North South University

EEE 154

ENGINEERING DRAWING

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1 Introduction

Engineering drawing is a two dimensional representation of three-dimensional objects. In general, it provides necessary information about objects or concepts through a visual media. It is the graphic language from which a trained person can visualize objects.

Drawings prepared in one country may be utilized in any other country irrespective of the language spoken. Hence, engineering drawing is called the universal language of engineers. Any language to be communicative should follow certain rules so that it conveys the same meaning to every one. Similarly, drawing practice must follow certain rules, if it is to serve as a means of communication. For example the drawings standards of DIN (Deutsches Institut für Normung or German Institute for Standardization) are used in Germany, BS (British Standards) are used in Britain, ANSI (American National Standards Institute) are used in America and the Bureau of Indian Standards (BIS) are used in India. The International Organization for Standardization (ISO) is an independent, non-governmental international organization with a membership of 163 national standards bodies. Bangladesh Standards and Testing Institution (BSTI), the only National Standards body of Bangladesh, is playing an important role in developing and promoting industrial standardization. The Government of Bangladesh has established the Bangladesh Standards and Testing Institution (BSTI) with the merger of Bangladesh Standards Institution and the Central Testing Laboratories in 1985. The BSTI is a body corporate and its administrative Ministry is the Ministry of Industries. It has become a member of the International Organization for Standardization (ISO) in 1974.

2 Role of Engineering Drawing

The ability to read drawing is the most important requirement of all technical people in any profession. As compared to verbal or written description, this method is brief and clearer. Some of the applications are: building drawings for architects and civil engineers, machine drawing for mechanical engineers, circuit diagrams for electrical and electronics engineers and computer graphics for all.

The subject in general is designed to impart the following skills:

1. Ability to read and prepare basic engineering drawings
2. Ability to visualize, analyze and communicate through drawings

3 Drawing Sheet Sizes

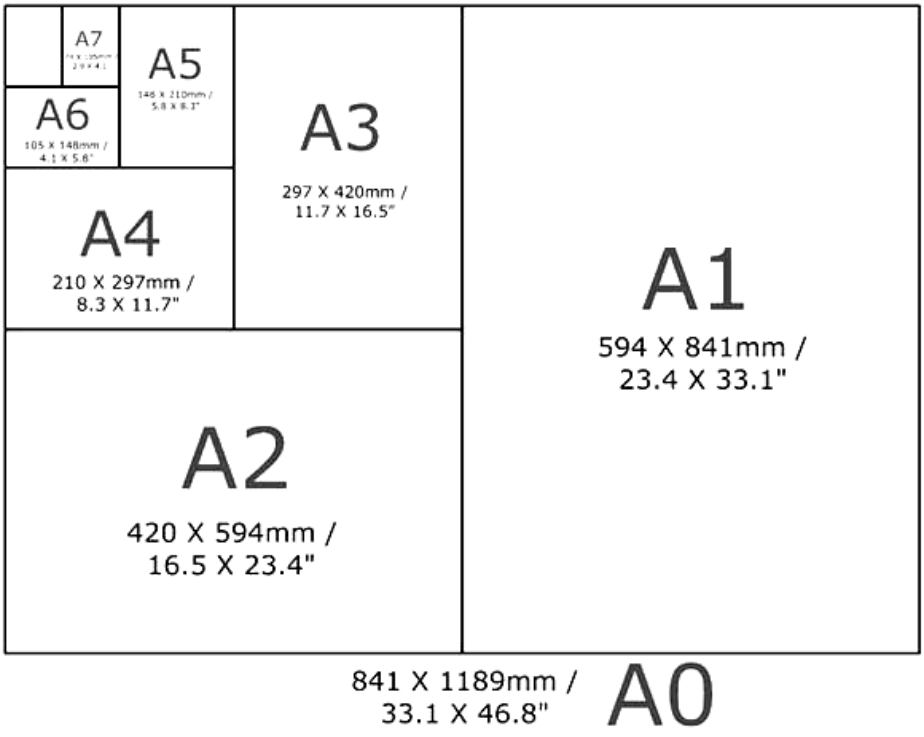
Engineering drawings are prepared on standard sized drawing sheets for uniformity. The standard drawing sheet sizes named A0, A1, A2, A3, A4 etc. are arrived at on the basic principal of following the relationships of:

x: y = 1 : √2 and xy = 1 where x is the short and y is the longside of the sheet

For example, a sheet size of AO having a surface area of 1 square meter will have a width (shorter side)of x = 841 millimeters and the height (longer side) y = 1189 millimeters; the successive sizes are obtained by either halving along the length or doubling the width, the area being in the ratio 1:2.

The standard paper dimensions are as shown in the table below:

Sheet Name	Sheet Size (mm)
AO	841 x 1189
A1	594 x 841
A2	420 x 594
A3	297 x 420
A4	210 x 297



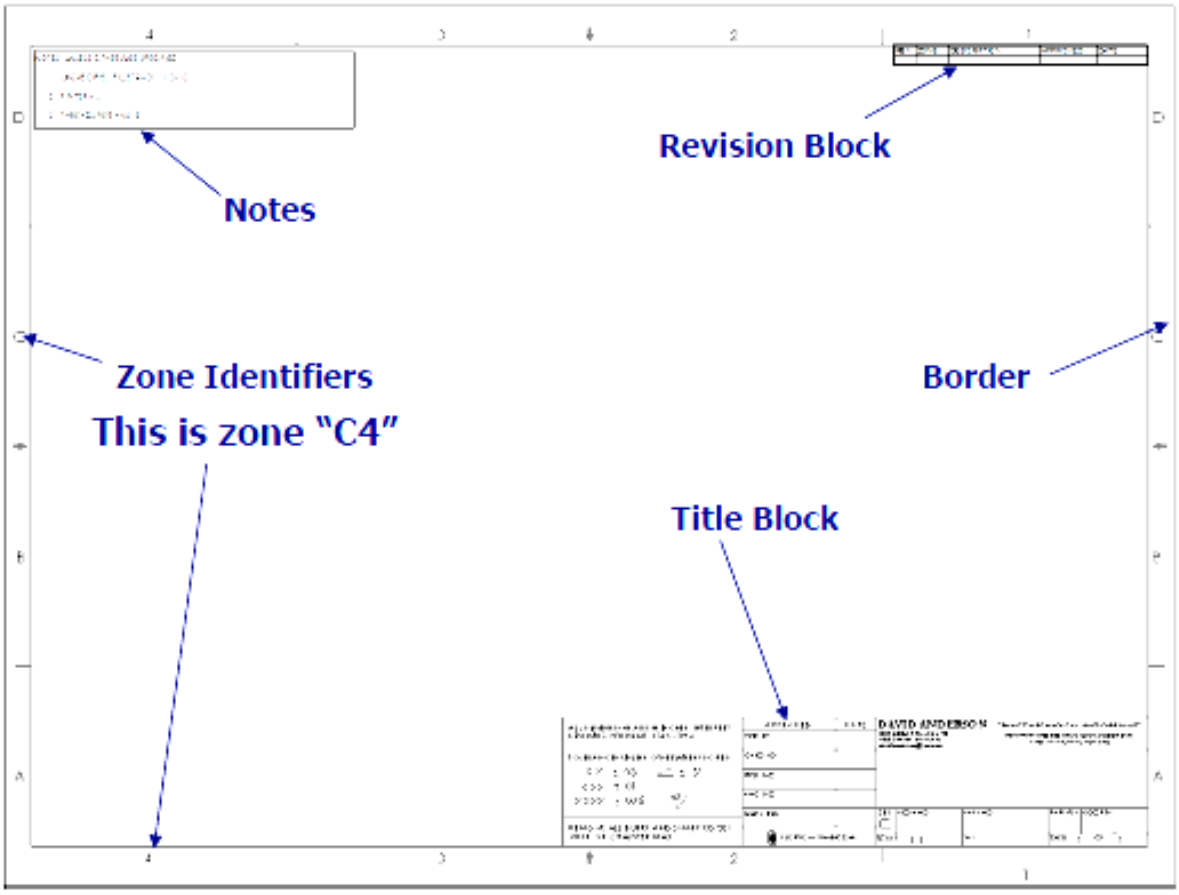
4 Title Block

The title block is placed within the drawing space at the bottom right corner of the drawing sheet. The title block may have a maximum length of 170 mm providing typically the following information:

1. Title of the drawing
2. Drawing number
3. Scale
4. Symbol denoting the method of projection
5. Name of the company, &
6. Initials of person who have designed, checked and approved

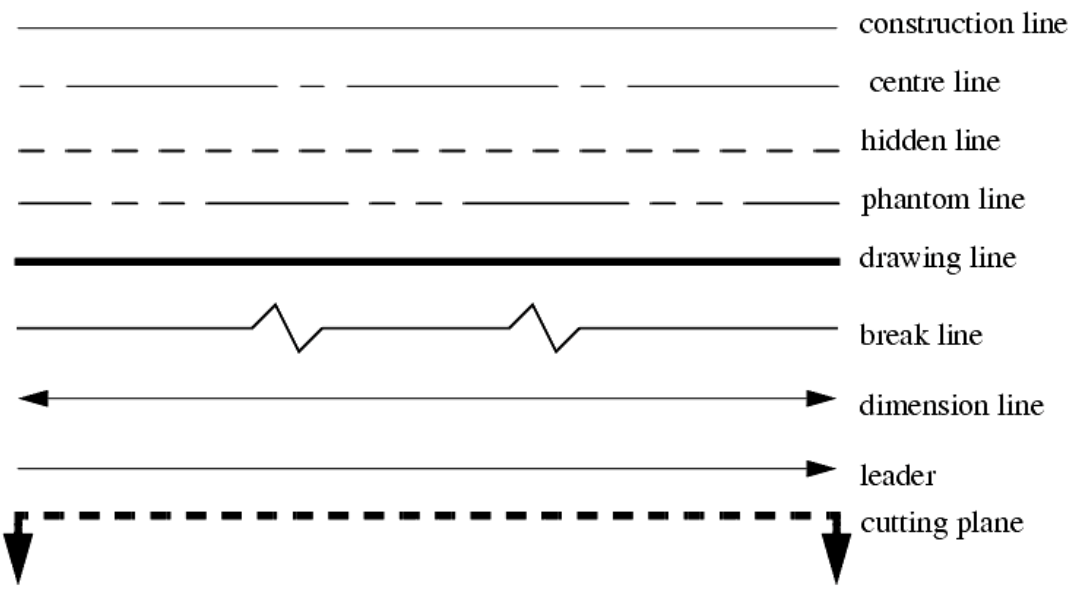
A sample title block is shown below:

	Name	Date	Signature	Scale	Sheet No.
Drawn by					
Checked by					
Approved by					
Drawing Title					
Name of Company					



5 Lines

In Engineering Graphics, the details of various objects are drawn by different types of lines each line having a definite meaning. Some of the common line types are shown below:



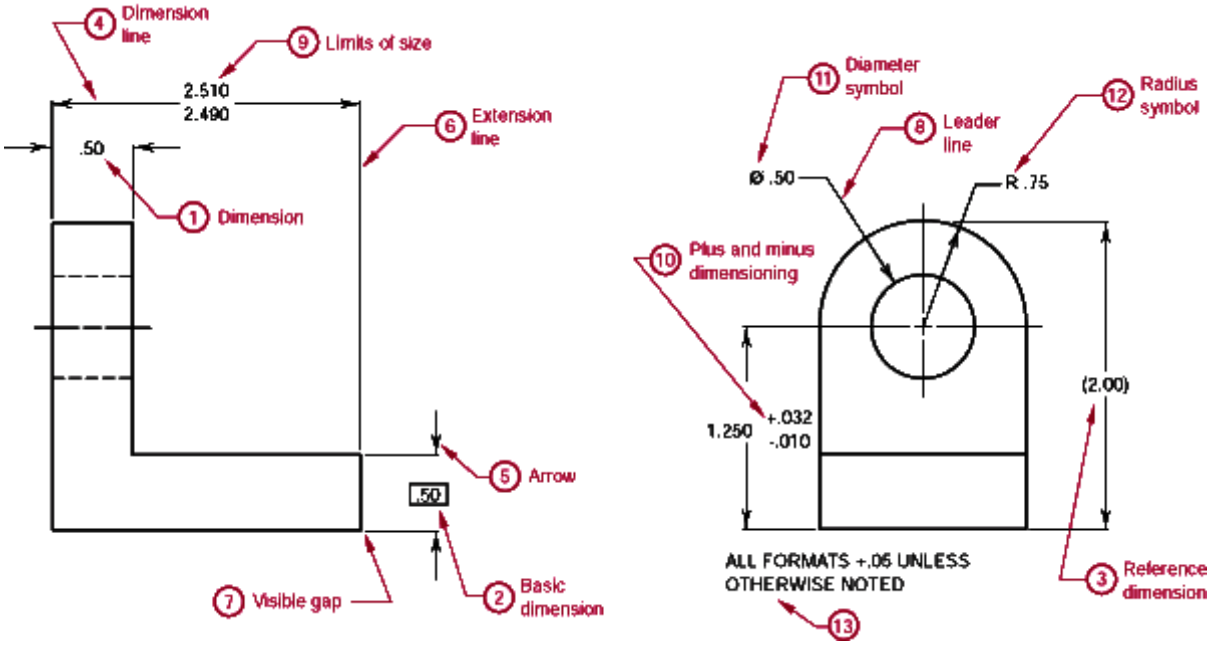
Rules for precedence of lines

1. When a Visible Line coincides with a Hidden Line or Center Line, draw the Visible Line.
2. Extend the Center Line beyond the outlines of the object
3. When a Hidden Line coincides with a Center Line, draw the Hidden Line
4. When a Visible Line coincides with a Cutting Plane, draw the Visible Line
5. When a Center line coincides with a Cutting Plane, draw the Center Line and show the Cutting Plane line outside the outlines of the view at the ends of the Center Line by thick dashes

Type: (thickness)	Example:	Application:
Continuous 0.7mm	A	Visible outlines
Continuous (thin) 0.3mm	B	Dimension lines
Short dashes 0.3mm	C	Hidden detail
Long chain 0.3mm	D	Center lines
Chain, thick at ends 0.7 – 0.3mm	E	Section cutting planes
Short chain 0.3mm	F	Developed views
Continuous wavy boundaries 0.3mm	G	Broken
Straight zigzag 0.3mm	H	Break lines
Straight lines with two short zigzags 0.3mm	I 85	Dimension lines

6 Dimensioning

The drawing of an object not only provides information of its shape but must also provide information regarding its size. These are done by means of dimensioning.

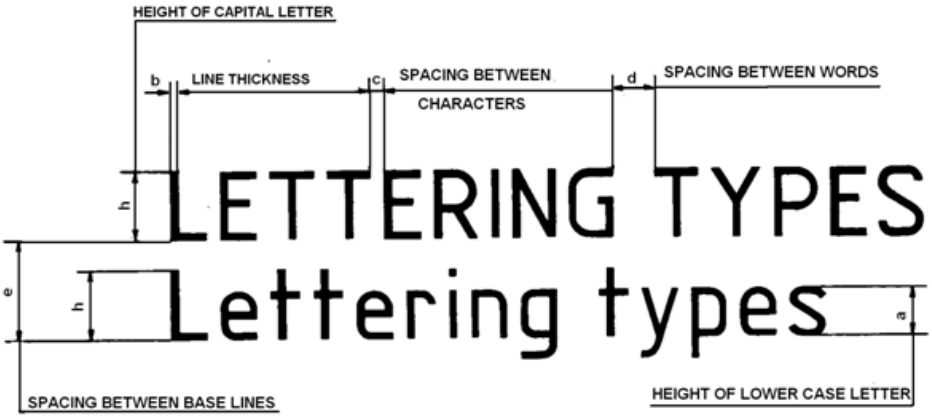


Some of the basic principles of dimensioning are:

1. All dimensional information necessary to describe a component clearly and completely shall be written directly on a drawing
2. Each feature shall be dimensioned once only on a drawing, i.e., dimension marked in one view need not be repeated in another view
3. Dimension should be placed on the view where the shape is best seen
4. As far as possible, dimensions should be expressed in one unit only preferably in millimeters, without showing the unit symbol (mm)
5. As far as possible dimensions should be placed outside the view
6. Dimensions should be taken from visible outlines rather than from hidden lines

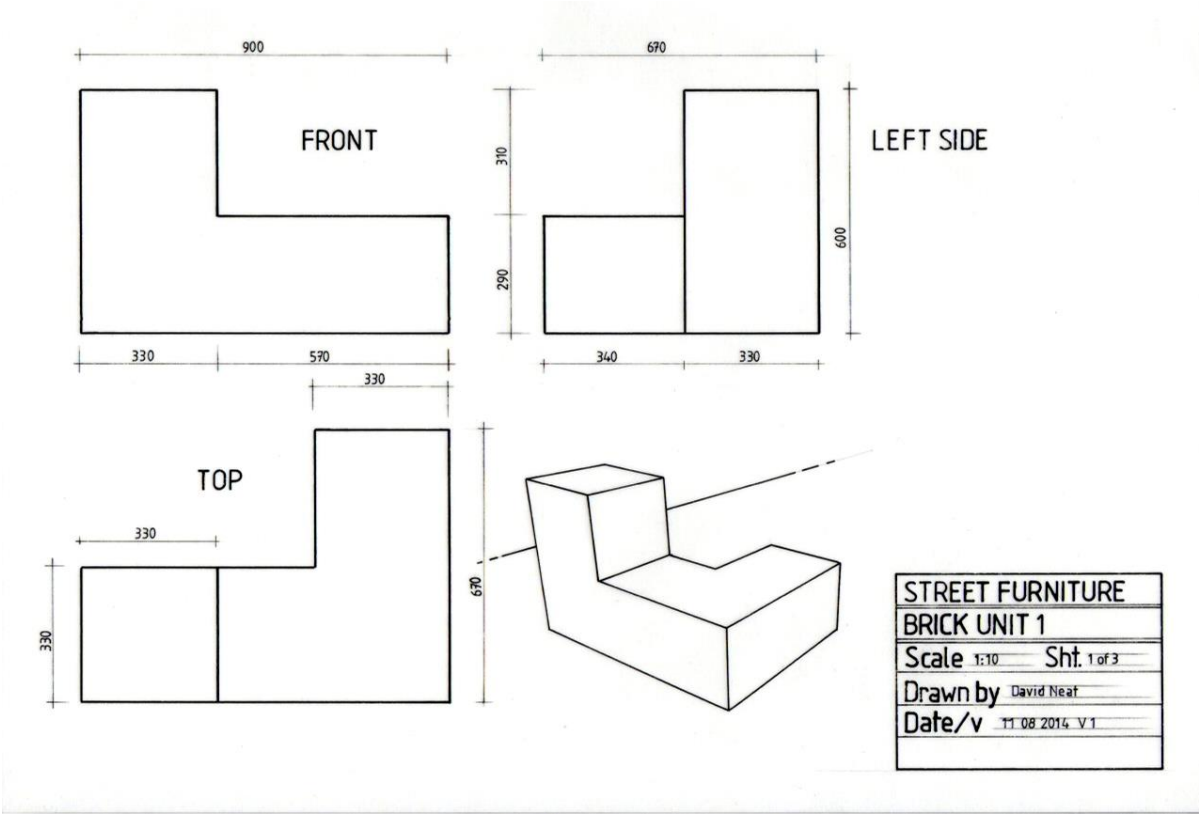
7 Lettering

Lettering text in a drawing is often necessary to completely describe an object or to provide detailed specifications. Lettering in engineering drawings should be easy to read and quick to draw, therefore, most commonly single stroke sans serif letters are used.



8 Drawing to Scale

When the object is drawn in its actual size, we say that the drawing is drawn to full-scale or drawn to the scale 1: 1. Many objects, however, including big electro motors, generators in power plants, transformers, antenna masts, towers of broadcast and television transmitters, radar aerials etc., are too large to be drawn in full-scale. Therefore, they must be drawn to a reduced scale. An example may be a drawing of a street furniture drawn to the scale 1:10 as shown below.

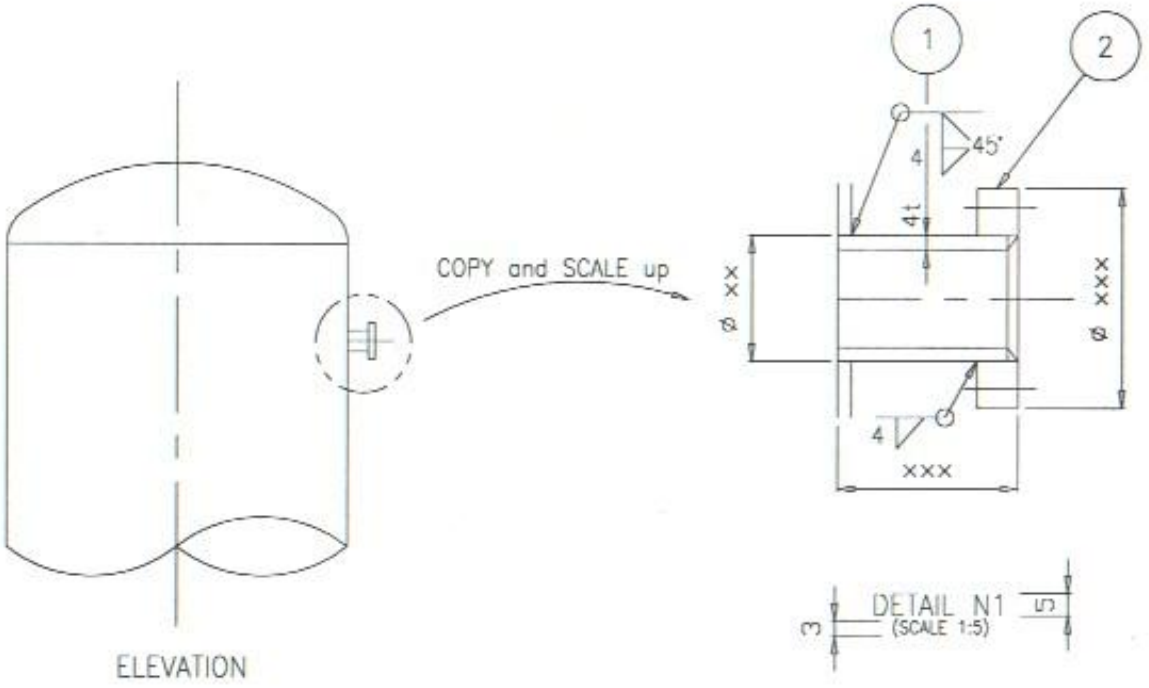


The pictures or diagrams in the drawing above are ten-times smaller than the actual street furniture proposed. For similar reasons, small parts of measuring apparatus, switches, push buttons, masks of integrated circuits and similar objects must be drawn larger than their actual size, in order to clearly define their shapes. These drawings are drawn to the enlarged scale. For example a contact of a small switch could be drawn to the scale 10:1 meaning pictures in the drawing are ten times bigger than the contact.

Some standardized scales:

- Basic scale (full scale) -1:1.
- Enlarged scale - 2:1,5:1, 10:1,20:1,50:1, 100:1, .. ,
- Reduced scale - l:2, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, ...

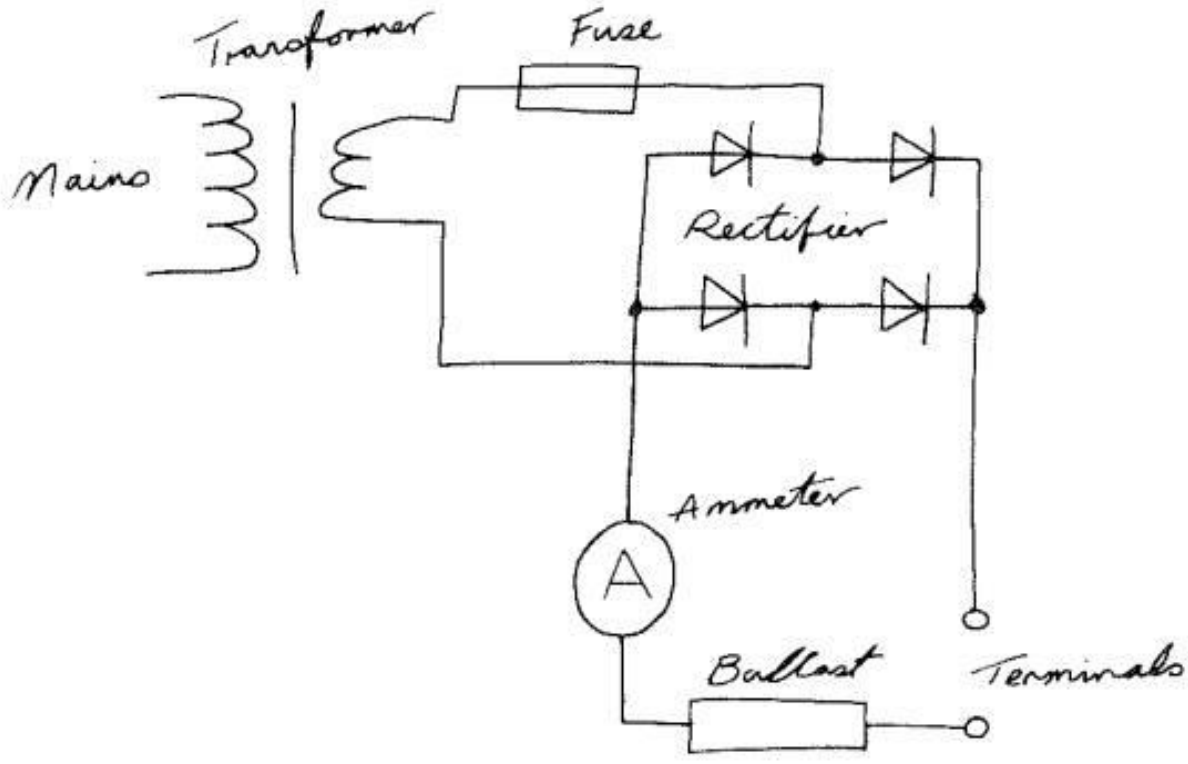
The appropriate choice of the scale is very important for the readability of thetechnical drawing.More than one, several drawing scales may be used on one drawing sheet to facilitate readability. However, all principal views and the majority ofthe other views must be drawn in the basic scale. But if there were some small parts onthe object, they would not be readable;such parts may be drawn in the enlarged partialviews.



in class exercises

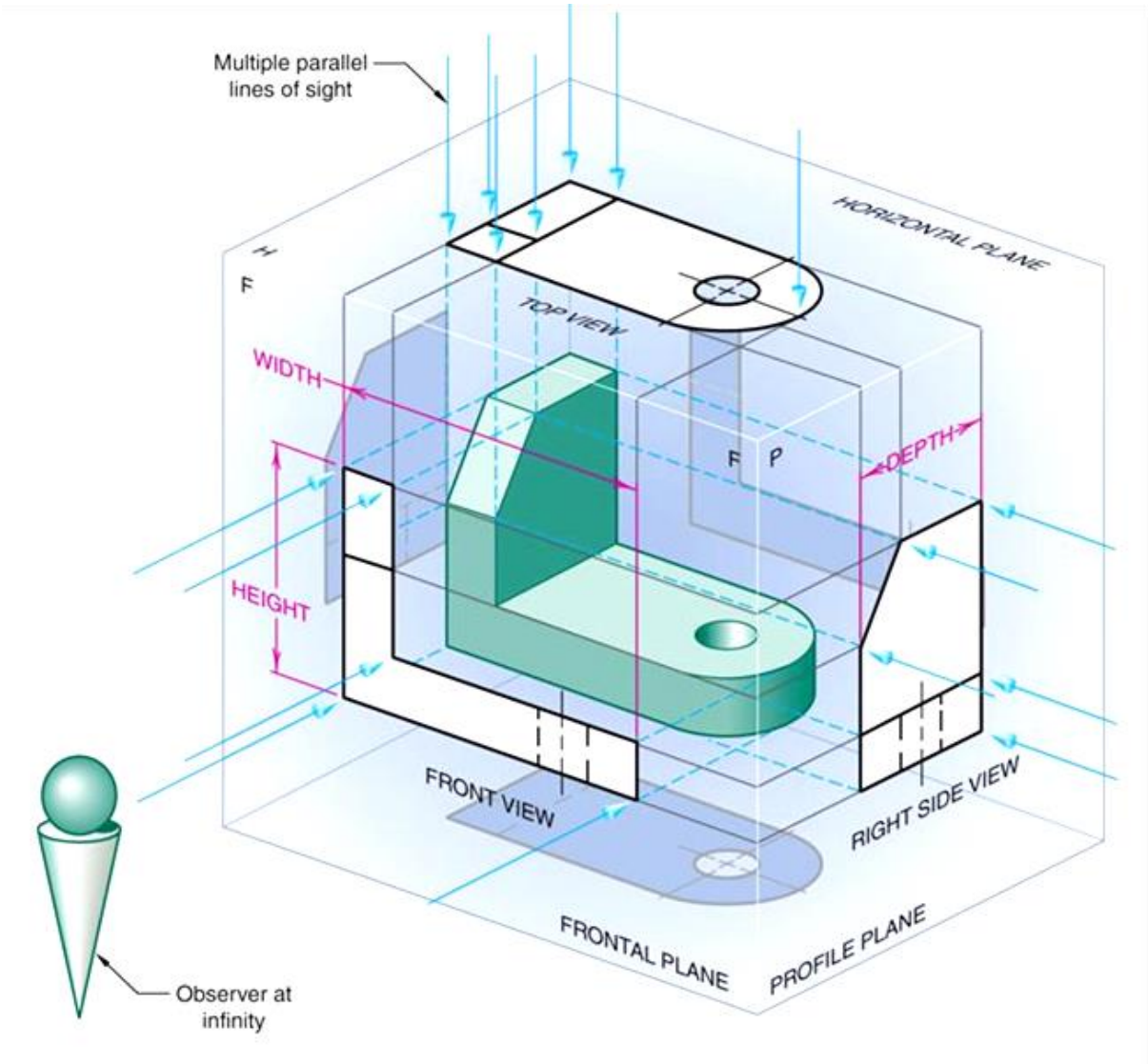
(1) Create a standard page template for your projects in AutoCAD (see video tutorial)

(2) Draw a circuit diagram as below using AutoCAD (see video tutorial):



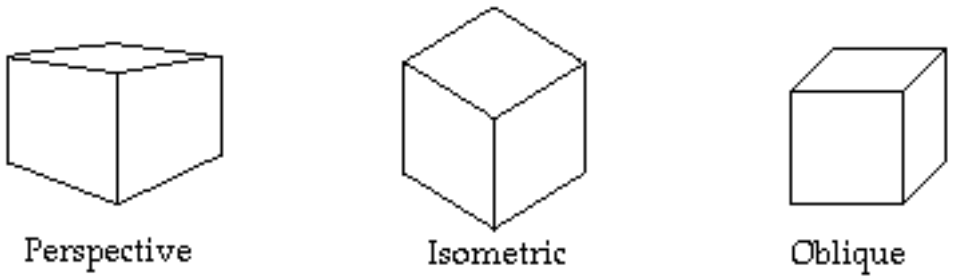
9 Projection drawing

Projection drawings are used for graphical representation of solid objects. The process relies on the perpendicular projection of geometry on perpendicular drawing planes by the method commonly called Orthographic Projection.The word orthographic means to drawn at right angles and is derived from the two Greek root words ORTHOS meaning straight, rectangular or upright and GRAPHOS meaning written or drawn.



Orthographic projections can, however, make it difficult to visualize the three dimensional nature of the object. Therefore, pictorial views (commonly known as3 dimensional views) can be created to give a three dimensional impression of the object as it appears to our eyes. Three basic types of pictorial projections are commonly used, and these are:

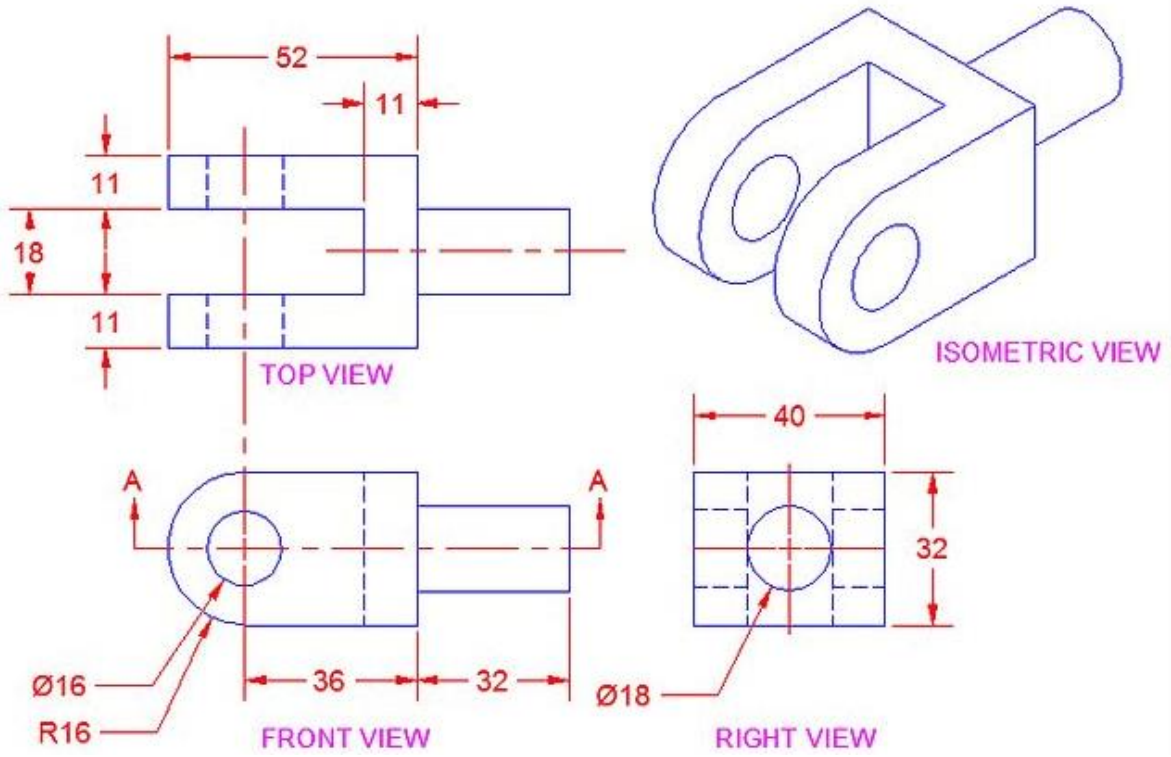
- Perspective projection
- Isometric projection
- Oblique projection



in class exercise

(1) Create a 3 Dimensional model of the mechanical part shown in the diagram below in scale using SketchUp software (see video tutorial).

(2) Prepare a two-dimensional layout drawing of the orthographic projections of three sides (top, front and right) and one isometric view (pictorial view) as shown below(also see video tutorial):



10 House wiring drawing

House wiring diagrams are typically broken down into three major drawings and these are:

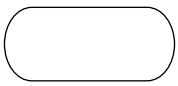
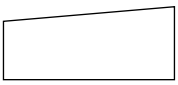
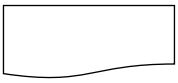
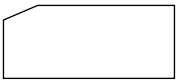
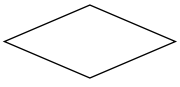
- Single line diagrams (SLD) outlining the overall electrical installation of a building
- Fixture diagrams whereby the location of the various electrical fixture sockets and switches are indicated within a building, along with their wiring setup
- Detail drawings such as earthing pit details

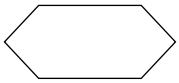
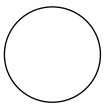
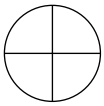
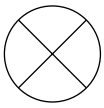
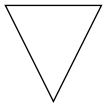
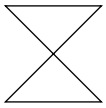
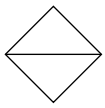
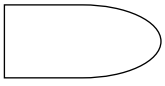
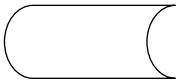
11 Flowcharts

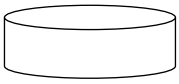
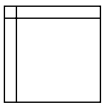
A program is a sequential set of instructions to be given to a computer to solve a problem. The sequence in which the steps are to be taken must be determined before the instructions can be written in the form of a program. This sequence of steps is called the algorithm of the problem. A complete program consists of an algorithm plus specific data and often provision for inputting variable data.

A flowchart diagram depicts events or actions and the sequence in which actions must be taken to correctly solve the given problem, or in other words, it gives a visual depiction of an algorithm.

Flowcharts, sometimes called block diagrams, uses several different types of symbols in depicting the sequence of steps and these are as below:

START/ STOP		Oval shape indicates START or STOP or in other words, the beginning and ending of steps of the sequence
PROCESS		A rectangle is used to represent arithmetic and memory function, indicating that a calculation or movement of data is to be performed
INPUT/OUTPUT (A) KEYBOARD		Input or output steps of a sequence are indicated by this symbol, particularly indicating a manual or keyboard entry
INPUT/OUTPUT (B) PRINT		This input or output symbol indicates an output into paper by printing
INPUT/OUTPUT (C) CARD		This input or output symbols indicates an input or output by card/ magnetic card
INPUT/OUTPUT (D) PAPER TAPE		This input or output symbol indicates an input or output by paper tapes
INPUT/OUTPUT (E) UNSPECIFIED		This input or output symbol indicates an input or output to an unspecified media
DECISION		The diamond shape symbol is called the decision symbol and the computer must compute a problem as either true or false (yes or no)

FLOWLINE		The sequence or direction to be followed in a series of operations is indicated by the arrow, also known as the flowline
MULTIPLE DOCUMENTS		This is a symbol of multiple documents in a process
PREPARATION SYMBOL		This symbol represents a set-up to another step in the process.
CONNECTOR SYMBOL		This symbol indicates that the flow continues where a matching symbol (containing the same letter) has been placed.
OR SYMBOL		Indicates that the process flow continues in more than two branches.
SUMMONING JUNCTION SYMBOL		Indicates a point in the flowchart where multiple branches converge back into a single process.
MERGE SYMBOL		Indicates a step where two or more sub-lists or sub-processes become one.
COLLATE SYMBOL		Indicates a step that orders information into a standard format.
SORT SYMBOL		Indicates a step that organizes a list of items into a sequence or sets based on some pre-determined criteria.
SUB ROUTINE SYMBOL		Indicates a sequence of actions that perform a specific task embedded within a larger process. This sequence of actions could be described in more detail on a separate flowchart.
MANUAL LOOP SYMBOL		Indicates a sequence of commands that will continue to repeat until stopped manually.
LOOP LIMIT SYMBOL		Indicates the point at which a loop should stop.
DELAY SYMBOL		Indicates a delay in the process.
DATA STORAGE SYMBOL		Indicates a step where data gets stored.

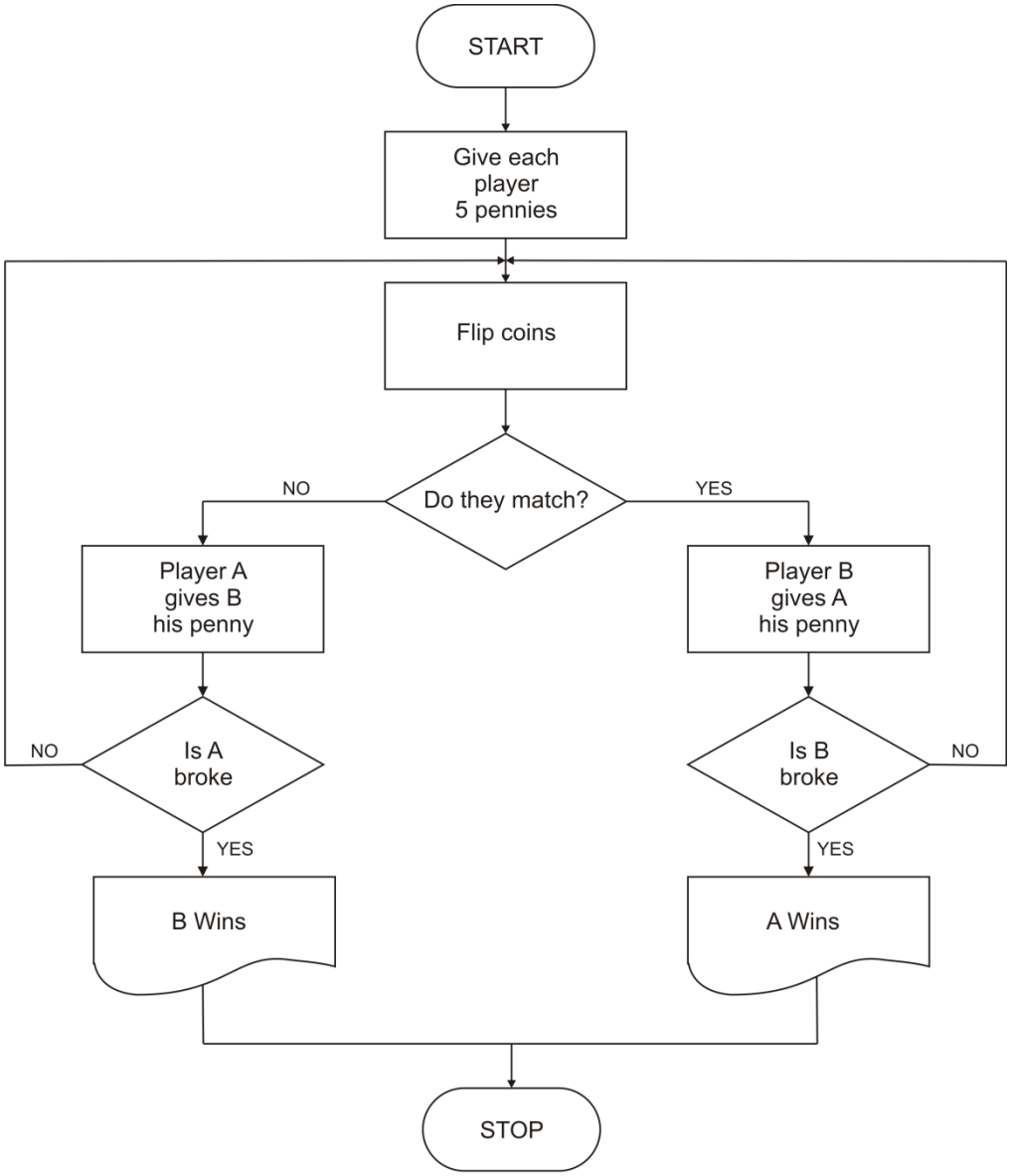
DATA BASE SYMBOL		Indicates a list of information with a standard structure that allows for searching and sorting.
INTERNAL STORAGE SYMBOL		Indicates that information was stored in memory during a program, used in software design flowcharts.
DISPLAY SYMBOL		Indicates a step that displays information.
OFF PAGE SYMBOL		Indicates that the process continues off page.

Example of a flow chart:

Following is a flowchart for the game of matching coins. The penny-matching game has two players; suppose we call them Player A and Player B. Each player starts with a given number of coins. Player A and Player B each flip one coin. If they match, one of the players – say Player A – takes the other's coin. If they don't match, Player B takes Player A's coin. The game continues until one of the players is out of coins. The logical sequence of the game can be written as below:

1. Start
2. Give each player 5 coins
3. Each player flips a coin
4. Do the coins match?
   a. Yes. Player B gives Player A his coin. Go to step 5
   b. No. Player A gives Player B his coin. Go to step 6
5. Is Player B broke?
   a. Yes. Player A wins. Go to step 7
   b. No. Go to step 3
6. Is Player A broke?
   a. Yes. Player B wins. Go to step 7
   b. No. Go to step 3
7. Stop. End of game

The flow diagram is given below.



Penny Matching Game Flowchart