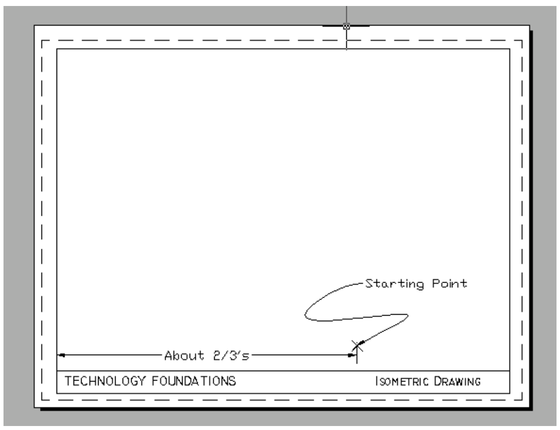
1) List and explain two basic types of drawings?
2) What is the definition of orthogonal drawing?

Operation Sheet 2	Isometric view drawing

How to Make an Isometric Drawing

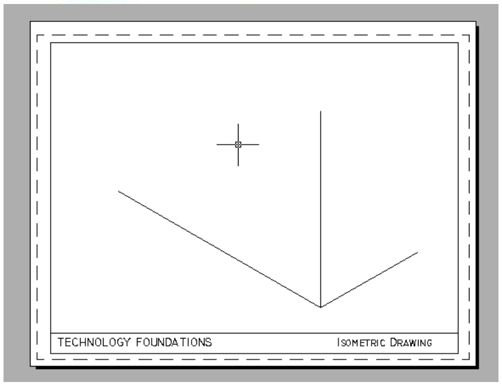
Step 1

If the starting point is not given, begin your drawing about 1" up from the title block and 2/3's across the page from the left margin



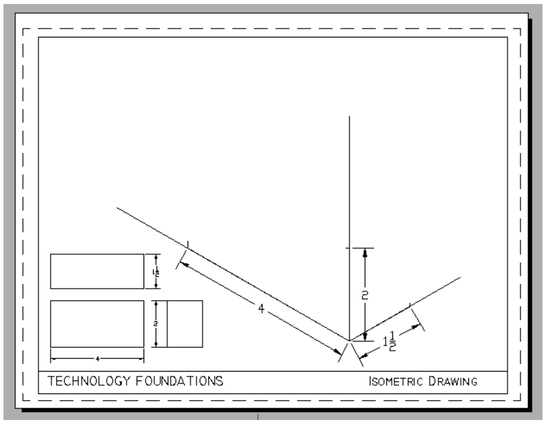
Step 2

From the starting point, draw lines 30 deg. to the left, 30 deg. to the right, and 90 deg. up with *light* construction lines.



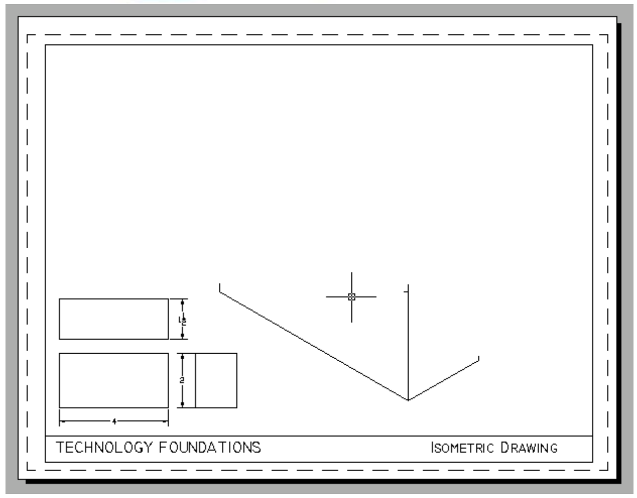
Step 3

Place the length measurement on the "30 deg. to the left" line, the thickness measurement on the "30 deg. to the right" line, and the height measurement on the "90 deg. up" line



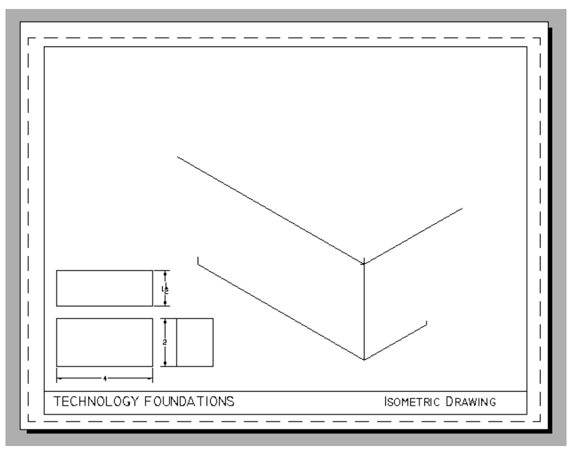
Step 4

Erase excess lines back to each mark.



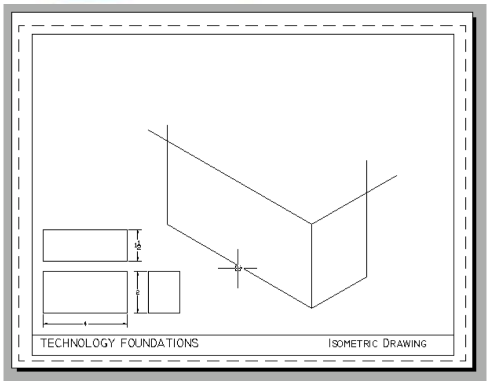
Step 5

Draw construction lines 30 deg. to the left and 30 deg. to the right from the height mark



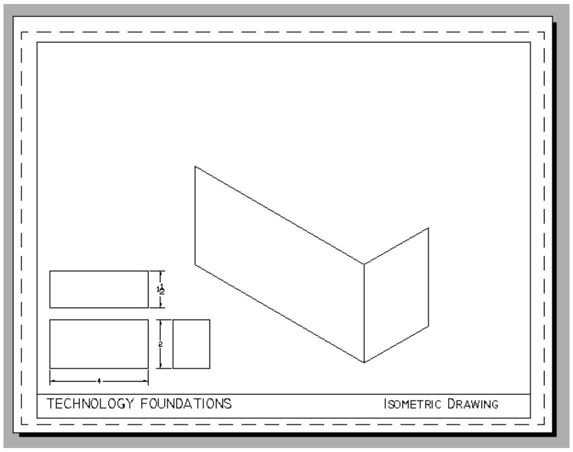
Step 6

Draw lines 90 deg. up from both ends



Step 7

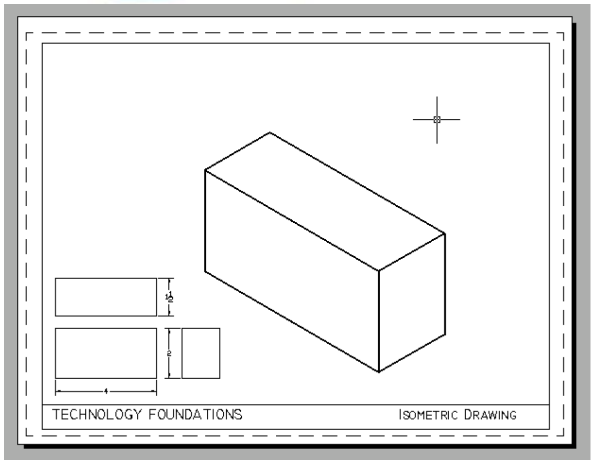
Erase excess lines back to each intersection.



Step 8

Draw construction lines 30 deg. to the left and 30 deg. to the right from each end until they intersect.

Convert all construction lines to object lines


TECHNOLOGY FOUNDATIONS
ISOMETRIC DRAWING

LAP Test	Practical isometric drawing

Instructions: Given necessary measuring tools, materials and drawing instrument you are required to perform the following tasks within 8-12 hours.

Task 1: Identify key information about different between isometric and orthographic drawing

Task 2: List use drawing instrument

Task 3: draw orthographic view using third angle

Unit Three: Prepare Engineering Parts List

This unit to provide you the necessary information regarding the following content coverage and topics:

- Customer requirements components or parts.
- Customer requirements parts list.

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

- Identified/organized components or parts of organisation/customer requirements
- prepared in part lists of organisation/customer requirements

3.1 Customer requirements components or parts.

3.1.1 Customer requirements

Customer requirements refer to the specifications or features of a product or service that are deemed necessary by customers. These requirements motivate customers to buy a product or service. To determine customer requirements, companies can research their target market to understand their desires and needs.

Developing products that people want to buy requires that companies consider customer requirements. These requirements represent the desires or needs customers have that will persuade them to make a purchase.

- Price
- Quality
- Functionality
- Reliability
- Performance
- Sustainability
- Transparency
- Convenience
- Efficiency

- Risk reduction
- Safety
- Compatibility
- Options
- Control
- Experience
- Design

3.1.2 Component or part drawing

A component or part drawing is termed as a production drawing, if it facilities its manufacture. It is an authorized document to produce the component in the shop floor.

It furnishes all dimensions, limits and special finishing processes such as heat treatment, grinding, etc., in addition to the material used. It should also mention the number of parts that are required for making of the assembled unit, of which the part is a member. Production drawing of a component should also indicate the sub or main assembly where it will be assembled. It is necessary to prepare the production drawing of each component on a separate sheet, since a craftsman will ordinarily make one component at a time. However, in some cases, the drawings of related components may also appear on the same sheet.

The Project Cycle The process of planning and managing projects follows a logical, continuous cycle. Each phase of the project leads to the next.

- The identify stage includes a needs assessment process to determine the needs and problems in a community.
- The design phase includes the actual planning and design of a project.
- The implement stage refers to the implementation of the project, whether it is a single-year or multi-year implementation period.
- The evaluation of project results occurs at the end of a project and involves determining whether the project's goal and objectives were achieved. The evaluation stage then leads to the identification of additional or persisting problems, allowing the cycle to begin again.

• Project monitoring occurs throughout all stages allowing for small adjustments in the project's planning, design, and implementation in order to ensure the project's success. An Overview of Project Planning Project planning involves a series of steps that determine how to achieve a particular community or organizational goal or set of related goals. This goal can be identified in a community plan or a strategic plan. Project plans can also be based on community goals or action strategies developed through community meetings and gatherings, tribal council or board meetings, or other planning processes. The planning process should occur before you write your application and submit it for funding. Project planning:

• Identify specific community problems. Solve problems in the way of meeting community goals.

• Creates a work plan for addressing problems and depends attaining the goals.

• Describes measurable beneficial impacts for the community the result is depends from the project's implementation.

• Determine the level of resources or funding necessary to implement the project.

Why is project planning important? Project Planning helps us to: Project Planning helps to eliminate: think ahead and prepare for the future clarify goals and develop a vision identify issues that will need to be addressed choose between options consider whether a project is possible make the best use of resources motivate staff and the community assign resources and responsibilities achieve the best results poor planning overambitious projects unsustainable projects undefined problems unstructured project work plans Approach to Community Development The community and its involvement are central to designing and implementing a successful project. Many government and other funders seeks to fund community-based projects that reflect the cultural values, collective vision, long-range governance, and social and economic development goals of native communities. The following overview includes some key points to consider during the project-planning phase

A component or part drawing is termed as a production drawing, if it facilities its manufacture.

3.2 Customer requirements parts lists.

3.2.1 Introduction

Parts list, also known as a bill of materials (BOM) is a tabular list of the items used to make an assembly. Parts list is usually combined with the assembly drawing, but it is a separate and individual document and can be and provides a complete list of all parts needed to build the **complete project.**

The information associated with the parts list generally includes:

Item number

Item numbers are based on the assembly structure, that is, the order in which parts are displayed in assembly.

Part number

Part number or drawing number which is a reference back to the detail drawing.

Description

Description is usually a part name or a complete description of purchase part or stock specification, including size and dimensions.

Quantity

The number of that particular part used on this assembly.

The four elements listed are the most common items and placed in the assembly drawing.

Parts list location

When placed on the assembly drawing, the parts list can be located in the upper-left or upper-right corner of the sheet, above or to the left of the title block, or in a convenient location. The location also depends on company standard.

A complete, independent, and documented physical and functional inspection process to verify that prescribed production methods have produced an acceptable item as specified by engineering drawings, planning, purchase order, engineering specifications, and/or other applicable design documents

Three main sets of production drawings include the following:

- Detail of each non-standard part on a drawing sheet, usually one part per sheet
- Assembly drawing showing all parts on one sheet
- A Bill of materials (BOM), essentially of each part

The basic elements of production drawings include:

- Size and shape of component
- Format of drawing sheet
- Process sheet
- Projection method
- Limits, fits, and tolerances of size, form, and position
- Production method
- Indication of surface roughness and other heat treatments
- Material specification and Shape such as Castings, Forgings, Plates, Rounds, etc.
- Conventions used to represent certain machine components
- Inspection and Testing Methods
- Specification of Standard Components

Self-Check - Three

Part I - Choose the best answer.

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

1) which of the following included about basic elements of production drawings include

   A, Size and shape of component B, Format of drawing sheet

   C, Process sheet D, all

2) ---------------basic elements of production drawings must be include.

A, Process sheet B, Projection method C, Testing Methods D, All

3) The engineer must be consider to draw selling product

A, Efficiency B, Production method C, Options D, All

Part II - True / False

Directions: Say True / False answer for the given question

1. The design phase includes the actual planning and design of a project

   A, True B, False

2. Component part or part drawing is termed as not a production drawing, if it facilities its manufacture.

   A, True B False

3. A Standard Operating Procedure is a set of written instructions that document a routine or repetitive activity followed by an organization.

   A. True B False

Part II Give short answer

I. List and Explain customer requirement components of part list drawing?

II. What are the basic elements of production drawings?

Operation Sheet 3.1	**Components of Part drawing**

How to Make Components of Part drawing

1. The steps to be followed to prepare part drawings from the assembly drawing are: Understand the assembly drawing thoroughly, by referring to the parts list and the different orthographic views of the unit.
2. Study the functional aspect of the unit as a whole. This will enable to understand the arrangement of the parts.
3. Visualize the size and shape of the individual components.

4. As far as possible, choose full scale for the drawing. Small parts and complicated shapes may require the use of enlarged scales so that their presentation will have a balanced appearance.
5. Select the minimum number of views required for describing each part completely. The view from the front selected must provide maximum information of the part.
6. The under mentioned sequence may be followed for preparing different views of each part:

   I- Draw the main center lines and make outline blocks, using the overall dimensions of the views.

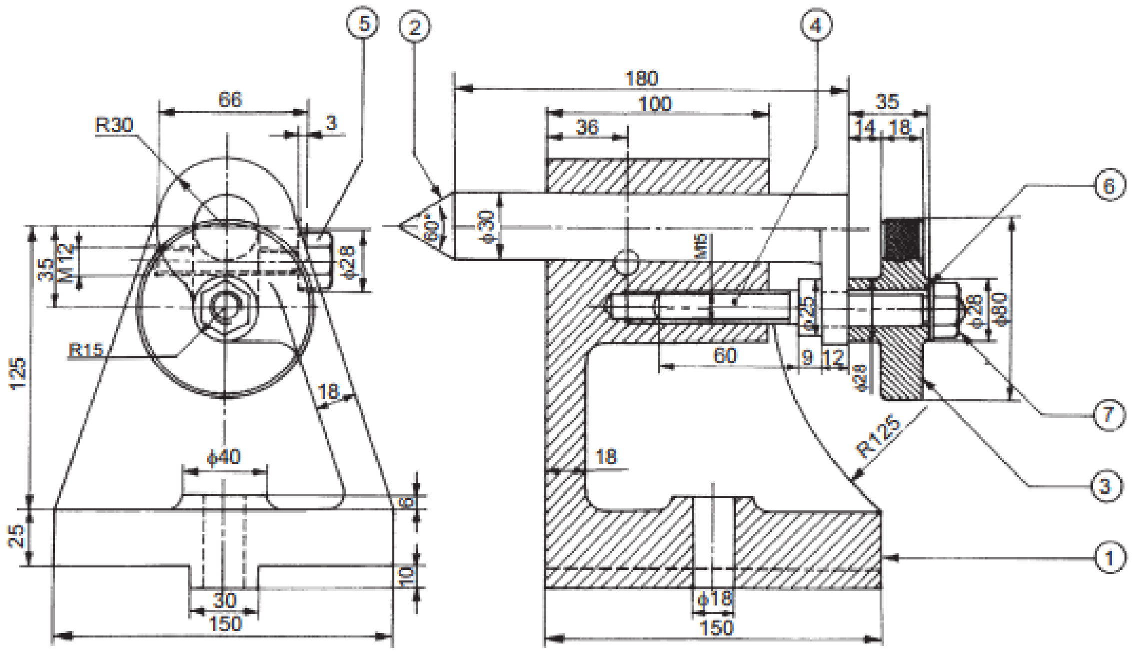
   II - Draw the main circles and arcs of the circles.

   III- Draw the main outlines and add all the internal features.

   IV- Cross-hatch the sectional views.

   V- Draw the dimension lines and add dimensions and notes.
7. Check the dimensions of the mating parts.
8. Prepare the parts list and add the title block.

The following figure shows detail part drawing of wood pattern making lathe tail stock



Parts list

Part No.	Name	Matl.	Qty.
1	Body	CI	1
2	Centre	Case hardened alloy steel	1
3	Hand wheel	Cast steel	1
4	Screw	MS	1
5	Screw	MS	1
6	Washer	MS	1
7	Nut	MS	1

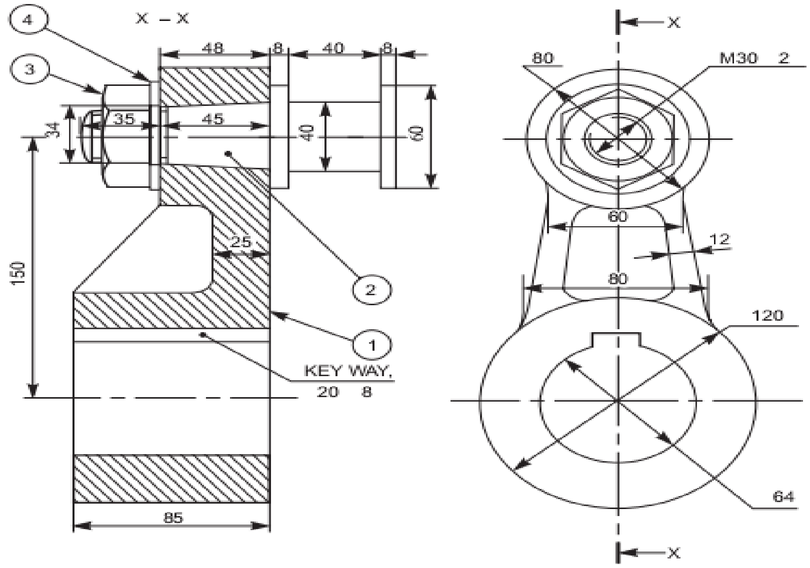
Operation Sheet 3.2	Assembly Components of Part drawing

How to make assembling Components of Part drawing

The following steps may be made use of to make an assembly drawing from component drawings:

1. Understand the purpose, principle of operation and field of application of the given machine. This will help in understanding the functional requirements of individual parts and their location.
2. Examine thoroughly, the external and internal features of the individual parts.
3. Choose a proper scale for the assembly drawing.
4. Estimate the overall dimensions of the views of the assembly drawing and make the outline blocks for each of the required view, leaving enough space between them, for indicating dimensions and adding required notes.
5. Draw the axes of symmetry for all the views of the assembly drawing.
6. Begin with the view from the front, by drawing first, the main parts of the machine and then adding the rest of the parts, in the sequence of assembly.
7. Project the other required views from the view from the front and complete the views.
8. Mark the location and overall dimensions and add the part numbers on the drawing.
9. Prepare the parts list.
10. Add the title block.

The following figure shows assembling detail part drawing of wood pattern making lathe tail stock



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

Lap test 3	Practical Assembling part drawing

Instructions: Given necessary measuring tools, materials and drawing instrument you are required to perform the following tasks within 8-12 hours for each task.

Task1. Draw the component parts of assemble tailstock drawing, detail drawing /part drawing

Task2. Assembling the component parts of tailstock detail part drawing.

Unit Four: Complete Drawing Task

This unit to provide you the necessary information regarding the following content coverage and topics:

- Check and confirm Dimensions.
- Present and ensure Drawing.
- File drawing issues
- Areas of improvement.
- Plot or print final drawing.

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

- Check and confirmed Dimensions, angles and proportions
- Ensure relevant and accurate information according to organizational requirements.
- Issue and filed according to workplace procedures
- Identify and work is evaluated Areas of improvement
- Plot or printed to a standard scale final drawing

4.1- Check and confirm Dimensions.

4.1.1 Definition

A dimension is for size and position (of the designed/modeled shape).dimension is a numerical value expressed in appropriate units of measurement and used to define the size, location, orientation, form or other geometric characteristics of a part.

Dimensioning is the process of specifying part's Information by using of figures, symbols and notes. Indicating on a drawing, the size of the object and other details essential for its construction and function, using lines, numerals, symbols, notes, etc.

4.1.2 Dimensioning System

. Metric system: ISO and JIS standards

Example 32, 32.5, 32.55, 0.5 *(not .5)* etc

Decimal-inch system example 0.25 *(not .25)*, 5.375 etc

fractional-inch system $\frac{1}{4}$ $5\frac{3}{8}$

4.1.3 Check Dimensioning Components

Indicate the location on the object's features that are dimensioned.

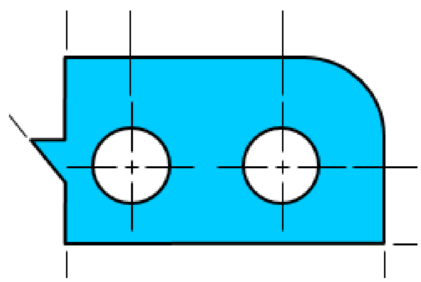


Figure 4. 1 Dimensioning Components

Leave a visible gap (≈ 1 mm) from a view and start drawing an extension line.

Extend the lines beyond the (last) dimension line 1-2 mm.

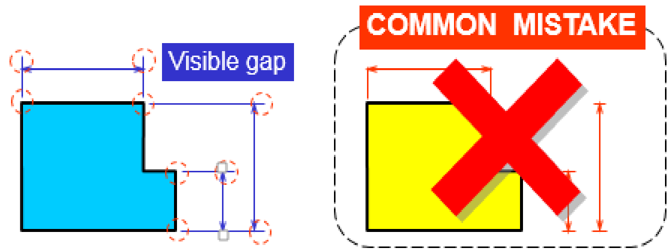


Figure 4. 2 common mistake of dimensioning

4.1.4 Check Dimension Lines

Indicate the direction and extent of a dimension, and inscribe *dimension figures*

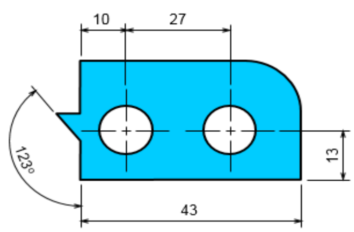
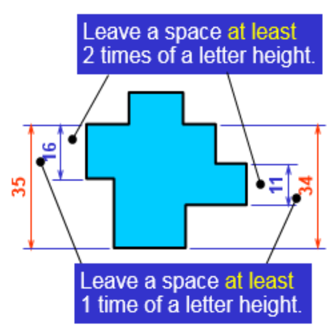


Figure 4. 3 Dimensioning lines

Dimension lines should not be spaced too close to each other and to the view.



The height of figures is suggested to be 2.5~3 mm Place the numbers at about 1 mm above dimension

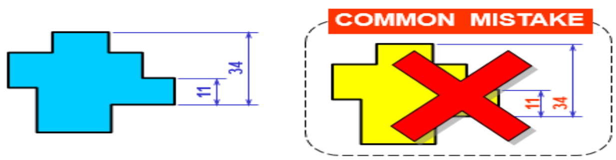


Figure 4. 4 line and between extension lines

When there is not enough space for figure or arrows, put it outside either of the extension lines

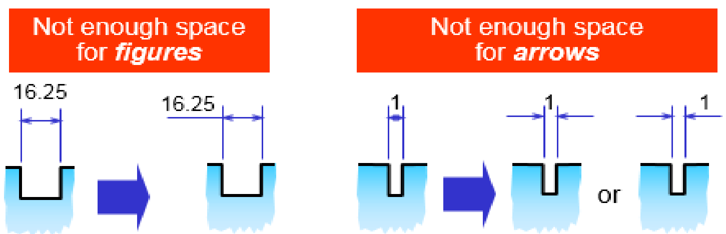


Figure 4. 5 Not enough space for figure

4.1.5 Dimension Figures: Units

The JIS and ISO standards adopt the unit of Length dimension in millimeters without specifying a unit symbol “mm”. Angular dimension in degree with a symbol “ ^{o} ”place behind the figures (and if necessary minutes and seconds may be used together

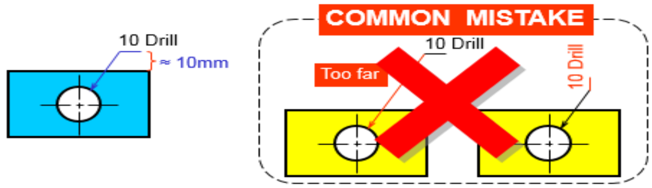


Figure 4. 6 common mistake of dimensioning

Size Scale Proportion

In order to take advantage of proportion in UI design, we must first understand the differences between size, scale, and proportion. All three of these terms are related, but there are some clear distinctions to consider.

Size is the actual dimensions of an element, often measured in px, pt, em, rem etc.

For example, the size of this logo is 75px tall and 275px wide

Scale is the relative dimensions of an element, often measured by percentages or multiples

For example, an element can be scaled to be bigger or smaller than it's original size.

Proportion is the harmonious relationship between two or more elements of scale.

For example, if one element increases in size, the remaining elements should also increase at the same rate to remain proportionate.

4.2 Presenting and ensuring Drawing.

4.2.1 Definition

After completing drawings with standard operating procedures Any of a set of design drawings made to articulate and communicate a design concept or proposal; such as for an exhibition, review, or publication.

Poorly drafted **presentation drawings** can result in losing great projects to other firms. We offer four different avenues to presenting your architectural concept which are highly illustrative and demonstrate professionalism to your clients:

2D Elevations and Sections

Simple projects such as warehouses and small office complexes may only require 2D elevations of the building facade and cross-sections that illustrate interior area functions. Overall dimensions and floor heights of the building are detailed along with the proper tones and hatching applied to the exterior surfaces to emphasize different materials can supply ample information and clearly illustrate simpler structures. These drawings are best printed in high resolution color on heavy board surfaces to enhance the presentation.

Isometric and Perspectives Drawings

A better visual solution for non-technical clients is given with an isometric or perspective view of the structure which emulates a three-dimensional view and shows the relationship between multiple sides of the building. Color and texture rendering of these drawings along with landscaping features will offer clients a greater representation of the proposed structure. The ability to alter view orientation in real-time can help create an exciting presentation as the building is tilted and rotated to different angles.

3D Wire Frame Models

As the pre-cursor to rendered models, wire frame 3D models are often employed to allow simultaneous viewing of underlying facets of the structure, such as beams, floors and walls. When the structural solution to a project outweighs the building appearance, wire frame models are the perfect solution. With the application of automatic hidden line removal, the model easily converts to a vector line exterior view of the structure.

3D Rendered Models

Fully rendered 3D models of the proposed structure is an optimum solution and well worth the investment for projects that are high-end or have great public interest. Surface textures can nearly replicate real world materials and give your clients a glimpse of what the new building will look like in the real world. The ability to simulate an actual building walk-through is an added benefit to solids models.

4.3 File drawing issues

4.3.1 Introduction

What is a workplace procedure? A workplace procedure directly relates to workplace policies. A procedure is a list of steps demonstrating how to implement a policy. Policies and procedures are used together to give employees a good understanding of company rules and values.

A workplace policy clearly defines an organization’s expectations regarding employee behavior and performance. A workplace procedure tells employees how to implement those policies. When used together, policies and procedures give employees a well-rounded understanding of their workplace. In this article, we discuss some examples of policies and procedures in the workplace.

policies and procedures in the workplace in drawings is filed

As an employee, it's important to comprehend the policies and procedures in your workplace. Understanding the policies and procedures significant to you can have a positive impact on your working life. It lets you know what is expected of you and what rights you have.

Code of conduct

A code of conduct is a common policy found in most businesses. It is a set of rules that companies expect employees to follow. The rules establish the expected behavioral standards for all employees. A code of conduct policy may cover the following:

- Attendance and absence
- Employee behavior
- Company values
- Break and mealtime policies
- Confidentiality
- Use of company property
- Use of social media
- Plagiarism
- Travel policies
- Conflicts of interest
- Client interaction
- Dress code
- Reporting misconduct

4.4 Areas of improvement. Whether you're providing a scheduled performance review or offering regular feedback to your team members, it can be helpful to understand general areas of improvement that make for a highly effective contributor and, as a result, a successful career. While your feedback should be specific to each individual based on their proven impact, growth and overall performance, below we will outline several core competencies you might consider when offering performance reviews.

Why is professional improvement important?

Professional improvement is important because people who feel challenged to excel in a healthy way can be more engaged and satisfied with their jobs. When people feel supported by their leadership with both positive feedback and constructive criticism, they are more likely to grow in their career and become a more effective contributor over time.

Many managers perform regular, one-on-one performance reviews with their team to evaluate their work and provide them with useful feedback on areas of improvement. Every individual, including managers, can work to improve specific skills in order to:

- Perform better in their current jobs
- Advance in their careers
- Adapt to change or take on new job duties
- Reach certain goals

Improved performance can benefit everyone in the workplace by saving time and money, producing higher-quality work and increasing employee morale and retention.

Areas of improvement for employees

While you should provide individuals with feedback based on their specific work, skill set and role, there are some common areas of improvement you might consider when evaluating performance. Common areas of improvement for employees with recommendations for improving each

- Customer service
- Teamwork
- Interpersonal skills
- Communication
- Writing
- Accepting feedback
- Good organization skills
- Flexibility
- Problem solving
- Leadership
- Setting goals
- Conflict resolution
- Listening
- Patience
- Honesty
- Proving impact
- Critical thinking

4.5 Plot or print final drawing.

4.5.1 Definitions

A plot is a graphical technique for representing a data set, usually as a graph showing the relationship between two or more variables. The plot can be drawn by hand or by a computer. In the past, sometimes mechanical or electronic plotters were used.

What you mean by plot?

In a narrative or creative writing, a plot is the sequence of events that make up a story, whether it's told, written, filmed, or sung. The plot is the story, and more specifically, how the story develops, unfolds, and moves in time.

What is difference between graph and plot?

So, in short, "plot" is used for a finite set of points, while a "graph" is used for a function comprised of infinite points.

Scale-location plot

A **scale-location plot** is a type of plot that displays the fitted values of a regression model along the x-axis and the square root of the standardized residuals along the y-axis.

When looking at this plot, we check for two things:

I. Verify that the red line is roughly horizontal across the plot. If it is, then the assumption of homoscedasticity is likely satisfied for a given regression model. That is, the spread of the residuals is roughly equal at all fitted values.

II. Verify that there is no clear pattern among the residuals. In other words, the residuals should be randomly scattered around the red line with roughly equal variability at all fitted values.

Scale-Location Plot in R

We can use the following code to fit a simple linear regression model in R and produce a scale-location plot for the resulting model:

We can observe the following two things from the scale-location plot for this regression model.

I. The red line is roughly horizontal across the plot. If it is, then the assumption of homoscedasticity is satisfied for a given regression model. That is, the spread of the residuals is roughly equal at all fitted values.

II. Verify that there is no clear pattern among the residuals. In other words, the residuals should be randomly scattered around the red line with roughly equal variability at all fitted values.

Self-Check – Four

Part I

Directions: Choose the best answer listed below. Use the Answer sheet provided in the next page:

I. _______ is accomplished by adding size and location information necessary to manufacture

A, Dimension B, Leader line C, Arc D, Extension line

II. Place the notes near to the feature which they apply, and should be placed outside the view always read horizontally incited to ________

A, Angle B, Dimension arrow C, Local notes D, all

III. ----------- is expressed the size and position of the designed shape.

A, fit B, measurement C, dimension D, all

Part II

Directions: Say True / False answer for the given question. Use the Answer sheet provided in the next page:

1. Leave a visible gap (≈ 1 mm) from a view and start drawing an extension line.

   A, True B, False

2. Project termination is the results of poorly drafted presentation drawings.

   A, True B, False

Part II

Directions Give the brief answer in the following question. Use the Answer sheet provided in the next page:

1. Explain the areas of improvement for employees to do their specific work?
2. List 3 points must be cover in the code of conduct policy?
3. What are the concepts of Presenting and ensuring Drawing?
4. List down Correct Dimensioning System must be follow?

List of Reference Materials

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- V.B. Sikka ,A course in civil engineering drawing ,1998,4th ed.
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